Effectiveness and economic impact of worksite interventions to promote physical activity and healthy diet

Background paper prepared for the WHO/WEF Joint Event on Preventing Noncommunicable Diseases in the Workplace (Dalian/ China, September 2007)

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Content

Executive summary

The worksite is an appropriate setting to provide various opportunities to promote the adoption and maintenance of healthy lifestyle behaviours. Over the past few decades, the number of health promotion programmes in workplace settings has continued to grow. Though employer rationales vary, health promotion programmes may yield economic benefits in terms of, for example, reduced absenteeism, presenteeism, employee health care costs, and employee turnover.

The aim of the present paper, which was used as background information for the WHO/WEF Joint Event "Preventing NCDs at the workplace", was to provide insight into the evidence for the effectiveness as well as the economic impact of worksite interventions for physical activity and healthy diet promotion.

Based on a literature review, it was concluded that worksite health promotion programmes addressing physical activity and diet are effective in changing behaviour (physical activity and diet) as well as in improving health-related outcomes, including cardiovascular risk disease factors. Despite the evidence as to the relationship between physical activity and worker productivity, there was limited evidence for an effect of physical activity and diet interventions at the workplace on work-related outcomes. Main reason for this conclusion was the lack of methodologically sound studies, and studies applying a randomised controlled design in particular. Although a randomised controlled trial is not always appropriate or feasible in the workplace setting, other high methodological quality (randomised) studies are needed.

The literature addressing the economic impact of worksite physical activity and diet programmes was even more scarce. The available evidence on the economic impact of worksite health promotion programmes is thus far from clear-cut. Based on evidence available from studies of lower methodological quality (eg. quasi-experimental, cohort, or case-control studies), cost savings from absenteeism have shown to vary from 2.5 to 4.9 for every dollar spent on the programme, and health care cost savings varied from 2.5 to 4.5 for each dollar spent on the programme. Other figures suggested that worksite programmes can achieve a 25-30% reduction in medical and absenteeism costs over an average period of about three to four years.

In conclusion, the following recommendations are drawn:

- To provide reliable data with respect to the economic impact of worksite physical activity and diet programmes, there is a need for high quality research using a randomised design. Such studies should investigate the total economic impact of such employer initiatives, that is including the impact on both direct health care costs and costs due to lost productivity.

- As there is no standardised method for an economic evaluation of worksite health promotion programmes, it is recommended to develop a standard technique for measuring the economic impact of such programmes.

- Most, if not all, of the research in this field has been performed in developed and high income countries. Therefore, more research is recommended addressing the implementation and (economic) evaluation of programmes at the workplace aimed at improving workers' physical activity and diet behaviour among medium and low income countries.

1.1 Introduction

Currently, the favourable effects of regular physical activity and a healthy diet are no longer under debate. Physical activity and a healthy diet have been identified as particularly important in counteracting the development of chronic diseases, including cardiovascular disease, diabetes type 2, and some cancers (Department of Health, 2004; USDHHS,1996; WHO, 2002). WHO reported that for non-communicable diseases the most important risk factors are high blood pressure, high concentrations of blood cholesterol, inadequate intake of fruit and vegetables, overweight/obesity, physical inactivity and tobacco use (WHO, 2002). Thus, physical activity and diet, are among the leading causes of the major non-communicable diseases, and contribute substantially to the global burden of disease, death and disability.

Despite strong evidence for the benefits of physical activity and healthy dietary habits, the majority of the adult population in most countries (high, middle, and low income countries) do not meet the internationally recommendations for physical activity and diet.

Physical activity guidelines

For physical activity, it is recommended that individuals engage in adequate levels throughout their lives. Different types and amounts of physical activity are required for different health outcomes: at least 30 minutes of regular, moderate-intensity physical activity on most days reduces the risk of cardiovascular disease and diabetes, colon and breast cancer (Pate et al., 1995). Muscle strengthening and balance training can reduce falls and increase functional status among other adults. More activity may be required for weight control.

Additionally, the American College of Sports Medicine (ACSM) has formulated a specific position stand to maintain and improve cardiorespiratory fitness, muscular fitness, and flexibility in healthy adults who are already active at a sufficient level (ACSM, 1998). This position stand recommends a well-rounded training programme including aerobic and resistance training, and flexibility exercises. The recommendations for the quantity and quality of training for developing and maintaining cardiorespiratory and body composition are (ACSM, 1998):

- Frequency of training: 3-5 times per week
- Intensity of training: 55/65%-90% of the maximal heart rate, or 40/50% of the maximum oxygen uptake reserve or heart rate reserve
- Duration of training: 20-60 minutes of continuous or intermittent (minimal bouts of 10 minutes accumulated throughout the day
- Mode of activity: any activity that uses large muscle groups, which can be maintained continuously, and is rhythmical and aerobic in nature (ACSM, 1998).

Dietary guidelines

For diet, recommendations for populations and individuals should include the following: achieve energy balance and healthy weight: limit energy intake from total fats and shift fat consumption away from saturated fats to unsaturated fats and towards the eliminations of trans-fatty acids; increase consumption of fruits and vegetables, legumes, whole grains and nuts; limit the intake of free sugars and limit salt (sodium) consumption from all sources and ensure that salt is iodized (WHO, 2004).

Nutrition intake goals

As for nutrient intake goals the following intakes should be considered (WHO, 2003):

Ranges of population nutrient intake goals

Dietary factor	Goal (% of total energy, unless otherwise stated)
Total fat	15–30%
Saturated fatty acids	<10%
Polyunsaturated fatty acids (PUFAs)	6–10%
n-6 Polyunsaturated fatty acids (PUFAs)	5–8%
n-3 Polyunsaturated fatty acids (PUFAs)	1–2%
Trans fatty acids	<1%
Monounsaturated fatty acids (MUFAs)	By difference[a]
Total carbohydrate	55–75%[b]
Free sugars[c]	<10%
Protein	10–15%[d]
Cholesterol	<300 mg per day
Sodium chloride (sodium)[e]	<5 g per day (<2 g per day)
Fruits and vegetables	≥400 g per day
Total dietary fibre	From foods[f]
Non-starch polysaccharides (NSP)	From foods[f]

[a] This is calculated as: total fat - (saturated fatty acids + polyunsaturated fatty acids + trans fatty acids).
[b] The percentage of total energy available after taking into account that consumed as protein and fat, hence the wide range.
[c] The term "free sugars" refers to all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and fruit juices.
[d] The suggested range should be seen in the light of the Joint WHO/FAO/UNU Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition, held in Geneva from 9 to 16 April 2002 (*2*).
[e] Salt should be iodized appropriately (*6*). The need to adjust salt iodization, depending on observed sodium intake and surveillance of iodine status of the population, should be recognized.
[f] See page 58, under "Non-starch polysaccharides".

Taking into account these guidelines on physical activity and a healthy diet, interventions aimed at delivering the right message regarding healthy diets and physical activity promotion should be implemented. An appropriate setting to do so is the workplace.

In the past few decades, diverse companies have answered this call by implementing worksite lifestyle promotion programmes. However, only a few attempts have been made to evaluate adequately its effectiveness, not to mention the cost-effectiveness or cost-benefits of the intervention of concern.

1.2 Aim and outline of this paper

The aim of this paper is to provide insight into the evidence for the effectiveness as well as the economic impact of worksite physical activity and diet interventions. In doing so, we will briefly describe the evidence for the relationship between diet and physical activity with health-related outcome measures and with work-related outcomes. This will be done through analysis of published reports, that have based their evidence on an exhaustive review of epidemiological studies investigating the (longitudinal) relationship between physical activity and diet, and health risk factors.

Physical inactivity and unhealthy diet behaviours are associated with costs. After explaining the different type of costs, the health care costs as well as the indirect costs of physical inactivity and a poor diet will be summarised. For that section, national reports from diverse countries, milestone WHO reports and some additional studies will be used.

The evidence with respect to the effectiveness and economic impact of worksite physical activity and diet interventions will be described. For physical activity interventions, a distinction will be made between interventions aimed at primary prevention, and those aiming at secondary/tertiary prevention, the latter focusing on return-to-work of workers who had been on sick leave due to back pain. Regarding the return-to-work studies, a few good examples from the Netherlands that performed an economic evaluation of physical activity interventions among sick-listed workers with back pain will be described. In interpreting the results, it should thus be taken into account that the evidence is not based on all studies available implying that prudence is called for the interpretation of the evidence. Nevertheless, it will provide an insight into the possible economic impact of such interventions incorporating physical activity. Regarding the (cost-)effectiveness of primary prevention physical activity and diet interventions, no systematic search has been performed to identify relevant studies. In spite of this, using a narrative overview of a few recent and sound (systematic), we believe this paper summarises the evidence available on the effectiveness and the economic impact of physical activity and diet interventions at the workplace. However, as far as the authors are aware, there is only one randomised controlled trial that incorporated an economic evaluation in the analysis to the effect of a primary prevention lifestyle intervention through the workplace. The results of that study will be described.

Despite the fact that no systematic strategy was used to select relevant studies and reviews, the present paper provides a good account of the current evidence available, and can therefore function as an important input to debate and policy.

2 Effect of physical activity and diet on heath- and work-related outcomes

2.1 Relationship between physical activity and diet, and health-related outcomes

The evidence for the links between physical activity and diet, and later disease and ill-health is strong. There is no doubt that participation in regular physical activity, defined according to the moderate-or vigorous intensity physical activity guidelines (see introduction), has beneficial effects to health, and consequently helps to prevent a broad range of health disorders and diseases (USDHHS, 2002; WHO 2005).

Taking some of the leading causes of death, physical inactivity was estimated to cause, globally, about 10-16% of cases each of breast cancer, colon and rectal cancers and diabetes mellitus, and about 22% of ischaemic heart disease (WHO, 2002). Moreover, physical inactivity was estimated to cause 1.9 million deaths and 19 million DALYs globally (WHO, 2002). Another study linked sedentary lifestyles to 23 percent of deaths from major chronic diseases (Hahn, 1998).

In 1992, the American Heart Association officially recognised physical inactivity as one of the four major modifiable risk factors for cardiovascular disease, along with smoking, high blood pressure, and elevated blood cholesterol. The prevalence of people being insufficiently active is much higher than the proportion people smoking, having a high blood pressure, or high blood cholesterol. Therefore, in terms of the sheer numbers affected, an increase in physical activity has the greatest potential to reduce the incidence of chronic diseases.

Together with a healthy diet, regular physical activity is a key determinant of energy balance and weight control. In order to maintain a healthy weight, there must be a balance between energy consumed (through diet) and energy expended (through physical activity). In the past years, the prevalence of overweight and obesity has increased dramatically in most countries. Although overweight and obesity are caused by many factors, in most individuals, weight gain results from a combination of excess energy consumption and inadequate physical activity (USDHHS, 2002). Thereby, to prevent and reduce overweight and obesity, which are associated with enormous public health and economic consequences, the promotion of physical activity in combination with a healthy diet is of huge relevance.

The 2002 World Health Report highlighted nutrition as a key factor for health worldwide (WHO, 2002). It was estimated that about one fifth of the global disease burden can be attributed to the joint effect of protein-energy or micronutrient deficiency not even included the burden attributed to risk factors that have substantial dietary determinants, such as high blood pressure, cholesterol, overweight, and low fruit and vegetable intake (WHO, 2002). Still, the evidence of the role of diet in health status is growing.

Similarly to physical activity, unhealthy ,dietary patterns are associated with increased mortality and morbidity due to increasing the risk of chronic diseases such as heart disease, stroke, some cancers, diabetes type 2 (WHO 2005, USDHHS, 1988). The dietary components that especially contribute to the increased risk are: excessive consumption of dietary fat, excessive consumption of dietary salt and low consumption of fibre rich foods, fruit, and vegetables. (USDHHS, 1988; WHO 2003, WHO 2005).

Looking at the intake of fruit and vegetables only, which are considered important components of a healthy diet, accumulating evidence suggests that sufficient consumption of fruit and vegetables can help prevent major diseases, such as cardiovascular diseases (Ness and Powles, 1997) and certain cancers principally of the digestive system (World

Cancer Research Fund and America Institute for Cancer Research, 1997). Low intake of fruit and vegetables is estimated to cause about 19% of gastrointestinal cancer, about 13% of ischaemic heart disease, and 11% of stroke worldwide. Overall, it was estimated that 4,9% of deaths and 1,8% DALYs are attributable to low fruit and vegetable intake with the majority of the burden (85%) from cardiovascular diseases (WHO, 2002).

Furthermore, the WHO estimated some numbers with respect to the mortality risk attributable to both physical inactivity and unhealthy diets (WHO, 2002). For physical inactivity, the attributable mortality risk was estimated at 2.3% in high mortality developing countries to 6.7% (in females) from developed countries. For low fruit and vegetable intake, these numbers were 3.6% and 7.4%, respectively. Taking into account the other diet-, and physical inactivity- related risks, like blood pressure, cholesterol, and overweight, the total deaths attributable to these factors varied from 7.4% to 23.9%, 5.0% to 17.6%, and 1.1% to 11.5%, respectively (WHO, 2002).

2.2 Relationship between physical activity and diet, and work productivity

Most of the studies available on the effect of physical activity on work-related outcomes examined the association between physical activity and absenteeism using transversal data or intervention studies. Therefore prospective data provide valid conclusions about the effects of physical activity on work-related outcomes.

One study that applied data from a prospective cohort with a follow up period of 3 years is from the Netherlands (Van den Heuvel et al., 2005). They investigated the effect of sporting activities on absenteeism of employees. Registered data on illness related absenteeism covering a period of 4 years were collected from 1,228 workers from 21 Dutch companies. The conclusions were clear: sporting activities have a favourable effect on absenteeism with those participating in sports having less sick leave (Van den Heuvel et al., 2005). A significant higher mean duration of absenteeism of about 20 days over a period of 4 years was observed among those not practicing sports compared to their sporting colleagues (Van den Heuvel et al., 2005).

The relation between aerobic physical activity and absenteeism was confirmed by a study of Jacobson and Aldana (2001). The aim of their study was to compare the frequency of self-reported exercise with illness-related absenteeism. The results revealed a significant relation between weekly exercise days and annual absenteeism with lower exercise rates being associated with higher rates of annual absenteeism duration. The association was specifically significant between no exercise at all (0 days per week) and 1 day per week of exercise compared to a higher exercise frequency rate (Jacobson and Aldana, 2001). Moreover, it appeared that non-exercisers were more likely to be absent for more than 7 days when compared to those exercising at least once per week.

A study of Pronk and colleagues (2004) investigated the association between work performance and physical activity and two other modifiable risk factors known to be associated with physical activity, namely cardiorespiratory fitness and obesity. Work performance was defined by variables such as days absent from work, quantity and quality of work performance, and overall work performance. Based on their cross-sectional dataset including 683 workers, results showed that physical activity was positively associated with quality of work performance and overall work performance. Further, higher levels of cardiorespiratory fitness were positively linked to quantity of work performance and a reduction of extra effort exerted to perform the work. The latter modifiable risk factor under study, i.e., obesity, appeared to be related to a higher number of work loss days (Pronk et al., 2004). So, based on their results, it can be concluded that physical activity and cardiorespiratory fitness are related to presenteeism, whereas obesity is related to absenteeism.

Another study from the Netherlands using the same longitudinal dataset as the study of Van den Heuvel et al. (2005) examined the dose-response relationship between physical activity and sick leave (Proper et al., 2006). That is, the authors tried to determine how much physical activity is needed to achieve effects on sickness absenteeism. Besides the data from the prospective cohort, they used data from two large Dutch cross-sectional databases. Results showed no dose-response relationship between moderate intensity physical activity with either duration or frequency of sick leave (Proper et al., 2006). However, as can bee seen from figure 2.2.1, a dose-response relationship between frequency of vigorous intensity activity up to the frequency of three times a week and sick leave duration was found. The two lines in the figure refer to the data from two cross-sectional databases. The longitudinal dataset found similar positive results with a difference of approximately seven days in mean sick leave duration per year between workers who were active three times a month at the highest (24.4 sick leave days), and workers active 1-2 time per week (17.7 days of sick leave) and those highly active, i.e., at least 3 times per week (18.0 days of sick leave) (Proper et al., 2006). Besides, longitudinal analysis showed that workers who had been vigorously active at least once per week had on average 8-10 days less sick leave than those who did not perform such activities.

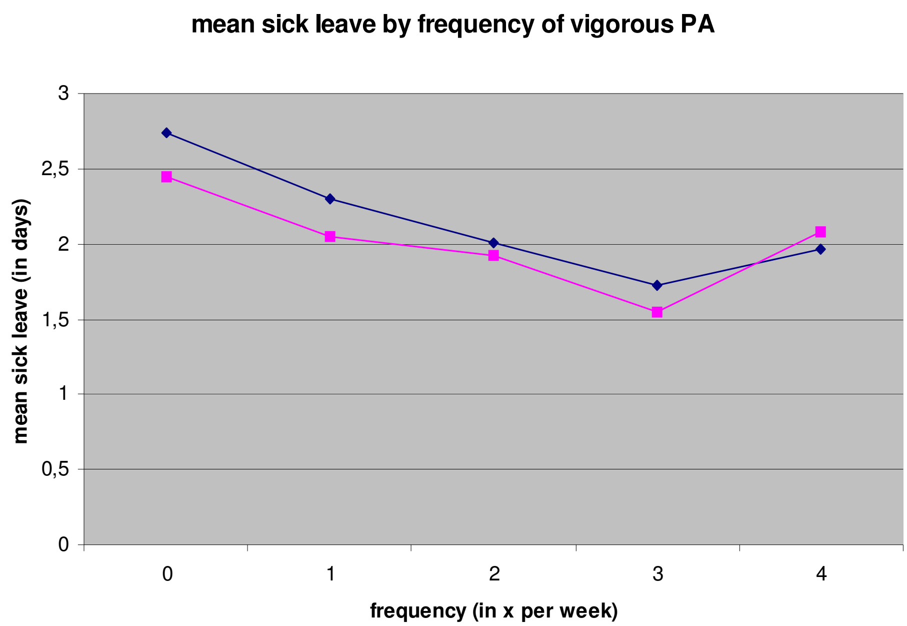


Figure 2.2.1. Dose-response relationship between vigorous intensity physical activity and sick leave duration (Proper et al., 2006)

Regarding the literature about the relationship between diet and work-related outcomes, there is only little literature. One of those studies was a recently performed one, performed by Pelletier and colleagues (2004). They examined the relationship between changes in various health risks and changes in work productivity. One of the health risks studied was poor diet, defined as: "regularly eats fatty foods or regularly eats meals away from home; usually eats fewer than three servings of fruits and vegetables daily" (Pelletier et al., 2004). From their baseline analyses, it appeared that those with a poor diet, unhealthy BMI, and physical inactivity had higher levels of productivity loss in terms of both lower absenteeism and presenteeism, than those without these health risks. To examine the possible improvement in productivity due to a reduction in health risk, the mean absenteeism and presenteeism for workers who reduced the health risk was compared. From those analyses, it appeared that those who improved their diet (i.e., reduced their risk for poor diet) significantly improved their presenteeism (Pelletier et al., 2004). No such associations were found for absenteeism. Finally, based on the observed and estimated mean effects, they calculated that those who had reduced one health risk factor could improve their presenteeism by 9%, and reduce their absenteeism by 2%. Hence, the overall conclusion of the authors was that reductions in health risks, among others poor diet, are associated with positive changes in work productivity.

3 Costs due to physical inactivity and unhealthy diet

3.1 Type of costs

One of the main challenges in economic evaluations is to decide which costs should be included. The costs that are relevant for economic evaluations can be sub-divided into direct and indirect costs, and costs within and outside the health care sector (Oostenbrink et al., 2002). Table 3.1.1 provides an overview of the different cost categories with examples of relevant costs within each category.

Direct health care costs are the costs of activities within the formal health care system that are directly related to the disease or disorder at issue (Oostenbrink et al., 2000). These costs are for preventative, diagnostic, and treatment services related to chronic conditions attributable to physical inactivity and poor diet, and may include expenditures for physician visits, medications, ambulance services, rehabilitation services and hospitalisation (USDHHS, 2002).
Direct costs outside the health care sector are the costs of activities outside the formal health care system that are related to the disease or disorder at issue. For instance, these costs may include out-of-pocket costs, travel expenses from and to the hospital, costs of over-the-counter medication, the cost of informal health care (e.g., care provided by the family), and costs of devices (Korthals-de Bos, 2002).
The indirect costs within the health care system are the costs patients incur during the life-years gained, for example the costs of treating unrelated heart problems several years after a life saving heart operation.
Indirect costs outside the health care system are the costs of production losses due to absenteeism, reduced presenteeism, work disability, or death of the worker (Oostenbrink et al., 2002; Korthals-de Bos, 2002).

Table 3.1.1. Type of costs in economic evaluations that are associated with physical inactivity and poor diet

	Within health care	*Outside health care*
Direct costs	- Visit to physician - Medication - Homecare - Physiotherapy, back school, graded activity, etc - Operation - Hospitalisation day	- Out-of-pocket costs - Travel expenses - Informal care - Costs of devices
Indirect costs	- Health care costs during life years gained	- Productivity losses due to: absenteeism from paid and unpaid work, reduced presenteeism, work disability, or death

3.2 Health care costs due to physical inactivity and unhealthy diet

Since regular physical activity and a healthy diet help prevent disease and promote health, it may actually decrease health care costs. To help make the case for health promotion activities more tangible, some scientists have calculated, or rather estimated, the economic consequences of physical inactivity for the national's health care system (e.g., Stephenson et al., 2000; Colditz, 2000; Pronk et al., 1999; Goetzel et al., 1998; Powell et al., 1999). Below, a summary of some of those national studies is given representing diverse (developed) countries. There are however hardly any studies, if at all, that estimated the costs attributable to an unhealthy diet. Instead, some researchers have estimated the costs due to obesity. As obesity can be considered as the result of an imbalance between the energy expenditure and the calories consumed, some of such studies are presented as well, thereby providing a proxy measure of the costs due to both physical inactivity and unhealthy diet behaviours.

The study of Garrett et al. (2004) aimed to estimate the total health care expenditures that are attributable to physical inactivity among members of a large health plan in Minnesota, USA. Using a cost-of-illness methodology to attribute costs to the risk of insufficient physical activity levels, it was estimated that almost one third (31%) of costs related to heart disease, stroke, colon cancer, and osteoporosis were attributable to physical inactivity. After applying the population-attributable risk proportion for each condition, the total health plan expenditures attributable to physical inactivity in 2000 were 83.6 million US dollar, or US$ 56 per member (Garrett et al., 2004). This is substantially lower than another study from the United States by Pratt and colleagues (1999) who compared medical expenditures between regularly active and inactive participants of the 1987 National Medical Expenditures Survey (1.5 million persons). Based on their analyses, the concluded a net annual benefit of physical activity of US$ 330 per person in 1987 dollars. The difference with the estimates from Garrett et al., (2004) is likely a result of the difference in methods used. For example, the study of Garrett and colleagues (2004) included only medical costs associated with the subset of conditions, while the Pratt et al. (1999) report included all medical costs related to inactivity.
A third study from the USA assessed the economic costs of physical inactivity, as well as those that are attributable to obesity (Colditz, 1999). The population-attributable risk percent, reflecting the maximum proportion of disease that attributable to physical inactivity or obesity was calculated. Using "conservative" (according to the authors) estimates of PAR% for physical inactivity, it was estimated that physical inactivity costs 24.3 billion US dollars per year for direct health care delivery, representing about 2.4% of the total health care expenditures, and US$ 91 per inhabitant (Colditz, 1999).

Outside the USA, similar studies have been conducted in among others, Canada (Katzmarzyk et al., 2000), the Netherlands (Proper et al., 2004), and Australia (Stephenson et al., 2000).

In the study of Katzmarzyk et al. (2000) and the one of Proper et al. (2004), the same methodology was used to assess the direct health care costs due to physical inactivity in Canada and the Netherlands, respectively. Based on relative risk estimates for physical inactivity on the main diseases that are known to be significantly related to physical inactivity, and using the relative risks in combination with the prevalence of physical inactivity, the population-attributable fractions (PAF) for each disease were computed. After, the PAF was applied to the total direct health care costs associated with each of the main diseases (Katzmarzyk et al., 2000; Proper et al., 2004). Katzmarzyk and colleagues (2000) found about Can$ 2.1 billion, or 2.5% of the total direct health costs in Canada attributable to physical inactivity. An updated study for the Canadian situation found a slightly higher proportion of inactivity attributable total health care expenditures, i.e., 2.6% (Katzmarzyk and Janssen, 2004). The Dutch data showed rather similar estimates, namely the health care costs due to insufficient levels of physical activity were 744 million euros, being 2% of the total Dutch health costs (Proper et al., 2004). Finally, Stephenson et al. (2000) also attempted to measure direct health care costs attributable to physical inactivity in the Australian population. A similar cost of illness approach as the Canadian and the Dutch studies described above was performed with the calculation of population attributable risks to estimate the proportion of main inactivity-related conditions. Using this approach, the annual direct health care costs attributable to physical inactivity was AUS$ 377 million (approx. US$ 280), representing 1.1% of the total health care costs.

The studies summarised before are just some of the studies performed as to the health care costs due to physical inactivity. Van Baal et al. (2006) in their report, have provided an outline of diverse studies, among others the ones that have been described above (see table 3.2.1). In that report, they also estimated the total health care costs that can be attributed to both physical inactivity and various nutrition-related components (Van Baal et al., 2006). From table 3.2.2, it can be seen that physical inactivity costs 805 million euro, or 1,4% of the total Dutch health care expenditures, whereas a poor diet defined as too much saturated fat, and too few fruit, vegetables, and fish consumption appeared to be responsible for 1266 million euros representing 2.1% of the total Dutch health care costs (Van Baal et al., 2006, table 3.2.2.).

Table 3.2.1. Costs of physical inactivity in the scientific literature (in US$)

Country	*Reference*	*Method*	*Year of study*	*Costs (per inhabitant)*
Australia	Stephenson	Top-down	1993/1994	14
Minnesota	Garrett	Top-down	2000	56
Canada	Katzmarzyk	Top-down	1999	58
United States	Colditz	Top-down	1999	91
Switzerland	Smala	Top-down	2000	173
United States	Pratt	Bottom-up	1987	330
United States	G. Wang	Bottom-up	1987	504 per inactive person
United States	F. Wang	Bottom-up	2001-2002	Negative association between activity and health care use

Source: RIVM, Van Baal et al., 2006; www.costofillness.eu

Table 3.2.2. Contribution of physical inactivity and unhealthy diet to health care costs in the Netherlands in 2003

	Million euro	*Share in total health expenditure (%)*
Physical inactivity	805	1.4
Unhealthy diet:		
- Too much saturated fat	115	0.2
- Insufficient intake of fruit	460	0.8
- Insufficient intake of vegetables	173	0.3
- Insufficient intake of fish	518	0.9
Total health care costs	59,529	100.0

Source: RIVM, Van Baal et al., 2006; www.costofillness.eu

For obesity, the study of Colditz (1999) found overall direct health care costs in the United States to be 70 billion dollar or 7% of the total health care costs attributable to obesity (Colditz, 1999). Studies from other countries, like France (Levy et al., 1995), the Netherlands (Seidell, 1995; Van Baal et al., 2004), and Australia (Segal et al., 1994) found estimates varying from 2-4% of the total health care costs attributable to obesity. It should however be noted that the definitions of obesity (BMI categories) differed between the studies, as well as the conditions included.

Even though some prudence is called in comparing the results to each other due to the different methods used in the studies, it can be concluded that an unhealthy lifestyle is associated with substantial health care costs.

3.3 Indirect costs due to physical inactivity and unhealthy diet

From the preceding section, it has become clear that physical inactivity, a poor diet, and obesity are associated with enormous health care costs. This conclusion was based on several cost of illness studies. However, in hardly any of those or other studies, an attempt was made to quantify the indirect costs from absenteeism, lost productivity, and years of life. Although it is a challenging job to measure lost productivity, there are some techniques available to estimate the lost productive value from disability and mortality. Below, the few studies identified, which were from Canada, are described.

The study of Katzmarzyk and Janssen (2004) estimated the direct and the indirect economic costs of physical inactivity and obesity in Canada. The results of the direct costs are presented in the preceding section. The indirect costs included the value of economic output lost because of illness, injury-related work disability, or premature death (Katzmarzyk and Janssen, 2004). Based on their analytic review, it appeared that the economic burden of physical inactivity was Can$ 5.3 billion, of which the majority (70%, Can$ 3.7 billion) was spent on indirect costs. The indirect costs attributable to physical inactivity represented 3.9% of the total indirect costs in Canada in 2001.
As to obesity, the total costs were estimated at Can$ 4.3 billion, and again, the majority (63%, Can$ 2.7 billion) of the costs involved indirect costs (Katzmarzyk and Janssen, 2004). The obesity-attributable indirect costs represented 2.9% of the total indirect costs in Canada in 2001.

The Genuine Progress Index (GPI) for Atlantic Canada published two reports as to the costs of physical inactivity in two regions: Halifax Regional Municipality (HRM) and Nova Scotia (Walker and Colman, 2004; Colman, 2002). Both studies followed the same methodology as the study of Katzmarzyk and Janssen (2004) (see above). As to the economic burden, it appeared that physical inactivity in HRM costs the provincial economy Can$ 44.7 million each year in indirect productivity losses due to premature death and disability.
Furthermore, two hundred HRM residents die prematurely each year due to physical inactivity, accounting for 7 percent of all premature deaths in the municipality. These premature deaths result in the loss of 850 potential years of life every year in HRM before the age of 70. In other words, if all HRM residents were physically active, the municipality would gain 850 productive years of life each year, with corresponding gains to the economy.
For Nova Scotia, physical inactivity appeared to be responsible for Can$ 247 million each year in productivity losses. Taking into account the numbers of Nova Scotians that die prematurely each year due to physical inactivity (accounting for 9% of all premature deaths), the province would gain 2,200 productive years of life each year.

In summary, despite lack of studies that estimated the indirect costs of physical inactivity and a poor diet, the few Canadian studies available suggest a consistent pattern, in that the indirect costs due to lost productivity are substantial and are the plural of the direct health care costs.
It is also concluded that more research is needed that investigate the total economic impact of physical inactivity and insufficient diet behaviours, that is including both direct health care costs and indirect costs, due to lost productivity.

4 Conclusion of (2) and (3):

Based on the preceding sections, it is concluded that physical inactivity and a poor diet are important risk factors for many diseases and conditions. Moreover, more people are put at risk as the general level of risk factors rises, e.g., by an increase in the proportion of those being physically inactive and consuming unhealthy diets. Prevention aimed at reducing risk by making a healthy lifestyle integral part of daily life is thus crucial (USDHHS, 2002).

For the adult population, worksites provide opportunities to promote the adoption and maintenance of healthy lifestyle behaviours, namely through established communication channels, existing support networks, and the worksite can serve as a vehicle for delivering interventions across multiple levels of influence including individual, personal, and environmental or organisational and policy influences (Sorensen et al., 2004). Moreover, worksites offer access to a significant proportion of the adult population. With the majority of the adult population being a worker, and many workers spending at least 40 hours per week in an occupational setting, obtaining their (lack of) physical activity at work, and consuming their meals during their time at work, initiatives that focus on stimulating healthy lifestyle changes may both improve the worker's health and positively impact the employing organisation.

Despite the rationale of employers differ, companies believe that health promotion programmes can reduce employee health care costs, disability, and employee turnover, and may enhance the company image, and worker productivity (Aldana and Pronk, 2001). Despite these beliefs, or in fact, these potential effects, there have only been a few serious attempts that have studied the effectiveness or the economic impact of workplace-based health promotion programmes addressing physical activity or diet. In the following section the literature as to this issue is summarised.

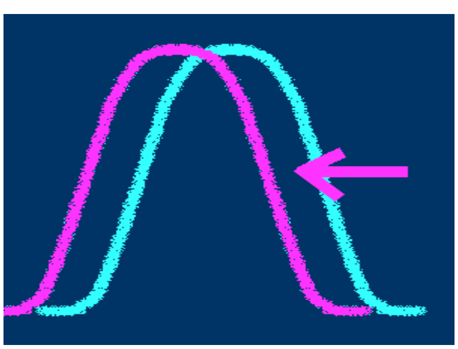
5 Physical activity and diet interventions at the workplace

5.1 Primary prevention versus secondary/tertiary prevention

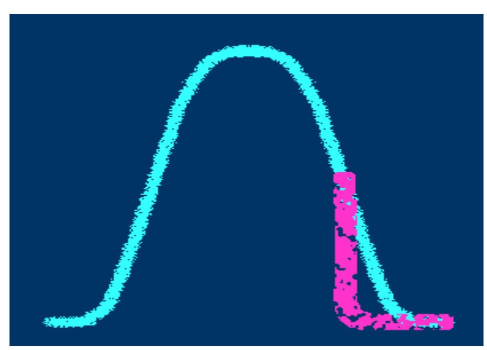
Two broad approaches to reducing risk can be defined. The first is seek to reduce risks in the entire population regardless of each individual's level of risk and potential benefits. This is also referred to as primary prevention. The intention of primary prevention interventions is to move the profile of the whole population in a healthier direction. Small changes in risk factors in the majority who are at small to moderate risk can have an enormous impact in terms of population-attributable risk of death and disability (WHO, 2003). By preventing disease in large populations, small reductions in blood pressure, blood cholesterol and so on can dramatically reduce health costs (see figure). This can be done by interventions that aim directly at the individual, but also by interventions that aim at the environment of the individual. In this context, it is worthwhile to mention that primary prevention interventions aim at those in the work force who are at work (i.e., instead of those who are sick-listed). Assuming that in Western society about 5% of the work force is off work, because of work disability, primary prevention interventions thus aim at those 95% who are actually present at work.

A second category of interventions is to focus the intervention on the people likely to benefit, or benefit most, from it. These secondary/tertiary prevention interventions are based on screening exposed populations for the early onset of sub-clinical illnesses and then treating them. This approach can indeed be very effective if the disease processes are reversible, valid screening tests exist, and effective treatments are available (WHO, 2002). Secondary prevention intervention in the occupational (health care) setting aim at facilitating early return-to-work for those who are off work because of some or other form of disability. Most disabilities are non-specific and refer to the musculoskeletal system (e.g., (low) back pain, neck pain, CANS (i.e., complaints of arm, neck and shoulder: approx. 1/3), the mind (e.g., work stress or burnout: approx. 1/3), or miscellaneous (approx. 1/3). Focussing on high-risk individuals can reduce costs at the population level because an intervention is provided to fewer people, but on the other hand, it might also increase the costs of identifying the group of people most likely to benefit. However, in general, population-wide (i.e., primary prevention) interventions are considered to have the greatest potential for prevention (WHO, 2002). For instance, in reducing risks from blood pressure and cholesterol, shifting the mean of whole populations will be more cost-effective in avoiding future heart attacks and strokes than screening programmes that aim to identify and treat all those people with defined hypertension or raised cholesterol levels (WHO, 2002).

Prevention strategies: high risk versus population strategy



Primary prevention: small risk reduction in the majority of the population



Secondary/tertiary prevention: truncate high risk end of exposure distribution

2 Effectiveness of worksite physical activity and diet interventions

This section reports on the evidence with respect to the effectiveness of worksite physical activity and/or diet interventions. It was beyond the scope of this overview to perform a systematic review. Rather, the evidence is based on relevant, sound, and recent systematic reviews, that were identified for the purpose of this background paper by a quick PubMed search next to a search in the personal database of the authors of this paper.
For physical activity interventions at the workplace, five reviews were selected: a meta-analysis (Dishman et al., 1998), two systematic, qualitative reviews performed by the authors of the present paper (Proper et al., 2002; Proper et al., 2003) evaluating the effectiveness on health-related outcomes, and work-related outcomes, respectively, a recent review commissioned by the National Institute for Health and Clinical Excellence (NICE, Dugdill et al., 2008), and another systematic review of the authors of the present paper, that evaluated the effectiveness of primary prevention lifestyle interventions that are applicable in the occupational (health care) setting (Proper et al., 2005). The latter included separate reviews of the effectiveness of physical activity interventions and interventions aimed at improving diet behaviours. Although not very recent, another key review summarising the effectiveness of worksite diet interventions was selected (Glanz et al., 1996).
The chief components and findings of each of the reviews are summarised below. After, some examples of effective primary preventive physical activity and diet interventions at the workplace are given.

Review #1 - Effectiveness of worksite physical activity programmes on physical activity (Dishman et al., 1998)

<u>Aim</u>
Dishman and his colleagues (1998) performed a quantitative synthesis of the literature that examined the effectiveness of worksite interventions intended to increase physical activity or physical fitness. An additional goal was to describe the factors that may moderate the success of the intervention.

<u>Methods</u>
Computer searches in diverse databases supplemented by bibliographies from the articles retrieved and by reference lists were performed to identify relevant studies. Criteria for including a study were:

1. Type of intervention: a worksite intervention designed to increase physical activity or fitness among employees;
2. Type of outcome measure: a measure of physical activity or a standard measure of physical fitness, which served as a surrogate of physical activity;
3. The outcome measure was quantified in a way that permitted change after the intervention to be calculated and compared with change in a comparison group;
4. An effect size could be calculated using the data reported in the article.

Next to a quantitative synthesis, the methodological quality of each studies was determined using three items, namely: 1) sample size, 2) study design, and 3) measurement of outcome variable.

For examining the moderating effects, diverse factors that might influence the estimated population effectiveness of worksite physical activity interventions were considered, among others subject characteristics, research design, intervention type and delivery, and incentives (financial, prizes, awards and recognition, release time).

Results

From the 26 studies that were selected, 45 effect sizes were retrieved with a total sample of about 8,800 people. The mean (95% CI) value of the correlation was 0.11 (-0.20 to 0.40), which is categorised as a small and non-significant effect. Only 10% of the studies reported large effects, i.e. a correlation (r) exceeding 0.40.

Despite the effects were heterogeneous, none of the features of the studies or interventions under study explained variation among the effects at a high level of statistical significance. Nevertheless, it appeared that slightly larger effects were found in non-randomised studies and in interventions that applied incentives. Smallest effects were found in randomised trials, interventions using health education/risk appraisal, and those studies that conducted the intervention at a corporation rather than at a university or public agency.

Review #2 - Effectiveness of worksite physical activity programmes on physical activity, physical fitness, and health-related outcomes (Proper et al., 2003)

Aim

The purpose of the review of Proper et al. (2003) was to update the literature and to systematically assess the effectiveness of worksite physical activity programmes on physical activity, physical fitness, and health-related outcomes.

Methods

Through diverse sources (electronic and personal databases) relevant studies were searched and selected afterwards. Studies were considered relevant if they met the following criteria for inclusion:

1. Type of study: randomised controlled study (RCT) or (non-randomised) controlled study (CT);
2. Type of study population: healthy working population (i.e. no selection of workers at risk);
3. Type of intervention: a programme offered by the employer and primarily aimed at enhancing employees' physical activity, exercise, and/or fitness levels;
4. Type of outcome measure: physical activity, physical fitness, and other health-related outcome measures.

The review concerned a qualitative review, in that no meta-analysis was conducted because of anticipated heterogeneity between the studies and interventions under study. The methodological quality of each study identified was evaluated by two researchers independently from each other, using a list consisting of nine methodological criteria. To draw conclusions about the effectiveness, a rating system consisting of five levels of evidence was applied:

1. Strong evidence: ≥ 2 RCTs of high quality with consistent results;
2. Moderate evidence: [1 RCT of high quality + 1 RCT of low quality] or [1 RCT of high quality + ≥ 1 CT of high quality]; for both situations, consistent results were required.
3. Limited evidence: 1 RCT of low quality, or: > 1 RCT of low quality, or: > 1 CT of high quality; for all situations, consistent results were required;
4. Inconclusive evidence: only one study or multiple CTs of low quality, or contradictory results;
5. No evidence: more than one study with the consistent result that no significant or relevant results were shown.

Studies were considered to be of (relatively) high quality if more than 50% of the methodological quality criteria was scored positively. Otherwise, the study was considered of (relatively) low quality. Furthermore, study results were considered consistent if at least 75% of the studies involved reported statistical significance or were meaningful (as defined by a 20% difference between the study groups).

Results

A total of 26 studies, of which 15 RCTs and 11 CTs, were finally selected. The studies were generally of low methodological quality: six RCTs were of high quality and none of the CTs could be marked as high quality. Reasons for these low ratings were, among others, a poor description of the randomisation procedure, inappropriate blinding, and the description of the compliance with the programme.

There was a variety of outcome measures used in the studies, namely: physical activity, physical fitness (i.e. cardiorespiratory fitness, muscle strength, muscle flexibility, and body composition), general health, fatigue, musculoskeletal disorders, blood serum lipids, and blood pressure. Based on the rating system for evidence, strong evidence for a positive effect of worksite physical activity programmes on physical activity as well as on musculoskeletal disorders was concluded. Even though there were only two and three, respectively high quality RCTs, results on the effectiveness were consistent in that they showed a positive effect. This was not valid for most of the other outcome measures, where the few RCTs of high methodological quality had inconsistent results showing a positive effect versus a null effect. The conclusion of 'no evidence' for a positive effect on blood lipids as well as on blood pressure was due to the very few RCTs identified that could not detect a positive effect of the intervention on these outcome measures.

Comparison of results of review#1 and #2

The results of this review (Proper et al., 2003) indicated a strong evidence for a positive effect on the level of physical activity, and inconclusive evidence for a positive effect of worksite physical activity programmes on cardiorespiratory fitness. Dishman et al. (1998) however concluded that such programmes have a small, non-significant effect on physical activity. The differences in the review methods used, seem to be a plausible explanation for the different conclusions. For example, review #1 included a quantitative analysis, taking into account the methodological quality of the studies included, whereas review #2 used a qualitative method. Further, the inclusion criteria differed between the two reviews resulting in other studies and interventions evaluated. In review #2, only those interventions that had a primary focus on stimulating the level of physical activity or fitness were included, whereas review #1 included programmes with a more comprehensive training regimen as well. In summary, in interpreting the conclusions of the reviews, the methods used should be taken into account.

Review #3 = Workplace physical activity interventions: a systematic review (Dugdill et al., 2008)

Aim

In order to develop guidelines for public health for England (NICE, 2006), the aim of this review was to report a synopsis of a recent systematic review of the literature as to the effectiveness of workplace physical activity interventions.

Methods

A search was performed in 12 electronic databases in addition to hand checking. If the primary aim of the intervention under study was to increase worker's physical activity level, was applicable to England, was initiated or endorsed by the employer, and the outcome measure included a measure of physical activity, the study was included. Further, only English-language studies published between 1996 and 2007 were included.
Each study identified was reviewed by one team member, checked by another two and graded as high quality (++), good quality (+) or poor quality (-).

Studies were grouped into five areas: 1) systematic reviews, 2) stair walking, 3) walking, 4) active travel, 5) and other, including counselling, health checks, etc.

Results

As to the first area, systematic reviews, three reviews were identified, of which two have already been described under review #1 and #2. Those two were considered as of good quality. The third review was graded as of poor quality. Therefore, as the two reviews were the main input for the conclusions of this review, conclusions were about the same.

Based on the seven studies that evaluated the effectiveness of stair walking and were not all consistent in their findings, limited evidence of the effectiveness was concluded, and interventions effects were short-lived. Further research was recommended.

As to workplace walking interventions, four studies were selected. Based on those four studies, evidence indicated that pedometers can increase daily step counts, where accompanied by facilitated goal setting, diaries, and self monitoring, and walking routes.

Only one good study reported evidence for a positive effect on walking to work of a walking and cycling to work campaign, through the use of written health materials to work in economically advantaged women.

There were rather many studies investigating the effectiveness of workplace counselling interventions. Based on those studies, there was strong evidence that workplace counselling increased physical activity levels.

Review #4 - Effectiveness of worksite physical activity and diet programmes on behaviour-, health-, and work-related outcomes (Proper et al., 2005)

Background

Next to the government, the Netherlands Society of Occupational Medicine recognises the importance of implementing lifestyle interventions in the worksite setting. That Society takes the view that the occupational physician (OP) should play a more initiating role in implementing lifestyle interventions aimed at primary prevention than they currently do. To date, Dutch OPs are predominantly aimed at secondary and tertiary prevention, i.e. the reduction of sick leave and return-to-work activities. Interventions aimed at primary prevention, and the promotion of a healthy lifestyle in particular, are hardly, if at all, implemented by OPs and other occupational health (OH) professionals. Moreover, of the few OPs, who do so, the strategies vary and moreover, are not based on the current evidence. Among OPs, there is a need on information how to perform counselling as to physical activity and dietary behaviour, and which strategy is effective. To implement primary prevention lifestyle interventions in the OH setting, information is needed about the effectiveness and feasibility for OPs.

Aim

The aim of this review was to investigate the (cost-)effectiveness of lifestyle interventions aimed at primary prevention that are applicable in the occupational (health care) setting. In doing so, four separate reviews were performed; one review per lifestyle topic, namely: 1) physical activity, 2) smoking cessation, 3) alcohol consumption, and 4) diet. For the purpose of the present paper, the results of the reviews regarding physical activity (1) and diet (4) interventions are described. Further, only those studies that examined the (cost-)effectiveness of interventions at the workplace (instead of those interventions performed in another setting, but applicable in the worksite setting) are summarised below.

Methods

Similar to the reviews described above, diverse sources were applied to search for relevant studies. To include studies in the review, the studies had to meet the following criteria:

1. Type of study: study with a randomised controlled design (RCT);

2. Type of intervention: lifestyle intervention addressing specifically physical activity and/or healthy diet behaviour that can be applied in the occupational health care or workplace setting. However, as mentioned before, for the present paper, only those interventions at the workplace will be described. Further, the intervention had to be focussed on primary prevention; those aimed at treatment were excluded.
3. Type of outcome measures: both behaviour-, health-, and work-related outcome measures were included. Behaviour-related outcome measures involve the level of physical activity and/or dietary habits. As to health-related outcomes, both objectively measured parameters, like blood pressure, blood cholesterol, as well as subjectively measured variables (e.g. self-reported general health and musculoskeletal disorders) were included. Examples of work-related outcomes are sick leave, productivity, job stress, or job satisfaction.

This review concerned a narrative review in that the literature search and inclusion of studies was done in a systematic, structured way indeed, but the studies retrieved, were not evaluated on their methodological quality. The aim of this review was rather to provide a thorough insight in the type of (effective) interventions available. Below, the description of the results will be done for physical activity interventions and diet interventions separately.

Results

1) Worksite interventions addressing physical activity

Twenty one studies were selected that investigated the effectiveness of health promotion interventions at the workplace addressing physical activity. The description of the studies and the interventions of concern are presented in the annex, table 1. There were different types of interventions evaluated, varying from a concrete physical activity or exercise programme offered either onsite or offsite, to education or counselling interventions. There were also combinations of intervention types. Further, the interventions included individual-based or group-based interventions. Most health education and counselling interventions were based on behaviour change theories with the TransTheoretical Model (TTM) being frequently applied.

As can be seen from table 1 (see annex), the interventions were generally effective in increasing physical activity behaviour levels. The health-related outcome measures were among others body composition (e.g. body weight, BMI, body fat%), blood pressure, blood cholesterol, physical fitness, and general health. The main results per outcome are summarised below.
Regarding body composition, none of the studies found an effect on BMI, whereas for body fat percentage, three out of four showed statistically significant favourable effects of the intervention under study. Of the studies evaluating the effectiveness on cardiorespiratory fitness, all except one (Perkio-Makela, 1999, 2001) found improved fitness levels. It also appeared that a worksite physical activity or fitness programme is beneficial for musculoskeletal disorders as overall positive results were shown by the studies selected. Despite strong evidence for the relationship between physical activity and cardiovascular risk factors, like blood pressure and blood cholesterol, results from this review could not conclude such evidence for the effectiveness of worksite physical activity interventions on these cardiovascular risk factors.

Nine studies evaluated the effectiveness on work-related outcomes, measured by job satisfaction, job stress, productivity, work ability, and sick leave. For all of these outcomes, there were only very few studies available. Moreover, of the few studies, inconsistent findings were apparent, making it almost impossible to draw bold conclusions. The majority of the studies (n=5) evaluated the effect on sick leave with three of them showing a null effect. Kerr and Vos (1993), on the other hand, found a significant effect of the in-company fitness programme among Dutch banking employees. Another Dutch study (Proper et al., 2004) investigating the effectiveness of an individual-based physical activity and diet counselling programme, did find a difference of six days in sick leave in favour of the intervention, but could not conclude statistical significance.

2) Worksite interventions addressing a healthy diet

Ten studies evaluated the effectiveness of interventions at the workplace aimed at improving healthy diet behaviour. As can be seen from table 2 in the annex, there were both mono-component interventions (i.e. aimed at dietary habits only) and multi-component interventions targeting other lifestyle factors next to diet. Almost all interventions included counselling or education interventions, either individual or group-based. Also, feedback was frequently applied in the interventions aimed to increase awareness about the worker's own (unhealthy) dietary behaviour. The diet interventions generally targeted increasing fruit and vegetables intake, intake of fibres, and a reduction of fat intake.

Below, the main conclusion as to the effect of diet interventions at the workplace are briefly described. For a further insight in the effectiveness of the studies, we refer to table 2 in the annex. The majority of the studies found improvements in the intake of fruit and vegetables. In addition, it can be concluded that worksite diet interventions seem to be effective on the intake of fat. Three studies evaluated the effectiveness of diet interventions in the workplace setting on health-related outcomes. The two studies that investigated the effect of the multi-component intervention on BMI (Nisbeth et al., 2000; Stamler et al., 1989) found a significant reduction in body weight among the intervention group versus an increase in the control group. For blood cholesterol and blood pressure, results of the few studies identified were inconsistent, as a consequence of which no conclusion can be drawn about the effectiveness of worksite diet interventions on blood cholesterol and blood pressure.

There were no randomised studies that investigated the effect of diet interventions on work-related outcomes. There was however one non-randomised study (Pegus et al., 2002). This study evaluated the effect of a multi-component intervention aimed at the promotion of physical activity and healthy diet on job satisfaction and absenteeism. In doing so, they used four modules about physical activity and diet, and provided messages through e-mail, flyers, and posters. Moreover, participants received a walking programme. Results showed that there was no effect of the intervention on job satisfaction; both study groups showed improved job satisfaction. As to absenteeism, the intervention appeared to be effective: at follow-up, the intervention group had 67% less sick leave compared to baseline versus 52% less sick leave among those in the control group.

Review #5 - Effectiveness of worksite physical activity programmes on work-related outcomes (Proper et al., 2002)

<u>Aim</u>

The aim of this review was to gain insight into the effectiveness of physical activity programmes at worksites on work-related outcomes by systematically reviewing the literature.

<u>Methods</u>

The same methodology as in review #2 (Proper et al., 2003) examining the effectiveness of worksite physical activity programmes on health-related outcomes, was used. Therefore, the methods of this review are not further described. The only difference with that review is the type of outcome measures. This review included intervention studies that evaluated work-related outcomes, such as absenteeism, work productivity, and job stress.

NB. Since the aim of this review overlapped the aim of the recently performed review (review #4), and thereby the studies included in this review were also selected for review #4, only the main results and conclusions of this review are mentioned. The main difference between review #4 and review #5 is the methodology, with the latter evaluating the methodological quality of each study and applying a best evidence synthesis, in order to draw a conclusion about the effectiveness of worksite physical activity programmes on work-related outcomes. For a further insight in the review or the studies, we refer to either the original article (Proper et al., 2002) or to table 1 in the annex.

Results

There were only eight studies (four RCTs and four CTs) identified that met the criteria for inclusion. The outcomes evaluated were absenteeism, job satisfaction, job stress, productivity, and employee turnover. The results were rather unsatisfactory, since the studies were generally of poor methodological quality, and - due to the lack of (randomised) studies, this review could only conclude limited evidence for a positive effect on absenteeism. For the other work-related outcome measures, the conclusions were either inconclusive or no evidence for a positive effect of the physical activity interventions.

The conclusion drawn was similar to earlier reviews. For example, in their literature study, Aldana and Pronk (2001) concluded that high levels of fitness program participation tend to be associated with decreased levels of near-term absenteeism (1 year) (Aldana and Pronk, 2001). They also emphasised the low validity of the studies included with all of them failing to use a true experimental design (Aldana and Pronk, 2001).

Review #6 - The health impact of worksite nutrition programmes (Glanz et al., 1996)

Aim

The aim of this review was to summarise and provide a critical review of worksite health promotion programme evaluations that addressed nutrition and hypercholesterolemia. For the purpose of this paper, the results of the intervention that targeted nutrition are summarised only.

Methods

Studies published after 1980 were included if they met the following criteria: 1) clear description of the intervention strategies focusing on nutrition, 2) an identifiable nutrition-related outcome measure was reported, 3) the study focused primarily on employees or a worksite population.

For the studies identified, a quality rating system was applied based on the research design. A three-star rating indicated an evaluation without a comparison or control group, a four-star rating was applied in case of a comparison group, but no randomised control group, and a five-star was given if the study used a randomised control group.

Results

Ten studies, of which four RCTs, that investigated the effect of a worksite nutrition programme were included. The interventions of concern were categorised as group education, group education plus individual counselling, cafeteria programmes, and group education plus cafeteria programmes. Virtually all of the non-randomised studies reported some favourable outcomes on the behaviour, or on food purchasing patterns. Despite differences in outcomes used, the randomised studies also reported generally positive results.

As to the question what strategy works best, a cautious conclusion was drawn that group education with individual counselling and instruction produced certain dietary changes. They also stated that comprehensive worksite nutrition education programmes that address both individual and environmental changes deserve further attention, given the potential for significant dietary changes among worksite populations as a whole, rather than only among programme participants.

In summary, similar to the previous review (review #5), this review emphasised that only limited conclusions could be drawn due to the poor methodological quality of the studies reviewed. That is, most of the studies did not use a randomised design. Despite they concluded that workers benefit from worksite nutrition programmes in the short-term, conclusive evidence about a causal relationship between worksite nutrition programmes and improved behaviour and health could not yet be provided.

Examples of effective worksite interventions aimed at the promotion of physical activity and a healthy diet

Below, a few examples of randomised trials that studied the effectiveness of interventions at the workplace addressing physical activity and/or diet are described. These studies have been selected based on 1) the content of the intervention, 2) its effectiveness, and as far as possible, 3) the country where the study was conducted. As to the content of the intervention, we aimed to show different types of interventions, for example those using an individual approach versus an ecological approach, or mono-component interventions versus multi-component interventions. Further, the examples presented below are based on their effectiveness, that is we aimed to present effective interventions. Finally, we aimed to show examples from different countries, or preferably from low and high income countries. However, as appeared from the reviews (see tables 1 and 2 in the annex), all studies were from the so-called high income countries with the Unites States and Europe being dominant. The global perspective is thus not covered.
healthier.

Example #1 - Promotion of physical activity and healthy diet through individual counselling at the workplace

<u>Background and aim</u>
In the early nineties, the PACE intervention (PACE: Physician-based Assessment and Counselling for Exercise) was developed in the United States (Calfas et al., 1996), based on the TTM (Prochaska and DiClemente, 1983) and social cognitive theory (SCT) (Bandura, 1986). It was developed as a minimal intervention strategy aimed at enhancing moderate intensity physical activity through advice from primary care physicians. A controlled trial in the United States showed that the PACE intervention was feasible and effective in producing a short-term effect on walking activity (Calfas et al., 1996; Long et al., 1996). Following this successful evaluation in the US, the PACE programme was adapted for implementation and evaluation in the Dutch occupational health care setting.
The aim of this randomised controlled study was to evaluate the effectiveness and cost-effectiveness (see section 5.4) of the individual-based counselling intervention addressing physical activity and diet (Proper et al., 2003).

<u>Methods</u>
All workers (approx. n=600) of a mid-sized Dutch town were invited to participate in a primary preventive intervention aimed at increasing levels of physical activity and promote a healthy diet. Of these, 299 decided to participate. They were randomised at the level of their operational unit over either a control group or an intervention group receiving a 9 months intervention. The intervention consisted of a baseline screening procedure (also performed in the control group), measuring their level of fitness, their lifestyle habits, as well as a number of cardiovascular risk factors and demographic variables. In addition, those in the intervention group received a maximum of seven personalized (face-to-face) sessions with a counsellor trained at changing lifestyle related behaviour. The intervention was set-up such that the primary focus was on increasing levels of physical activity; the secondary focus was on stimulating healthy dietary habits.

Outcome measures were physical activity, a number of risk factors for cardiovascular disease, and musculoskeletal disorders.

Results

In short, this study showed significant favourable effects on total energy expenditure, physical activity during sports, cardiorespiratory fitness, percentage of body fat, and blood cholesterol (see table 5.2.2). No effects were found for the proportion of subjects meeting the public health recommendation of moderate-intensity physical activity, physical activity during leisure time other than sports, prevalence of musculoskeletal symptoms, body mass index, and blood pressure.

In this study, the effect on sick leave was also evaluated (Proper et al., 2004). It appeared that both groups increased in their mean sick leave rate during the nine months lasting intervention compared to before the intervention. However, after the intervention period, sick leave rates among the control group continued to increase (from 22.9 to 27.6 days) whereas the intervention group slightly decreased (from 21.5 to 20.5 days). Results of the multilevel analysis, adjusting for baseline sick leave, showed a difference of mean sick leave rate between the two study groups of six days in favour of the intervention group. It should be noted that none of the intervention effects on sick leave was significant, most likely due to the fact that this study was not primarily powered to find an effect on sick leave.

In conclusion, this study showed that individual face-to-face counselling at the workplace positively influenced physical activity levels and some relevant components of physical and cardiovascular fitness. Despite a positive trend as to effects on absenteeism due to sick leave, differences were not statistically significant.

Table 5.2.2. Results of the individual counselling intervention (Proper et al., 2003)

Outcome measure	*Effect size (beta (sd))*	*95% CI*	*p*
Energy expenditure (kca/day)	176 (59)	61 - 292	<0.01
Sports activities	0.22 (0.08)	0.07 - 0.37	<0.01
Leisure time physical activities	0.06 (0.05)	-0.04 - 0.17	ns
Submaximal heart rate[2]	-4.71 (1.35)	-7.38 - -2.05	<0.01
BMI	-0.22 (0.13)	-0.47 - 0.03	0.08
Body fat %	-0.79 (0.32)	-1.43 - -0.16	<0.05
Diastolic blood pressure	-0.04 (1.00)	-2.01 - 1.92	ns
Systolic blood pressure	0.10 (1.50)	-2.85 - 3.05	ns
Blood cholesterol	-0.18 (0.09)	-0.36 - -0.01	<0.05

[1] index ranged from 1 to 5: the higher the index, the more physically active; [2] submaximal heart rate derived from the submaximal bicycle test; a lower submaximal heart rate indicates a higher cardiorespiratory fitness

Example #2 - Foodsteps: a workplace environmental intervention to promote physical activity and a healthy diet

Background and aim

Next to aiming interventions at the individual, an ecological approach allows for changing lifestyle related behaviours through changing the workplace environment. From the perspective of what is called 'environmental justice', one may argue that such an approach is even more effective. In order to evaluate the effect of such an intervention, the Foodsteps project (www.foodsteps.nl) was carried out (Engbers et al., 2006).

Methods
In short, a controlled trial, including two worksites, was done. Measurements took place at baseline and at 3- and 12-months follow-up. The intervention consisted of two parts focusing on both sides of the energy balance: one part on 'Food' to stimulate healthy food choices, and the other part on 'Steps', to stimulate stair use. The stair use intervention took place over 10 months and consisted of placing motivational signs on elevator doors at the ground floor. Further, foodsteps were printed on the floor leading to the stairs and mirrors were placed in the staircases to make workers look slim. The 'Food' part took place during 12 months and was aimed to stimulate healthier food choices by means of product information in the canteen and at other decision points (Engbers et a., 2006).

Results
Significant differences in change between study groups in favour of the intervention group were found on: total cholesterol for women (−0.35 mmol/l); HDL for men at 3 months (0.05 mmol/l) and 12 months (0.10 mmol/l); and the total cholesterol/HDL-ratio for the total intervention group at 3 and 12 months (−0.45 mmol/l). Both groups showed a decrease in all body composition values at both follow-up measurements. A significant difference in change in systolic BP was found in favour of the control group (approx. 4 mm Hg), due to an increase in the intervention group at both follow-up measurements. In this study, the effect on objective stair use was also assessed. Results showed a short-term significant effect on change in stair use frequency and the number of floors covered per week. At the long-term, no significant effects were found. Based on these contrasting results it was concluded that this modest environmental intervention was ineffective in reducing cardiovascular risk in a population of office workers.

Interim conclusions from example #1 and #2
From these two Dutch interventions, it can be concluded that worksite interventions either aimed at individual or at the environment are effective in changing physical activity behaviour and lead to changes in relevant indicators of cardiovascular risk. It seems however that the individualised, one-to-one approach is providing better effects than the environmental, ecological approach. Saying this, it should be taken into account that the environmental intervention as studied by Engbers et al. (2006) concerned a minimal intervention strategy with only small changes in the worksite setting. Further, although small effects on cardiovascular disease risk factors, results shown are considered relevant. From a primary prevention standpoint, even small changes in health behaviours, as well as small changes in health outcomes are of great public and occupational health significance, if the trend over time in these variables is detrimental. More high quality research is definitely needed in this area to provide a definitive blue print for worksite lifestyle interventions.

Example #3 - Treatwell 5-a-Day: a worksite and a worksite-plus-family intervention to increase fruit and vegetable consumption

Background and aim
In order to increase the proportion of Americans meeting the fruit and vegetables recommendations to consume five or more servings of fruits and vegetables per day, the National Cancer Institute launched an initiative, the "5-a-Day for Better Health" campaign (Havas et al., 1994; Subar et al., 1995). That campaign included nine studies, of which the one summarised here, was one of them.
The aim of this study was to assess the effectiveness of a worksite-based nutrition intervention involving families in promoting increased intake of fruits and vegetables (Sorensen et al., 1999). This study is unique as it is one of the first studies that incorporated education for families into a worksite-based health promotion programme (Sorensen et al.,

1999). Considering the health care costs for both workers and their dependents, a focus on the family, in stead of on the worker only, may be attractive to employers.

Methods
A randomised controlled study was performed with 22 worksites randomly assigned to three groups: 1) a minimal control group, 2) a worksite intervention, and 3) and worksite-plus-family intervention. The interventions took place during well over 19 months. The minimal intervention received by those in the control group was also offered to the intervention groups. This consisted of periodic exposure to the national 5-a-Day campaigns, general nutrition information given during a 1-hour presentation, and a taste test. The worksite, and the worksite-plus-family intervention applied an ecological model, including three main elements, namely: 1) worker participation in programme planning and implementation, 2) programme aimed at individual behaviour change, and 3) programme aimed at changes in the worksite environment (Sorensen et al., 1999). The additional components offered in the worksite-plus-family intervention were a written "learn-at-home" programme, an annual family newsletter, an annual family festival, and periodic mailings to the family.

Results
A 7% increase in the consumption of fruits and vegetables, which equals about 0.2 servings was seen among those in the worksite intervention. The worksite-plus-family intervention group showed an increase of 19%, corresponding to 0.5 servings. It further appeared that the increase in fruits and vegetables consumption among the worksite-plus-family group was significantly greater than that in the control. This was not the case for the worksite intervention only group.

5.3 Economic evaluations within the worksite setting

In an economic evaluation, the costs and effects of an intervention are compared with the costs and effects of an alternative, or more alternatives (Drummond et al., 1997). In the case of worksite health promotion interventions, the alternative can be usual care or a cut-down version of the intervention, for instance posters or written, general information only. The former, that is "doing nothing", is often the case in worksite health promotion programmes, because the company probably did not have a health programme before.
An economic evaluation is aimed to answer the question whether an intervention is worth doing compared to other strategies that could be performed within a certain budget, implying that both costs and effects are considered. Thus, if an intervention is more effective than the alternative, but is associated with higher costs, the intervention may still be preferred (Van der Roer, 2006). If such a situation occurs, there may be a need to determine whether the effects outweigh the extra costs. There are different forms of economic evaluations that are described below. In interpreting this section, it should be considered that it focuses on economic evaluations alongside RCTs. This means that economic evaluations with respect to modelling studies are left out of consideration.

Full and partial economic evaluations
Economic evaluations can be subdivided into full and partial economic evaluations. A full economic evaluation is characterised by 1) a comparison of at least two interventions and 2) measurement of both costs and consequences of the interventions of concern (see table 5.3.1) (Van der Roer, 2006). Many economic evaluations are partial evaluations in which only the costs, or the costs and effects of one intervention are described, or in which the costs of at least two interventions are compared (Drummond et al., 1997). Although partial evaluations may contribute to understanding effectiveness or costs involved in an intervention, full economic evaluations are the most useful in resource allocation questions (Van der Roer, 2006).

Four types of economic evaluations
Four commonly used full economic evaluations can be distinguished (see table 5.3.1). These types of economic evaluations mainly differ in the way of measuring the consequences of the interventions. That is, the way of calculating costs do not by definition differ between the types of economic evaluations. It should be noted that there is no best or worst type of evaluation; the choice for a certain type of economic evaluation just depends on the research question, and the data available.

The most commonly used types of full economic evaluations are (Drummond et al., 1997):

1. *Cost-minimisation analysis (CMA)*
   A CMA includes a comparison between the costs of the interventions only. Logically, the intervention with the lowest costs is preferred. A CMA is performed if it is clear that the interventions has similar effect sizes.
2. *Cost-effectiveness analysis (CEA)*
   In a CEA, the difference in costs between the interventions are compared to the difference in interventions effects, expressed as behaviour-, health-specific, or work-related effects. For example, the effects can be expressed as kilocalories expended by physical activity, grams of fruit and vegetables intake, mmol per liter blood cholesterol, days of sick leave, etcetera. As part of a CEA, a cost-effectiveness ratio is calculated, representing the incremental effects of an intervention related to the incremental costs.
3. *Cost-utility analysis (CUA)*
   A CUA is a special form of cost-effectiveness analysis. A CUA compares the costs of the interventions with the effect defined as utility, which takes into account both the duration of life and the quality of life. Commonly used utility measures are the quality-adjusted life-years (QALYs) or disability-adjusted life-years (DALYs).
4. *Cost-benefit analysis (CBA)*
   In a CBA, both costs and consequences are expressed in monetary items. An intervention may therefore be considered efficient when the benefits outweigh the costs. However, a CBA is not that easy, because of the difficulties in translating the consequences to monetary terms (Van der Roer, 2006). For such a translation, diverse methods are available. One of such techniques is the so-called "willingness-to-pay", where respondents are being asked what they would pay for an intervention given a certain effect (Drummond et al., 1997).

Table 5.3.1. Types of economic evaluations (Drummond et al., 1997)

		Study of both costs and effects?		
		No	No	Yes
		Only effects	Only costs	
Comparison of two or more alternatives?	No	*1. Partial evaluation*: a. description of effects	b. description of costs	*2. Partial evaluation*: costs/effects description
	Yes	*3. Partial evaluation*: a. efficacy or effectiveness analysis	b. cost analysis	*4. Full evaluation*: CMA; CEA; CUA; CBA

Perspective
An economic evaluation can be conducted from different perspectives, such as the societal perspective, the individual worker's perspective, the health insurance perspective, or the employer's perspective. An economic evaluation performed from a societal perspective takes into account all relevant costs and consequences, regardless of who is responsible for the costs and who benefits from the effects. In an economic evaluation from the employer's perspective, on the other hand, only outcomes like job satisfaction, days of sick leave, or productivity loss may be considered the most relevant outcomes, next to intervention costs for the company only.

Time frame of analyses
The most ideal situation is to perform an economic evaluation over a long period of time, that is, over the period of time that the effects are obtained. For instance, to be able to obtain an effect on sick leave or employee turnover, a time frame of several years, say, at least five years, is necessary. As most studies (RCTs) are performed within a limited time frame, such an effect can not be analysed. In those cases, it is possible to extrapolate the data available. It should however be considered that such calculations are based on assumptions that might be incorrect. Therefore, it is recommended to perform sensitivity analyses using variations in the assumptions to determine the sensitivity of the outcomes.

Discounting
Particularly at prevention programmes, like worksite health promotion initiatives, costs and effects take place at different time periods. This means that the investments are immediately, whereas the effects occur after a while, say, after several years. Policymakers, including employers, do however attach less value to future costs and effects than they do on current costs and effects. To be able to compare (current) costs and (future) effects, discounting factors can be applied. Discounting means computing equivalent present values of future costs or benefits. It is recommended to discount costs in studies with a time horizon longer than one year. As to the discount factor to be used, there is no international guideline. Nevertheless, discount rates for costs usually vary between 3% and 5% (Gold et al., 1996; Drummond and Jefferson, 1996). For the effects, discount rates varying from the same or a lower rate as the costs have been proposed (Gold et al., 1996; Gravelle and Smith, 2001). For example, Dutch guidelines recommend a discounting percentage of 1.5% for the effects (Brouwer et al., 2005).

Cost-effectiveness planes
In a cost-effectiveness analysis, a cost-effectiveness plane gives relevant information. In a cost-effectiveness plane, uncertainty surrounding the incremental cost-effectiveness ratio (ICER), representing the difference in costs divided by the difference in effects, are graphically presented (O'Brien and Briggs, 2002). As can be seen from figure 5.3.1, there are four quadrants. The southeast quadrant indicates that the new intervention is more effective and less costly than the alternative intervention. In this case, the new intervention is dominant and will obviously be preferred. If the new intervention is less effective and more costly, the alternative intervention is dominant and will be preferred (northwest quadrant). The northeast quadrant indicates that the new intervention is more effective, but more costly. The southwest quadrant indicates that the intervention is less effective, and cheaper. In the latter two situations, it is not directly clear which intervention should be preferred and implemented.

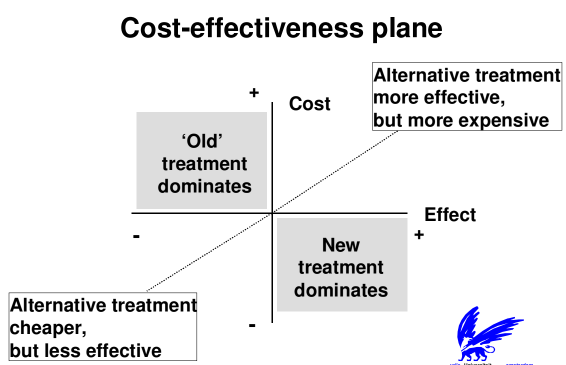


Figure 5.3.1. Cost-effectiveness plane for a comparison between two interventions

5.4 Economic evaluations of worksite physical activity and diet interventions aimed at primary prevention

In the past few decades, diverse reviews were performed that investigated the effectiveness of health promotion programmes at the workplace (see preceding section). Those reviews generally concluded positive effects on lifestyle behaviour as well as on certain important health risk factors. From a theoretical point of view it may be expected that the employer benefits from implementation of a worksite lifestyle promotion programme. Moreover, it seems plausible that the employer is even more interested in an insight into the balance between the investment and the benefits. Although there may be diverse rationales for an employer to implement a health promotion programme, some of them need to be convinced about the financial benefits for them ("What's in it for me?"). Suggested benefits include among others an improvement of corporate image, a decrease of employee turnover, gains in productivity, reduced absenteeism, and reduced medical costs.

Shephard, for example, explicitly stated the following postulated early benefits of interest to an employer:
1) improvement of corporate image,
2) selective recruitment of premium employees,
3) increase of work satisfaction,
4) reduction of absenteeism and turnover of staff,
5) reduction in medical costs, and
6) reduced incidence of industrial injuries (Shephard, 1992).

However, looking at the literature, the conclusion is simple: there is lack of sound studies that incorporated an economic evaluation. That is, there are hardly any studies using a randomised controlled design, that assessed both actual costs of the intervention under study, and measured relevant (work-related) data, like absenteeism or presenteeism, and eventually translated such data to monetary units in a valid way. As far as the authors of this paper are aware of, the study of Proper and colleagues (2004), as presented in example #1 (section 5.2), is the only randomised trial published that incorporated a CEA and CBA using actual data of the study population (instead of using modelling studies). Although not many, there are however some quasi-experimental studies that calculated a cost saving ratio for health care costs and/or sickness absenteeism per dollar spent on the programme. Clearly, the lack of economic evaluations of health promotion interventions at the workplace can be considered striking, since still many employers decide to implement such a programme based on an anticipated positive return on investment. To provide reliable data with respect to the cost-effectiveness or cost-benefits of worksite physical activity or diet programmes, there is thus a strong need to conduct studies with a sound methodology (read: using a randomised controlled design) evaluating the effectiveness, as well as the costs and benefits of such programmes.

Below, three commonly used reviews that investigated the financial impact of worksite health promotion programmes are summarised (Aldana, 2001; Chapman et al., 2005; Shephard, 1992), followed by a description of the RCT of Proper and colleagues (2004) that included a CEA and a CBA in their study as to the effect of the workplace-based lifestyle counselling.

Review #1 - Financial impact of worksite health promotion programmes (Aldana, 2001)

<u>Aim</u>
This review aimed to answer the following two questions:
1. Do individuals or populations with high health risks have worse financial outcomes than individuals with low health risks?

2. Do health promotion programmes and fitness programmes improve financial outcomes (i.e. reduce employee-related health care expenditures and absenteeism)?

Methods

A comprehensive search was conducted in diverse databases. Only studies published in peer-reviewed journals in the English language were included. Moreover, the study had to be original, data-based, and to directly measure an association or comparison. Based on the study design, each intervention study was assigned a scientific quality grade. The highest grade (A) was referred to research that applied a properly randomised controlled study, and the lowest grade (E) was applied to descriptive studies and expert opinions. The intermediate levels, grade B, C, and D, referred to studies using a quasi-experimental design, pre-experimental design, and correlational design, respectively.

Results

Association between health risk behaviour (diet and physical activity) and financial outcomes

- Two studies, both using the Health Enhancement Research Organization (HERO) database, examined the link between diet and health care costs. In contrast to what was expected, both reported that poor nutritional habits were associated with lower medical expenditures. The researchers of the studies suggested that this finding may be due to deficiencies in the nutrition measure.
- No studies were identified that investigated the link between diet and absenteeism (table 5.4.1).
- Six studies examined the association between physical activity/fitness and health care costs. Of these, three reported no significant differences in health care costs between those at low risk versus those at high risk levels of physical activity/fitness. The remaining three showed a positive relationship indicating an association of physical inactivity and higher health care expenses (table 5.4.1).
- Further, seven studies examined the association between physical activity/fitness and absenteeism with five of them showing no significant relationship (table 5.4.1). Based on these results, Aldana concluded that this association is ambiguous at best (Aldana, 2001). He stated that moderate and high levels of fitness or physical activity have the ability to reduce incidence of many chronic diseases, but this may or may not translate into lower levels of absenteeism.

As shown in section 2.2, we would like to refine the conclusion of Aldana, since recently two studies using longitudinal data have been published that found evidence for a positive (causal) relationship, and dose-response relationship between vigorous physical activities and less sick leave (Van den Heuvel et al., 2005; Proper et al., 2006).

Table 5.4.1. *Association between diet and physical activity, and health care and absenteeism costs (Aldana, 2001).*

Type of association	Number of studies	Results, Conclusion
Diet - health care costs	2	negative association (n=2), inconclusive
Diet - absenteeism	0	No data
Physical activity/fitness - health care costs	6	Positive association (n=3), no association (n=3), inconclusive
Physical activity/fitness - absenteeism	7	Positive association (n=2), no association (n=5), inconclusive

Impact of health promotion programmes on absenteeism and health care costs

Impact on absenteeism

Eleven of the 14 studies that evaluated the impact of a health promotion programme on absenteeism, used a design that included comparison groups, but did not use randomisation to make group assignments. Regardless of the research design, all studies reported reduced absenteeism. Three studies, of which two had a quasi-experimental design and one a correlational design, also reported cost-benefit ratios to compare the intervention costs with the financial amount saved. In total, 13 studies were identified that reported cost-benefit ratios. The correlational study (Henritze et al., 1989) found a relatively high ratio for the absenteeism cost saving per dollar spent on programming, namely 10.1. The ratios found for the quasi-experimental studies were 1:2.5 (Bertera, 1990) and 1:4.85 (Shephard et al., 1992). The average savings from absenteeism among these three studies was 5.82 (table 5.4.2). However, it should be taken into account that the ratio found in the correlational study was much higher than those found in the relatively higher quality studies (but still had no equivalent control group).

Impact on health care costs

Of the 32 studies that evaluated a health promotion programme on health care costs, only four used an experimental design, and 11 were quasi-experimental studies. Of the seven studies that calculated a cost-benefit ratio, only one used an experimental design (Fries et al., 1993). However, this study targeted a retiree population instead of a (currently) working population. The four quasi-experimental studies found health care cost savings varying from 2.5 to 4.45 (table 5.4.2). Taking into account the reaming studies as well, that is also those that used a pre-experimental (i.e. cohort or case-control) or a correlational design, the average was 3.48 suggesting that health promotion programmes may be able to reduce health costs by 3.48 dollar for every dollar spent on the programme (table 5.4.2).

Three studies, of which two quasi-experimental studies and one a pre-experimental study, combined the savings from both health care costs and absenteeism. The combined savings found were 6.0, 3.5, and 3.4, respectively with an average cost saving of 4.3 per dollar invested in the programme (table 5.4.2).

Table 5.4.2. Average cost savings per dollar spent on intervention, based on 13 studies (Aldana, 2001)

Health care savings	Absenteeism savings	Savings from both health care costs and absenteeism combined
3.48	5.82	4.3

Impact of fitness programmes on absenteeism and health care costs

Impact on absenteeism

Five of the seven studies, which all appeared to fail a randomised controlled design, suggested that participation to the fitness programme tend to be associated with decreased levels of near-term (1 year) absenteeism.

Impact on health care costs

As to the impact of participation to a fitness programme on health care costs, three (non randomised studies) studies were retrieved. Two of these used programme participation as an independent variable and showed some reduction in health care costs as a function of programme participation. The third study did not measure programme participation, but did find short-term reductions in disability and health care costs.

In conclusion, despite study design weaknesses, there are indications for a positive effect of participation of a fitness programme on absenteeism and health care costs.

Review #2 - A meta-evaluation of worksite health promotion economic return studies (Chapman et al., 2005)

Aim

The aim of this review was to update the earlier performed meta-analysis of economic return studies of worksite health promotion studies (Chapman, 2003).

Methods

An exhaustive search process was conducted and studies published between 1982 and 2005 were included. To be included the study had to meet the following criteria:

- a multi-component intervention (a minimum of 3 types of programmes)
- the workplace setting only
- reasonable rigorous study designs
- original research
- examination of economic variables, typically including any one or a combination of the following: health benefit plan costs, health care consumption indicators, sick leave absenteeism, workers' compensation costs, disability management costs, pension costs, or presenteeism effects.
- publication in a peer reviewed journal
- use of statistical analysis
- sufficient sample size
- replicable interventions minimum length of intervention period (>12 months)

This review involved a systematic review of research studies used a standardised set of design and methodological criteria to estimate the relative degree and strength of the internal validity and external validity of the studies reviewed. The validity criteria included the areas of research design, sample adequacy, quality of baseline delineation, quality of measurements used, appropriateness and replicability of interventions, length of observational period, and recentness of experimental time period.

Results

In total, 56 peer reviewed journal articles were included. Based on all studies, Chapman concluded that worksite programmes achieve a 25-30% reduction in medical and absenteeism costs in an average period of about 3.6 years. Results of the meta-analysis showed:

- an average 27% reduction in sick leave absenteeism
- an average 26% reduction in health care costs
- an average 32% reduction in workers' compensation and disability claim costs, and
- an average $ 5.81 to $ 1 savings-to-cost ratio.

Point to consider

Despite diverse studies were found that estimated a cost benefit ratio of the programme under study, it was emphasised that there is a lack of standardisation in the methodology used in economic analysis of worksite health promotion programmes. Despite these different techniques, the studies were consistent in that they generally showed an average reduction in sick leave, health plan costs, and workers' compensation and disability costs of slightly more than 25%.

Review #3 - Benefits op worksite fitness programmes (Shephard, 1992)

Aim

The aim of this review was to look critically at appropriate techniques for the economic analysis of worksite fitness and lifestyle programmes, postulated programme benefits, anticipated programme costs, and the relationship of such costs to programme effectiveness.

Results

As to the effect on employee turnover rate, results of the Toronto Life Assurance programme (Cox et al., 1981), a fitness and lifestyle programme evaluated in a quasi-experimental study, showed a drop from 18% to 1.8% per annum in programme adherents. Similar positive findings were found in the other studies reviewed. Besides, the Toronto Life Assurance programme showed an increase of 7% in productivity in the experimental company. The matched control group, however, also showed a productivity gain, namely of 4.3% leading to a net benefit of 2.7% (Cox et al., 1981).

Of the studies reviewed, of which relatively few used controls, many found decreases in absenteeism. In addition, Shephard (1992) suggested that medical cost savings could arise from an immediate improvement of perceive health or from a reduction of chronic disease, and especially ischaemic heart disease.

Point to consider

Despite the above mentioned potential benefits, the literature is consistent in that the authors of the reviews performed in this field all confirm that the available evidence on the benefits of worksite lifestyle (or more comprehensive: health) promotion programmes is far from clear-cut (Shephard, 1992), which is due to the lack of high quality studies using an experimental design.

Review #4 - Workplace physical activity interventions - a rapid overview of economic literature (Beale et al., 2007)

Aim

The aim of this review, performed by the National Institute for Health and Clinical Excellence (NICE) was to review the literature on the economic impact of workplace interventions which aim to increase employees' physical activity levels.

Methods

A search was carried out in economic databases (i.e., NHS EED, HEED, and EconLit) as well as in grey literature. The search strategy was designed to be broad. For example, all research designs were considered, taking into mind that randomised controlled trials are not always appropriate for measuring public health interventions. To be included in the review, the studies needed to provide economic evidence that was directly linked to workplace based physical activity initiatives. Moreover, the initiatives under study should be applicable in England or to initiatives outside the workplace that are initiated or endorsed by the employers.

A quality grading system of evidence consisting of the codes ++, +, and - was used. The codes were based on the extent to which the potential sources of bias had been minimised.

Results

A total of seven studies that evaluated the economic benefits of workplace physical activity programmes were identified as being relevant for the purpose of this review. The studies included were performed in the USA (n=4), Australia (n=1), The Netherlands (n=1), and Canada (n=1) with only one published within the last nine years. Main characteristics and results of the studies are presented in table 5.4.2.

Main conclusion was that there appeared to be very limited recent research reporting the economic benefits of workplace physical activity interventions. Thereby, there was no strong economic evidence to support the implementation of workplace physical activity programmes. Moreover, the authors emphasised that there does not currently appear to be any standard methodology for measuring the economic benefits of such interventions.

Table 5.4.3. Main characteristics of the studies that incorporated an economic analysis of a workplace physical activity intervention (Beale et al., 2007)

Study and quality	Intervention	Economic measure	Main result
Erfurt et al. +	Physical activity counselling and education	Cost-effectiveness	The incremental costs showed $1.48 and $2.09 spend per worker per year to reduce an additional percent of risk and prevent relapse in the high-level risk reduction group for sites C and D
Oldenburg et al. +	Physical activity counselling and education	Cost-effectiveness	The study concluded that individual-specific behavioural counselling was a cost-effective strategy for the initiation and maintenance of CVD risk reduction
Proper et al. +	Physical activity counselling and education	Cost-effectiveness and partial cost-benefit	The cost-effectiveness ratios were: - EUR 5.2 per extra kcal/day per worker - EUR 234 per beat/min decrease in submax heart rate See also under example below
Shephard et al. -	Physical activity facility	Cost-effectiveness and partial cost-benefit	- Recruitment and turnover decreased from 18% to 1.8% among frequent participants - Absenteeism reduced frequent participants by 1.3 days per year among frequent participants - A 7% gain in the volume of work performed versus a 4.3% gain among non-participants The study found a cost-benefit ratio of 1:6.85 See also under review #3
Bell et al. +	Physical fitness programme	Cost-analysis	The results suggest significant reductions in hospital stay, medical costs, and medical claims among members
Brown et al. -	Physical fitness programme	Cost-effectiveness	The study found no significant difference between the study groups in terms of lost time cost and medical cost. The total cost was $6,092 lower in the back school group and the number of injuries was significant
Goetzel et al. +	Physical fitness programme	Cost-analysis	The adjusted multivariate model showed the following expenditures for each of the groups: - non-participants: $1,041; - level 1 participants: $1,195; - level 2 participants: $990; - level 3 participants: $685. The study found that those participating at medium levels had higher medical expenditures than non-participants

Example - Cost-effectiveness and cost-benefits of individual-based counselling aimed at the promotion of physical activity and dietary behaviour (Proper et al., 2004)

As part of the study described under example #1, an economic evaluation was performed. For the description of the study population and the methods including the intervention, we refer to section 5.2. Both a cost-effectiveness (CEA) and a cost-benefit analysis (CBA) was carried out (Proper et al., 2004).

Costs and benefits

As the economic evaluation was performed from the company's perspective, only costs relevant for the company were considered, notably intervention costs as well as indirect costs, i.e., costs due to productivity loss of the participants. Health care costs were not included, as in The Netherlands, these are not for the account of the company.

Intervention costs included costs that were directly related to the implementation of the individual counselling programme (i.e., development and management of the programme, the information session, consultation with the sports physician who gave feedback about test results, written information, and the actual counselling sessions, and costs due to the time spent by employees of the Personnel Department for the organisation of the intervention).

Monetary benefits of the intervention included reduction of costs due to sick leave. Both the time spent by the Personnel Department employees and the benefits due to reduced sick leave were valued using the mean gross salary costs of the workforce.

Cost-benefit analysis

A CBA was performed to compare the intervention costs with the monetary benefits due to the (expected) reduced sick leave. At first, the costs of the monetary benefits due to reduced sick leave were calculated for the nine months lasting intervention period. Subsequently, the single intervention expenditures were compared to the monetary benefits of sick leave reduction during the intervention period. For the same nine month period in the year after the intervention, the difference in monetary benefits due to sick leave reduction between the intervention group and the control group was calculated. Because of the gap of three months between the two nine month periods of the two subsequent years, no comparison was made between the benefits in the year after the intervention and the intervention costs. Moreover, the intervention costs were already taken into account in the former analysis.

Cost-effectiveness analyses

For the primary outcome measures, a cost-effectiveness ratio was calculated. For the CEA, total costs included intervention costs plus sick leave costs. Thus, in the CEA, all costs and monetary benefits were put in the numerator and compared to the effect in the nominator. Further, to evaluate differences in costs and effects in the same (nine months) period, benefits due to a reduction in sick leave during the intervention period were taken only.

Bootstrapping

Bootstrapping techniques were used to compare differences in mean costs and benefits between the study groups, and to calculate 95% confidence intervals (Efron and Tibshirani, 1993). Bootstrapping is a suitable method for the analyses of cost data, as cost data are usually highly skewed and bootstrapping does not make any assumptions on the distribution of the data as is done with the traditional statistical methods, such as a Student's t-test (Efron and Tibshirani, 1993).

Results

Results of the CBA are presented in table 5.4.1. The intervention costs were €430 per participant. During the intervention period, the intervention group had (non-significant) lower costs due to sick leave (€-125). The mean total costs during the intervention were higher in the intervention group compared to the control group (€305).

In the year after the intervention, the benefits due to a reduction in sick leave increased further. The mean difference in sick leave costs between the two study groups after the intervention period was €-635 (95% CI: €-1,883 - €814) in favour of the intervention.

Table 5.4.1. Mean costs for the intervention and control group during and after the intervention

	During intervention period			*During year after intervention period*		
	Intervention group	*Control group*	*Difference*	*Intervention group*	*Control group*	*Difference (95% CI)*
Mean days of sick leave	21.5	22.9	1.4	20.5	27.6	7.1
Intervention costs	430	0	430	-	-	-
Sick leave costs	1,915	2,040	-125	1,830	2,465	-635
Total costs	2,345	2,040	305			

Source: Proper et al., 2004

Figures 5.4.1 and 5.2.2. show the cost-effectiveness planes. From these planes, it can be seen that most of the incremental cost/effect pairs were in the north-east quadrant, indicating positive effects at higher costs for the counselling intervention compared to the control condition. The point estimate of the cost-effectiveness ratio for energy expenditure is €5.2 (95%CI: €-4.9 - €27.4) per extra kcal.day^{-1} per employee. For cardiorespiratory fitness, the ratio is €235 (95%CI: €-10 - €827) per beat per minute decrease in submaximal heart rate. These point estimates mean that the positive effects on total physical activity and submaximal heart rate, respectively could be gained at the price of €5.2 per extra kilocalorie of energy expenditure per day, and at €235 per beat per minute decrease in submaximal heart rate.

Points to consider

As is common in economic evaluations alongside a RCT, analysing and interpreting costs data is challenging due to the highly skewed distribution of cost data and relatively small sample sizes. This was also the case in this example. Thereby, the trial is underpowered to find statistical significant differences in costs between the groups since (sick leave) cost data are skewed, leading to wide confidence intervals of the differences.

Further, the CBA presented in this example in fact concerns a partial CBA, since in a full CBA, all costs and all health-related effects are expressed in monetary units. In the present analysis, the authors refrained from valuing the health effects, because of the difficulties associated with the valuing. Additionally, there may be several other potential benefits for the company, such as reduced employee turnover, increased presenteeism, commitment to the company, etcetera. As mentioned before, most of these benefits are hard to measure and value, and were therefore not included. Health care costs were also not taken into account for two reasons: 1) these costs are not for the account of the company of concern and 2) since the intervention was a primary prevention programme aimed at the entire (healthy workforce, these costs were assumed to be low.

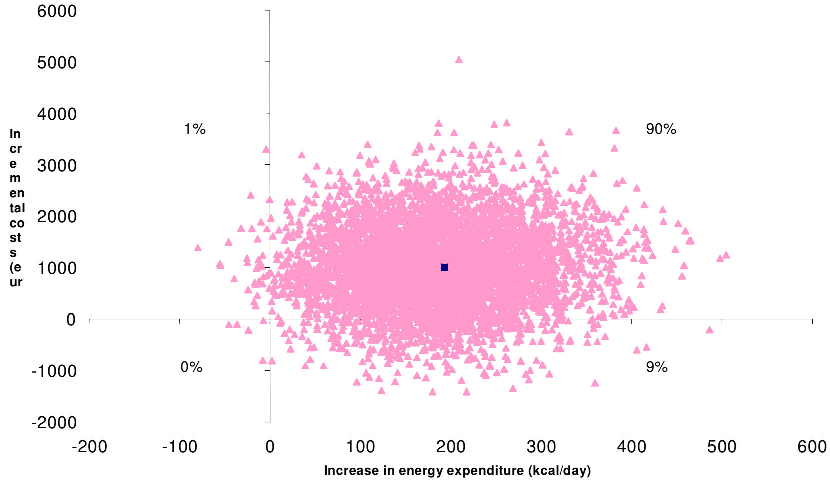


Figure. Cost-effectiveness plane for energy expenditure (point estimate: 5.2; 95% CI: -4.9 - 27.4).

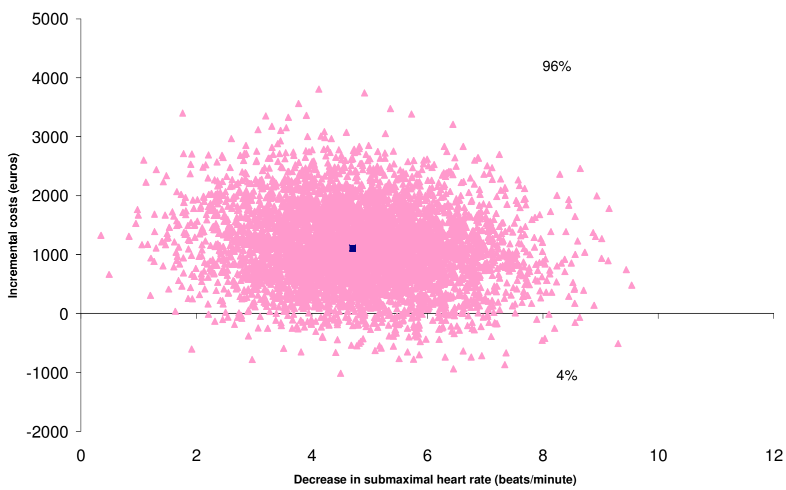


Figure. Cost-effectiveness plane for submaximal heart rate (point estimate: 235; 95% CI: -10 - 827).

5.5 Economic evaluations of worksite physical activity interventions aimed at return-to-work

In the Netherlands, sick-listed workers receive social medical guidance from an occupational physician (OP), who is contracted by the workers' company. In 2002, the so-called 'Gatekeeper Act' was introduced, which stipulates that the employer, together with the worker, has to put adequate effort into the rehabilitation process during the first year of sick leave to actively promote return-to-work. If the employer fails to put effort into the rehabilitation process, he has to pay wages for an additional number of years. This Act further made the worker partly responsible for his own employment status and the worker can now loose vocational rights in case of negligence in the rehabilitation process. Therefore, both the employer and the employee have an interest in effective strategies to speed up recovery from illness and to return-to-work. However, until recently, little evidence was available on the effectiveness as well as the cost-effectiveness and cost-benefit of commonly applied interventions in the Dutch occupational health setting. Below, two recently conducted large Dutch RCTs are described. Both conducted an economic evaluation of different physical activity interventions on return-to-work among workers who were on sick leave due to non-specific low back pain.

Example #1 - Graded activity

<u>Background and aim</u>
From the literature, graded activity (GA) programmes seem to be promising in improving back disorders and the associated sick leave. There is however little information about the costs and benefits of such interventions. The aim of this study was to compare the long-term costs and the benefits of a GA programme for sub-acute work-related low back pain from the employer's perspective (Hlobil et al., 2007).

<u>Methods</u>
The study included 134 Dutch airline company workers (mean age 39 years), who were randomly assigned to either GA (n=67) or usual care (n=67). The GA intervention was based on the study of Lindstrom et al. (1992), and consisted of physical exercises, applied according to operant conditioning behavioural principles. The training load was increased in a time (and not in a pain-) contingent manner. The main purpose of the intervention to be communicated by the caregiver to the worker was: "pain does hurt, but that does not necessarily mean that it harms, it is therefore okay to exercise". The GA intervention had a maximal duration of three months and was provided by a skilled physiotherapist twice a week, with usual guidance by the occupational physician. Those receiving usual care were advised according to Dutch guidelines for patients with low back pain. This included a consultation with the OP, who discussed the generally good prognosis and the intended date of return-to-work. Besides, the worker was advised to continue his physical activities, and after six weeks, an exercise programme or physical therapy was recommended (Staal et al., 2004; Hlobil et al., 2005).
The main outcomes of the cost-effectiveness analysis were the costs of health care utilisation during the first follow-up year and the costs of productivity loss during the second and the third follow-up year. Health care costs were estimated using the Dutch guidelines for costs analysis. The days of sick leave, or: the total lost productivity days, were quantified as gross and net ones with the gross lost productivity days reflecting the total number of calendar days that workers were completely or partially sick-listed. The partial lost productivity days was counted for its percentage of work absence and expressed as net lost productivity days (Hlobil et al., 2007).

Results

After six months, results indicated that those in the GA group returned to work faster, with a median sick leave of 54 days compared with 67 days among those in the UC group (Staal et al., 2004). Cox regression analysis showed that participants in the GA programme were significantly more likely to return-to-work than those in the UC group [Hazard Ratio (HR): 1.9, 95% CI: 1.2–3.2]. This effect was sustained over the entire study period (12 months) (HR: 1.9, 95% CI: 1.2–3.1) with a median sick leave days of 67 among those in the GA group versus 102 among those in the UC group (Hlobil et al., 2005).

At the end of the first follow-up year, an average investment for the GA intervention of €475 per worker, only €83 more than health care utilization costs in UC group, yielded an average savings of at least €999 (95% CI: –1,073; 3,115) due to a reduction in productivity loss (Hlobil et al., 2007). The potential cumulative savings were an average of €1,661 (95% CI: –4,154; 6,913) per worker over a 3-year follow-up period. The results of these cost analyses are shown in tables 5.5.1 and 5.5.2.

From these results it is concluded that the GA intervention for non-specific LBP is a cost-beneficial return-to-work intervention.

Table 5.5.1. Mean difference of costs of lost productivity in 1999 €GA-usual care (95% CI)

Follow-up period	*Quantification*	*Mean difference of costs of lost productivity in 1999 €GA-usual care (95% CI).*
First year	Net	999 (-1,073 to 3,115)
	Gross	3,665 (157 to 6,933)
Second year	Net	118 (-2,079 to 2,541)
	Gross	1,522 (-2,315 to 5,126)
Third year	Net	467 (-1,173 to 2,207)
	Gross	1,685 (-1,673 to 5,623)
Fourth year	Net	1,661 (-4,154 to 6,913)
	Gross	7,581 (-3,262 to 17,348)

Source: Hlobil et al., 2007

Table 5.5.2. Mean health care costs

Follow-up period	*Group*	*Cost of intervention Mean (sd)*	*Total health care costs Mean (sd)*	*Difference in total health care costs (usual care - GA) Mean (sd)*
First 3 months	GA	475 (203)	501 (215)	-263 (-346 to 172)
	Usual care	0	238 (218)	
12 months	GA	-	800 (680)	-83 (-467 to 251)
	Usual care	0	716 (1,096)	

Source: Hlobil et al., 2007

Example #2 - Back schools

Background and aim

Back schools have shown to be effective in reducing low back pain or recurrences of low back pain for most intensive back schools. However, a reduction in work absence has not been found (Heymans et al., 2004). From the literature, it also became clear that economic evaluations in low back pain research is generally weak (Goosens et al., 1999; Maetzel and Li, 2002). This argues for a need for high quality economic evaluations alongside a RCT to study the cost-effectiveness of back schools in occupational health care. The aim of this study was to determine the cost-effectiveness of a low and a high intensity back school in worker who are sick-listed for a period due to low back pain (Heymans, 2004).

Methods
299 workers sick-listed for a period of 3 to 6 weeks due to non-specific low back pain were randomly assigned to one of three groups: 1) low intensity back school, 2) high intensity back school, or 3) usual care (UC) (Heymans et al., 2006). The low intensity back school was based on the Swedish model (Zachrisson-Forsell,1980) and consisted of four group sessions once a week, supervised by a physiotherapist. The sessions included education and strength exercises for abdominal, back, and leg muscles. The high intensity back school programme was based on the principles of the GA programme (see earlier, example #1), including cognitive behavioural therapy using a time-contingent (instead of pain-contingent) increase in the level of physical activity. Sessions took place twice a week during eight weeks. It thus comprised 16 training sessions, each lasting one hour (Heymans et al., 2006). Additionally, strength exercises for abdominal, back, and leg muscles were performed. Usual care was performed by the OP according to the Dutch guidelines for the occupational health management of patients with low back pain.
The economic evaluation was performed from a societal perspective, taking into account direct health care costs, non-health care costs and indirect costs (Heymans et al., submitted). Direct health costs included the (usual care and back school) intervention costs, additional visits to other health care providers, drugs, professional home care and hospitalisation. Direct non-health care costs involved out-of-pocket expenses, such as over-the counter medication, equipment aid, and costs of paid and unpaid help. Finally, indirect costs included loss of production due to back pain related absence from work, or days of inactivity for workers were assessed as well (Heymans et al., submitted).

Results
After six months, the median number of sick-leave days was 68, 85, and 75 in the low intensity back school, high intensity back school, and usual care, respectively. The low intensity back school expedited return-to-work during the initial six months of sick leave compared to usual care with a HR of 1.4 (95% CI: 1.0 - 1.9) (Heymans et al., 2006). The median number of days of sick leave covering a period of 12 months were 75, 95, and 89, respectively (Heymans et al., submitted). This difference was not statistically significant.
The analysis showed greater effects for the low intensity back school compared to the high intensity back school and usual care on work absence, kinesiophobia, recovery and QALYs. Total cost were lowest for the low intensity back school (€11,386) compared to the high intensity back school (€13,476) and usual care (€13,788) (see table 5.5.3). The higher direct costs in the usual acre and high intensity back school group were mainly caused by the higher costs of the intervention itself (Heymans et al., submitted).
Favourable cost-effectiveness ratios were found for the low intensity back school compared to both other treatments on work absence, kinesiophobia, and recovery. For pain intensity the low intensity back school was cost-effective compared to usual care. Furthermore, the low intensity back school showed a better cost-utility (Heymans et al., submitted).
From these analysis it was concluded that the low intensity back school was cost-effective compared to usual care and the high intensity back school and also showed better cost-utility.

Table 5.5.3. Mean (sd) total costs during the 12 months period for each study group

Costs	*Mean (sd) total costs*		
	Usual care	*Low intensity back school*	*High intensity back school*
Direct health care costs	1,841 (3,713)	996 (869)	1,606 (828)
Direct non-health care costs	239 (600)	208 (454)	375 (1,081)
Total direct costs	2,079 (3,918)	1,204 (1,039)	1,980 (1,547)
Indirect costs	11,709 (6,923)	10,183 (6,050)	11,496 (6,369)
Total costs	13,788 (9,130)	11,386 (6,491)	13,476 (6,966)

Source: Heymans et al., submitted

Where to from here?

The effectiveness of two secondary prevention physical activity interventions aimed at return-to-work were considered above. These studies examined the effectiveness of physical activity interventions started in workers in their subacute phase of sick-leave due to non-specific low back pain. The interventions were aimed at physical activity stimulation and incorporated principles of cognitive behavioural therapy, i.e., tried to modify workers' irrational beliefs about their back pain. One intervention can be considered of a low intensity low cost nature, i.e., the low intensity back school, whereas two interventions can be considered of a high intensity and high cost nature, i.e., the GA and high intensity back school. The more intensive interventions treated and supervised the workers for a longer period, but did not significantly stronger facilitate return-to-work compared to the less intensive and cheaper intervention. Although the low intensity intervention as described above seems promising, the crucial question remains: where to from here?, and what intervention is most effective on return-to-work among low back pain patients? On basis of the results from these two Dutch trials, it is recommended that:

1. OPs should refer workers with low back pain in the subacute phase of sick-leave, which is at three to six weeks of continued sick leave.
2. OPs should refer workers to an intervention that follows a protocol and actively incorporates the work situation of the worker, such as: several short meetings containing information and exercises aimed at changing the behaviour of the worker, or graded activity, to increase function.
3. OPs should contact GPs and physiotherapists about their treatment strategy to prevent for conflicting advice and guidance.

6. Overall discussion

Effective interventions at the workplace to promote workers' physical activity levels and dietary habits are available. Such interventions enable workers to live longer and healthier lives, and can enhance workers' work ability, the latter being of corporate relevance. As became clear from the reviews presented, worksite lifestyle promotion programmes can significantly improve the lifestyle behaviour as well as some relevant health risk factors, such as the blood cholesterol level, or body composition, the latter being highly relevant considering the worldwide obesity epidemic. From the employer's perspective, who invests in the programme, the question that may also arise is: "What's it in for me?" or "If worksite health promotion programmes can change health habits, can they also save money?". Looking to the studies that examined the impact of worksite lifestyle promotion programmes on work-related outcomes, such as reduced absenteeism or presenteeism, it is concluded that the evidence is limited. There are indeed indications that worksite lifestyle promotion programmes are effective in changing such outcomes, but the evidence is mainly based on non-randomised studies comparing a self-selected group of participants to non-participants. This methodological shortcoming is also true for those studies that tried to investigate the economic impact of worksite health promotion interventions.

Despite the lack of randomised studies that incorporated an economic evaluation of worksite health promotion programmes addressing physical activity and diet, it seems plausible that such programmes do have a financial benefit for the employer. Briefly, the theory that participation in a worksite lifestyle promotion intervention leads to reduced employee financial outcomes depends on the following assumptions:

1. The physical activity and diet intervention leads to improved behaviour (i.e., physical activity and diet);
2. Physical activity and diet behaviour is positively related to health outcomes, and thereby leads to reduced health care costs; and
3. Physical activity and diet behaviour is either directly or indirectly (through improved health outcomes) related to work-related outcomes (e.g., work absenteeism and presenteeism), and thereby leads to cost savings for the employer.

All of the above mentioned hypotheses have been confirmed by the literature. From chapter 2, it has become clear that the relationship between physical activity and diet with health-related outcomes, i.e. morbidity and mortality, is convincing. Based on the studies that calculated the health care costs due to an unhealthy lifestyle, physical activity and a healthy diet appeared to be associated with reduced health care costs. Although there were less studies that examined the relationship between physical activity and diet with reduced work absenteeism and presenteeism, results supported a relationship with those being more active having less absenteeism and higher productivity. It was also shown that the indirect costs, including costs due to loss of productivity, are the plural - varying up to the fourfold - of the health care costs.

Even though we cannot draw a bold conclusion about the economic impact of worksite physical activity and diet interventions due to lack of randomised studies, below we will attempt to do so. For that, several assumptions are made, namely:

- The effect of the intervention on both physical activity and diet behaviour is 10% each; (NB. this is based on results of worksite physical activity and diet programmes, tables 1 and 2 in the annex)
- An increase of 10% in the prevalence of workers being sufficiently active according to the common public health guidelines equals about 10% of the health care costs attributable to physical inactivity; the same is assumed for diet; (NB. this is based on Dutch and Canadian studies)

- Based on an overlap between the costs due to physical inactivity and a poor diet, the cumulative effect of a 10% improvement in both physical activity and diet is assumed to be about 15% (and not 20%);
- The share in total health care costs attributable to physical inactivity and a poor diet is 2.0% each; considering the overlap between physical inactivity and diet, the share in total health care costs attributable to both lifestyle factors is assumed to be 3% (NB. this is based on the available studies, and is about the average of the findings)
- The 15% effect on the health care costs attributable to physical inactivity and poor diet, affecting the 3% of total costs equals a reduction of 0.45% on the total health care costs due to worksite health promotion programmes.

For the impact on the indirect costs, similar assumptions are made, i.e.:

- The share in total indirect costs attributable to both physical inactivity and a poor diet is 3.5% together (NB. this is based on data regarding the contribution of physical inactivity and/or obesity, the latter to be considered as a proxy for physical inactivity plus a poor diet)
- An increase of 10% in the prevalence of workers being sufficiently active equals about 10% of the indirect costs attributable to physical inactivity; the same is assumed for diet
- Based on an overlap between the costs due to physical inactivity and a poor diet, the effect of the 10% improvement in physical activity and diet is assumed to be about 15%
- The 15% effect on the health care costs attributable to physical inactivity and poor diet, which is 3.5%, equals a reduction of 0.53% on the total indirect costs

Again, based on above mentioned assumptions, it is concluded that worksite physical activity and diet interventions may produce:

- **a reduction of 0.45% on the total health care costs**
- **a reduction of 0.53% on the total indirect costs**

Considering the total impact of about 1% on total health care and indirect costs, which is substantial, implementation of a worksite physical activity and/or diet programme must yield benefits to the employer. Moreover, it should be taken into account that such worksite programmes do not necessarily have to be expensive. For instance, programmes like the promotion of walking during lunchtime, taking the stairs instead of the elevator, increasing awareness through pedometers, food labelling in the company canteen, or changing the supply canteen (i.e. more healthy products and less unhealthy, fatty products), are simple, minimal intervention strategies that have proven to be effective.

7. Conclusions and recommendations

- Physical inactivity and a poor diet are associated with increased health care costs; on average they are each attributable to approximately 2% of the total health care costs.

- The indirect costs from lost productivity that is attributable to physical inactivity and a poor diet are the plural and can run up to the fourfold of the health care costs from physical inactivity and a poor diet. It has also been estimated that the indirect costs of physical inactivity and obesity, which can be considered as a proxy measure of physical inactivity and insufficient diet, were 3.9% and 2.9% of the total indirect costs (in Canada).

- Worksite health promotion programmes addressing physical activity and diet have shown to be effective in changing behaviour (physical activity and diet) and health-related outcomes, among others cardiovascular risk disease factors.

- Despite lack of methodological sound studies using a randomised design that investigated the effectiveness of worksite physical activity and diet promotion programmes on work-related outcomes there are indications that such programmes can yield decreased levels of absenteeism and presenteeism.

- Due to lack of randomised studies that incorporated an economic evaluation of worksite health promotion programmes, the evidence available from lower methodological quality studies (e.g., quasi-experimental, cohort or case-control studies), have found a cost saving from absenteeism of 2.5 and 4.9 for every dollar spent on the programme. Besides, health care cost savings varying from 2.5 to 4.5 for each dollar spent on the programme have been shown.

- To provide reliable data with respect to the economic impact including a cost-benefit ratio, of worksite physical activity or diet programmes, there is a strong need for high quality research using a randomised design. Such studies should investigate the total economic impact of worksite health promotion programmes, that is including both the impact on direct health care costs and on indirect costs, due to lost productivity.

- Since there is no standardised method for an economic evaluation of worksite health promotion programmes, it is recommended to develop a standardisation, for example to be achieved through a Delphi technique.

- Most, if not all, of the research in this field has been performed in the developed and high income countries. Therefore, more research as to the implementation and (economic) evaluation of programmes at the workplace aimed at improving workers' physical activity and diet behaviour among low income countries is recommended.

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Table 1. Studies (RCTs) identified in the review of Proper et al. (2005) as to effectiveness of workplace physical activity interventions

First auteur (ref)	*Intervention*	*Sample size*	*Follow-up measurement*	*Outcome measure*	*Results*	*Effect*
Marcus (1998)	*I*: 2x written information based on stage of change *C*: written information about diverse physical activity related topics	11 companies (n=1559) after 3 months: *I*: n=441 *C*: n=462	3 months after intervention	total minutes physical activity per week	no overall effect but the progress of 39 to 115 min. per week was positively related to the stage of behaviour change	+
Perkiö-Mäkelä (1999,2001)	*I*: fitness (cardiorespiratoir and strength), group-based, 1-2 x per week during 2,5 month, plus sessions specifically focused on work. One group of *I* also received general advice + specifically focused on work lpus diet and coping *C*: no intervention	*I*: n=62 *C*: n-64	1, 3 en 6 years after intervention	physical activity in leisure time	Positive effect after 1 year, but no effect after 3 and 6 years; % participants doing moderate-intensive physical activity: *I*: before intervention ca. 25%, after 3 years: ca 15% *C*: before intervention and after 3 years: more than 20%	0
				1. BMI 2. cardiorespiratory fitness (based on 2 km walk test) 3. MSD (diverse body regions) 4. muscle strength (legs and back)	1. slight increase in *I* (from 25,5 to 25,9) and *C* (from 25,6 to26,3); no significant difference between study groups 2. fitness index improved significantly among *I* (from 96 to 100) and C (from 97 to 104); no significant difference between I en C 3. less MSD in I after 1, 3 en 6 years (p<0,01), no change in MSD among C with after 6 years even more MSD than at baseline. Significant difference between I and C after 1 and 3 years (p=0,04 en p=0,021) 4. greater improvements in I than in C; no significant difference between *I* en *C*	1. 0 2. 0 3. ++ 4. +
				functioning at work	no effect after 3 and 6 years	0
Emmons (1999)	Multi-component (diet and smoking) *I*: individual activities + strategies	22 companies n=2291	2,5 years after intervention	% participants that is physically active at a regular basis	51% of *I* is physically active at a regular basis at final measurement compared to 41% among *C* (p<0.01)	++

	aimed at social norms and company policy; intervention developed together with workers *C*: self-help programmes					
Peterson (1999)	*Ia*: once written information, based on stage of change and motivating exercises (goal setting, relapse prevention) *Ib*: general information about physical activity *C*: no information	1 company (n=784) after 6 weeks: *Ia*: n=174 *Ib*: n=168 *C*: n=185	6 weeks after intervention	energy expenditure (kcal/kg/week)	Increase of 13% in *Ia*, compared to 1% in *Ib* and a decrease of 8% in *C*. Significant intervention effect for both *Ia* and *Ib*, with the greatest effect for *Ia* (p<0.05)	++
Speck (2001)	*I*: physical activity monitoring diary during 12 weeks *C*: no intervention	25 locations *I*: n=25 *C*: n=25	12 weeks after intervention	number of steps per day (pedometer)	9251 steps per day in *I* compared to 7103 in *C* (p=0,022)	++
Hager (2002)	*Ia*: encouraging mails based on stage of change, during 6 weeks *Ib*: encouraging mails aimed at action and maintenance of behaviour regardless the stage of change, during 6 weeks *C*: informative mails about nutrition, weekly during 6 weeks	1 company *Ia*: n=175 *Ib*: n=175 *C*: n=175	6 weeks after intervention	1. energy expenditure (kcal/day) 2. physical activity at work 3. physical activity in leisure time	1. Increase in *Ia*: 0,3%, *Ib*: 2,8%, *C*: 1,2%. Only for *Ib* a significant effect (p<0,05) 2. Increase in *Ia*: 3,2%, *Ib*: 8,4%, *C*: 6,4%. Only for *Ib* a significant effect (p<0,05) 3. Increase in *Ia*: 6,3%, *Ib*: 8,6%, *C*: 5,3%. Significant effect for both *Ia* and *Ib* (p<0,05)	1. + 2. + 3. ++
Campbell (2002)	Multi-component (diet and smoking) *I*: 2x information with personal advice, strategies for change in behaviour change stage and feedback about behaviour, plus social support *C*: delayed intervention, 1x personal information and advice after 6 months	9 companies (n=859) after 6 months: *I*: n=362 *C*: n=298	18 months after intervention	1. frequency of vigorous/ intensity physical activity per week 2. % that is physically active 3. energy expenditure (MET values)	1. increase from 1,4 to 1,6 times per week in *I* compared to decrease from 1,6 to 1,5 in *C* (n.s.) 2. increase from van 61% to 68% in *I* compared to decrease from 67% to 65% in *C* (n.s.) 3. increase from 4,2 to 4,9 MET in compared to decrease from 4,8 to 4,1 MET in *C* (n.s.)	1. + 2. + 3. +
				1. BMI 2. flexibility (legs)	1. no effects 2. significant difference (p<0,01)	1. 0 2. ++
Napolitano	*I*: 12 x weekly e-mail tips + access	*I*: n=30	3 months after	1. moderate-intensity	1. *I:* from 69 to 112 minutes, *C:* from 81 to 82	1. +

(2003)	to website, based on stage of change *C*: waiting list	*C*: n=35	intervention	physical activity (minutes) 2. minutes of walking	minutes; after 1 month significant difference, after 3 months no longer a significant effects 2. *I:* increase from 57 to 100 minutes, *C:* decrease from 88 to 68 (p<0,05); some improvements between 1 and 3 months	2. ++
Proper (2003, 2004a, 2004b)	*I*: personal advice about physical activity and diet, based on stage of change + written information about diverse lifestyle topics *C*: written information about diverse lifestyle topics	3 municipal services *I*: n=131 *C*: n=168	9 months after intervention	1. energy expenditure (kcal/day) 2. sports activities 3. leisure time activities 4. % meeting the moderate-intensity guideline	1. increase of 64 kcal/day in *I* compared to a decrease of 129 kcal/ day in *C* (p<0,01); effect size: 176 kcal/day 2. change of -0,01 in *I* compared to -0,14 in *C* (p<0,01); effect size: 0,22 3. increase of 0,05 in *I* compared to 0,02 in *C* (n.s.) 4. 23% of those in *I* changed from not sufficiently active to sufficiently active compared to 19% in *C* (n.s.)	1. ++ 2. ++ 3. 0 4. 0
				1. % body fat 2. BMI 3. blood pressure 4. cholesterol 5. cardiorespiratory fitness (heart rate after submaximal bicycle test) 6. back disorders 7. upper extremity disorders (arm, neck and shoulder)	1. significantly greater decreased in I (1,4%) compared to the decrease in C (0,6%) (p=0,015) 2. remained almost the same in both groups 3. decreased in I (diastolic: -3,5 mmHG, systolic: -4,1 mmHG) and in C (diastolic: -3,9 mmHG, systolic: -5,2 mmHG), no significant differences between I en C 4. decreased significantly in I, no change in C; effect size: 0,18 mmol/l (p=0,04) 5. improvement in I (-2,24 beats per min); deterioration in C (increase of 2,47 beats per min) (p<0,01) 6. decrease in symptoms in both *I* en C; no significant difference; % complaints in I: from 50% to 47%; in C: from 49% to 44%. 7. decrease in symptoms in both *I* en C ; no significant difference; % complaints in I: from 73% to 55%, in C: from 62% to 56%	1. ++ 2. 0 3. 0 4. ++ 5. ++ 6. 0 7. +
				Sick leave (days and frequency)	Mean sick leave duration increased in both groups, but significantly more in % complaints in C than in I (I: from 17,2 to 20,5 days; C: from	+

					15,2 to 27,6 days) (p>0,05); frequency of sick leave slightly decreased in I en C (p>0,05) (I: from 1,3 to1,0, C: from 1,3 to 1,1)	
Marshall (2003)	*Ia*: written brochures + 4x a twice-weekly encouraging letter *Ib*: interactive website, quiz with feedback, personal targets based no stage of change and encouraging mails with information and web links	1 company *Ia*: n=328 *Ib*: n=327	10 weeks after intervention	1. total amount of physical activity in MET/min/week 2. sitting time 3. % meeting the moderate-intensity guideline	1. increase of 105 MET/min/week in *Ia* compared to 8 MET/min/week in *Ib*; significant increase in *Ia* 2. decrease of 71 MET/min/week in *Ia* compared to 105 MET/min/week in *Ib*; significant decrease in *Ib* 3. no significant change in both groups	1. + 2. + 3. 0
Aittasalo (2004)	*Ia*: meeting with goal setting plus three subsequent dates for adjusting goals and plans *Ib*: like *Ia* + 3x a fitness test, evaluation of results and adjustment of plans *C*: no intervention	9 companies *Ia*: n=52 *Ib*: n=51 *C*: n=52	12 months after intervention	1. energy expenditure in leisure time 2. steps per day (pedometer)	1+2. slight increase in all study groups in leisure time energy expenditure; no significant differences between the study groups in energy expenditure or steps per day	1. 0 2. 0
Dunn (1997, 1999), Smolander (2000), Sevick (2000)	I: advice to be active according to the recommendation and integrated in daily life, plus meetings for learning cognitive and behaviour strategies, 20x in 24 weeks, based on stage of change. C: cardiorespiratory fitness during 6 months, individual supervision	*I*: n=62 *C*: n=64	6 months 2 years after intervention	functioning at work	already good at baseline; no change after 2 years; no difference between I en C	0
Oden (1989)	*I*: cardiorespiratory fitness, individual based, in-company, 3x per week during 24 weeks *C*: no intervention, the same frequency of contact with researchers as in I	n=45	6 months after intervention	1. % body fat 2. VO2max	1. decreased more in *I* (-14,3%) than in *C* (-4,7%) (p <0,05) 2. significantly improved in *I* (increase of 17,9%, p<0,01), no change in *C* (increase of 0,6%)	1. ++ 2. ++
				1. job satisfaction 2. work productivity 3. work stress	1. hardly any change in *I* (score changed from 72,5 to 75,8), in *C* a slight deterioration was seen (score changed from 74,4 to 72,5); no significant difference between I en C	1. + 2. 0 3. +

					2. significant increase in both I and C due to increase of work 3. less work stress in I (score changed from 33,6 to 31,3), more work stress in C (score changed from 26,9 to 33,7); no significant difference between I en C	
Rosenfeld (1989, 1990), Halfon (1994)	I: cardiorespiratory and muscular fitness, group-based, in-company, 5 x per week, during 7 months C: social activities I en C: general advice provided by lectures, movies, etc	n=522	7 months after intervention	perceived fatigue	decreased in *I* (-24%) and increased in *C* (4%) (p<0,01)	++
				1. job satisfaction 2. perceived work stress 3. work productivity (objective en subjective) 4. sick leave	1. decreased in both groups, but less in I minder (I:-5,4%, C: -12,8%) (p<0,01) 2. increased in both groups, but more in I (I: 42%, C: 34%) (p< 0,01) 3. subjective efficiency increased more in I (44%) than in C (12%) (p< 0,01); objective efficiency and productivity remained constant in both groups 4. no change in either I or C	1. ++ 2. -- 3. ++/ 0 4. 0
Grønningsæter (1992)	*I* 1: cardiorespiratory fitness, group-based, in-company, 3x per week during 10 weeks *I* 2:stress management training as frequent and long as *I* 1 *C*: waiting list	*I* 1:n=30 *I* 2:n=27 *C*: n=31	10 weeks after intervention	1.general health complaints 2. blood pressure 3. cholesterol 4. VO2max 5. neck pain 6. back pain 7. arm/shoulder pain	1. decreased in all groups except for the males in I 2-mannen. Greatest improvement in I 1; no significant differences between the groups 2. slight decrease in I 1-females: from 120 to 116; others remained constant or increased a bit 3. slight decrease in all females; no significant differences between the groups. I 1- en I 2-men showed a slight increase, C decreased a bit 4. *I* 1 significantly improved compared to *I* 2 and C (p<0,01); increase in *I* 1-men from 37,7 to 40,8, *I* 1- females from 41,7 to 44,2; *C* and *I* 2 decreased 5. decrease in *I* 1 (men and women) and in *I* 2-females, an increase in neck pain among *I* 2-males and among *C* (men and women)	1. + 2. 0 3. 0 4. ++ 5. ++ 6. ++ 7. +

					6. decrease in *I* 1 (men and women) 7. a slight decrease in *I* 1-females; a greater decrease among other females. *I* 1-men decreased (from 1,5 to 0,7), *I* 2-men increased, no change in *C*-men	
				1. job satisfaction 2. work stress	1. a higher decrease in I 1 than in C (p< 0,01); job dissatisfaction increased in I1 with 8%; I 2 and C remained almost the same 2. no significant effects	1. -- 2. 0
Kerr (1993)	I 1:fitness (cardiorespiratory and strength), individual-based, in-company, on a regular basis: on average 44x in first year I 2:I 1, but irregular: 23x in first year C1: physical activities outside the programme, ate least once per week C 2: no physical activities	I1: n=38 I2: n=38 C1: n=38 C2: n=38	12 months after intervention	1. fitness (subjective) 2. well being (burnout, stress)	1. p<0,01; scores in *I* 1 were the highest (no data) 2. highest burnout scores for *C*2 (scores *I* 1: 14,4, *I* 2: 13,8, *C*1: 13,7, *C* 2: 15,7); no significant difference between the groups; stress scores were also the worst for *C* 2 (*I* 1: 6,4, *I* 2: 5,7, *C* 1: 6,6, *C* 2: 8,7); borderline significance levels between the study groups (p=0,06)	1. ++ 2. +
				sick leave	A decrease in sick leave in both I -groups (I 1: -41%, I 2: -28%), an increase in sick leave in both C -groups (C 1: 11%, C 2: 481%) (p=0,01); the effect was mainly caused by long sick leave (>2 days); the difference between the groups was not significant for short periods of sick leave	++
Gundewall (1998)	I: individual fitness programme, ca 6x per month, during 20 minutes, during work, specifically aimed at back muscles C: no intervention	n=69 after drop-out: I = 28 C = 32	13 months after intervention	MSD (back disorders)	during the intervention period, 1 person from the I-group was on sick leave due to back pain for 28 days (p<0,01) compared to 12 persons in the C-group with a total of 155 days of sick leave. There were also less days with back disorders in the I-group compared to the C-group (p<0,01)	++
Grandjean (1996)	I: cardiorespiratory fitness, in-company, 3x per week during 24	I: n=20 C: n=17	6 months after intervention	1. % body fat 2. cholesterol (total,	1. a decrease in I and C (p<0,01); I: from 27,6 to 23,5, C: from 28,7 to 26,6. No signifi9cant	1. 0 2. 0/+

	weeks C: no intervention			HDL, LDL, V-LDL, triglycerides) 3. VO2max	difference between I and C 2. total cholesterol decreased in both *I* and *C*; in *I*: from 201 to 180, in *C*: from 205 to 185. Other cholesterol measures showed no or slight improvements 3. improvement in *I* (from 1,88 to 2,16, p<0,01), it remained constant in C (change from 1,87 to 1,83)	3. ++
Harrell (1996)	I: info door 4 lectures, supervised fitness (cardiorespiratory and muscular) 3x per week during 9 weeks C: standard training programme	n=1504	9 weeks after intervention	1. % body fat 2. muscle strength (abdominal en arm) 3. flexibility (legs) 4. VO2max	1. greater decrease in I than in C (p<0,01); I decreased with 5,6%, C: 1,2% 2. abdominal muscle strength: increase in I with 26%, in C: 16%; significant difference between groups (p<0,01); arm muscle strength: only significant in the group without a training programme before the intervention, in that group, strength increased in I with 7,4%, and in C with 4,8% 3. greater increase in I (8,3%) than in C (7,4%) (p<0,01), not significant after adjusting for baseline training activities 4. greater increase in I (21,5%) than in C (13,4%) (p<0,01), not significant after adjustment for training activity at baseline	1. ++ 2. ++/0 3. + 4. +
Eriksen (2002)	I 1: cardiorespiratory fitness, group-based I 2: I 1 + information about work stress, coping, diet, etc plus a workplace observation I 3:stress management training, coping strategies + general information about health C: no intervention	I: n=189 I 2: n=165 I 3: n=162 C: n=344	1 year after intervention	subjective health complaints (somatic and psychological)	no significant difference between study groups nor over time; *I* 2 showed the greatest effects	0
				1. work stress 2. sick leave	1. no significant difference between study groups nor over time 2. no significant difference between study groups nor over time	1. 0 2. 0

Nurminen (2002)	I: prescription for exercises and advices as to physical activity, fitness (cardiorespiratory and muscular), 1x per week during 8 months, grou-based, in-company C: prescription for exercises and advices as to physical activity	*I*: n=133 *C*: n=127	15 months after intervention	1. job satisfaction 2. sick leave	1. no significant difference between study groups nor over time 2. no significant difference between study groups nor over time	1. 0 2. 0

MSD = musculoskeletal disorders; MET = metabolic equivalent; I: Intervention group; C: Control group; ns: non-significant; ++: significant favourable change; +: non significant favourable change; 0: no change; -: non significant negative change; --: significant favourable change

Table 2. Studies (RCTs) identified in the review of Proper et al. (2005) as to effectiveness of diet interventions at the workplace

First auteur (ref)	*Intervention*	*Sample size*	*Follow-up measurement*	*Outcome measure*	*Results*	*Effect*
Buller (1999)	*I*: 1,5 year; general diet educational programme via e-mail, promotion materials in canteen and loud speakers, plus 2 hours/week *peer education* about fruit & vegetables *C*: general educational programme via e-mail, promotion materials in canteen and loud speakers	*I*: n=492 41 companies *C*: n=505 41 companies	0 en 6 months after intervention	1. food intake *0 months* after intervention a. total portions/day b. total portions fruit/day c. total portions veg./day d. total portions fruit juice/day 2.voedselinname *6 months* after intervention a. total portions/day b. total portions fruit/day c. total portions veg./day d. total portions fruit juice/day	1a. greater increase in I than in C (0,77 portions) (p<0,0001) 1b. greater increase in I than in C (0,41 portions) (p<0,0001) 1c. greater increase in I than in C (0,26 portions) (n.s.) 1d. greater increase in I than in C (0,10 portions) (n.s.) 2a. greater increase in I than in C (0,41 portions) (p=0,034) 2b. greater increase in I than in C (0,06 portions) (n.s.) 2c. greater increase in I than in C (0,24 portions) (n.s.) 2d. greater increase in I than in C (0,10 portions) (n.s.)	1a. ++ 1b. ++ 1c. + 1d. + 2a. ++ 2b. + 2c. + 2d. +
Brug (1996)	*I*: 2-3 weeks; computer-based individual feedback letter based on personal diet behaviour, perceived social influence, self-efficacy and awareness *C*: general flyer of the Dutch Nutrition Center	1 company *I*: n=178 *C*: n=169	0 month after intervention	1. fat intake (total points/day) 2. total portions fruit/day 3. total portions veg./day	1. number of fat points was 26,9 in *I* compared to 27,2 points in *C* (p<0,01) 2.an increase in portions (of 1.57) in both *I* and *C* (n.s.) 3.increase in portions in *I* of 1,07 compared to an increase of 1,06 in *C* (n.s.)	1. ++ 2. 0 3. +
Sorensen (1999)	*I*: 1,5 year; *Ia*: worksite intervention: *C* + workers advice group,	n=ca. 2800 *Ia*: 7 departments	0 month after intervention	change (%) in number of portion fruit & veg. per day	increase of 7% in total portions of fruit & veg./day in *Ia* compared to 19% in *Ib* and 0,4% in *C* (p<0,05). Difference between *Ia*	++

	programmes aimed at individual stage of change and workplace environment *Ib*: worksite intervention + family intervention: *C* + *Ia* + written information for at home; yearly newsletter & family party; periodic mailings *C*: *minimal intervention*: periodic exposure to media campaign with respect to 5 portions fruit and vegetables per day, 1 hour education as to nutrition and taste tests	*Ib*: 7 departments *C*: 8 departments			and *C* is not significant; difference between *Ib* and *C* is significant: p=0,02	
Sorensen (1998)	*I*: 2 year; three main components: 1. worker & management participation at planning and implementation of intervention 2. discussions with management about changes needed at the workplace; smoking policy, availability of healthy diets, and reduction of diverse risk behaviours 3. health education about diverse risk behaviours *C*: no interventions	24 companies n=2658	0 month after intervention	1. energy% from fat 2. total portions fruit & veg./day (% change) 3. fibre intake (g) (% change)	1. decrease of 2,31 energy% in *I* compared to 1,52 in *C* (p=0,007) 2. increase of 0,10 portions (10%) in *I* compared to 0,23 (4%) in *C* (p=0,03) 3. increase of 0,58 g (8%) in *I* compared to 3,39 (5%) in *C* (p=0,08)	1. ++ 2. ++ 3. +
Tilley (1999)	*I*: 2 years; stimulating of fat-arm and fibre-rich en diet habits by: 1st year: 5 lessons about diet, self-help information by mail, 2nd year: posters at workplace, individual diet advice, newsletters *C*: no intervention	*I*: n=1578 15 companies *C*: n=1899 13 companies	1 en 2 years after intervention	*after 1 year* 1a. energy% from fat 1b. fibre intake (g/1000kcal) 1c. number of portions fruit/day 1d. number of portions veg./ day *after 2 years*	1a. greater decrease in I than in C (0,09) (p=0,004) 1b. greater increase in I than in C (0,04) (p=0,002) 1c. greater increase in I than in C (0,12) (p=0,02) 1d. greater increase in I than in C (0,10) (p=0,004)	1a. ++ 1b. ++ 1c. ++ 1d. ++ 2a. +

				2a. energy% from fat 2b. fibre intake (g/1000kcal) 2c. number of portions fruit/day 2d. number of portions veg./ day	2a. greater decrease in I than in C (0,5) (n.s.) 2b. greater increase in I than in C (0,4) (p=0,003) 2c. greater increase in I than in C (0,07) *C* (n.s.) 2d. greater increase in I than in C (0,03) (n.s.)	2b. ++ 2c. + 2d. +
Beresford (2001)	*I:* 2 years; based on stage of change to increase fruit & veg. consumption at the workplace, by workplace environment changes and individual behaviour level *C*: no intervention	28 companies *I*: n=1428 *C*: n=1400	2 years after intervention	1. number of portions fruit & veg. from canteen 2. total number of portions fruit & veg./day 2a. based on food frequency questionnaire 2b. based on questionnaire as to fat- and fibre intake 2c. based on checklist 'usual day' 2d. based on a single question	1. greater increase in *I* than in *C* (0,16) (n.s.) 2a. greater increase in *I* than in *C* (0,25) (n.s.) 2b. greater increase in *I* than in *C* (0,11) (p<0,01) 2c. greater increase in *I* than in *C* (0,47) (p<0,05) 2d. greater increase in *I* than in *C* (0,13) (p<0,05)	1. + 2a. + 2b. ++ 2c. ++ 2d. ++
Sorensen (1992)	*I*: educational programmes as to dietary habits (e.g. 8 discrete messages) and change in workplace environment (choice); goal: reduction of fat consumption and increase of fibre intake *C*: no intervention	*I*: n=947 8 companies *C*: n=1064 8 companies	0 months after intervention	1. energy% from fat 2. fibre intake (gram)	1. decrease was 1,70 energy% from fat in *I* and 0,60 in *C* (p<0,01) 2. increase was 0,39 gram in *I* and 0,27 in *C* (n.s.)	1. ++ 2. 0
Nisbeth (2000)	*I*: 5 months; 3 groups: 1: no need to change, 2: no motivation for change, 3: counselling about diet (or smoking or physical activity) using cardiovascular risk profile:	1 company *I*: n=56 *C*: n=29	1 year after intervention	1. body weight (kg) 2. BMI (kg/m^2) 3. cholesterol (mmol/l) 4. systolic blood pressure (mmHg)	1. decrease of 0,2 kg in *I* compared to increase of 1,4 kg in *C* (p<0,05) 2. decrease of 0,06 kg/m^2 in *I* compared to increase of 0,42 kg/m^2 in *C* (p<0,05) 3. increase of 0,14 mmol/l in *I* compared to	1. ++ 2. ++ 3. 0 4. 0

	advice with respect to reduction of saturated fat, increase of fish products; 6 meals per day (less per time); 15 min. consultation and counselling after 5 months *C*: no intervention			5. diastolic blood pressure (mmHg)	0,38 in *C* (n.s) 4. increase of 1,6 mmHg in *I* compared to 1,0 in *C* (n.s) 5. increase of 2,5 mmHg in *I* compared to 2,1 in *C* (n.s)	5. 0
Stamler (1989)	*I*: 5 years; intensive individual approach by physicians and diet counsellors as to goal setting. Start once per 2 weeks, afterwards 1 per 4 weeks; involve family, plus group counselling *C*: at smokers: advice to quit smoking	*I*: n=102 *C*: n=99	0 month after intervention	1. incidence hypertension 2. systolic blood pressure (mmHg) 3. diastolic blood pressure (mmHg) 4. body weight (kg)	1. incidence of hypertension was 8,8% in *I* compared to 19,2% in *C* (p<0,027) 2. greater decrease in *I* than in *C* (1,3 and 2,0 mmHg, respectively) (p=0,061 and 0,061, respectively) 3. greater decrease in *I* than in *C* (1,2 and 1,9 respectively) (p<0,05) 4. decrease of 2 kg in *I* compared to increase of 0,8 kg in *C* (p<0,001)	1. ++ 2. ++/+ 3. ++ 4. ++
Reynolds (1997)	*I*: 6 months; *Ia*: complete intervention: announcement about cholesterol, self-help brochure aimed at reduction of fat intake and increase of complex carbohydrates *Ib*: *Ia* without announcement about cholesterol *C*: no intervention	6 companies *Ia*: n=236 *Ib*: n=284 *C*: n=115	6 months after intervention	cholesterol (% change)	decrease of 4,9% in *Ia* compared to 3,9% in *Ib* and 9,6% in *C* (p<0,05)	--