

A Review of the Effectiveness of Worksite Dietary and Physical Activity Interventions for Obesity Prevention

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Executive Summary: Given the epidemic of obesity and lifestyle-related chronic diseases in the United States, constructing an evidence base for dietary behavior change interventions with a wide population reach is of critical importance. The worksite is an ideal setting to implement dietary change strategies for reducing the prevalence and burden of obesity. Many American adults work and using a worksite setting allows access to individuals in a controlled environment through existing channels of communication and a social support system. Thus, the purpose of this study was to evaluate the effectiveness of worksite interventions in promoting healthy eating and physical activity in order to prevent obesity. A systematic literature review of published literature was carried out. In general, worksite interventions led to positive changes in promoting healthy diet and physical activity. This in turn had a positive effect on weight outcomes. Multiple aspects of the interventions were examined for effectiveness. Both interventions with an educational component alone and combined educational and environmental components were found to be effective. On-site interventions had the best results. Web-based interventions had mixed effects. Worksite interventions that are multi-prong and aim to intervene at multiple levels were found to be effective. One caveat in these studies is that reliance on self-reported methods of dietary assessment means there is a significant risk of bias. However, these results may be helpful in guiding choices about the adoption or design of future worksite obesity interventions. Going forward, well-designed studies with proper matched controls are needed in order to reliably determine the effectiveness of the interventions. Future programs to prevent obesity among workforce should be theory-driven.

I. Background

Obesity is a serious health issue both in developed and developing countries. It became prevalent at the start of the 20th century and then progressively increased to reach epidemic proportion by the end of the century (Caballero, 2007). The obesity epidemic is one of our country's most serious health problems. According to the Centers for Disease Control and Prevention (CDC, 2012), more than one-third of adults in America are obese (defined as a body mass index (BMI) of 30 or higher). While U.S. obesity rates have, overall, stayed steady since 2003, they have more than doubled since 1980 (CDC, 2012). The obesity problem takes a heavier toll on some U.S. ethnic and racial groups (including non-Hispanic Black, Hispanic, and Mexican American adults) than others, with rates continuing to rise in these groups (Flegal et al.,

2012). If trends continue as they have today, then by 2030, an estimated 51 percent of US adults will be obese (Wang et al., 2011).

Obesity is associated with increased risk of chronic diseases including cardiovascular diseases, type-II diabetes, and certain types of cancer (CDC, 2012). These chronic diseases are responsible for decreased quality of life, reduced productivity and increased overall mortality (Ogden et al., 2006). In addition to the burden on the nation's health, obesity also poses a tremendous financial threat to our economy and health care system. In 2008, the estimated obesity related annual medical cost in the U.S. was \$147 billion. The medical costs for people who were obese were \$1,429 higher than those of normal weight (Finkelstein et al., 2009). This indicates that obesity puts a huge economic burden on society. These costs are shouldered by employers,

workers, and states in the form of worker absenteeism, reduced productivity, health care premiums, out-of-pocket expenses, and co-payments (Finkelstein et al., 2004; U.S. Department of Health and Human Services, 2001).

Obesity is a complex health disorder that results from multiple factors including genetic, behavioral, socio-cultural, and environmental influences. However, the current high rates of overweight and obese individuals (defined as a BMI of 25 or higher) amongst adults in the U.S. has been characterized as a result of individual behaviors and environmental factors that lead to excess caloric intake (energy intake) and inadequate amounts of physical activity (energy expenditure) (U.S. Department of Health and Human Services, 2003). Though the prevalence of obesity has increased in adults at all socio-economic levels, low income women are more likely to be obese than higher income women (CDC, 2010). Among non-Hispanic black and Mexican-American men, those with higher income are more likely to be obese than those with low income (CDC, 2010). There is no clear explanation for the disparity by sex and income.

A. Relevance of social ecological framework:

The CDC employs a five-level Social-Ecological Model (SEM), credited to Urie Brofenbrenner, to address and understand the issues of overweight and obesity (Hamre et al., 2006). The SEM is a highly adaptable framework which validates that there are distinct yet interrelated factors which affect human behavior. The model (see Figure 1) suggests that there are multiple levels of influence (individual, interpersonal, organizational, community, and society), and that effective prevention programs should address each of these levels. Environment (both social and built) is a major influence on both physical activity and dietary behaviors – the proximal determinants of weight status among individuals. The SEM also serves as a reminder that individual knowledge is not sufficient for behavior change. Increasing knowledge, skills training and creating a supportive environment are all important components of behavior change. Educating people to make healthy choices when environments are not supportive is likely to produce weak and short-term effects. Therefore, it is imperative to look at obesity from a social ecological perspective.

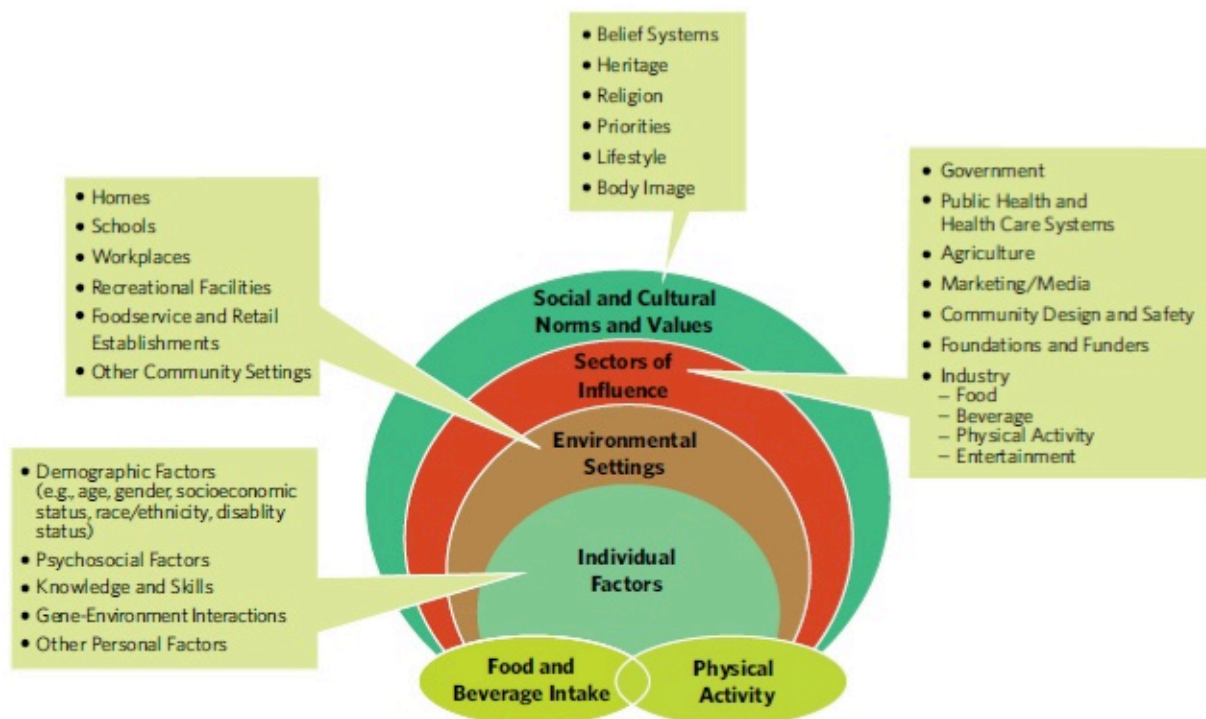


FIGURE 1: A social ecological framework for nutrition and physical activity decisions (from Story, *et al.* (2008)).

Public health policies, both at the organizational level and above, are important and help in furthering public health, including obesity prevention. In the case of obesity, organizational (worksite) policies increasingly attempt to modify environments to have a more positive influence on individuals' food and drink choices. For example, the food/snacks available in the worksite café, vending machines, and during meetings, facilities for physical activity within the worksite, promoting bike use, and health care intervention programs, including screening programs, should serve to encourage behavior change. However these policies may be criticized for unduly inhibiting choice, being overly paternalistic and stigmatizing low-income populations. As outlined in a review of public health regulation (Gostin, 2000), Lawrence Gostin's criteria of policy evaluation stated that entities considering a policy or regulation should justify the regulation by demonstrating a significant risk, showing the intervention's effectiveness, and ensuring reasonable economic costs, human rights burdens, and fundamental fairness (Gostin, 2000). Exploring ethical acceptability is beyond the scope of this paper; however, it could be argued that while currently the regulation on food choices are negligible, there is evidence of effectiveness of worksite dietary and physical activity interventions. Moreover, gains in terms of reduced absenteeism, increased productivity, and health care cost savings are likely to more than offset the costs of implementing worksite interventions (Jensen, 2011). Thus obesity interventions are likely satisfying the Gostin's criteria to a great extent.

The worksite is an ideal, focused, and efficient setting to prevent and treat obesity because a majority of adults spend a substantial amount of time at work (Baicker, Cutler & Song, 2010) and 60 percent of Americans get their health insurance through their employer (Blumenthal, 2006). The worksite is truly a microcosm of the adult world, filled with elements that promote health as well as those that weaken it. Employers have an incentive to reduce and prevent obesity in their workforce because they pay more for obese workers and have to deal with reduced output because of them (Goetzl et al., 2010). The worksite provides the opportunity to implement interventions through already established channels of communication and social support networks. These interventions also have the potential to reach large parts of the adult population

from a range of social backgrounds. Therefore, it becomes significant and meaningful to understand the efficacy of worksite interventions.

The concept of health promotion in the worksite is not new (Blair et al., 1986; Pelletier, 1997), but employers' interest in providing wellness programs has increased due to the rapidly rising cost of providing healthcare for employees and the recent provision for worksite health promotion in the Affordable Care Act (Baicker, Cutler & Song, 2010; Koh & Sebelius, 2010). Studies have been conducted to evaluate the economic and worker productivity effects of worksite-based interventions (Aittasalo, Miilunpalo & Suni, 2004; Block et al., 2004; Dishman et al., 1998; Pratt et al., 2007; Proper et al., 2003; Sorensen et al., 2007; Williams et al., 2007). All these studies differed in their focus regarding the type of study, the type of intervention and the type of outcome variables included.

The aim of this literature review is to assess the effectiveness of interventions in promoting healthy eating and physical activity to prevent obesity in a worksite setting. The primary objective of this review was to summarize the evidence about effects of interventions aimed at body composition, dietary, and physical activity in promoting a healthy diet and physical activity in worksite settings in the United States. This review helps us better understand the effectiveness of interventions and fill the gaps in knowledge related to the identification of interventions that influence body composition, nutrition, and physical activity behavior. Finding specific interventions that are highly successful would help inform policy makers and public health professionals working in the area of worksite wellness about successful interventions and to further form the basis for developing effective strategies and interventions that would help to achieve the long-term goal of improving employee's health and enhancing productivity. This study is intended to inform decision makers, public health professionals, and researchers about the current research knowledge related to worksite dietary and physical activity interventions.

II. Methods

A. Search Strategy:

Systematic strategies for literature review were used to locate and secure potential studies, determine eligibility, extract data from research studies, analyze study results, and interpret findings.

A search was undertaken for all worksite health promotion studies with anthropometric (BMI), dietary and physical activity outcomes within specific electronic databases (PubMed, MEDLINE, and CINAHL) from peer-reviewed English language articles published between January 2002 and March 2014. Articles published during past 12 years were considered for this review, starting with the time around when the obesity rates in the U.S. held steady. Earlier articles did not need to be considered because a previous review (Anderson et al., 2009) was conducted in 2005 that targeted articles published during the time period 1966 to 2005. The following search terms were used: worksite, workplace, obesity, diet, fruits and vegetables, physical activity, body mass index (BMI). Reference lists of all retrieved articles were reviewed for potentially eligible articles.

B. Selection criteria:

Inclusion criteria were: studies in the United States; interventions at the worksite aiming at the prevention of obesity in which the main component or one of the components was the promotion of healthy diet and physical activity (as these two behaviors are more closely related to body weight of an individual); including dietary intake and physical activity behavior outcome measures and/or anthropometrics. There were no restrictions on study design, study duration, follow-up period, intervention strategies and control conditions, or on who delivered the intervention. The review was

restricted to published peer-reviewed English language articles. The targeted population included working adults (age 18 years and above) living in the United States.

Exclusion criteria were: studies conducted outside the United States; published before January 2002; evaluating interventions that had a worksite component but conducted mainly outside the worksite (e.g. community, family); interventions that were not designed for health promotion and primary prevention of obesity (i.e. aimed at obese adults only, aimed at treatment of eating disorders or chronic diseases) and studies that did not report the effect on behavior and/or on anthropometrics.

C. Data extraction and synthesis:

Data were extracted using a standardized data extraction form. Data were recorded on publication year, type of study (study design), theory used, participants, intervention characteristics, the study's main outcome measures (focus/ impact measures), and reported results. Descriptive data on the reviews, and the author's results and conclusions are summarized in Table 1. Because of the heterogeneity of studies with respect to interventions, participants, and measures, a meta-analysis was not conducted. The findings therefore resulted in a descriptive literature review. The level of evidence was assessed according to outcome measures (i.e. dietary and physical activity behavior and anthropometrics) and type of intervention (i.e. educational, environmental, and multi-component).

Definitions of important terms	
Terms	Definitions
<i>Worksite</i>	The place where one is employed and customarily does one's work or spends most of his/her time working
<i>Worksite Health Promotion</i>	The combination of intra- and interpersonal (educational), organizational, and environmental activities and programs designed to motivate and support healthy lifestyles among the company's employees
<i>Individual/interpersonal level interventions</i>	Interventions aimed to educate individual workers and to build social norms supportive of worker health, for example through educational classes or one-on-one training programs
<i>Environmental/organizational level Interventions</i>	Interventions aimed to modify the work environment or organization in support of worker health outcome
<i>Overweight</i>	BMI equal to or greater than 25 but less than 30
<i>Obese</i>	BMI equal to or greater than 30

III. Results

The initial literature search using the search terms yielded 108 publications (Figure 2). Titles and abstracts were reviewed for exclusion criteria and 29 articles were left. These articles were reviewed in detail and 11 articles were excluded because they did not meet one or more inclusion criteria. The remaining 18 articles were included. These studies focused on nutrition and physical activity alone or in combination with other related health behaviors.

A. Characteristics of the studies:

Study characteristics are summarized in Table 1. The most prevalent type of study in the review was a randomized controlled trial (RCT) (67 percent). Others were group randomized trial, quasi-experimental studies and pre-post designs. Among the 18 studies in this review, the median sample size was 724 (range 84– 2894). The behavioral focus of majority of studies (84 percent, $n = 15$) was solely on diet and physical activity behaviors. Of the three types of interventions coded (intra- and interpersonal (educational), environmental / policy, and multicomponent (both educational and environmental)) 11 studies (61 percent) had an educational component, six studies (33 percent) had both educational and environmental components, and only one study had an environment component alone. The duration of the intervention was less than 6 months in five studies (33 percent), 6- 12 months in three studies (17 percent), 12-36 months in nine studies (50 percent), and over 36 months in one study (6 percent). The long term efficacy of studies that were short as two months is debatable, since behavior change such as diet and physical activity requires focused and long term evaluation.

The type of worksite setting included corporate offices, manufacturing industries, chemical industries, metro transit sites, small businesses (including a human resource company), healthcare organizations, schools, and state and county departments. Maximum representation was from the healthcare and corporate settings. The setting does not seem to be related to success or failure of the interventions as interventions in different worksite settings were found to be successful. Except for one study, all the studies had both male and female participants (females ranged from 21 percent to 90 percent). Information on the feasibility of implementing programs across small to very large worksite settings, however, was limited by missing workplace characteristics data in a majority of studies.

The environmental intervention strategies in these studies included portion size reduction, recipe modifications of cafeteria foods, preferential pricing for healthful foods in vending machines, and provision of fitness equipment. Individual-level interventions were, for example, group or individual weight management programs or group-level educational programs. Web-based interventions included messages tailored to the participant's self-identified needs and barriers. There was variability in the aspect of diet examined and methods of dietary assessment used. The most common methods of dietary assessment were questionnaires on eating frequency and habits. Some of the studies also measured total fat intake. All studies used daily servings as the unit of measure for fruit and vegetables.

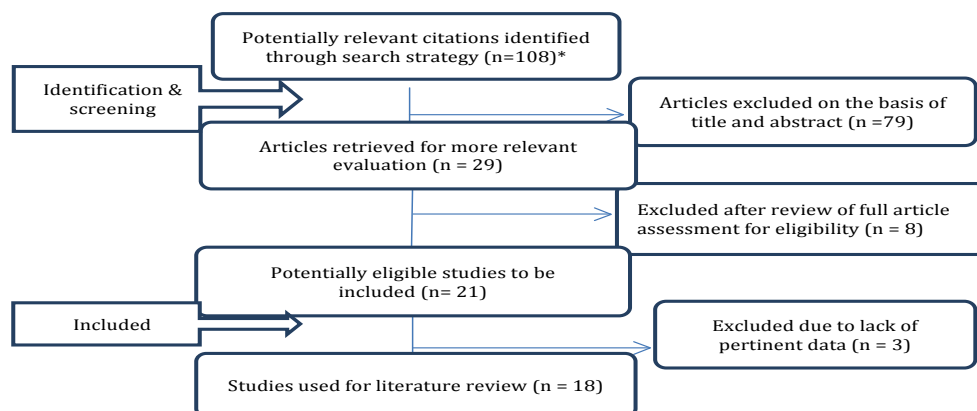


FIGURE 2: Flowchart of literature search results for studies examining the effects of nutrition and physical activity related worksite interventions to prevent obesity.

All the information on dietary intake (frequency and portion size) was self-reported. The dietary outcome that included servings of fruits and vegetables and fatty food consumed were self-reported by the participants. Physical activities of participants are assessed by the Godin leisure-time physical activity questionnaire. For all of the studies, the Godin questionnaire was modified for clarity by listing the intensity of physical activity for days per week, and minutes of activity in 10- to 15-minute increments, from 0 minutes to 60 minutes. Most of the interventions were implemented by the researchers themselves. However, one intervention was implemented by a Master of Public Health-educated health coach (Hughes et al., 2011). It is surprising to note that despite the fact that majority of these interventions were educational in nature; only one intervention was implemented by a trained educator.

B. Evidence of effectiveness of interventions:

The results of the studies are summarized in Table 1. Positive changes were best conferred for live (on-site) programs (i.e. scheduled individual or group sessions) for behavioral skills development related to healthy eating and physical activity. Change in behavior was significantly associated with the number of weeks the participant interacted with the program. Web-based (i.e. self-directed) interventions alone had a mixed effect (Perez et al., 2009; Sternfeld et al., 2009; Thorndike et al., 2012). Better efficacy of live sessions than a self-directed web based approach reiterates the point that motivation is an important aspect in weight maintenance, and is best carried out by interaction between individuals. Informational or educational approaches along with environmental approaches were found to produce desirable changes (Goetzel et al., 2010; French et al., 2010; Lemon et al., 2010; Lowe et al., 2010; Neville, Merrill & Kumpfer, 2011 ; Sorensen et al., 2007). However, educational approaches alone had a beneficial effect too (Block et al., 2004; Campbell et al., 2002; Cook et al., 2007; Hughes et al., 2011; Irvine et al., 2004; Kim et al., 2010; Perez et al., 2009; Siegel et al., 2011 al., 2010; Perez et al., 2009; Siegel et al., 2010; Sternfeld et al., 2009; Tamers et al., 2011). Interventions targeting both physical activity and nutrition behaviors were more successful than dietary interventions alone in influencing behavior change. With BMI as one of the primary outcomes, multiple studies with RCT design

showed largely positive results with respect to weight outcome. Thus, overall interventions had a desired effect on healthy behavior which was translated to a healthy effect (either no weight gain or weight loss) on weight measure.

Weight loss results were broadly consistent with reported dietary changes. Identification of the effectiveness of worksite health promotion programs on weight and physical activity outcomes for specific subgroups of the population was constrained by limited reporting of important study population characteristics, such as ethnicity or socio-economic data. Equally important is the maintenance of weight loss in the long run, as once the weight goal is achieved, a person's mindset may change and this can reverse the gains achieved (Prochaska, 2008). The theoretical framework of the interventions was examined, as theories can help to explain health behaviors or provide a systematic method to guide health promotion practice. Seventy-three percent (n=13) were conceptualized in terms of one or more social and behavioral theories. The theories that were used (alone or in combination) included social cognitive theory (SCT) (n = 6) (Block et al., 2004; Cook et al., 2007; Irvine et al., 2004; Kim et al., 2010; Siegel et al., 2010; Thorndike et al., 2012), the trans-theoretical model (TTM) (n = 5) (Block et al., 2004; Cook et al., 2007; Hughes et al., 2011; Kim et al., 2010; Perez et al., 2009), and the social ecological model (SEM) (n = 5) (Campbell et al., 2002; Goetzel et al., 2010; Lemon et al., 2010; Linde et al., 2012; Sorensen et al., 2007). The SCT posits that learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behavior. The unique feature of SCT is the emphasis on social influence and its emphasis on external and internal social reinforcement. The TTM on the other hand is an integrative, bio-psychosocial model to conceptualize the process of intentional behavior change. It posits that health behavior change involves progress through six stages of change: pre-contemplation, contemplation, preparation, action, maintenance, and termination. The TTM seeks to include and integrate key constructs from other theories into a comprehensive theory of change that can be applied to a variety of behaviors, populations, and settings. The SEM is a comprehensive public health approach that not only addresses an individual's risk factors, but also the norms, beliefs, and the social and economic systems that create the conditions for

health problems to occur. The use of a theory helps in discerning which components work and which components do not work. However, the interventions that have used behavioral theories have not measured changes in constructs that predict behavior. Such measurement is important as it helps in identifying salient constructs and increasing predictive potential as well as improving the theory.

IV. Discussion

This review summarizes the evidence of effects on body composition, nutrition, and physical health behavior of interventions promoting a healthy diet and physical activity at worksites in the United States. Although the investigators of each study focused on different populations, used diverse intervention strategies (like on-site, web-based, or telephone interventions) and addressed their own specific research questions, the studies have similar outcome measures (Table 1). This review reflects that there is evidence of effectiveness of educational and multi-component interventions on dietary and physical activity behaviors.

It is challenging to conduct worksite-based research studies. It frequently proves difficult to combine the need for academic objectivity with the practicalities of delivering a worksite-based intervention that must meet employer and employee needs, often within short timeframes and constrained budgets. Yet it is important that robust, independent, long-term evaluation of worksite health promotion initiatives occurs if we are to reach definitive conclusions about how effects on employee behavior change translate into hard outcomes like changes in body weight, health risks, healthcare utilization, absenteeism, and productivity. It was notable that only a few studies gave information on the quality of the intervention. No study included in the review measured the effect of worksite interventions on employee absenteeism, productivity and/or healthcare costs, even as secondary outcomes, even though the health of employees has direct association with these aspects. Worksite health intervention research has usually been methodologically weak and many studies have not included appropriately matched control groups including RCT, meaning reported intervention effects may be due to trial participation rather than the actual worksite program. The use of self-reported dietary outcomes in the included studies is

of particular concern as reporting bias due to dietary education makes it likely that effects on diet are over-estimated.

This review provides a comprehensive assessment of the impact of worksite interventions published during the past 12 years on dietary and physical activity outcomes. It complements previous reviews that examined the impact of worksite interventions on physical activity and weight loss outcomes (Aittasalo, Miilunpalo & Suni, 2004; Blair et al., 1986; Block et al., 2004; Dishman et al., 1998; Pelletier, 1997; Pratt et al., 2007; Proper et al., 2003; Sorensen et al., 2007; Williams et al., 2007). Strengths include the methodical approach to searching the literature and inclusion of a broad range of study designs. This review also highlights a critical lack of evidence regarding the most acceptable and cost-effective worksite health programs. In addition to measuring mean weight change, it would have been useful to learn what percentage of participants had clinically meaningful weight loss (i.e., >5 percent body weight loss) (Stevens, et al., 2006), especially in studies with longer duration. Furthermore, there is need for such intervention designs that could be reliably replicated by trained health professionals.

A policy about time allowance for physical activity during work hours will perhaps need to be adopted, while ensuring that the means to be physically active are in place, e.g. safe environment for walking during lunch break or an exercise facility such as a gymnasium. On the other hand, to address poor eating behavior it may be necessary to implement a policy of selling only healthy foods in work-based food outlets (Lowe et al., 2010; Sorensen et al., 2007). Applying ecological models to workplace interventions has the advantage of establishing settings and incentives that may contribute to sustained behavior change. Before worksite programs can be implemented with confidence and rolled out on a large scale, more social and behavioral research is needed to help identify determinants of eating habits and physical activity, and predictors of uptake of worksite health promotion programs. Worksites must also adhere to similar procedures in data collection (e.g. validated and reliable questionnaire) and must develop common analytical plans to establish comparability and generalization of the results.

Despite the information gained, there are limitations to this study. This review looked at

weight-related outcomes only. Many other physical and mental health effects (like osteoarthritis or eating disorders) that may be related to obesity were not captured. Limited in-depth quality assessment of the study designs and interventions was done. Although, the intention was to produce results that could be generalized for all worksite settings, many of the included studies were done in health care and the corporate sector leaving the question whether the same results are applicable for all types of worksite settings. Assessment of cost effectiveness of the interventions could not be done, since it was beyond the scope of this review. Limitation of this review also included restriction of the search to studies published in English. Publication bias might be an issue since most of the studies reported some positive effects.

A. Recommendations for practice and research:

Based on this review there are some recommendations for future practice and research. The quality of worksite studies is often sub-optimal. Well-designed studies are needed in order to reliably determine their effectiveness. Such studies should include well matched comparison groups, objective measures for individual and environmental dietary and physical activity change, and sufficiently long-periods of follow-up to determine long-term effects of these programs on employee health and productivity. Studies can more precisely pinpoint the strengths and weaknesses of specific components of the program rather than be able to make statements about the program as a whole. It is also important to assess key determinants of change based on the potential for improvement among the study population. Interventions need to focus on utilizing behavioral theories to develop strategies. Besides considering theories, it is also needed for interventions to develop instruments that measure constructs of behavioral theories. In terms of duration of the intervention, interventions that are more than six months long must be planned, so as to see not only weight loss but also weight maintenance in the longer run. Assessing the extent of employer and employee involvement in implementation and development of such a program

is another aspect of effective and successful programs. Future programs to prevent obesity should aim at multiple levels of worksite environments and integrate qualitative methods with study designs in order to provide more insight into reasons for program success or failure. Interventions need to integrate educational, behavioral, environmental, and economic support. Individual educational programs need to be supplemented with health promotion interventions that change policies and environments as well. Furthermore, outcomes may be positive and sustainable in those organizations where employers demonstrate a commitment to health and wellness that is fully integrated with their mission, values and long-term vision. The strategies should essentially be flexible, cost effective, and continually responsive to the needs of the users.

V. Conclusions

Effective multilevel population-based interventions are needed to combat the global epidemic of obesity-related disorders (James, Rigby & Leach, 2004; U.S. Department of Health and Human Services, 2001). Employers may hesitate to adopt or sustain such programs without confirmation of their effectiveness in their industry and region. More interventions should target worksite settings where early stages of obesity can be detected and programmatic efforts can be initiated in a timely manner. The findings of this review suggest that worksite interventions promoting healthy eating and physical activity have a positive effect on behavioral skills leading to reduction or maintenance of body weight. Obesity prevention interventions must focus on both physical activity and nutrition behaviors, as they tend to be more beneficial as well as cost efficient. The growing evidence for the contributions of worksite health programs to worker health outcomes thus provides an impetus for further dissemination of these programs across a wide range of work settings. Programs to promote healthy diet and increase physical activity can be readily integrated into broad-based workplace programs in support of worker health.

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TABLE 1 : Summary of reviewed studies addressing worksite interventions related to nutrition and physical activity for obesity prevention

Publication	Type of study	Theoretical framework used	Participants / worksites	Intervention design	Impact / primary outcome measures	Results
Educational (n = 11)						
Block et al. (2004)	Non-randomized study	multiple behavioral theories like TTM, HBM, TRA, SCT	84 employees at a corporate worksite	12 week email based nutrition program (WIN)	Self-reported Behavior change: Reduce dietary fat and increase fruit and vegetable intake	Significant improvements in both fruit and vegetable intake and reductions in fat intake
Campbell et al. (2002)	RCT	SEM	660 females blue collared workers	18-month intervention period (computer-tailored health message & social support activities by lay health workers) (HWW)	Increase fruit and vegetable intake, and physical activity, reduce fat intake. Increase rates of smoking cessation and cancer screening	Significant increase in fruit and vegetable consumption . Improved physical fitness. No change in rates of smoking cessation and cancer screening
Cook et al. (2007)	RCT	SCT & TTM	419 employees of a Human resource company at three different location	3- month web based program	Weight, eating practices, physical activity and stress management	Significant improvement in diet and nutrition but not in physical activity and stress management. Small non-significant weight change observed
Hughes et al. (2011)	RCT	TTM	423 participants aged 40 years and older support and academic staff at a University	12- month enhance wellness program with combined Web-based risk assessments with personal coaching support	Weight, body mass index (BMI), waist circumference,	Significantly increased fruit and vegetable consumption and participation in physical activity (At 6 and 12 month follow-up). No significant weight change
Irvine et al. (2004)	RCT	Combined theoretical approach	517 employees at a large hospital system and a corporation	2 month interactive multi-media program	Decrease dietary fat consumption and increase consumption of fruits and vegetables	Significant increase consumption of fruits and vegetables and low fat diet, and self-efficacy and attitude towards diet
Kim et al. (2010)	GRT	SCT, Self-Determination Theory, TTM	2470 employees from companies and community organizations	2- year telephone intervention (counseling & tailored messages)	Improve fruits & vegetable intake, increase physical activity, healthy BMI	Significant improvement in fruits & vegetable intake and weight management.
Perez et al (2009)	Pre-post design	TTM	214 state health employees	12- month web based program (HEL P)	Healthy food intake, physical activity and smoking cessation	Significant improvement in fruit & vegetable intake but not in fatty and sweetened food

Siegel et al. (2010)	RCT	SCT	413 school worksite staff (school staff) from 16 schools	3-year intervention program developed by participatory process	Body mass index (BMI), waist-hip ratio, physical activity, and fruit and vegetable consumption	Modest change in BMI (reduced) as well as physical activity
Sternfeld et al. (2009)	RCT	No known behavioral theory	787 employees in the administrative offices of a large healthcare organization	a 16-week e-mail program offered individually tailored messages, 4 months intervention period (ALIVE)	Self-reported change in dietary intake and physical activity	Significant increase in the consumption of fruits and vegetables, fat intake declines and physical activity increased
Tamer et al. (2011)	GRT	No known behavioral theory	2,878 employees from 34 different types of worksites	2-year intervention program including social support component to promote healthy eating and physical activity	BMI, physical activity and fruits and vegetable intake	Increase in physical activity and fruits and vegetable intake with significant association with worksite social support. No association with BMI reduction
Thorndike et al. (2012)	RCT	SCT	330 employees at a large hospital worksite	10-week exercise and nutrition program, followed by web-based maintenance program (goal-setting and self-monitoring)	Weight loss, percentage weight loss, time spent in physical activity, and frequency of consumption of fruits/vegetables, fatty foods, and sugary foods	Moderate weight loss and improvements in diet and exercise behaviors. Internet-based maintenance program did not result in better outcomes (after 1 year follow-up)
Environmental (n = 1)						
Linde et al. (2012)	RCT	socio-ecologic framework	1700 employees recruited from 6 corporate worksites in a U.S. metropolitan area	a two-year, continuous worksite environment intervention	Height & weight (BMI), change in stairwell use, change in food offerings	No significant change in BMI, improvement in healthy food offerings, and stairwell use
Multicomponent (n = 6)						
Goetzal et al. (2010)	Quasi-experimental study	Socio-ecologic framework	2431 Dow employees at 12 worksites	Two year exposure to Multi-component environmental interventions (individual as well as organizational level)	Weight and BMI, blood pressure and cholesterol	Intervention participants maintained their weight and BMI. Significant differences in blood pressure and cholesterol values
French et al. (2010)	RCT	No known behavioral theory	1123 transit drivers across four bus garages	18 month multi-component intervention focused on individual behavior change & environment support	Height & weight, BMI, dietary intake, physical activity	BMI change and Physical activity change was not significant. However, Energy intake decreased significantly, and fruit and vegetable intake increased significantly

Lemon et al. (2010)	Pair-matched, cluster-RCT	Socio-ecologic framework	806 employees representing the workforce of six hospitals	2 year multi-component weight gain prevention intervention (Step ahead)	BMI evaluation, improving perceptions of organizational commitment and perceptions of coworker normative behaviors	Significant weight gain prevention among those who participated in intervention workshops and in presence of environmental strategies like cafeteria and stairway signage
Lowe et al. (2010)	RCT	No known behavioral theory	96 employees at two hospitals	12 month multi-component intervention (environmental changes, nutrition education)	Cafeteria food intake, BMI, waist circumference	Less fatty food intake from Cafeteria, more fruits & vegetable intake, no significant change in waist circumference, body composition or weight
Neville et al. (2011)	8 years longitudinal time-series study (quasi-experimental)	No known behavioral theory	1,671 county office employees	8 year Comprehensive, Incentivized Worksite Wellness Program (with free annual screenings, tailored feedback on screening results, and financial incentives)	BMI, percent body fat, blood pressure, and total cholesterol	Improvements in BMI, blood pressure, and cholesterol
Sorensen et al. (2007)	RCT	Social contextual model	Employees at a Health Centers (n=1920) & a Small Business (n = 974)	18 month exposure to multi-component intervention focus on individual behavior change & environment support	Healthy eating - fruit and vegetable consumption, red meat consumption, multivitamin intake	Significant change in fruit and vegetable intake, Greater behavior change with stronger social networks and supportive social norms
Abbreviations: RCT: Randomized control trial GRT: Group randomized trials SEM: Socio-ecological model BMI : Body mass index ALIVE: A lifestyle intervention via email		TTM: Trans-theoretical model HBM: Health belief model SCT: Social cognitive theory TRA: Theory of reasoned action WIN: Worksite internet nutrition HWW: Health works for women HELP: Healthy employee lifestyle program				