

Physical Activity Promotion in Business and Industry: Evidence, Context, and Recommendations for a National Plan

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Background: The contemporary workplace setting is in need of interventions that effectively promote higher levels of occupational and habitual physical activity. It is the purpose of this paper to outline an evidence-based approach to promote physical activity in the business and industry sector in support of a National Physical Activity Plan. **Methods:** Comprehensive literature searches identified systematic reviews, comprehensive reviews, and consensus documents on the impact of physical activity interventions in the business and industry sector. A framework for action and priority recommendations for practice and research were generated. **Key recommendations:** Comprehensive, multicomponent worksite programs that include physical activity components generate significant improvements in health, reduce absenteeism and sick leave, and can generate a positive financial return. Specific evidence-based physical activity interventions are presented. Recommendations for practice include implementing comprehensive, multicomponent programs that make physical activity interventions possible, simple, rewarding and relevant in the context of a social-ecological model. The business and industry sector has significant opportunities to improve physical activity among employees, their dependents, and the community at-large and to reap important benefits related to worker health and business performance.

Keywords: physical activity, fitness, worksite, employee health, productivity, systematic review

Physical activity is an integral component of healthy living. The human body is designed for movement, and repeated, rhythmic, dynamic activity interspersed with periods of relaxation confers major health benefits.¹ Unfortunately, physical activity levels are unacceptably low across many segments of the population, including the working population.² To counteract the negative consequences of the increasingly sedentary nature of work (due to automation, process efficiencies, etc.), the contemporary workplace needs interventions that effectively promote higher levels of occupational and habitual physical activity. In the context of shaping a National Physical Activity Plan, business and industry represents an important sector because of its access to working adults and their families and the role employers play in shaping public policy. Furthermore, the business and industry sector may leverage its influence on other sectors, such as health care and public health.

Purpose

A plan to promote physical activity in the business and industry sector would provide guidance for the implementation of a comprehensive National Physical Activity Plan (www.physicalactivityplan.org) based on the 2008 Physical Activity Guidelines for Americans.¹ This paper reviews evidence of the effectiveness of physical activity promotion at the worksite, identifies important contextual issues, presents examples of effective physical activity interventions, identifies priorities for action in the business and industry sector, and provides recommendations for further study.

The Business and Industry Sector

Definition of Business and Industry. For the purpose of this paper, the business sector is defined as a subdivision of the economic system comprised of organizations designed to provide goods and/or services to consumers, governments or other businesses. The industry sector is defined as an economic subdivision involved in activities related to the creation of finished,

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usable products as the result of the manufacturing of raw materials into goods and products.

Relevance of Physical Activity to Business and Industry. In the contemporary workplace, many job tasks have become increasingly sedentary as a result of technological advancements that have attempted to optimize work efficiency, minimize redundancy of tasks, and maximize output. “Lean thinking” in business and industry is about reducing waste and doing more with less—less human effort, less equipment, less time, less space—while exceeding customer expectations.³ An unintended consequence, however, is prolonged periods of low levels of occupational physical activity, which predispose employees to musculoskeletal problems, pain, sick leave, absenteeism, and other ill-health effects.⁴ Because low levels of physical activity among employees have been associated with absenteeism, reduced quality and quantity of work, excess health care costs, short-term disability, and overall work impairment,⁵⁻⁹ employers should implement programs that promote healthy levels of physical activity in the work-site setting.

Potential to Improve Physical Activity Through the Business and Industry Sector. Employees represent an audience with whom the employer can engage in an extended dialogue on physical activity. The entire group can be reached with sufficient frequency to elicit meaningful responses sustained over time.¹⁰ Interventions implemented according to a social-ecological model¹¹ will allow multiple levels of influence to support individuals and groups of employees in their efforts to adopt and maintain healthy levels of physical activity. Simultaneous individual, interindividual, organizational, and environmental levels of influence will position behavior change interventions in a supportive context of workplace policies and culture. By extension, employer-sponsored programs also have the potential to reach families. Physical activity interventions that are designed to extend outside the workplace, for example by leveraging community resources or using health benefits incentives that include spouse participation, may engage spouses and dependents as well.

Employers may effectively leverage their role in the community and influence community-level action to promote physical activity in a variety of ways. For small and medium-sized employers—in particular those companies that lack internal resources or on-site programs—community-based organizations or local public health agencies may be effective partners in leveraging resources, capabilities, capacity, space, expertise, etc., to provide access to and opportunities for the promotion of physical activity. Through their influence on public policy, employers can help shape the physical environments of their communities (eg, parks and recreation, green space, sidewalks) to improve access and opportunity for all community residents including their own employees to engage in a physical activity lifestyle.

Through active engagement in local Chambers of Commerce or other employer coalitions, sustained emphasis on the promotion of active living will pay dividends in terms of access to healthier employees in the future. Through coalitions, employers can influence health policy to optimize access to evidence-based physical activity resources (eg, comprehensive health promotion programs, insurance benefit design, public health law, community-based legislative action), potentially supported by tax advantages.¹² Examples of such efforts include the National Business Coalition on Health, the National Business Group on Health, and the Pacific Business Group on Health.

The business and industry sector includes companies that create products and services that relate to physical activity, exercise, and health. Those companies should set a good example and position themselves as leaders in their field by promoting physical activity for the health of their own employees. In addition, they can stimulate product innovation through novel approaches to reach increasingly large proportions of their target audiences. For example, the U.S. sporting goods industry uses technology as their main strategy to ensure product innovation and since 1990, health club memberships have doubled from 20 million to more than 40 million, and more than 25 million people now use a home gym.¹³ Other business or industry examples include health insurance, medical care, software companies, electronics, and many, many others, that can also use innovative means to improve upon the outreach, engagement, participation, adoption, and maintenance of physical activity among the populations they serve. This may be achieved through design, development, and deployment of new tools and support services for employers, new models of business partnerships or public-private collaborations, new methods for establishing social, service, or delivery networks, new approaches to data collection, integration, management, and analysis, just to name a few. For those companies whose products are related to the promotion of health through physical activity and exercise, setting a powerful example of how to do this inside their own organizations will not only stimulate the promotion of physical activity within their respective communities and society as a whole, but likely will be good for business as well.

Methods

Approach to Identifying the Evidence

The author reviewed evidence of the effectiveness of physical activity programs in business and industry by systematically identifying current and credible sources of evidence-based physical activity interventions. First, the Medline (PubMed), Sport Discuss, and PsycINFO databases were searched to produce relevant systematic reviews of physical activity in the business and industry setting. Search terms included physical activity, exercise,

fitness, motor activity, workplace, worksite, occupational health, productivity, absenteeism, multicomponent, comprehensive. These terms subsequently were combined with the search terms systematic review or meta-analysis. Second, additional credible sources of systematic reviews on physical activity in the business and industry sector were identified using the National Library of Medicine and Wikipedia. Sources identified included The Cochrane Collaboration, the Evidence for Policy and Practice Information and Coordinating Centre, health-evidence.ca, the National Institute for Health and Clinical Excellence, and the Task Force on Community Preventive Services. Searches were limited to reports in the English language.

The Role of Context

To support interpretation of the findings in the broader context of worksite-specific considerations, additional reports on the topic of worksite health promotion complemented the review. Contextual information drawn from widely-distributed and highly-accessible resources provided comprehensive, contemporary practice-based considerations for promotion of physical activity in the workplace setting. The contextual factors considered included feasibility, efficacy, effectiveness, reach, equity/diversity, health literacy, health policy, worksite size, workplace culture, incentives, communications, environmental factors, social-ecological model, measurement and evaluation, business performance, best practice components, and organizational leadership issues. Resources accessed for this information included the American College of Sports Medicine (ACSM) and International Association for Worksite Health Promotion (IAWHP) text titled *ACSM's Worksite Health Handbook, Second Edition*, the Centers for Disease Control and Prevention Healthier Worksite Initiative, the Institute of Medicine's text titled *Integrating Employee Health: A Model Program for NASA*, the National Institute for Occupational Health and Safety's WorkLife program, the proceedings of the WHO/World Economic Forum Joint Event on Preventing Noncommunicable Diseases in the Workplace through Diet and Physical Activity, and original research.

Physical Activity Interventions

The review of the resources and evidence identified physical activity interventions that have demonstrated effectiveness. Reports of single-focus (physical activity) interventions are not necessarily representative of real-world programming. Because employer-sponsored programs tend to involve multiple components, they pose challenges in regard to assessing the relative contribution of a single intervention to overall population health improvement. Therefore, an effort was made to identify specific effective interventions, in the context of a social-ecological model,¹¹ which may inform planning efforts for workplace health programs that include physical activity interventions.

Organizing the Evidence

Based on the results of the review, a framework for action and prioritized recommendations for practice and research were outlined. These are presented in the following sections and tables. Because of the unique challenges involved in measuring the economic and financial impact of physical activity programs at the worksite, a separate section is dedicated to this literature.

Results

Identification of Systematic Reviews for Physical Activity in the Workplace

The review identified 28 reviews on physical activity in the context of the worksite setting, which are described in Table 1. The table provides a brief summary of the main results of each review and indicates whether the findings were positive, neutral, or negative.

In general, the results show that the majority of interventions resulted in positive effects among the employee populations studied. Across all reviews, research appears to support the contention that comprehensive, multicomponent programs (that include physical activity interventions) lead to significant improvements in health outcomes, reduce absenteeism, generate increased resiliency (eg, based on reductions in sick leave), and may generate positive return on investment for the employer. Some studies reported no impact or neutral. No reviews reported negative results.

Identification of Reports on Contextual Factors and Best Practices for Physical Activity in Business and Industry

An additional 15 reports were identified from other sources that addressed specific contextual factors and were based on comprehensive, in-depth reviews of health promotion efforts in the business setting that included physical activity. Contextual factors represent important variables that support and complement the effectiveness and efficiency of physical activity and other behavioral interventions implemented at the worksite. The review of contextual factors is presented in Table 2. Column 3 in Table 2 identifies key contextual factors and the list below provides a summary of these factors organized according to sections that are consistent with the list of essential elements of effective workplace programs previously proposed.⁴⁹

Leadership and Organizational Culture:

1. Top management support
2. Supportive environment, social norms, and social support
3. Employee advisory boards

Table 1 Literature Reviews on Physical Activity in the Worksite Setting

Review	Publication year	PA impact indicator			Comment
		+	0	-	
Aldana et al ¹⁴	2001	+	0		No participation in fitness program was associated with absenteeism. Insufficient evidence was available on the association between low fitness or PA and absenteeism.
American Heart Association ¹⁵	2006	+			In general, workplace interventions were associated with favorable outcomes. Successful strategies included individually-tailored, theory-based materials and environmental prompts.
Boyer et al ¹⁶	1990		0		Review examined the role of PA and exercise in organizational effectiveness by considering the literature on integration of health promotion in human resource strategies, general health impact, and a commentary on general business trends. The review included worksite-based studies, but did not provide specific results applicable to this setting.
Dishman et al ¹⁷	1998		0		Small, heterogeneous mean effects were observed among studies included in this review. Moderating variables did not explain variation in the effects, although randomized trails tended to show smaller effects than quasi-experimental study designs.
Engbers et al ¹⁸	2005		0		Physical activity increased in all studies included in the review in which PA was studied (n = 4 studies). However, overall results for environmental changes at the worksite to promote physical activity were considered inconclusive due to methodological quality concerns and the small number of studies.
Hildebrandt et al ¹⁹	2000	+			Relatively sedentary workers, nonparticipation in sports, or a sedentary leisure lifestyle were found to be associated with higher prevalence of musculoskeletal morbidity. PA promotion, particularly for sedentary workers, could be an effective means to reduce musculoskeletal symptoms among employees.
Heaney et al ²⁰	1997	+			Results from well-conducted randomized trials suggested that providing opportunities for individual risk reduction within the context of comprehensive multi-component programming may be a critical component of effective worksite health promotion programs.
Kaewthummanukul et al ²¹	2006	+			Self-efficacy, perceived benefits of PA, and perceived health status were the strongest determinants influencing PA participation among employees.
Kuoppala et al ²²	2008	+			Exercise appeared to improve overall workers' health and well-being and work ability.
Maher ²³	2000	+			Workplace exercise was effective in the prevention of low back pain, whereas braces and education were ineffective, and workplace modification plus education was of unknown value in preventing low back pain.
Mattson-Koffman et al ²⁴	2005	+			Policy and environmental interventions may promote PA among employees. Strongest evidence for influencing these behaviors was observed regarding prompts to increase stair use, access to places and opportunities for PA, comprehensive worksite approaches including education, employee and peer support for PA, incentives, and access to exercise facilities.

continued

Table 1 *continued*

Review	Publication year	PA impact indicator			Comment
		+	0	-	
Pelletier ²⁶	1991	+			Comprehensive programs that provide ongoing, integrated services related to health promotion and disease prevention were included in this review, whereas single focus components were not included. The conclusions of this review supported the contention that comprehensive programs are effective. Most comprehensive programs included PA interventions in their design.
Pelletier ²⁷	1993	+			Comprehensive programs that provide ongoing, integrated services related to health promotion and disease prevention (and include exercise or PA components) showed positive results for health-, productivity-, and cost-related outcomes.
Pelletier ²⁸	1996	+			The research reviewed in this study indicated favorable health and cost outcomes for comprehensive programs. The more recent and rigorously-designed studies tended to support rather than refute positive conclusions even though the effect sizes reported may be smaller than the less rigorously-designed studies.
Pelletier ²⁹	1999	+			Results of this study confirmed earlier conclusions on health and cost-related outcomes. Increased productivity, reduced absenteeism, positive return on investment and improved health behaviors, including PA, outcomes were noted.
Pelletier ³⁰	2001	+			The vast majority of research conducted indicated positive clinical and cost outcomes.
Pelletier ³¹	2005	+			Further evidence of positive clinical and cost outcomes was noted; however, the quantity and quality of the research conducted continues to decline and if not corrected, may pose a serious challenge to the field of worksite health promotion.
Proper et al ³²	2002	+	0		Work-related outcomes studied included absenteeism, job satisfaction, job stress, productivity, and employee turnover, in response to PA interventions. Significant results were limited to reductions in absenteeism.
Proper et al ³³	2003	+			This systematic review found strong evidence for a positive effect of PA on musculoskeletal disorders and limited evidence for a positive effect on fatigue.
Proper et al ³⁴	2006	+			Readiness to change stage-based interventions were effective in increasing PA, mostly due to increases in vigorous intensity activities. Low intensity PA interventions for workers with nonspecific low back pain also were effective in promoting earlier return to work.
Shephard ³⁵	1992	+			Worksite fitness and health programs appeared to yield corporate benefits that more than match the program costs, at least in the short-term.
Shephard ³⁶	1996	+			Participation in worksite fitness programs can enhance health-related fitness and reduce risk-taking behavior, but population effects were limited due to low participation rates. Studies reviewed in this report cover the literature between 1972 and 1994.

continued

Table 1 *continued*

Review	Publication year	PA impact indicator			Comment
		+	0	-	
Task Force on Community Preventive Services ³⁷	2005	+			On the basis of strong evidence of effectiveness, the Task Force recommended the creation of or improved access to places for physical activity, combined with distribution of information. On the basis of strong evidence of effectiveness, the Task Force recommended providing social support for increasing PA. Social support interventions focused on changing physical activity behavior through building, strengthening, and maintaining social networks that provided supportive relationships for behavior change (e.g., setting up a buddy system, making contracts with others to complete specified levels of physical activity, or setting up walking groups or other groups to provide friendship and support). On the basis of strong evidence of effectiveness, the Task Force recommended individually-adapted health behavior change programs. On the basis of sufficient evidence of effectiveness, the Task Force recommended use of point-of-decision prompts (such as signs placed by elevators and escalators that encouraged people to use nearby stairs for health benefits or weight loss).
Verhagen et al ³⁸	2007	+			Exercise proved effective in the treatment of work-related complaints of the arm, neck, and/or shoulder.
Waalder et al ³⁹	1982	+	0		Physical activity can diminish disease and was considered worthwhile in every respect. However, due to lack of data, insufficient evidence was available to make conclusions related to cost outcomes.
Wanzel ⁴⁰	1994		0		Low participation rates in worksite fitness programs were of concern when the entire employee population was considered.
Wilson et al ⁴¹	1996	+			Overall ratings for the reviews suggested the effectiveness of worksite health promotion programs for exercise. Multiple studies were consistent with a positive relationship, but no well-designed studies including randomized control groups were found.

Abbreviations: AHRF, assessments of health risks with feedback; PA, physical activity; Task Force, the Task Force on Community Preventive Services.

Note. + indicates positive effect; 0 indicates no effect or insufficient evidence of effectiveness; - indicates negative effect.

Table 2 Review of Contextual Factors

Report source	Report type	Key contextual factor(s) identified	Comment
ACSM's Worksite Health Handbook, 2nd Edition ⁴²	Book	Comprehensive, multicomponent worksite health programs are most successful when they integrate: Incentives, communications, data-driven strategies for identification and engagement, theory-based programming, individually-tailored programs, population-based programs, strong leadership (executive, midlevel, and front-line), a healthy workplace culture, occupational health and safety and onsite services, eHealth strategies, diversity initiatives, privacy concerns, environmental approaches, and measurement and evaluation.	This book presents a comprehensive and contemporary overview of worksite health programs and their impact on health and productivity.

continued

Table 2 *continued*

Report source	Report type	Key contextual factor(s) identified	Comment
Bravata et al ⁴³	Systematic review	Use of pedometers to increase PA is a supportive strategy for behavior change.	The use of pedometers is associated with significant increases in PA and is accompanied by significant decreases in body mass index and blood pressure. Application of this strategy into worksite health programs appears warranted.
Eakin et al ⁴⁴	Systematic review	Telephone-based interventions to support behavior change.	Solid evidence emerged as a result of this review supporting the efficacy of PA and dietary behavior change interventions in which the telephone is the primary method.
Engbers ⁴⁵	Background paper on measurement and evaluation of interventions to promote PA and healthy diet	Self-report measures of PA are appropriate and should include items on occupational PA. Use of online questionnaires is promising. Environmental measures related to PA should be used more frequently.	Evidence of effectiveness of worksite health programs comes from measurement and evaluation approaches that cover multiple levels including, at a minimum, the individual and organizational levels.
Harris et al ⁴⁶	Research report	Four avenues for delivering preventive interventions are identified: health insurance, workplace policies, health promotion programs, and communications.	Systematic evidence-based 5-stage approach to improving health at the worksite is discussed.
Hersey et al ⁴⁷	Study to identify promising practices for worksite health promotion	Promising practices associated with promoting PA included free access to fitness facilities and incentives	The Swift Worksite Assessment and Translation (SWAT) rapid evaluation method was used in this study to identify innovative and promising practices. Practices identified included peer coaching, wellness screening with motivational interviewing and follow-up, free access to fitness facilities, incentives to stimulate participation, and use of aggregate data to build the business case for worksite health programs.
Institute of Medicine "Integrating Employee Health: A Model Program for NASA" ⁴⁸	Book	Wellness programs can reach large numbers of employees with information, activities, and services that enhance occupational health and encourage the adoption of dietary and PA behaviors.	This resource draws conclusions based on an in-depth study of the NASA health and wellness programs, an examination of best practice programs, and relevant published research.
NIOSH WorkLife Initiative ⁴⁹	Resource document	A list of 20 components that collectively make up the essential elements for successful programs are organized into 4 sections: 1) organizational culture and leadership, 2) program design, 3) program implementation and resources, and 4) program evaluation.	This document presents a list of essential elements of effective worksite health programs. The 20 elements present an integrated approach to worker health protection and health promotion programs that include guiding principles and practical directions.

continued

Table 2 *continued*

Report source	Report type	Key contextual factor(s) identified	Comment
Proper et al ⁵⁰	Background paper on effectiveness and economic impact of interventions to promote PA and healthy diet	Cost savings from reduced absenteeism show a return on investment between 2.5 and 4.9 for each dollar invested. Similarly, savings for health care costs show a ROI between 2.5:1 and 4.5:1.	Worksite health programs can achieve substantial savings for employers. Figures based on credible research reports suggest that worksite health programs can achieve a 25–30% reduction in medical and absenteeism costs over a period of 3 to 4 years.
Quintiliani et al ⁵¹	Background paper on promotion of PA and healthy diet at the worksite	Factors related to promoting PA at worksites include multiple levels that can influence behavior (e.g., individual-level, organizational-level), top management support, PA activities can be connected to company goals, communications to a defined population, incentives can be applied over time, social support and social norms can be applied, and program can be integrated across occupational safety and health, disability management, and employee assistance programs.	A broad review of the literature on diet and PA promotion at the worksite, this paper identifies important contextual factors that should be considered in the design and implementation of comprehensive worksite health programs. To design and organize a strong intervention model for diet and PA program at the worksite, the authors propose a social-ecological model.
Sallis et al ⁵²	Systematic review	Successful environmental and policy interventions to promote PA include: 1) placing signs encouraging stair use, 2) installing showers and changing rooms, 3) providing secure parking for bicycles, 4) subsidizing health club memberships, 5) paying mileage costs for employees who transport by bicycle, and 6) reducing insurance rates for active and fit employees. The authors encourage using an ecological model as a basis for organizing a policy and environmental approach to promoting PA.	This review identifies the need for more research in the policy and environmental area of PA promotion. The review identified factors that should be considered in program design and implementation.
Soler et al ⁵³	Systematic review	This paper reviewed assessments of Health Risk (AHRF), such as health assessment surveys, health risk appraisals, and biometric screenings, as part of a comprehensive, multicomponent program.	Due to sufficient evidence of effectiveness, the Task Force on Community Preventive Services recommends using AHRF combined with health education programs to reduce physical inactivity. Due to insufficient evidence of effectiveness, the Task Force could not determine the effectiveness of using AHRF combined with health education programs to alter fitness.
Williams et al ⁵⁴	Systematic review	Referrals for PA from credible health professionals may be used as a means to integrate services into a comprehensive worksite health program.	Exercise-referrals by a primary care clinician to a program that encourages PA or exercise, were shown to be effective in increasing PA among sedentary adults. Referral into worksite-based PA programs is an appropriate application of these review findings.

continued

Table 2 *continued*

Report source	Report type	Key contextual factor(s) identified	Comment
World Health Organization ⁵⁵	Background document on best practice interventions to promote PA across the world	Key strategies identified that could be applied to the worksite setting included: 1) Raising awareness, 2) education, 3) effective interventions (with easy access), 4) a supportive environment, and 5) recognition/awards for people who succeed.	This report found that a mix of factors is necessary for programs to be successful in helping people increase and maintain their level of PA. Besides the identified strategies, other important factors included: integrating PA within other related interventions, multiple intervention strategies, population-based and individually-tailored approaches, program identity (brand), employee participation, leadership support, evaluation, and implementation within the "local reality."
World Health Organization ⁵⁶	Background document on preventing noncommunicable disease in the workplace through diet and physical activity	Key elements identified from evidence-based diet and PA interventions: 1) linking programs to business objectives, 2) top management support, 3) forming employee advisory boards, 4) effective communications, 5) supportive environment, 6) use of incentives, 7) goals setting, 8) self-efficacy, 9) social environment, social norms, and social support, 10) tailored programs, and 11) building effective programs across the individual-to-environment continuum.	The workplace is a setting in which population health may be improved. Promoting PA through worksites may improve health related outcomes, enhance employee productivity, improve corporate image, and moderate medical care costs. A multistakeholder approach is deemed essential to generate effectiveness and sustainability. In a broad sense, stakeholders include international organizations, ministries of health, nongovernmental organizations (NGOs), civil societies, employers, employees, trade unions, health insurance companies/funds, and the sports industry.

Abbreviations: AHRF, assessments of health risks with feedback; NIOSH, National Institute for Occupational Safety and Health; PA, physical activity; Task Force, the Task Force on Community Preventive Services.

4. Engaged executive, midlevel, and front-line management.

Program Design:

1. Programs linked to business objectives
2. Privacy issues addressed
3. Effective communication
4. Appropriate use of incentives
5. Goal setting
6. Self-efficacy
7. Individually-tailored programs
8. Organized around a social-ecological model
9. Integration of PA interventions into broader health promotion, disease prevention, and occupational safety and health initiatives.

Program Implementation and Resources:

1. Identified program leadership with accountability
2. Formal program budget
3. Contracting policies.

Program Evaluation:

1. Measure and analyze health, productivity, and financial outcomes
2. Integrate continuous improvement cycles into program operations.

Intervention Approaches. Evidence of the effectiveness of physical activity interventions is supported by the review presented in Table 1 and the contextual analysis presented in Table 2. In general, workplace programs tend to combine multiple interventions into a single strategy labeled "physical activity." As a result, Table 2 contains

high level strategic approaches that fall short of practical program solutions (ie, specific interventions) that are more tactical in nature. Table 3 presents an overview of specific physical activity interventions that have been described in the literature. It should be noted that this list of interventions does not represent a comprehensive set of solutions. The need to mold local solutions to the uniqueness of each worksite population and the culture of the workplace, the

creativity that practitioners bring to program implementation and the various forms of incentives, communications, and specific characteristics of the audience will ultimately define the specifics of the intervention. The table is organized around a social-ecological model,¹¹ supporting the notion that recommended interventions exert their effects at different levels of the organization and should consist of multiple components to optimize impact.

Table 3 Worksite-based Interventions to Promote Physical Activity Organized According to a Social-Ecological Model

Social-ecological dimension	Intervention example	Reference example
Individual	Printed motivationally-tailored PA intervention materials	37, 57
	Standard and motivationally-tailored Internet-based messages to promote PA	37, 58
	E-mail intervention using messaging to promote PA	59
	Internet-based counseling for PA, nutrition and weight management	60
	Telephone-based coaching or counseling for PA change	44
	Use pedometers to increase PA	43, 61
	Individual face-to-face counseling to increase PA levels	62
Inter-individual, group-based	Integrate 10-minute exercise breaks into daily routines conducted individually or in a group setting	63–65
	Incentive-based online PA intervention using a team-based format	66
	Light physical exercise interventions (resistance training and guidance) focused on headache, neck, and shoulder symptoms	67
	Health fairs and worksite-wide events that include biometric and behavioral self-assessments with feedback	68
	Walking groups and buddy systems to create supportive social networks at work	37
	Facilities and signs aimed at helping workers meet recommended levels of PA (point-of-decision prompts)	37, 68
Organizational	Implementation of an all-employee health assessment or health risk appraisal including PA assessment and feedback integrated with educational outreach and follow-up	53
	Use of incentives to promote PA among employees and their families, e.g., subsidize health club memberships, pay mileage costs for employee transport by bicycle, use insurance benefits-integrated incentives to promote PA (e.g., reduction in copays or deductibles), and/or reduce health insurance premiums.	52, 70
	Policies designed to support employee PA, e.g., permission to conduct business meetings during walks, create and/or enhance access to places for physical activity (painted, well-lit stairs, etc.)	37, 69
	Informational outreach activities and campaigns to promote PA	37
Environmental	Provide secure parking for bicycles	52
	Install showers and changing rooms for workers' use	52
	Advocate and support the introduction and passage of legislation that supports active commuting to work.	71
	Provide tax breaks for companies that implement comprehensive worksite health promotion programs	12
	Provide onsite fitness facilities and/or a PA-friendly campus, including the distribution of walking maps and easy access to walking/running routes	72
	Companies participate in community-based worksite exercise competitions	73
Community-wide PA campaigns	37	

Abbreviations: PA, physical activity.

Economic Considerations. Few systematic reviews exist that address the economic impact of worksite-based physical activity programs. An early comprehensive review by Shephard³⁵ reported on 14 studies of company-sponsored fitness programs and showed cost-benefit ratios between \$1.07 and \$5.58. A recent literature review by Proper and van Mechelen⁵⁰ indicated a potential for worksite-based diet and physical activity programs to achieve reductions of 25 to 30% in medical and absenteeism costs, although this review was primarily based on studies of lower methodological quality. Another systematic review of physical activity programs at worksites by Proper and colleagues considered outcomes including absenteeism and productivity and reported positive results for absenteeism, but no other productivity indicator.³²

Although a randomized controlled trial by Proper, et al⁷⁴ of worksite physical activity counseling did not provide a financial basis for implementing such programs, other literature indicates that low levels of physical activity, fitness, or fitness center participation are associated with higher health care costs^{7,8,75,76} or productivity-related losses among employees.^{5,9} Frequency of aerobic activity has been associated with illness-related absenteeism⁷⁷ and this finding was corroborated by a dose-response relationship between physical activity and sick leave.⁷⁸

In general, the social costs of inactivity related to healthcare utilization are substantial⁷⁹ and community-based physical activity interventions compared with other well-accepted preventive strategies are considered to be cost-effective and good value for money.⁸⁰ In the context of the worksite setting, overall findings of a series of financial impact reviews by Pelletier²⁶⁻³¹ indicate that integrating physical activity into a comprehensively designed program is a sound strategy to generate health and economic impact. More rigorous research using innovative research designs may provide stronger

evidence of the effectiveness of physical activity interventions on economic outcomes in the worksite setting.

A Framework for Action

To align the contextual factors that allow for the acceptance and integration of physical activity efforts at the worksite with factors that make the value of physical activity relevant for key stakeholders, a framework for action is proposed. This type of framework⁸¹ allows for the alignment of stakeholder interests with the implementation of the interventions themselves. Figure 1 depicts the proposed framework as an interaction grid of stakeholders' interests in physical activity in the context of multiple levels of influence through which physical activity may be promoted. Stakeholders, including but not limited to employees and companies, are more likely to commit to a physical activity agenda when their respective interests are clearly defined and tangible.⁸¹ Each cell in the grid may hold physical activity interventions and implementation processes. As the grid becomes more and more populated, the likelihood for program scalability and sustainability increases. Outcomes associated with the overall experience of implementation of this framework will include population health improvement, increased workforce productivity, and positive financial impacts. Affordability and cost-effectiveness are considered in the context of stakeholders' interests that are financially rewarding. Furthermore, substantial focus should be placed on the processes of implementation since these directly impact upon the experience of employees with the program—if the experience is poor, participation (both short- and long-term) will likely suffer. Hence, the process used to implement physical activity promotion programs constitutes a dimension quite as distinct and fully as important as the selection of the interventions themselves.

		Make Physical Activity...						
		Possible	Simple	Socially rewarding	Financially rewarding	Personally relevant	Organizationally relevant	Community connected
Level of Influence	Individual							
	Inter-individual							
	Organizational							
	Environmental							

Figure 1 — A physical activity framework for action in the business and industry sector. Note: Interaction grid of stakeholders' interests in physical activity in the context of multiple levels of influence through which physical activity may be promoted. Each cell in the grid may hold physical activity interventions and implementation processes that across all cells may be reflective of physical activity intervention scalability and sustainability that will result in population health improvement, increases in workforce productivity, and positive financial impacts.

Prioritized Recommendations

Practice Recommendations:

- Stakeholders within the business and industry sector should implement physical activity interventions according to a multilevel framework that makes being physically active possible, simple, socially and financially rewarding, personally and organizationally relevant, and community connected.
- Stakeholders within the business and industry sector should implement evidence-based and evidence-informed physical activity interventions that provide choice, allow for preferred learning style, provide broad access, are individually tailored, meet privacy and nondiscrimination requirements,⁸² and are affordable.
- Stakeholders within the business and industry sector should implement physical activity interventions as part of comprehensive,⁸³ multicomponent employer-sponsored health management programs.
- Stakeholders within the business and industry sector should implement programs that include assessment, measurement, and monitoring of individual and population levels of physical activity using measurement techniques and tools with known psychometric properties and include periodic progress reports to all stakeholders involved. In addition, evaluation should be an integral part of the program for purposes of impact documentation and continuous program improvement.
- Stakeholders within the business and industry sector should consider supporting their internal capacity and capabilities for physical activity promotion among their own employees through community partnerships. A connection to broader community may lead to more sustainable action by extending the reach of the worksite into the community and vice versa.
- Stakeholders within the business and industry sector should support and be actively engaged in the development of policy and legislative action that promotes employer-sponsored physical activity programs while protecting individual employees' and dependents' rights in the context of their responsibilities for personal health and safety. Partnerships to support the promotion of healthy communities through the physical and social environment, such as community parks and recreation, sidewalks, physical activity friendly neighborhood design, etc., are another public policy example through which employers may support their own employees, their dependents, and the community at-large.

Research Recommendations:

- Conduct research trials that generate evidence on the importance of the context in which physical activity interventions are being implemented and that allow for direct translation to real-world practice and policy. Without abandoning high internal validity, direct funding toward research trials designed for external validity such as “practical clinical trials”⁸⁴ or “realistic evaluation” models.⁸⁵ These research paradigms are couched in nonlinear contextualism (as opposed to linear reductionism) and supported by models such as complexity science⁸⁶ and systems thinking theory.⁸⁷ Fundamentally, these research paradigms will optimize contextual factors and focus on how complex systems adapt, the patterns of relationships within such systems, the factors that sustain these relationships, how the systems self-organize, and how outcomes emerge. This type of research may be appropriately positioned in the business setting (finding the best “fit” for a given research question) and closely linked to ongoing, day-to-day operations.^{88,89} The recently conducted *Move to Improve* study⁹⁰ represents a good example of moving into this direction. This study tests a social-ecological intervention delivered at the worksite using a group-randomized study design consisting of organizational action and personal and team goals-setting in a multiracial/ethnic sample of employees across 16 worksites.
- Conduct research focused on measurement and validation of energy expenditure and physical fitness through the use of assessment/measurement tools designed to monitor multiple modalities (eg, across a spectrum of activities that provide physical activity (eg, walking, swimming, basketball, etc.) that are effective, relevant, acceptable, and marketable.⁹¹ Respondent or participant burden should be minimal, approaches studied should be scalable and sustainable, and technologies deployed should be affordable. Validation objectives should consider occupational and habitual levels of physical activity separately and in combination.
- Conduct research on diverse populations, business characteristics, and outcomes. Diversity among the population may consider factors such as age, race, language, socioeconomic status, work shifts, organized labor, and job type, among others.⁴² Diversity related to the business entity may consider factors such as size of the company (small, large, jumbo), single-site or multisite, domestic or multinational, workplace culture, leadership characteristics, among others. Diversity among outcomes should consider health-, productivity-, and financially-related outcome variables, but may also consider factors such as integration with occupational safety and health, methods of identification and population stratification, and methods that impact employee participation, among others.

- Conduct research on the overall health or economic/financial efficiency impact of physical activity tactics or strategies as part of multicomponent, comprehensive worksite health promotion programs. In general, evidence supports the contention that worksite health promotion programs generate a positive return on investment. The role of specific physical activity interventions on health outcomes that are proximal to economic or financial impact should be explored in more detail and inform the design of highly effective employer-sponsored programs.

Conclusion

Business and industry represents an important sector for promoting physical activity in support of a National Physical Activity Plan. The review of systematic reviews generated a solid base of evidence of effectiveness for physical activity interventions from both health and financial points of view. Considering the context of the worksite, prioritized recommendations for action have been delineated for both practice and research. The implementation of physical activity programs at the worksite may be guided by the framework for action that leverages multiple levels of influence and factors that make physical activity relevant for all stakeholders involved. The business and industry sector has significant opportunity to improve physical activity among employees, their dependents, and the community at-large and thereby reap important benefits related to worker health and business performance.

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References

1. Physical Activity Guidelines Advisory Committee. *Physical Activity Guidelines Advisory Committee Report, 2008*. Washington, DC: U.S. Department of Health and Human Services; 2008.
2. Troiano RP, Berrigan D, Dodd KW, et al. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*. 2008;40(1):181–188.
3. Womack JP, Jones DT. *Lean Thinking*. New York: Free Press; 2003.
4. Berqvist U. *Musculoskeletal Disorders and the Workplace: Low Back and Upper Extremities*. Washington, DC: National Academies Press; 1995.
5. Pronk NP, Martinson B, Kessler RC, et al. The association between work performance and physical activity, cardiorespiratory fitness, and obesity. *J Occup Environ Med*. 2004;46:19–25.
6. Anderson DR, Whitmer RW, Goetzel RZ, et al. The relationship between modifiable health risks and group-level health care expenditures. *Am J Health Promot*. 2000;15(1):45–52.
7. Wang F, McDonald T, Champagne LJ, Edington DW. Relationship of body mass index and physical activity to health care costs among employees. *J Occup Environ Med*. 2004;46:428–436.
8. Pronk NP, Tan AWH, O'Connor P. Obesity, fitness, willingness to communicate and health care costs. *Med Sci Sports Exerc*. 1999;31(11):1535–1543.
9. Burton WN, McCalister KT, Chen C-Y, Edington DW. The association of health status, worksite fitness center participation, and two measures of productivity. *J Occup Environ Med*. 2005;47:343–351.
10. Pronk NP, Kottke TE. Physical activity as a strategic corporate priority to improve worker health and business performance. *Prev Med*. In press.
11. McLeroy KR, Bibeau D, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q*. 1988;15:351–377.
12. The Healthy Workforce Act introduced in the Senate by Senators Tom Harkin (D-IA) and Gordon Smith (R-OR) on July 9, 2007. (see http://healthpromotionadvocates.org/legislative_priorities.htm; accessed 11/3/08).
13. Sporting Goods Manufacturers Association. *2008 Sports and Fitness Participation Report*. Accessed 1/9/09. (see <http://www.sgma.com/reports/6/2008-Sports-and-Fitness-Participation-Report>).
14. Aldana SG, Pronk NP. Health promotion programs, modifiable health risks, and employee absenteeism. *J Occup Environ Med*. 2001;43:36–46.
15. Marcus BH, Willaims DM, Dubbert PM, et al. Physical activity intervention studies. What we know and what we need to know. A scientific statement for the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity); Council on Cardiovascular Disease in the Young; and the Interdisciplinary Working Group on Quality of Care and Outcomes Research. *Circulation*. 2006;114:2739–2752.
16. Boyer ML, Vaccaro VA. The benefits of a physically active workforce: An organizational perspective. *Occup Med*. 1990;5(4):691–706.
17. Dishman RK, Oldenburg B, O'Neal H, Shephard RJ. Worksite physical activity interventions. *Am J Prev Med*. 1998;15(4):344–361.
18. Engbers LH, van Poppel MNM, Chin A Paw MJM, van Mechelen W. Worksite health promotion programs with environmental changes: A systematic review. *Am J Prev Med*. 2005;29(1):61–70.
19. Hildebrandt VH, Bongers PM, Dul J, van Dijk FJH, Kemper HCG. The relationship between leisure time, physical activities, and musculoskeletal symptoms and disability in worker populations. *Int Arch Occup Environ Health*. 2000;73:507–518.
20. Heaney CA, Goetzel RZ. A review of health0-related outcomes of multi-component worksite health promotion programs. *Am J Health Promot*. 1997;11(4):290–308.

21. Kaewthummanukul T, Brown KC. Determinants of employee participation in physical activity. *Critical review of the literature. AAOHN J.* 2006;54(6):249–261.
22. Kuoppala J, Lamminpää A, Husman P. Work health promotion, job well-being, and sickness absences: A systematic review and meta-analysis. *J Occup Environ Med.* 2008;50:1216–1227.
23. Maher CG. A systematic review of workplace interventions to prevent low back pain. *Aust J Physiother.* 2000;46:259–269.
24. Matson-Koffman DM, Brownstein JN, Neiner JA, Greaney ML. A site-specific literature review of policy and environmental interventions that promote physical activity and nutrition for cardiovascular health: What works? *Am J Health Promot.* 2005;19(3):167–193.
25. Marshall AL. Challenges and opportunities for promoting physical activity in the workplace. *J Sci Med Sport.* 2004;7(1):S60–S66.
26. Pelletier KR. A review and analysis of health and cost-effective outcome studies of comprehensive health promotion and disease prevention programs. *Am J Health Promot.* 1991;5(4):311–315.
27. Pelletier KR. A review and analysis of health and cost-effective outcome studies of comprehensive health promotion and disease prevention programs at the worksite: 1991-1993 update. *Am J Health Promot.* 1993;8(1):50–62.
28. Pelletier KR. A review and analysis of the health and cost-effectiveness outcomes studies of comprehensive health promotion and disease prevention programs at the worksite: 1993-1995 update. *Am J Health Promot.* 1996;10(5):380–388.
29. Pelletier KR. A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: 1995-1998 update. *Am J Health Promot.* 1999;13(6):333–345.
30. Pelletier KR. A review and analysis of the clinical- and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: 1998-2000 update. *Am J Health Promot.* 2001;16(2):107–116.
31. Pelletier KR. A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: Update VI 2000-2004. *J Occup Environ Med.* 2005;47:1051–1058.
32. Proper KI, Staal BJ, Hildebrandt VH, van der Beek AJ, van Mechelen W. Effectiveness of physical activity programs at worksites with respect to work-related outcomes. *Scand J Work Environ Health.* 2002;28(2):75–84.
33. Proper KI, Koning M, van der Beek AJ, et al. The effectiveness of worksite physical activity programs on physical activity, physical fitness and health. *Clin J Sport Med.* 2003;13:106–117.
34. Proper KI, Heymans MW, Chin A Paw MJM, et al. Promoting physical activity with people in different places: a Dutch perspective. *J Sci Med Sport.* 2006;9(5):371–377.
35. Shephard RJ. A critical analysis of work-site fitness programs and their postulated economic benefits. *Med Sci Sports Exerc.* 1992;24(3):354–370.
36. Shephard RJ. Worksite fitness and exercise programs: a review of methodology and health impact. *Am J Health Promot.* 1996;10(6):436–452.
37. Task force on Community Preventive Services. In: Zaza S, Briss PA, Harris KW, eds. *The Guide to Community Preventive Services. What Works to Promote Health?* New York: Oxford University Press; 2005.
38. Verhagen AP, Karels C, Bierma-Zeinstra SMA, et al. Exercise proves effective in a systematic review of work-related complaints of the arm, neck, or shoulder. *J Clin Epidemiol.* 2007;60:110–117.
39. Waaler HT, Hjort PF. Physical activity, health, and health economics. *Scand J Soc Med.* 1982;S29:265–269.
40. Wanzel RS. Decades of worksite fitness programmes. Progress or rhetoric? *Sports Med.* 1994;17(5):324–337.
41. Wilson MG, Holman PB, Hammock A. A comprehensive review of the effects of worksite health promotion on health-related outcomes. *Am J Health Promot.* 1996;10(6):429–435.
42. Pronk NP (Ed). *ACSM's Worksite Health handbook, Second Edition. A Guide to Building Healthy and Productive Companies.* Champaign, IL: Human Kinetics; 2009.
43. Bravata DM, Smith-Spangler C, Sundaram V, et al. Using pedometers to increase physical activity and improve health. *JAMA.* 2007;298(19):2296–2304.
44. Eakin EG, Lawler SP, Vandelanotte C, Owen N. Telephone interventions for physical activity and dietary behavior change. *Am J Prev Med.* 2007;32(5):419–434.
45. Engbers L. *Monitoring and Evaluation of Worksite Health Promotion Programs – Current State of Knowledge and Implications for Practice. Background Paper Prepared for the WHO/WEF Joint Event on Preventing Noncommunicable Diseases in the Workplace.* Geneva: World Health Organization; 2007.
46. Harris JR, Lichiello PA, Hannon PA. Workplace health promotion in Washington State. *Prev Chronic Dis.* 2009;6(1). Accessed 04/01/09. http://www.cdc.gov/pcd/issues/2009/jan/07_0276.htm.
47. Hersey J, Williams-Piehot P, Sparling PB, et al. Promising practices in promotion of healthy weight at small and medium-sized US worksites. *Prev Chronic Dis.* 2008;5(4). Accessed 04/01/09. http://www.cdc.gov/pcd/issues/2008/oct/07_0172.htm.
48. Institute of Medicine. *Integrating Employee Health: A Model Program for NASA. Committee to Assess Worksite Preventive Health Program Needs for NASA Employees, Food and Nutrition Board.* Washington, DC: The National Academies Press; 2005.
49. NIOSH WorkLife Initiative. *Essential elements of effective workplace programs and policies for improving worker health and wellbeing.* National Institute for Occupational Safety and Health. Accessed 04/01/09. <http://www.cdc.gov/niosh/worklife/essentials.html>.

50. Proper K, van Mechelen W. *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*. Geneva: World Health Organization; 2007.
51. Quintiliani L, Sattelmair J, Sorenson G. *The Workplace as a Setting for Interventions to improve Diet and Promote Physical Activity. Background Paper Prepared for the WHO/WEF Joint Event on Preventing Noncommunicable Diseases in the Workplace*. Geneva: World Health Organization; 2007.
52. Sallis JF, Baumann A, Pratt M. Environmental and policy interventions to promote physical activity. *Am J Prev Med*. 1998;15(4):379–397.
53. Soler R, Griffith MG, Hopkins DP, Leeks K. The Assessment of Health Risks with Feedback. Results of a Systematic Review. In: Pronk NP (Ed). *ACSM's Worksite Health handbook, Second Edition. A Guide to Building Healthy and Productive Companies*. Champaign, IL, Human Kinetics, 2009.
54. Williams NH, Hendry M, France B, Lewis R, Wilkinson C. Effectiveness of exercise-referral schemes to promote physical activity in adults: systematic review. *Br J Gen Pract*. 2007;57:979–986.
55. World Health Organization. *Review of Best Practice in Interventions to Promote Physical Activity in Developing Countries. Background Paper Prepared for the WHO Workshop on Physical Activity and Public Health*. Geneva: World Health Organization; 2007.
56. World Health Organization and World Economic Forum. *Preventing Noncommunicable Diseases in the Workplace through Diet and Physical Activity. WHO/World Economic Forum Report of a Joint Event*. Geneva: World Health Organization; 2008.
57. Marcus BH, Emmons KM, Simkin-Silverman LR, et al. Evaluation of motivationally-tailored vs. standard self-help physical activity interventions at the workplace. *Am J Health Promot*. 1998;12(4):246–253.
58. Marcus BH, Lewis BA, Williams DN, et al. A comparison of Internet and print-based physical activity interventions. *Arch Intern Med*. 2007;167:944–949.
59. Plotnikoff RC, McCargar LJ, Wilson PM, Loucaudis CA. Efficacy of an e-mail intervention for the promotion of physical activity and nutrition behavior in the workplace context. *Am J Health Promot*. 2005;19(6):422–429.
60. Van Wier MF, Ariëns GAM, Dekkers JC, et al. ALIFE@Work: A randomized controlled trial of a distance counseling lifestyle program for weight control among and overweight working population. *BMC Public Health*. 2006;6:140.
61. Thomas L, Williams M. Promoting physical activity in the workplace: using pedometers to increase daily activity levels. *Health Promot J Austr*. 2006;17(2):97–102.
62. Proper KI, Hildebrandt VH, van der Beek AJ, Twisk JWR, van Mechelen W. Effect of individual counseling on physical activity, fitness and health. A randomized controlled trial in the workplace setting. *Am J Prev Med*. 2003;24(3):218–226.
63. Yancey AK, McCarthy WJ, Taylor WC, et al. The Los Angeles Lift Off: a sociocultural environmental change intervention to integrate physical activity into the workplace. *Prev Med*. 2004;38:848–856.
64. Pronk SJ, Pronk NP, Sisco A, Schiller Ingalls D, Ochoa C. Impact of a daily 10-minute strength and flexibility program in a manufacturing plant. *Am J Health Promot*. 1995;9:175–178.
65. Taylor WC. Transforming work breaks to promote health. *Am J Prev Med*. 2005;29(5):461–465.
66. Herman CW, Musich S, Lu C, Sill S, Young JM, Edington DW. Effectiveness of an incentive-based online physical activity intervention on employee health status. *J Occup Environ Med*. 2006;48:889–895.
67. Sjögren T, Nissinen KJ, Järvenpää SK, et al. Effects of a workplace physical exercise intervention on the intensity of headache and neck and shoulder symptoms and upper extremity muscular strength of office workers: a cluster randomized controlled cross-over trial. *Pain*. 2005;116:119–128.
68. Sorensen G, Barbeau E, Stoddard AM, et al. Promoting behavior change among working-class, multiethnic workers: results of the Healthy Directions-Small Business study. *Am J Public Health*. 2005;95:1389–1395.
69. Hammond SL, Leonard B, Fridinger F. The Centers for Disease Control and Prevention Director's Physical Activity Challenge: an evaluation of a worksite health promotion intervention. *Am J Health Promot*. 2000;15:17–20.
70. Thygeson NM, Gallagher J, Cross K, Pronk NP. Employee health at BAE Systems: an employer-health plan partnership approach. In: Pronk NP (Editor). *ACSM's Worksite Health Handbook, Second Edition. A Guide to Building Healthy and Productive Companies*. Champaign, IL: Human Kinetics; 2009.
71. Vuori IM, Oka P, Paronen O. Physically active commuting to work—testing its potential for exercise promotion. *Med Sci Sports Exerc*. 1994;26:844–850.
72. Van Poppel MNM, Engbers LH. Programs designed to improve health through changes in the built environment. In: Pronk NP (Editor). *ACSM's Worksite Health Handbook, Second Edition. A Guide to Building Healthy and Productive Companies*. Champaign, IL: Human Kinetics; 2009.
73. Blake SM, Caspersen CJ, Finnegan J, et al. The Shape-Up Challenge: A community-based worksite exercise competition. *Am J Health Promot*. 1996;11(1):23–34.
74. Proper KI, de Bruyne MC, Hildebrandt VH, et al. Costs, benefits, and effectiveness of worksite physical activity counseling from the employer's perspective. *Scand J Work Environ Health*. 2004;30(1):36–46.
75. Dunnigan T, Haynes G, Smith V. The relationship between stages of change for exercise and health insurance costs. *Am J Health Behav*. 2001;25(5):447–459.
76. Goetzel RZ, Anderson DR, Ozminkowski RJ, et al. The relationship between modifiable health risks and health-care expenditures. *J Occup Environ Med*. 1998;40:843–854.

77. Jacobsen BH, Aldana SG. Relationship between frequency of aerobic activity and illness-related absenteeism in a large employee sample. *J Occup Environ Med.* 2001;43(12):1019–1025.
78. Proper KI, van den Heuvel SG, De Vroome EM, Hildebrandt VH, van der Beek AJ. Dose-response relation between physical activity and sick leave. *Br J Sports Med.* 2006;40:173–178.
79. Sari N. Physical inactivity and its impact on healthcare utilization. *Health Econ.* 2009;18:885–901.
80. Roux L, Pratt M, Tengs TO, et al. Cost effectiveness of community-based physical activity interventions. *Am J Prev Med.* 2008;35(6):578–588.
81. Pronk NP, Peek CJ, Goldstein MG. Addressing multiple behavioral risk factors in primary care. A synthesis of current knowledge and stakeholder dialogue sessions. *Am J Prev Med.* 2004;27(2S):4–17.
82. Earles AC, Heinen L. Employee health promotion: a legal perspective. In: Pronk NP (Editor). *ACSM's Worksite Health Handbook, Second Edition. A Guide to Building Healthy and Productive Companies.* Champaign, IL: Human Kinetics; 2009.
83. Linnan LA. State of the worksite health promotion industry: the 2004 Worksite Health Promotion Survey. In: Pronk NP (Ed). *ACSM's Worksite Health handbook, Second Edition. A Guide to Building Healthy and Productive Companies.* Human Kinetics: Champaign, IL; 2009.
84. Tunis SR, Stryer DB, Clancey CM. Practical clinical trials. Increasing the value of clinical research for decision making in clinical and health policy. *JAMA.* 2003;290:1624–1632.
85. Pawson R, Tilley N. *Realistic Evaluation.* Thousand Oaks, CA: Sage Publications; 2007.
86. Zimmerman B, Lindberg C, Plsek P. *Edgework. Insights from Complexity Science for Health Care Leaders.* 2nd ed. Irving, TX: VHA Inc.; 2001.
87. Gharajedaghi J. *Systems Thinking. Managing Chaos and Complexity: A Platform for Designing Business Architecture.* 2nd ed. Boston, MA: Elsevier; 2006.
88. Estabrooks PA, Glasgow RE. Dissemination, knowledge exchange, or knowledge integration: Explaining the gap between medical office-based physical activity intervention research and practice. *Am J Public Health.* 2005;31(4, Suppl):S45–S56.
89. Pronk NP. Practice and research connected: a synergistic process of translation through knowledge transfer. In: Pronk NP (Editor). *ACSM's Worksite Health Handbook, Second Edition. A Guide to Building Healthy and Productive Companies.* Champaign, IL: Human Kinetics; 2009.
90. Dishman RK, DeJoy DM, Wilson MG, Vanderberg RJ. Move to Improve: A randomized workplace trial to increase physical activity. *Am J Prev Med.* 2009;36(2):133–141.
91. Waikar A, Bradshaw ME, Tate U. Improving marketability of exercise programs: implications for health promotion in the workplace. *Health Mark Q.* 1997;14(3):91–106.