

Using Formative Research to Develop Environmental and Ecological Interventions to Address Overweight and Obesity

Mark G. Wilson,* Ron Z. Goetzel,†‡ Ronald J. Ozminkowski,†‡ Dave M. DeJoy,* Lindsay Della,* Enid Chung Roemer,† Jennifer Schneider,† Karen J. Tully,§ John M. White,§ and Catherine M. Baase§

Abstract

WILSON, MARK G., RON Z. GOETZEL, RONALD J. OZMINKOWSKI, DAVE M. DEJOY, LINDSAY DELLA, ENID CHUNG ROEMER, JENNIFER SCHNEIDER, KAREN J. TULLY, JOHN M. WHITE, AND CATHERINE M. BAASE. Using formative research to develop environmental and ecological interventions to address overweight and obesity. *Obesity*. 2007;15(Suppl 1): 37S–47S.

Objective: This paper presents the formative research phase of a large multi-site intervention study conducted to inform the feasibility of introducing environmental and ecological interventions.

Research Methods and Procedures: Using mixed methods that included an environmental assessment, climate survey, leadership focus groups and interviews, and archival data, information was collected on employee health and job factors, the physical environment, social-organizational environment, and current health programs.

Results: Results show that 83% of employees at the study sites were overweight or obese. Leadership was very supportive of health initiatives and felt integrating the strategies into organizational operations would increase their likelihood of success. Environmental assessment scores ranged from 47 to 19 on a 100-point scale. Health services personnel tended to view the organizational climate for health more positively than site leadership (mean of 3.6 vs. 3.0, respectively).

Discussion: Intervention strategies chosen included increasing

healthy food choices in vending, cafeterias, and company meetings, providing a walking path, targeting messages, developing site goals, training leaders, and establishing leaders at the work group level.

Key words: environment, intervention, formative research

Introduction

Approximately 119 million or two-thirds of all Americans are overweight or obese (1), accounting for approximately 400,000 deaths per year (2). Being overweight or obese increases an individual's chances for developing chronic health problems, including type 2 diabetes, cardiovascular disease, stroke, musculoskeletal disorders, certain cancers, depression, sleep apnea, gallbladder disease, fatty liver disease, and other preventable health conditions (3,4). The national medical cost burden attributable to obesity and overweight is estimated to be \$117 billion (in direct and indirect costs), or 5.7% to 9.1% of U.S. spending on health-care (5,6). Obesity may increase inpatient hospital costs by 36% and medication costs by 77% (7). For employers, the annual medical costs for obese or overweight employees are 21% higher than for those not overweight. Obesity is estimated to cause 39 million lost workdays and 239 million restricted activity days (8).

Business leaders are becoming increasingly aware of the human and economic toll that poor health imposes on their workers and their companies' competitiveness. Many employers have invested in health promotion and disease prevention programs aimed at reducing the prevalence of obesity in the workplace through encouragement of physical activity, healthy diet, and improved management of health risk factors (9). Employers continue to seek innovative and evidence-based interventions that can be imported into the workplace to address a growing public health epidemic that also adversely affects worker productivity (10). A large

*Department of Health Promotion and Behavior, College of Public Health, University of Georgia, Athens, Georgia; †Institute for Health and Productivity Studies, Cornell University, Ithaca, New York; ‡Thomson Medstat, Washington, DC; and §The Dow Chemical Company, Midland, Michigan.

Address correspondence to Mark G. Wilson, Department of Health Promotion and Behavior, College of Public Health, University of Georgia, Athens, GA 30602-6522.

E-mail: mwilson@uga.edu

Copyright © 2007 NAASO

body of literature supports the application of individualized health promotion interventions directed at reducing employees' health risk factors, including overweight and obesity (11,12), but there is growing interest in interventions that support individual change efforts through the creation of more supportive environments (13). At the worksite, this includes introducing changes to the physical and social environments, in which individuals spend an increasing portion of their lives, and providing supportive work policies that promote increased physical activity, healthy eating, and weight management among workers.

Preliminary evidence suggests that physical environmental interventions are successful in increasing physical activity (14–18) and altering dietary habits (14,19–24). For example, signs that prompt staircase use have been shown to significantly increase such use by 63% in a train station (17,18), 113% in a shopping mall (18), and 5.5% in a library (15). Furthermore, an intervention to reduce the price of healthy foods in vending machines increased sales by 78% of those foods (21) and interventions to reduce the price of healthy foods in cafeterias produced similar results (19,21,22). In addition, interventions in which food labels were included in cafeterias produced a 5% decrease in caloric intake (24) and a 5% reduction in fat consumption (23). Although many of these environmental and policy innovations have been introduced at worksites, there is still sparse research on their individual and combined effects on such outcomes as improving the health of workers, reducing use of health care services, and improving worker productivity.

Purpose

Responding to this gap in knowledge, the National Heart, Lung, and Blood Institute (NHLBI)¹ funded seven research centers to study the impacts of innovative workplace interventions that emphasize environmental approaches or a combination of environmental and individual approaches to prevent or treat obesity in adults. This paper will discuss one of those projects, a 4-year study that will test two levels of environmental interventions: a moderate-level intervention that introduces an array of inexpensive environmental changes primarily to the physical environment and an intensive-level intervention that reflects a high level of commitment and resources throughout the organization aimed at achieving an impact on the social-organizational environment.

Formative research was conducted to assure, to the extent possible, the feasibility and logistics of conducting the study and to collect baseline data on key environmental variables. The purpose of this paper is to describe the formative research process and discuss how the information gathered

on employee health and job factors, physical environment, social-organizational environment, and current health promotion activities were used to craft the intervention.

Model Guiding the Project

The recent interest in ecological models of health promotion (25–27) represents a shift in orientation and greater attention to the role of environmental and contextual factors. The central premise is that an ecological or multilevel analysis can provide heightened understanding of behavioral antecedents and additional leverage points for intervention. This systems-level perspective argues that the environment, broadly defined, must be conducive to good health and good health practices. Ecologically-based interventions are usually multilevel, but most ecologic models fall short of providing operational guidance concerning where and how to intervene in the mix of social and environmental factors (25). More specific to workplace programming, the ecological perspective is represented by recent work on integrated workplace health promotion models (28,29), health and productivity management (30,31), and organizational health promotion (32,33). Each of these approaches emphasizes the centrality of the environment-behavior interaction.

Specifically, the integrative model proposed by DeJoy and Southern (29) was the foundation for this project. In this model, the development of workplace environmental interventions begins with an examination of job/task factors. Job/task factors include the physical and psychological demands of specific jobs. The immediate job-worker interaction is an important part of the environment at work. At the next level, there are two broad and important sets of environmental factors: the physical work environment and the social-organizational environment. The third level includes the sociocultural and economic and legal factors that exist outside the immediate sphere of influence by the organization, yet ultimately influence individual and organizational actions. Thus, the three primary and most practical target areas for workplace environmental interventions are: job factors, physical work environment, and social-organizational environment. These targets match up well with other more general discussions of environmental and structural approaches to health behavior (e.g., 27,34,35).

Research Methods and Procedures

Formative research uses social science techniques to assess beliefs, perceptions, and behaviors and describe the context in which these behaviors take place, ultimately attempting to understand why people do what they do (36). The data, typically collected through a combination of quantitative and qualitative methods, enable the development of an intervention tailored to the individual and/or group in which they reside. This increases the fit between

¹ Nonstandard abbreviations: NHLBI, National Heart, Lung, and Blood Institute; EAT, Environmental Assessment Tool; LBE, Leading by Example; HRA, health risk assessment.

Table 1. Summary of formative research instruments and data collected

Instrument	Health-related factors	Job factors	Physical environment	Social-organizational environment
EAT	✓		✓	✓
LBE				✓
Leadership interviews/focus groups		✓		✓
Corporate leadership interviews		✓		✓
Archival data	✓			

the intervention and the work group culture, enhancing the likelihood that the intervention will have its desired effect. Additionally, conducting formative research demonstrates an interest in understanding the target population and can build trust, collaboration, and acceptance of the project (37).

Subjects and Setting

Together with its affiliates, The Dow Chemical Co. is a diversified chemical, science, and technology company with ~180 manufacturing sites in 37 countries. The average age of employees of The Dow Chemical Co. and its U.S. consolidated subsidiaries (together referred to as Dow) is ~44 to 46, and 75% are men. The ethnic composition of the workforce is ~82% white, 8% African American, 6% Hispanic, 3% Asian, and ~1% other. In terms of job categories, ~54% are laborers or clerical or technical workers, 44% professional or managerial, and 2% are in sales. Of the 12 Dow worksites participating in the study, eight are primarily manufacturing facilities, two are research and development/administrative facilities, and the remaining two house manufacturing, research and development, and administrative facilities. Most sites are very large and house multiple business units.

Data Collection and Instruments

In this project, the formative research was designed to collect data on the key target areas for workplace environmental interventions including the workers (health and job factors), workplace (physical environment and current health promotion activities), and corporate and site leaders (social-organizational environment) (Table 1). Environmental assessments and organizational climate surveys were conducted at all study sites to understand baseline differences that may influence result patterns later and document ongoing health promotion activities and the physical and social-organizational environment. Focus groups and interviews were only conducted at the nine intervention sites because the purposes of these were to inform the research team about which interventions may be most useful and how the culture of each site may influence the use of potential interventions. Archival data analysis was con-

ducted with approval of the organization's management and under the auspices of existing contractual agreements. Participation in all data collection activities was voluntary, and all information collected by the research team was kept strictly confidential. The study protocols were approved by the Institutional Review Boards at Cornell University and Dow.

Environmental Assessment

An environmental assessment was used to gather information about the organization's physical environment, its health-promoting programs and policies, and the surrounding community. A search of the literature found a considerable number of physical activity-related environmental assessments (38,39), but none specifically geared toward obesity or nutrition. Thus, these data were collected using a newly developed instrument called the Environmental Assessment Tool (EAT), an adaptation of the Checklist of Health Promotion Environments at Worksites instrument (39). The EAT consists of two sections, one completed by site staff and the other by independent observers who toured the site and recorded their observations, and has three subscales: physical activity, food choices and weight management, and organizational characteristics and support.

In recording their observations at each site, researchers were also able to discern aspects of the social environment, through interaction with employees who could influence the intervention and/or its implementation. Observers were two individuals trained by the project team. Each observer completed the EAT independently and met afterward to compare responses to achieve consensus on the final ratings. Because many of the sites were too large for observers to inspect every building (site size ranged from 50 to 5000 acres with 12 to 300 inhabited buildings), with the assistance of local staff, six occupied buildings that were representative of the site and its employees were selected for assessment.

Organizational Climate Survey

Based on earlier work performed by Partnership for Prevention, the project team developed a new data collection

tool, dubbed the Leading by Example (LBE) survey. This survey assessed leaders' level of support for health improvement programs and the extent to which the company is committed to providing a healthy culture to its employees (social-organizational environment). Validity and reliability estimates for the LBE were conducted by Della et al. (40), and a paper on the analysis of the instrument is under review. This survey was administered to three groups at each site: the site leader and leadership team; a cross-discipline team consisting of representatives from various levels of the organization, which served as an advisory group to site leadership; and health services staff consisting of occupational physicians, nurses, and health educators who manage health service operations at each site's medical clinic.

The survey was designed to collect site level and work group information about perceived worksite support for health enhancement initiatives, business alignment with health-promoting objectives, and specific policy initiatives that support employee health improvement. The survey consisted of 15 items that respondents rated on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The average response rate across sites was 57%, resulting in an initial sample size of 135.

Leadership Focus Groups and Interviews

Focus groups were used to collect information from employees primarily related to the individual job factors influencing programs and health and possible intervention strategies. At each site, focus group discussions were held with site leadership, cross-discipline team members, and health services staff. The focus groups were moderated by a member of the research team and were about an hour in length. Group size ranged from 8 to 10 participants, participation was voluntary, and responses were recorded anonymously.

The focus groups were designed to collect information about potential intervention strategies from key stakeholders and to determine factors that might influence successful implementation of these strategies. Based on a review of the literature and discussions with leaders in the field, a list of potential intervention strategies was generated and given to the groups to initiate the discussion. However, all potential strategies, whether on the list or generated by the participants, were discussed and evaluated. In the sessions, participants were asked questions to determine what environmental strategies were currently in place and what new strategies could be implemented that would be effective at their site. In addition, before the session, individuals were asked to respond in writing to four open-ended questions: What key factors have led to the success of previous programs/initiatives at your site? What are some of the challenges to getting employees involved in new programs/initiatives? What do you believe would be the best way to get employees involved in new programs/initiatives? What

do you think would be the best way to communicate to employees about new programs/initiatives? Follow-up questions were asked during the focus group sessions to fill in gaps or clarify issues that were raised.

Individual interviews were conducted of the site leaders to garner the same information about strategies and their implementation that was collected during the focus groups. It was felt that the site leader would speak more freely if interviewed outside of the group context. As with the focus group sessions, these interviews were not recorded at the request of the organization but were observed by at least three researchers who compared observations afterward. All interviews varied in length but did not exceed 1 hour.

Semistructured interviews were chosen as the most appropriate data gathering technique for both focus groups and individual interviews. The project's research strategy required information concerning participants' personal beliefs, opinions, and insights. Such data are difficult to obtain through structured interviews, where rigid questioning sometimes prevents the pursuit of interesting angles or elaboration. The semistructured interview technique builds into the questions sufficient flexibility to capture insights that may otherwise be lost to the imposition of structured questions (41). Initially, broad questions were asked that did not constrain the conversation, and then new questions were allowed to arise as a result of the discussion. Conversational probes were then used to encourage the participants to expand on their answers on the various strategies (42).

Discussions with Corporate Leadership

Discussions were conducted with Dow's leadership groups at corporate and regional offices because they were the individuals responsible for employee health and productivity and would eventually be involved in championing and implementing the interventions. Questions directed at corporate leadership were primarily designed to elicit information about the organization: corporate culture, leadership support for the study, the nature of health services operations, and current health improvement initiatives. At each meeting, three researchers took notes and compared observations afterward.

Review of Archival Data

The organization routinely collects health risk assessment (HRA) and biometric data from its employees as part of ongoing risk assessment and surveillance programs. These assessments are conducted on a schedule that considers the employee's age and health risk. Historical HRA and biometric data collected within a specified time window (2003 and 2004) were aggregated for treatment sites ($n = 2011$ for 2003 and 2470 for 2004), control sites ($n = 513$ and 857), and all other U.S. Dow sites not included in the study ($n = 1481$ and 1865). HRA and biometric data provided insights about worker health risk factors, including self-reported

Table 2. Percent of Dow employees who completed an HRA who were at high risk at baseline (2004)

Risk factors	Treatment sites (<i>N</i> = 2470) (%)	Control sites (<i>n</i> = 857) (%)	Other U.S. locations (<i>n</i> = 1865) (%)
BMI category*			
Normal	15.3	16.7	26.0
Overweight	39.1‡	43.0	39.8
Obese	45.6	40.3	34.2
High low-density lipoprotein	12	12	11
Low high-density lipoprotein (<46)	45	39	44
High total cholesterol (>199)	48	51	44
High blood glucose (>99)	27	22	14
High blood pressure	24	24	14
Current smoker	21	18	12
Poor exercise habits†	63	59	59

HRA, health risk assessment.

* Overweight or obese, BMI > 24.

† Poor exercise habits, less than three times a week.

‡ Significant differences between treatment and control groups ($p < 0.05$).

physical activity and biometric values for weight, blood pressure, cholesterol, and blood glucose levels.

Data Management and Analysis

All of the data, with the exception of the archival data, were collected over a 6-month period of time, with the majority (surveys, focus groups/interviews, environmental assessments) being collected during 2 consecutive months. The archival data were provided to Medstat as part of its ongoing data management operations.

Responses to the LBE survey were entered into an SPSS database (SPSS, Inc., Chicago, IL), checked for quality, and standardized. Descriptive statistics were generated to examine trends and determine outliers, with only one outlier found. Based on the pervasiveness of this outlier, data for this respondent were removed from further analyses, which reduced the total sample to 134 respondents. Mean values were calculated for the total instrument and each subscale by site and by group (site leaders, cross-discipline team members, and health services staff). One-way ANOVA was conducted for each subscale by group.

Data from the EAT were entered into an Access database (Microsoft, Redmond, WA). A scoring algorithm was developed so that points were awarded for having certain environmental supports in place that fostered physical activity, healthy eating, and weight control. Summary scores for each building were calculated from these data for the three subscales (physical activity, food choices and weight management, and organizational characteristics and support) and for the entire instrument. The scores for each

building were then aggregated to the site level, resulting in a mean score for each site; the higher the score, the more supportive the environment.

Because discussions with corporate leadership, focus group members, and individual employees were not recorded, researchers' notes were typed verbatim, collected, coded, and analyzed. The research team compared findings using the constant comparative method of analysis (42). Potential regularities, patterns, and explanations were flagged, developed into conceptual themes, and placed into relevant categories using a cut-and-file process.

Results

Health and Job Factors

Analysis of routinely collected HRA data for 2004 (Table 2) found that overweight and obesity were prevalent throughout the organization, particularly at the study sites. At the treatment sites, 85% of the employees were classified as overweight or obese (BMI > 24), whereas at control sites, the rate was 81%. These rates were higher than those found at the remainder of company sites, where 75% of all employees were classified as overweight or obese. Table 2 also provides insights into the risk profile of employees. As shown, approximately one-half of screened employees at the 12 study sites had total cholesterol levels of 200 and above, one-quarter had high blood glucose levels, one-quarter high blood pressure, one-fifth smoked, and three-fifths reported exercising less than three times a week.

Table 3. EAT scores by site

	Access to physical activity (32 points maximum)	Access to healthy food choices and weight management (32 points maximum)	Organizational characteristics and support activity (36 points maximum)	Total score (100 points maximum)
Intervention sites				
Site 8†	12.50	15.00	19.00	46.50
Site 6	6.99	8.98	21.00	36.97
Site 7	10.67	7.50	17.50	35.67
Site 9	8.07	10.38	17.00	35.45
Site 4	9.17	7.84	14.00	31.00
Site 5	8.34	7.42	15.00	30.76
Site 2*	11.42	2.13	16.00	29.55
Site 1*	11.09	1.55	15.00	27.64
Site 3*†	1.00	1.67	16.00	18.67
Mean score	8.81	6.94	16.72	32.47
Control				
Site 10	13.67	7.92	21.00	42.59
Site 11*	16.00	1.93	19.00	36.93
Site 12*	5.94	3.79	18.00	27.73
Mean score	11.87	4.55	19.33	35.75
Overall mean score	8.99	6.74	17.23	32.95

EAT, environmental assessment.

* The site does not have a cafeteria on-site.

† The site does not have a fitness facility on-site.

Our individual and group interviews with employees pointed to the need for active leadership participation in health promotion initiatives as the key success factor. When asked what led to the success of previous health improvement initiatives, the majority of respondents indicated leadership support and involvement was the most important factor, followed by use of incentives, ease of access to programs, and promotional activities. Employees and leaders reported the most common challenges to such programs were time constraints, current workload (especially due to the volume of daily tasks, overtime work, and shift work), and low perceptions of the relevance of employee health to business objectives. Suggested strategies for overcoming these challenges included incorporating healthy activities into work duties (e.g., walking rounds) and daily routines (e.g., offering healthy foods in the cafeteria and vending machines).

A majority of respondents stated that incentives and leadership support/involvement were key factors to getting employees involved in new health improvement programs. A large number of the respondents also suggested that easy participation and access (e.g., bringing the program to them

and making participation free or inexpensive) and active promotion would facilitate employee involvement. Finally, respondents suggested using in-person presentations during already established communication venues, such as training and operations meetings, to attain high participation rates. Other communication strategies suggested included using e-mail and the company web site.

Physical Environment

Scores on the EAT for each site are shown in Table 3. Sites received points for having environmental supports in place to nurture healthy eating and physical activity. Two categories on the EAT focused on the characteristics of a cafeteria and fitness center. Hence, sites with functioning cafeterias and physical fitness facilities tended to score higher than sites without such facilities. The sites that were largely research and development and/or administrative sites (Sites 8, 6, 10, and 11) also tended to score higher than those that were predominately manufacturing. Overall, the control sites scored higher (average score = 35.75 of a possible 100) than the intervention sites (average score = 32.47), probably because of the predominance of research

Table 4. Key informant group means on the LBE by subscale

Team factor/total responses	Site leaders (69)	Cross-discipline (32)	Health services (33)
Business alignment with health objectives	2.96^A	2.99^A	3.61^B
Awareness of the economics of health and productivity	2.77	2.53	2.73
Worksite support for health promotion	2.93^A	2.95^A	3.36^B
Leadership support for health promotion	3.34	3.15	3.29
Total	3.03	2.98	3.25

LBE, leading by example. Ratings based on a scale of 1 to 5: 1, strongly disagree; and 5, strongly agree. Values in bold, overall F in ANOVA is significant ($p < 0.05$). Superscript letters indicate significant group differences ($p < 0.05$) using least significant difference post hoc contrasts in a one-way ANOVA assessed for each factor.

and development/administrative facilities at those locations (two of three control sites). Generally speaking, sites provided greater support for physical activity (average score = 8.99) than healthy eating and weight management (average score = 6.74).

Social-Organizational Environment

It was clear from the discussions with corporate leaders and site leaders that the company's senior leadership was strongly supportive of health promotion efforts at the company. The chief executive officer had produced a video wherein he discussed the company's health strategy, one component of which was prevention and employee health improvement. The video clip was widely distributed within the company and externally on the Partnership for Prevention web site, demonstrating the company's leadership stance related to health as a company priority. The current project was presented as complementary and aligned with the company's overall health strategy being implemented worldwide.

Discussions with senior leaders brought to the surface elements of the company's culture that were critical to the success of any initiative including this one. The organization placed strong emphasis on improving products and processes using Six Sigma tools (used to measure, analyze, and modify an organization's business processes) and leaders were constantly searching for new techniques that would improve productivity and profitability. At the same time, the business environment was extremely competitive so almost anything that could improve efficiencies was welcomed. The organization's culture emphasized goal setting and metrics that track progress toward achieving goals. Employees and leaders were rewarded for achieving specific goals developed by site and business teams. Senior leaders emphasized the need to implement this particular health improvement program keeping the organizational culture in mind.

Table 4 summarizes the responses on the LBE survey of each organizational group (site leaders, cross-discipline teams, and health services) for the total scale and each of the four subscales. Clearly, health services staff tended to perceive higher levels of the four factors than the site leaders or cross-discipline teams. These were significantly different for business alignment with health objectives [$F = 7.479$ (2128), $p \leq 0.05$] and worksite support for health promotion [$F = 4.596$ (2132), $p \leq 0.05$].

Table 5 shows the mean value and standard deviation for each subscale by site. The variation in the number of respondents across sites was largely a function of the size of the site (i.e., Site 6 was large, whereas Site 7 was small) and that, by design, control sites did not create cross-disciplinary teams (Sites 10 and 11; Site 12 was used to pilot the instrument, so its results were excluded from these analyses). There was considerable variability among sites for the overall scale on the LBE (range from 3.30 to 2.62, on a 1 to 5 scale where the higher the score the greater the organizational support for health improvement initiatives) and on each subscale (alignment, 3.66 to 2.45; awareness, 3.14 to 2.24; worksite support, 3.59 to 2.51; leadership support, 3.57 to 2.87). Sites were not consistent across categories, meaning that high scores on one subscale did not necessarily correlate with high scores on all subscales.

Health Promotion Activities

Focus groups with key informants identified eight physical activity and seven nutrition and weight management strategies that respondents felt would be feasible and successful at the worksite. Strategies for increasing physical activity included (in order of frequency): using competitions, conducting general physical activity education, creating safe walking areas, designating company time to exercise, building a fitness center on-site or providing off-site fitness center reimbursement, having health promotion personnel conduct stretching sessions in control rooms, install-

Table 5. Key informant mean and SD values on the LBE for each subscale by site

Site (total responses)	Alignment	Awareness	Worksite support	Leadership support	Total
Site 1 (17)	3.58* (0.50)	2.79 (0.60)	3.08 (0.52)	3.41 (0.57)	3.22
Site 2 (17)	3.66 (0.89)	2.97 (0.64)	3.07 (0.85)	3.33 (0.81)	3.26
Site 3 (8)	2.68 (0.44)	2.24 (0.46)	2.87 (0.37)	2.97 (0.66)	2.69
Site 4 (11)	2.61 (0.72)	2.49 (1.02)	2.67 (0.57)	3.15 (0.73)	2.73
Site 5 (19)	2.63 (0.67)	2.49 (0.64)	2.51 (0.51)	3.06 (0.59)	2.67
Site 6 (24)	3.55 (0.70)	2.73 (0.64)	3.33 (0.87)	3.57 (0.69)	3.30
Site 7 (6)	2.45 (0.35)	2.97 (1.27)	3.25 (0.33)	3.05 (0.66)	2.93
Site 8 (11)	3.26 (0.81)	2.58 (0.76)	3.39 (0.61)	3.35 (0.87)	3.14
Site 9 (11)	2.47 (0.89)	2.41 (0.74)	2.74 (0.79)	2.87 (0.80)	2.62
Site 10 (4)	3.25 (0.19)	3.14 (0.78)	3.59 (0.46)	3.05 (0.29)	3.26
Site 11 (6)	3.49 (0.96)	3.06 (0.67)	3.14 (0.67)	3.22 (0.66)	3.23
Total (134)	3.12 (0.84)	2.68 (0.73)	3.02 (0.72)	3.25 (0.71)	3.02

LBE, leading by example; SD, standard deviation.

* Table values are means with SD values in parentheses.

ing cardio-fitness equipment in control rooms, and encouraging more bicycle use on-site to get from one building to the next.

Nutrition and weight management strategies most frequently cited included: educating about cooking healthy meals (including demonstrations in control rooms), labeling the nutrition content of items in vending machines and cafeterias, increasing healthy eating choices in vending machines and cafeterias, changing company policy to require company-sponsored events that serve food to only serve healthy foods, providing a mobile food cart that offers healthy foods at moderate prices, having healthy prepared meals available for employees to purchase and take home after their shifts, and offering preferential pricing for healthy options in vending machines and cafeterias.

Discussion

The NHLBI has funded several organizations to study the effects of introducing environmental and ecological interventions at worksites to reduce and manage overweight and obesity among employees. In this paper, we describe the results of a 1-year formative research effort conducted in advance of the start of a multi-year study at The Dow Chemical Co. that will examine the effects of environmental interventions on health and financial outcomes of employees of a large manufacturing company. Results reported in this paper summarize quantitative and qualitative data collected from the targeted worksites and how these data informed the development of appropriate interventions in this organization.

Employee Health

Review of archival HRA and biometric data revealed that almost three-fourths of Dow employees were overweight or obese, with an even larger proportion (~83%) being employed at the study sites. About three-fifths of the employees (63% at treatment sites) reported having a mostly sedentary lifestyle, and a surprisingly high number of employees had high-risk biometric values including high total and low-density lipoprotein-cholesterol, high blood glucose, and high blood pressure. Overall, baseline employee health risks were sufficiently elevated to attract the attention of senior leadership and prompt them to launch a new Dow Global Health Strategy for the company, an important element of which was prevention. This provided considerable corporate support for the interventions in this project.

Interventions

The research plan called for offering two levels of interventions, one that could be easily introduced by an organization with a minimal level of commitment (moderate level) and the second, which required significant commitment and effort on the part of organization (intense level); however, the specific strategies within each level were not predetermined. Although each site's interest varied with the intervention strategy discussed, certain strategies were agreed on by sites as being feasible and potentially effective.

For the most part, the moderate-level strategies could be implemented without employee's knowledge or agreement. However, employee buy-in and participation are clearly required for any strategy to be successful, so employee input

was sought throughout this process, and considerable communication promoting the strategies was planned. The final moderate-level interventions chosen included providing healthy choices in the vending machines and cafeterias, providing healthy choices at all company-sponsored meetings, establishing a marked walking path on site, targeting messages to encourage healthy eating and physical activity, and developing an employee recognition program. These would be supplemented with an individual behavior change program to encourage weight loss and increased physical activity. The company has traditionally offered a variety of individual behavior change programs to its employees, so this was not considered to be a key element of the intervention; it was more usual care.

The EAT showed that 85% of vending foods were unhealthy, and not many healthy options were available in the cafeterias. Therefore, modifying food choices in vending machines and cafeterias (so that at least 25% of items offered were healthy) was an important first step. Obviously, it is difficult for an individual who wants to eat healthy to do so without healthy options available on site, and studies have supported this as being effective (19,21,22). Some employees could go off site to eat, but that seemed to be a relatively small portion of the workforce—primarily administrative personnel. Most of the production employee's schedules did not allow for extended lunches off site. Most employees could order from off-site food establishments to be delivered where available. However, many of these sites were in remote locations, so there was seldom a food establishment right outside the plant. The majority of the production facilities had working kitchens (including refrigerators, stoves, sinks, etc.), so most employees either ate available foods onsite or brought their own. It was clear that, in addition to providing healthy options onsite, education needed be provided about healthy foods that could be brought from home, in addition to eating healthy at home. Options for working with local food establishments to offer healthy items was considered but not pursued due to the lack of control over the establishments and the small portion of employees who chose this option.

The moderate intervention also included requiring that 50% of items ordered for company meetings or special events meet healthy food criteria. This was clearly supported by corporate and onsite leadership and should be easy to implement because most catered foods came from the vendors running the cafeterias.

The EAT and focus groups showed that there were few available on-site facilities for exercising, and walking around the expansive plant was not a preferred option by site leadership (primarily for safety reasons) or employees (largely because personal protective equipment was required to be worn, and it was considerably hot and humid in these southern locations during much of the year). Although employees indicated that the availability of exercise equip-

ment and facilities would facilitate their exercising, the provision of exercise equipment and facilities was discussed but not pursued due to the considerable expense involved. Some locations could work out an agreement with a local facility, and sites could provide incentive to employees by reimbursing part of the fees; however, this was not an option for all sites (due to the remote location), so this was not required as part of the intervention. Establishing walking paths in safe areas of the plant that did not require personal protective equipment was a viable option and was included as part of the interventions.

Like all companies in this industry, Dow is extremely safety conscious. This was clearly evident in data collected as part of the EAT and focus groups and interviews with corporate and site leadership. The site physical and social environment was saturated with messages imploring employees to think and act safely. Therefore, the leadership and employees were very supportive of an intervention designed to saturate the environment with healthy eating and physical activity messages. This included point-of-purchase messages on the vending machines and in the cafeterias and signs marking the walking paths. A concerted communication campaign including signs, posters, table tents, e-mails, messages in meetings, and information on the Dow web site would also be developed to create awareness and foster participation.

Finally, the moderate interventions would include an employee recognition program for workers who engaged in health improvement initiatives and/or changed their behavior (suggested during focus groups). The company culture is very supportive of recognizing and rewarding employees for a variety of work-related activities. This would be conducted quarterly to provide ongoing reinforcement and/or incentive.

In addition to the moderate-level strategies discussed above, the intense-level interventions included establishing site level goals as part of the site's management plan, training site leaders, reporting site progress to senior corporate leadership, establishing and training leaders at the work group level (named Healthy Culture Focal Points), and recognizing and rewarding leaders. These interventions were designed to garner strong leadership support, integrate the interventions into company operating processes, establish a support structure, and hold individuals accountable and reward them for progress toward their goals. Considerable discussion has taken place in the worksite health promotion literature about the importance of management support (reference); however, few studies have specifically tested this universally accepted belief. The focus groups with site and corporate leadership indicated that, to achieve broad-based, lasting support, the interventions needed to be incorporated as part of company-operating processes. The chosen intense interventions were designed to make it part of the company culture. Dow, like many organizations,

establishes goals with employees, holds employees accountable, rewards employees, trains employees, and provides a support structure to help them accomplish the goals. This intervention will link into Dow's current structure to include health-related goals in addition to the usual business/organizational goals.

Organizational Climate

Our experience reinforced realities experienced by many worksite health promotion practitioners and researchers. Like many organizations, Dow faces considerable competition and must constantly adapt its business operations to address emerging challenges. As a result, employees experience continued uncertainty about their future and are under considerable pressure to perform. In light of this, Dow has moved toward a mindset that providing health improvement programs is an investment in the company's future rather than a growing expense that needs to be lowered. However, at the site level, gaining support and participation from local leadership and employees for activities not directly related to their work can be difficult under the best of circumstances. On the other hand, gaining leadership support is key to the success of any initiative, health-related or otherwise. Our observations supported the notion that leadership engagement at the local or site level was as important as support at the corporate level. This is true at Dow given the decentralized nature of the organization. Clearly, local and corporate realities can sometimes be quite different. In short, we found that each site had its own personality, with different perspectives, capabilities, needs, and histories.

What was even more challenging was that different stakeholder groups at the local or site level differed on the value of the various proposed interventions. Therefore, we found that it was difficult to achieve complete consensus on any of the proposed interventions across sites, ultimately raising concerns related to autonomy and treatment fidelity. Although a true participatory action approach would give each site the power to determine the nature and extent of its activities, that approach magnifies the difficulty of determining the efficacy and effectiveness of specific intervention activities, which is of growing interest among funders and the research community.

Limitations

Being fully aware of the limitations inherent in this type of research, the formative research methods used in this project were chosen to triangulate the data to the extent possible to assure validity of our findings. However, these findings suffer from the limitations associated with collecting self-report data from a self-selected sample of the population using measures developed for the study. As such, readers should compare these findings with their own data and experiences to determine their relevance to their own specific circumstances. Only through replication and wide-

spread dissemination of research such as this can we begin to draw conclusions about efficacious strategies across organizations and populations. This paper is an initial step down that road.

Summary

When systematically and properly conducted, formative research can greatly enhance the appropriateness of the interventions and the chance that those interventions will impact the health of workers, including overweight and obesity rates. In this project, these interventions will be conducted over a 2-year period with outcome measures (primary measure BMI) being collected at baseline and end of Years 1 and 2 and a process evaluation designed to measure dose and fidelity conducted throughout.

Acknowledgments

This work was supported by the NHLBI (Grant R01 HL79546). However, its contents are the sole responsibility of the authors and do not necessarily represent the official views of NHLBI.

References

1. **National Center for Health Statistics.** *Prevalence of Overweight and Obesity Among Adults: United States, 2003–2004.* http://www.cdc.gov/nchs/products/pub/pubd/hestats/overweight/overweight_adult_03.htm (Accessed November 9, 2007).
2. **Mokdad AH, Marks JS, Stroup DF, Gerberding JL.** Actual causes of death in the United States. *JAMA.* 2000;291:1238–45.
3. **Must A, Spadano J, Coakley EH, Field AE, Colditz G, Dietz WH.** The disease burden associated with overweight and obesity. *JAMA.* 1999;282:1523–9.
4. **National Heart, Lung, and Blood Institute.** *Overweight and Obesity: What Can You Do.* http://www.surgeongeneral.gov/topics/obesity/calltoaction/fact_whatcanyoudo.htm (Accessed January 25, 2003).
5. **Wolf AM, Colditz GA.** Current estimates of the economic costs of obesity in the United States. *Obes Res.* 1998;6:97–106.
6. **Finkelstein EA, Fiebelkorn IC, Wang G.** National medical spending attributable to overweight and obesity: how much and who's paying. *Health Aff.* 2003;10:1377.
7. **Strum R.** The effects of obesity, smoking and drinking on medical problems and costs. *Health Aff.* 2002;21:245–53.
8. **U.S. Department of Health and Human Services.** *The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity.* Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General; 2001.
9. **Okie S.** The employer as health coach. *N Engl J Med.* 2007; 357:1465–9.
10. **National Business Group on Health.** *About the Institute on the Costs and Health Effects of Obesity.* <http://www.businessgrouphealth.org/healthy/about.cfm> (Accessed April 20, 2006).

11. **Aldana SG.** Financial impact of health promotion programs: a comprehensive review of the literature. *Am J Health Promot.* 2001;15:296–320.
12. **Chapman LS.** Meta-evaluation of worksite health promotion economic return studies. *Am J Health Promot.* 2003;17:1–10.
13. **Sallis JF.** The built environment can encourage or obstruct healthful behavior. Proceedings of the Ecology of Obesity Conference at Cornell University, June 6–7, 2005. Ithaca, NY: College of Human Ecology, 2005; pp. 3–4.
14. **French SA, Story M, Jeffery RW.** Environmental influences on eating and physical activity. *Annu Rev Public Health.* 2001;22:309–35.
15. **Russell WD, Dziewaltowski DA, Ryan GJ.** The effectiveness of a point-of-decision prompt in deterring sedentary behavior. *Am J Health Promot.* 1999;13:257–329.
16. **Andersen RE, Franskowiak SC, Snyder J, Bartlett SJ, Fontaine KR.** Can inexpensive signs encourage the use of stairs? Results of a community intervention. *Ann Intern Med.* 1998;129:363–9.
17. **Blamey A, Mutrie N, Aitchison T.** Health promotion encouraged by stairs. *Br Med J.* 1995;311:289–90.
18. **Brownell KD, Stunkard AJ, Albaum JM.** Evaluation and modification of exercise patterns in the natural environment. *Am J Psychiatry.* 1980;137:1540–5.
19. **Biener L, Glanz K, McLerran D, et al.** Impact of the Working Well Trial on the worksite smoking and nutrition environment. *Health Educ Behav.* 1999;26:478–94.
20. **Holdsworth M, Haslam C.** A review of point-of-choice nutrition labeling schemes in the workplace, public eating places and universities. *J Hum Nutr Diet.* 1998;11:423–45.
21. **French RW, Story M, Jeffery RW, Synder P, Eisenberg M.** Pricing strategy to promote vegetable purchase in high school cafeterias. *J Am Diet Assoc.* 1997;97:1008–10.
22. **Jeffery RW, French SA, Raether C, Baxter JE.** An environmental intervention to increase fruit and salad purchases in a cafeteria. *Prev Med.* 1994;23:788–92.
23. **Sorensen G, Morris DM, Hunt MK, et al.** Worksite nutrition intervention and employees' dietary habits: The Treatwell program. *Am J Public Health.* 1992;19:31–54.
24. **Zifferblatt SM, Wilbur CS, Pinsky JL.** Changing cafeteria eating habits. *J Am Diet Assoc.* 1980;76:15–20.
25. **Green LW, Kreuter MW.** *Health Promotion Planning: An Educational and Ecological Approach.* 3rd ed. Mountain View, CA: Mayfield; 1999.
26. **McLeroy KR, Bibeau D, Steckler A, Glanz K.** An ecological perspective on health promotion programs. *Health Educ Q.* 1988;15:351–77.
27. **Stokols D.** Establishing and maintaining healthy environments: toward a social ecology of health promotion. *Am Psychol.* 1992; 47:6–22.
28. **Dalton BA, Harris JS.** A comprehensive approach to corporate health management. *J Occup Med.* 1991;33:338–48.
29. **DeJoy DM, Southern DJ.** An integrative perspective on worksite health promotion. *J Occup Med.* 1993;35:1221–30.
30. **Goetzel RZ, Ozminkowski RJ.** Health and productivity management: Emerging opportunities for health promotion professionals for the 21st century. *Am J Health Promot.* 2000; 14:211–4.
31. **Goetzel RZ, Guindon AM, Turshen IJ, Ozminkowski RJ.** Health and productivity management: establishing key performance measures, benchmarks, and best practices. *J Occup Environ Med.* 2001;43:10–7.
32. **Danna K, Griffin RW.** Health and well-being in the workplace: a review and synthesis of the literature. *J Management.* 1999;25:357–84.
33. **DeJoy DM, Wilson MG.** Organizational health promotion: Broadening the horizon of workplace health promotion. *Am J Health Promot.* 2003;17:337–41.
34. **Cohen DA, Scribner RA, Farley TA.** A structural model of health behavior: a pragmatic approach to explain and influence health behaviors at the population level. *Prev Med.* 2000;30:146–54.
35. **Stokols D, Grzywacz JG, McMahan S, Phillips K.** Increasing the health promotive capacity of human environments. *Am J Health Promot.* 2003;18:4–13.
36. **Gittlesohn J, Evans M, Helitzer D, et al.** Formative research in a school-based obesity prevention program for Native American school children (Pathways). *Health Educ Res.* 1998; 13:251–65.
37. **Vastine A, Gittlesohn J, Ethelbah B, Anliker J, Caballero B.** Formative research and stakeholder participation in intervention development. *Am J Health Behav.* 2005;29:57–69.
38. **Golaszewski T, Fisher B.** Heart Check: the development and evolution of an organizational heart health assessment. *Am J Health Promot.* 2002;17:132–53.
39. **Oldenburg B, Sallis J, Harris D, Owen N.** Checklist of health promotion environments at worksites (CHEW): development and measurement characteristics. *Am J Health Promot.* 2002;16:288–99.
40. **Della L, DeJoy DM, Goetzel RZ, Ozminkowski RJ, Wilson M.** Assessing management support for worksite health promotion: psychometric analysis of the Leading By Example instrument. *Am J Health Promot.* (in press).
41. **Connell J, Lynch C, Waring P.** Constraints, compromises, and choice: comparing three qualitative research studies. *Qual Rep.* 2001;6:1–14.
42. **Patton MQ.** *Qualitative Research and Evaluation Methods.* 3rd ed. Thousand Oaks, CA: Sage; 2002.
43. **Glaser BG, Strauss AL.** *The Discovery of Grounded Theory: Strategies for Qualitative Research.* New York: Aldine; 1967.