Total Worker Health® Intervention for Construction Workers Alters Safety, Health, Well-Being Measures

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Objective: The aim of this study was to evaluate the effectiveness of a 14-week Total Worker Health® (TWH) intervention designed for construction crews. **Methods:** Supervisors ($n = 22$) completed computer-based training and self-monitoring activities on team building, work-life balance, and reinforcing targeted behaviors. Supervisors and workers ($n = 13$) also completed scripted safety and health education in small groups with practice activities. **Results:** The intervention led to significant ($P < 0.05$) improvements in family-supportive supervisory behaviors ($d = 0.72$). Additional significant improvements included reported frequency of exercising 30 minutes/day and muscle toning exercise ($d = 0.50$ and 0.59), family and coworker healthy diet support ($d = 0.53$ and 0.59), team cohesion ($d = 0.38$), reduced sugary snacks and drinks ($d = 0.46$ and $d = 0.46$), sleep duration ($d = 0.38$), and objectively-measured systolic blood pressure ($d = 0.27$). **Conclusion:** A TWH intervention tailored for construction crews can simultaneously improve safety, health, and well-being.

Keywords: construction, intervention effectiveness, occupational, total worker health, TWH

Worldwide, over 49 million people are employed in construction,[1] including 9.1 million workers in the United States.[2] Construction is dangerous work. For example, the US construction industry experiences three times more fatal injuries than all other industries and 9% of all nonfatal illnesses and injuries requiring days away from work (all-industry average = 1.7%).[3] In the United Kingdom (UK) in 2014, as another example, construction fatalities were also more than three times the UK national average and 3% (65,000) of construction workers reported nonfatal workplace injuries. An additional 3% of UK construction workers reported work-related illnesses (eg, musculoskeletal disorders).[4]

Not only is construction one of the most dangerous industries, there is also evidence that the construction workforce is unhealthy. Compared with US national adult male averages,[3] a sample of 349 workers drawn from two city construction/utility departments had higher systolic (126.95 and 128.85 vs 122 mm Hg in the US) and diastolic (79.06 and 79.65 vs 71 mm Hg) blood pressure, and they had higher rates of obesity (58% and 46% vs 32% in the US) among other chronic conditions[5]; these are also substantially worse than worldwide adult averages.[6] And safety and health are linked. For example, workplace injuries with comorbid obesity generated 80% greater cost and lost work time than in workers who were not obese, in a review of workers' compensation cases in California.[7]

Improving Safety, Health, and Well-Being in Construction

Federal and state safety requirements and regular safety inspections, designing construction projects for safety,[8] development of safety plans for construction projects, and regular toolbox safety talks[9,10] have contributed to the substantial reduction in deaths and injuries over the years in the construction industry.[11] Scientific studies of the effectiveness of specific safety training interventions for construction workers have not met with much success,[12,13] although Yu et al[14] recently demonstrated convincingly that participatory training reduced injury rates in construction workers. Although there are national initiatives to stimulate increases in workplace wellness programs in construction,[15] results are typically reported as case studies and not evaluated with systematic research methods. Few construction interventions simultaneously address safety, health, and well-being together. However, there is a new broader area of intervention research called Total Worker Health® (TWH) that encourages such integrated approaches. First defined in 2011 by the National Institute for Occupational Safety and Health (NIOSH),[16] TWH strategies present the promise of producing changes in safety, health, *and* well-being through single interventions. A key rationale for the effectiveness of such interventions is that the integration of safety, health, and well-being (often wellness is the primary focus) provides changes by the organization to make the work environment more conducive to safety, health, and well-being, rather than placing the primary load for change on individual employee behavior. Two reviews of the research base in this area identified only 17[17] and 15[18] TWH intervention studies, respectively. Two of these seminal TWH interventions focused on construction workers.[19,20]

The TWH intervention by Hammer et al[19] was evaluated with supervisors ($n = 264$) and workers ($n = 167$) in city utility construction departments. Supervisors completed computer-based training in family- and safety-supportive behaviors followed by 2 weeks of behavior tracking (self-monitoring). The program also involved a 4-hour facilitated ''team effectiveness'' session with both supervisors and employees in public sector construction departments, followed up by sessions without facilitation. At the 6-month follow-up, there were improvements in family-supportive supervisory behaviors and blood pressure. Team effectiveness and work-life effectiveness also improved among supervisors/work groups that had low baseline levels of team cohesion and leader-member exchange (viz., poor initial relationships between supervisors and their employees). In the other TWH intervention study with construction workers, Okechukwu et al[20] combined a smoking cessation program with industrial hygiene walk-throughs and committee reviews of processes using chemicals. The intervention reduced the proportion of smokers due to some workers stopping smoking or reducing smoking frequency and exposures to workplace chemicals that synergize with the carcinogenic chemicals found in cigarette smoke. The

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results of these studies support the promise of TWH approaches for construction workers and encourage experimentation with other models of intervention delivery with other segments of the construction industry.

Purpose

We sought to conduct a pilot study to test the hypothesis that a TWH intervention could be implemented in the commercial construction industry and produce targeted positive impacts on Kirkpatrick's four levels of training evaluation.[21] A comprehensive TWH intervention was developed to incorporate methods found effective in individual[22–24] and TWH[17,19] interventions, including behaviorally based supervisor skills training[19,22,23] self-monitoring,[24] and scripted wellness education conducted by self-selected members of small work groups or teams with off-site practice.[17] The supervisor training was designed to provide organizational change, and the self-monitoring was designed to provide feedback to the supervisors if they were following the training. The scripted training was designed to engage all employees in improving their lifestyle and to support each other in doing so and the off-site practice was designed to reinforce the information learned in the scripted training and to put it into practice. Relevant impacts are positive reaction measures, improved scores on the post-tests following training, changes in self-reported behaviors and climate, and objective measures of health.

METHODS

The intervention consisted of two components: (1) Computer-based training for supervisors supported by a self-monitoring app ''HabiTrak'' (OHSU Enterprise app; Portland, Oregon) to track and increase the frequency of interactions in which supervisors show support for their employees and reinforce safe work practices and healthy lifestyles; and, (2) ''Get Healthier'' scripted training cards discussed by supervisors and employees in small groups followed by take-home activity sheets to reinforce each topic. The intervention followed the schedule summarized in Table 1.

Computer-Based Training

The training was presented to supervisors in cTRAIN (NwETA; Lake Oswego, Oregon) software designed to follow behavioral education principles (viz., self-paced, interactive by providing quiz questions every few screens and returning the learner to the information about any incorrectly answered questions). The training, administered in week 3 (Table 1), taught supervisors to develop a sustainable and effective level of interactions with their employees about their home activities as well as their work, the value of work–life balance, and effective supervision skills (eg, reinforcing appropriate work or nonwork practices).[22,23] Knowledge tests were given before and after the training, and overall reaction measures were taken at the end of the intervention program.

Behavioral Self-Monitoring

Supervisors recorded interactions with their employees daily using the enterprise-level (Oregon Health & Science University, Portland, Oregon) behavioral self-monitoring app, *HabiTrak,*[24] for iPhones; this provided a practice component for supervisors and a measure of interaction and reinforcement fed back to the supervisor by the app via graphs.

Supervisors self-monitored target behaviors within the broad categories of family-supportive supervisory behaviors (FSSBs),[25] safety supportive supervisory behaviors, and healthy lifestyle behaviors. Specific types of FSSBs included asking employees about their weekend, hobbies, and families, and telling them about their own family life and hobbies; users could access examples of each in the app (''talk about family'' in Table 1). Safety behaviors included communicating safety and health expectations, making sure people have needed equipment and materials to complete work in a safe and healthy manner, and working with safety or health precautions to direct crewmembers to prioritize safety and health, also with examples accessible in the app (''Reinforce safety'' in Table 1). Supervisors were to select healthy lifestyle actions of employees, such as eating an apple as a snack instead of chips (''Reinforce Healthy Lifestyles'' in Table 1). Self-monitoring is designed to focus the user's attention on specific tasks or behaviors by having the user set goals, and then count the dimension (frequency, quality, duration) of those tasks/behaviors over time, and evaluate progress toward their goals. This general process typically leads to changes in behavior.[26] Reaction measures were taken each week on how well Supervisors ''liked'' and how they rated the usefulness of *HabiTrak* (0 = Not very good or Poor, 1 = OK or Neutral, 2 = Good, 3 = Excellent).

''Get Healthier'' Scripted Training

Scripted training on healthy lifestyles (Table 1, bottom row) was presented on 8.5 x 11 (22 x 28 cm) cards (see Fig. 1), one card per topic. Each card had information and questions about the information to be asked by a peer ''leader,'' and the leader's card had the answers to the questions. ''Member'' cards had the questions but no answers, and ''members'' (all other people in the group) were encouraged to write the answers on their cards and take them home to use with their family. The 12 topics were Get Healthier (goals, pedometer included to record steps), Sleep, Calories, Liquids and Calories, Basic Nutrition/Labels, Snacks, Sugar, Exercise, Strength Training, Flexibility, Stress, and Moving Forward (health goals). Each was created from evidence-based information, and documented.

Knowledge tests were given the week before and immediately after each 30-minute ''Get Healthier'' session, and reaction measures were collected at the end of each session. A research assistant attended most ''Get Healthier'' sessions and rated the question ''were the members engaged?'' (eg, participated in discussions) on a scale from 1 (not at all) to 5 (substantially).

One- to two-page activity sheets provided practice (eg, setting goals, recording steps, meal calorie counts) for each topic

TABLE 1. Schedule of Intervention

	Intervention Weeks			
	1–2	3–4	5–8	9–14
Supervisors	Self- monitoring begins	Computer training		Self-Monitoring ends
Supervisor tasks	Record employee conversation topics	Talk about family	Reinforce safety	Reinforce Healthy Lifestyles
Supervisors and Employees	Get Healthier Scripted Training (1/week for 12 weeks)			
	Surveys			Surveys

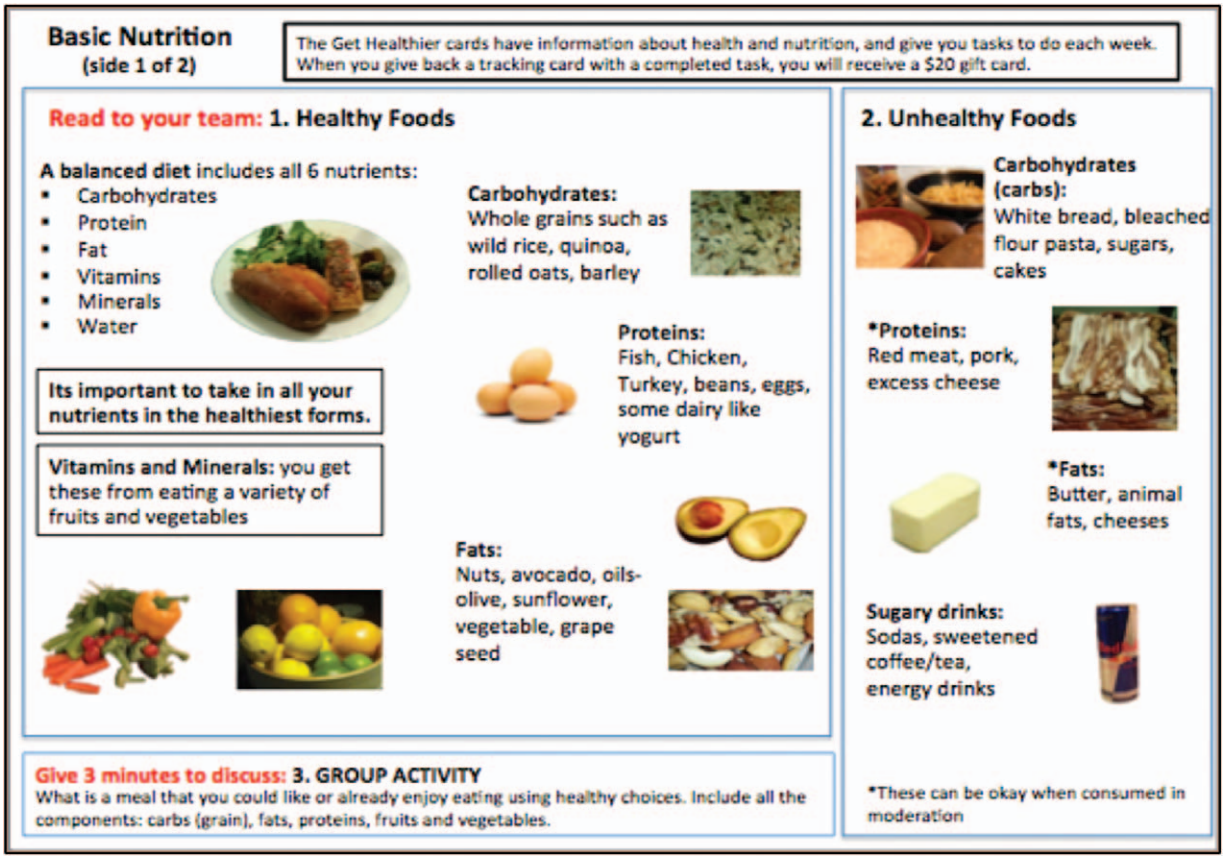

FIGURE 1. Front of ''Get Healthier'' card.

at the end of each weekly session. A research assistant rated the degree of perceived amount of effort put into the homework (1 = Minimal effort, 2 = Good Effort, 3 = Above and Beyond).

Survey, Biomarker, and Grip Strength Measures

Surveys were given to all participants before and after the intervention (week 1 and 14 in Table 1); both supervisors and workers participated in the scripted wellness training. A broad range of measures were selected, all of which could have been affected by the intervention that encouraged the supervisors to reinforce safer and healthier behaviors and the lifestyle training that taught a very broad range of wellness information. In addition, these were common measures selected by the Oregon Healthy Workforce Center (www.OHSU.edu/ohwc) for all projects to allow cross-project comparisons. In all, there were 245 questions presented from the surveys listed below on an iPad (Apple Computers; Cupertino, California) in SurveyGizmo (Boulder, Colorado) and five biomarker measures (Basal Metabolic Index; heart rate average; systolic and diastolic blood pressure; fat percentage) were collected that required approximately 35 minutes to complete (Table 2).[27–47]

Procedures

All participants signed an IRB-approved consent form from Oregon Health & Science University. Supervisors were given an overview of the project expectations and taught how to use the *HabiTrak* behavioral self-monitoring app (Table 1); this required approximately 30 minutes to complete. Supervisors were given an Apple iPod Touch with *HabiTrak* or optionally downloaded it onto their Apple iPhone, to record their family-related and job interactions with their employees for 2 weeks.

Supervisors completed the supervisor team-building and behavioral reinforcement topics (about 90 minutes), and then began a series of 2-week periods of goal-based tracking with *HabiTrak*. Weeks 1 to 2 of the intervention served as a baseline period when supervisors tracked interactions as work-related or family-related (Table 1, top supervisor row).

Following baseline, the training was given that requested supervisors to increase in their interactions with their employees and to inquire about family and job topics for weeks 1 to 2, then to increase the frequency of interactions (weeks 3 to 4), reinforce safety behaviors (weeks 5 to 8), and later well-being behaviors (weeks 9 to 14) in their employees (Supervisor Tasks row of Table 1). Every other week, supervisors created goals for how many individual supportive interactions they would like to reach in discussion with a research staff member. Alarms were set on their phones or iPods as a reminder to record counts. Participation in the supervisor training was incentivized by a vest or jacket with the project name on it or with a gift card of about equal value.

The *Get Healthier* scripted lifestyles cards (Table 1) for all employees including supervisors consisted of 12 weekly group meetings that lasted approximately 30 minutes; one topic was discussed each week. Different peer leaders (some self-selected, some selected by the group; sometimes they were supervisors, sometimes employees) were selected to ''lead'' each session. Participants (supervisors and employees) completed a quiz (five to nine questions) to test their knowledge on the card topic, respectively, the week before and immediately after each Get Healthier group meeting; this added 10 minutes to the meeting. The optional take-home activities were distributed at the end of each

TABLE 2. Surveys and Measures

Demographics (developed for study)	Safety Behaviors: Safety Compliance and Participation[25]
Injury[26]	Safety Behaviors: Safety and Motivation[27]
Pain[28]	Safety Climate[29]
Job Satisfaction[30]	Family-Supportive Supervisor Behaviors (FSSB) – Supervisor[31]
Occupational Stress: Work-family Conflict[32]	FSSB – Employee[33]
Occupational Stress: Family-Work Conflict[32]	Team Cohesion[34]
Wellbeing: SF-12[35]	Social Support for Diet[36]
Wellbeing: CES-D[37]	Social Support for Exercise Behaviors[36]
Wellbeing: Life Satisfaction[38]	Basic Reaction[39]
Nutrition: Fruit/Vegetables/Fat[40]	Basic Reaction Adapted for Wellness (developed for study)
Nutrition: Fat/Sugar Screener[41]	Basal Metabolic Index (BMI), Weight (Tanita Corporation; Tokyo, Japan)
Lifestyle: Alcohol, Smoking, Caffeine[39]	Height
Exercise[42]	Grip strength (Patterson Medical, Warrenville, IL) - Left and Right Hand
Sleep Deficiency Construct[43–49]	Blood pressure (Omron Corporation, Kyoto, Japan)

meeting, for the participants to complete and return the following week for a $20 gift card incentive.

At the beginning and end of the project, the surveys were taken on Apple iPads, and biomarker measures were collected individually in a private room; the data collection took approximately 90 minutes. Overall, the project burden on supervisors was 2 hours of training, 5 hours of tracking, and increased interactions with employees that we expected would take about 5 minutes per employee (x the number of employees) per day. The burden on all employees was thus 6 hours for the Get Healthier discussions and 6 hours for data collection distributed over 14 weeks.

Statistical Analyses

Analyses were performed using SPSS Version 23 (SPSS Inc., Armonk, New York). Postintervention measures were compared with preintervention measures using paired-samples *t* tests; *P* values are one-tailed. Results were interpreted as significant when the *P* value was less than 0.05. Effect size (*d*) was calculated as the mean post-pre difference divided by the pooled standard deviation (pre- and postintervention).

RESULTS

Recruitment/Partners

Four General Contractor companies provided time for supervisors to participate. InLine Commercial Construction oversees remodels, new construction, and special projects (eg, seismic retrofits and fire/water restoration). Fortis Construction offers general contracting, preconstruction, value analysis, constructability, construction management, site selection/feasibility studies, financial modeling, and building information management. General Sheet Metal provides mechanical, architectural, and HVAC fabrication, installation and repair. Mortenson Portland offers development, design-build, engineering, procurement, and general contracting.

Participant Demographics

The demographics of the 22 supervisors and 13 employees (35 total) who participated in the study are summarized in Table 3. Their job titles included carpenter, safety engineer, field engineer, (senior) project engineer, site administrator, project coordinator or manager, health care market leader, and (senior) superintendent. The supervisors were a mean of 39 (±8.0) years of age, while the employees were a mean of 37 (±11.1) years of age. Participants were primarily white, over three-quarters had at least some college or technical school education, more supervisors (77%) than employees (46%) were married, and supervisors had a longer tenure in the industry than did employees.

Computer-Based Training

All 22 supervisors completed the computer-based training (the number of supervisors is listed by company in Table 4, along with the number of employee by company). Knowledge scores improved from pre- (78%) to post-test [98%; $t(20) = 9.45$; $P < 0.001$; effect size $d = 2.92$]. Reactions to the training were a highly positive median of 2.5 on a 3.0 scale (3 = excellent), and most reported that they would recommend the training to coworkers ''as is'' (median = 3, the highest rating).

Behavioral Self-Monitoring

Behavioral self-monitoring with *Habitrak* showed relatively high frequency counts of contacts with employees during baseline in weeks 1 to 2 and slightly increased counts in weeks 3 to 4 when supervisors were requested (by the computer-based training) to increase the number of family and job contacts without a specific focus (see Fig. 2). In weeks 5 through 8, the supervisor training requested increased counts directed toward safety messages followed in weeks 9 through 14 by a request to increase messages related to personal health. These requests were met, as more safety messages were reported in weeks 5 to 8, while more health messages were reported in weeks 9 to 14 (Fig. 2). The supervisors rated *HabiTrak* as ''liked'' and ''useful'' (both median ratings of 3.0 to 4.0 on 5-point scales). The frequency of counts (185.2 to 23.2) and submissions (46.9 to 16.8) declined over time, even though the reaction ratings of *HabiTrak* remained consistently high. The focus of the contacts (safety or health/healthy lifestyles) did follow the request of the training (Fig. 2).

The training supported by *HabiTrak* led to a significant increase in family-supportive supervisor behaviors toward employees as self-reported by supervisors [$t(20) = 2.87$, $P = 0.005$; $d = 0.72$] and a trend toward improved safety climate [$t(34) = 1.65$, $P = 0.054$; $d = 0.27$] following the intervention that focused on creating positive interactions with employees and increasing safety behaviors. The safety compliance and motivation measures did not change significantly.

Scripted Training: ''Get Healthier'' Cards

The pre-tests for the Get Healthier cards revealed between 56% and 86% correct answers (from three response options) or relatively good knowledge of basic information about healthy lifestyles (see Table 2). Nevertheless, the participants (supervisors and employees) did increase their knowledge significantly for all but two of the topics. Cohen effect size (*d*) for those knowledge increases ranged from 0.18 to 1.59, and for almost half of the topics the effect size was large (0.8 or above) per Cohen guidelines.[50]

TABLE 3. Demographic Information for Supervisors and Employees

Measure	Supervisors $N = 22$		Employees $N = 13$	
	Mean (SD) or % Reporting	Median	Mean (SD) or % Reporting	Median
Age	39.2 (8.0)	38.0	37.0 (11.1)	34.0
% female	9.1%		30.8%	
Racial category*				
White	90.9%		92.3%	
More than one race	4.5%		7.7%	
Other	4.5%		0.0%	
Education level†				
Some high school	4.5%		0.0%	
High school graduate (or GED)	9.1%		7.7%	
Some college/technical school	59.1%		53.8%	
College graduate	27.3%		38.5%	
Relationship status‡				
Married	77.3%		46.2%	
Divorced or separated	4.5%		15.4%	
Living with significant other	9.1%		15.4%	
Never married	9.1%		23.1%	
Children living at home				
No	13.6%		61.5%	
Yes	86.4%		38.5%	
Tenure in construction, years				
0–5	9.1%		46.2%	
6–10	13.6%		23.3%	
11–20	59.1%		7.4%	
21–30	9.1%		23.1%	
31+	9.1%		0.0%	
Hours worked per day	9.3 (1.2)	9.0	9.5 (1.9)	8.0
Hours worked per week	48.6 (7.7)	50.0	48.5 (10.1)	40.0

Excluded Categories due to zero responding include:
*Race: Black/African American, American Indian/Alaskan Native, Asian and Native Hawaiian/Pacific Islander.
†Education level: No high school, and.
‡Relationship status: Widowed.

Reactions to the ''Get Healthier'' cards were positive, with a median of 2.0 or ''good'' for the Cards across the weeks (Table 5). The team cohesion survey revealed a significant improvement from the beginning of the sessions until the end [$t(34) = 1.90$, $P = 0.033$; $d = 0.38$].

Research staff rated the participants as ''substantially engaged'' (median and mode = 5 on a 5-point scale) in the discussion during ''Get Healthier'' card sessions. Anecdotally, some participants who were already involved in a health regimen, such as a diet or exercise routine, reported that the ''Get Healthier'' cards were useful as reinforcement for those regimens. Research staff reported that at least one to two participants per ''Get Healthier'' group stated that they shared what they learned with their families (eg, ''I think it changed me for the better and my family too'').

TABLE 4. Number of Supervisors and Employees for Each Construction Company

Company	No. of Supervisors	No. of Employees	Total
A	7	0	7
B	10	0	10
C	3	4	7
D	2	9	11
Total	22	13	35

''Get Healthier'' Card Practice Take-Home Activity Sheets

The practice Take Home Activity (THA) sheets were completed by between 60% and 74% of participants (ie, supervisors and employees) each week. Most completed them to a degree staff rated their effort as ''high'' or ''adequate,'' though some invested a great

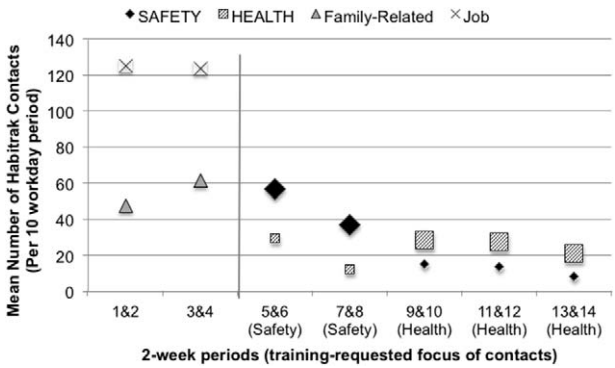

FIGURE 2. *Habitrak* counts by topic and focus of contacts. Vertical line indicates a break between job (x) and family (triangle) contacts to safety and health contacts to recording safety (diamond) and health (square) contacts, which was the requested emphasis of contacts in the computer-based training; enlarged markers during weeks 5–14 indicate the requested focus of contacts for each 2-week period.

TABLE 5. Weekly Health Topic Knowledge Question Scores (Pre- to Post-Test) Percent Correct

	Measurement Session					
	Pre-Test *M (SD)*	Post-Test *M (SD)*	*T* Statistic (df)	*P* *	Cohen *d*	Reaction (Median)†
Get healthier	69.5 (17.5)	88.6 (13.5)	−6.52 (20)	<0.001	1.22	2
Sleep	83.0 (16.3)	93.0 (11.7)	−2.70 (19)	0.007	0.71	2
Calories	67.3 (15.8)	78.2 (16.2)	−2.81 (21)	0.006	0.68	2
Liquids and calories	83.2 (14.9)	92.6 (10.1)	−3.92 (26)	<0.001	0.74	2
Basic nutrition	83.0 (13.3)	86.4 (11.4)	−1.69 (25)	0.052	0.27	2
Snacks	81.6 (16.7)	87.9 (11.1)	−1.74 (26)	0.047	0.44	2
Sugar	82.6 (15.8)	91.7 (09.3)	−3.51 (28)	0.001	0.71	2
Cardiovascular	55.8 (22.1)	73.3 (16.3)	−3.49 (23)	0.001	0.90	2
Strength training	72.6 (11.9)	89.9 (09.9)	−7.61 (23)	<0.001	1.59	2
Flexibility	72.7 (19.6)	85.5 (10.7)	−2.92 (21)	0.004	0.81	2
Stress	86.3 (13.0)	88.7 (13.5)	−1.13 (28)	0.134	0.18	2
Average	77.4 (06.3)	86.9 (06.2)	−10.82 (34)	<0.001	1.51	2

*One-tailed values were calculated by dividing two-tailed *P* values in half.
†Higher scores reflect more positive reactions such that 3 = Excellent, 2 = Good, 1 = OK or Neutral, 0 = Not very good or Poor.

deal of effort, while a few completed them in a perfunctory (''low'') manner (see Fig. 3).

Measures

Drawing on data from all participants, there was a significant reduction in sugary drink and sugary snack consumption (both with an effect size $d = 0.46$) reported in healthy lifestyle activities from pre- to post-''Get Healthier'' card sessions, as seen in Table 6. Social support for a healthy diet (encouragement) by family ($d = 0.53$) and others ($d = 0.57$) increased significantly as did sabotage by the family ($d = 0.28$) (Table 6); presumably, different people provided the support and the sabotage. Exercising 30 minutes/day ($d = 0.50$) and strengthening or toning muscles ($d = 0.59$) increased significantly; all but one of the other measures of exercise improved though not significantly. Coworkers offered support to ''make the environment healthier'' (median rating of 4.0 on a 5-point scale reflecting ''agree''), but a more modest response was seen for ''team members supported your healthy lifestyle'' (median rating of 2.0 reflecting ''somewhat'') in measures collected only postintervention. Sleep increased significantly from 7.0 to 7.6 hours per day ($d = 0.38$), but snoring frequency also increased significantly ($d = 0.54$). The other six measures of sleep did not change significantly (Table 6). Systolic blood pressure decreased significantly ($d = 0.27$); there were no other significant changes in biomarkers (Table 7). Positive changes were seen in vitality ($d = 0.42$), but social functioning decreased ($d = 0.31$), and there was a positive trend ($P = 0.051$) in better general health ($d = 0.21$) on the SF-12 (Table 8). On the contrary, there were two other significant changes in a negative direction (noncigarette tobacco use and minor injuries).

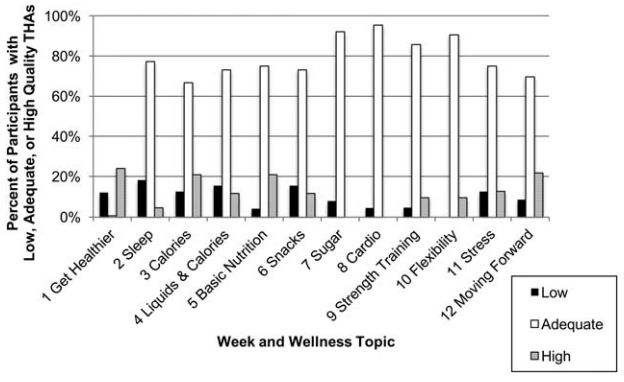

FIGURE 3. Quality of ''Get Healthier'' Take-Home Activity sheet completions, per week.

DISCUSSION

Overall Impacts

Results provide further encouraging evidence that a TWH approach with construction workers can simultaneously improve safety, health, and well-being measures in a single integrated intervention. The hypothesis under test was that the intervention would produce positive changes in Kirkpatrick's four levels of training evaluation[21]: (1) Reaction was positive to the supervisor training and the ''get healthier'' group education sessions; (2) posttest scores improved significantly in the supervisor training and all ''get healthier'' topics; (3) self-reported behaviors changed by the end of the project (eg, safety climate and team cohesion, and a trend toward more family-supportive supervisory behaviors, suggestive of improved supervisor behaviors; reduced sugary snacks and drinks, increased days per week with 30 minutes of exercise and strengthening and toning of muscles, and longer sleep reaching closer to recommended levels reflect changes related to four or five of the get healthier topics); and (4) diastolic blood pressure was lower. On the basis of changes in the direction recommended by the intervention, the hypothesis is confirmed. Of course, many measures did not change significantly in a positive direction, but very few changed in a negative direction.

Wilson et al,[51] in a meta-analysis of 150 publications, concluded that a moderate number of recommended or targeted changes (two to three) in healthy behaviors produce better outcomes than a larger number (four or more) or only one recommendation. The present intervention encouraged a much larger number of health and safety recommendations through education, reinforcement of good practices, and team-based activities, with good effect and thus does not support the conclusion by Wilson et al.[51] This is an important issue for population health and TWH in the workplace, each of which would benefit from broad changes in healthy lifestyles, as TWH is virtually defined by employing multiple change recommendations.[16] Of course, this group-based model of safety and healthy lifestyle education also fosters motivation from peers and colleagues and does so over a period of weeks in a way that may sustain the motivation and support.

TABLE 6. Sleep Behaviors; Daily Servings of Fruits, Vegetables, Snacks, Drinks; Monthly-Weekly Meals; Weekly Exercise, Social Support for Diet and Exercise (Pre- to 12 Week Post-Test)

	Measurement Session				
	Pre-Test *M (SD)*	12Wk-Test *M (SD)*	*T* Statistic (*df*)	*P* *	Cohen *d*
Sleep behaviors					
Sleep duration	7.0 (0.8)	7.6 (2.0)	−1.88 (34)	0.035	0.38
Feel rested	2.7 (0.9)	2.8 (0.9)	−0.17 (34)	0.433	0.04
Cannot sleep	2.1 (1.0)	2.1 (1.1)	−0.35 (34)	0.365	0.05
Wake up mid-night	3.0 (1.2)	3.0 (1.2)	0.21 (34)	0.419	0.02
Do you snore?	0.7 (0.6)	0.7 (0.7)	−0.30 (34)	0.384	0.04
Snoring loudness	1.7 (0.8)	1.5 (1.1)	1.10 (24)	0.142	0.22
Snoring frequency†	2.8 (1.3)	2.0 (1.7)	1.92 (24)	0.034	0.54
Tired during wake time	2.9 (1.3)	2.6 (1.3)	1.06 (34)	0.149	0.21
Dietary behaviors					
Fruits and veggies	5.2 (4.2)	5.6 (4.7)	−0.42 (34)	0.337	0.07
Sugary snacks	3.7 (1.5)	3.0 (1.5)	2.45 (34)	0.010	0.46
Sugary drinks	4.1 (2.1)	3.2 (1.8)	2.17 (34)	0.019	0.46
Fast food meals	2.2 (1.0)	2.0 (0.7)	1.29 (34)	0.103	0.20
Meals from home	4.8 (2.2)	4.6 (2.0)	0.47 (34)	0.322	0.08
Exercise					
Exercise activities per week‡	2.2 (1.4)	2.7 (1.2)	−1.43 (34)	0.081	0.32
How phys. active at work?§	1.4 (0.6)	1.3 (0.7)	0.70 (34)	0.244	−0.09
30 min/day (1–7 Agreement)‖	3.2 (1.8)	4.1 (1.7)	−2.77 (34)	0.005	0.50
Average exercise beliefs¶	6.2 (0.9)	6.3 (0.9)	−0.18 (34)	0.429	0.03
Soc. support for diet					
Fam. diet encouragement	7.0 (5.4)	10.1 (6.4)	−3.49 (34)	<0.001	0.53
Other diet encouragement	4.9 (5.0)	8.0 (5.8)	−4.21 (34)	<0.001	0.57
Family diet sabotage	9.8 (6.4)	11.7 (7.4)	−1.83 (34)	0.039	0.28
Other diet sabotage	8.6 (4.8)	9.7 (6.6)	−1.11 (34)	0.137	0.19
Soc. support for exercise					
Family exercise encouragement	13.9 (10.4)	14.7 (10.2)	−0.43 (34)	0.335	0.07
Other exercise encouragement	9.5 (8.9)	9.3 (9.1)	1.33 (34)	0.448	0.03
Family exercise sabotage	0.2 (0.7)	0.4 (0.9)	−0.88 (34)	0.192	0.21
Other exercise sabotage	0.1 (0.5)	0.1 (0.7)	0.00 (34)	0.500	0.00

Exer., Exercise and Phys., Physical(ly).
*One-tailed values were calculated by dividing two-tailed *P* values in half.
†Higher scores on the snoring frequency variable reflect less frequent snoring. Thus, the significant effect presented here reflects an *increase* in the mean frequency of snoring from pre- to post-test.
‡Average days of Hard, Moderate, Sweat Inducing, and Strengthening/Toning Exercise per week.
§Scale of 0 = Not Active, 1 = Somewhat Active, and 2 = Active.
‖"I exercise for 30 min almost every day" is on a scale from 1 = Strongly Disagree to 7 = Strongly Agree.
¶Exercise attitude items are on a scale from 1 = Strongly Disagree to 7 = Strongly Agree.

TABLE 7. Objective Biomarker and Grip Strength Measures (Pre- to 12-Week Post-Test)

	Measurement Session				
	Pre-Test M (SD)	12Wk-Test M (SD)	*T* Statistic (*df*)	*P* *	Cohen *d*
Body mass index	29.3 (4.3)	29.2 (4.7)	0.86 (33)	0.198	0.03
Fat percentage	27.8 (9.2)	28.2 (9.8)	−1.01 (33)	0.160	0.06
Heart rate Average	70.6 (12.7)	71.1 (13.8)	−0.33 (33)	0.371	0.04
Systolic blood pressure	128.4 (14.0)	124.9 (12.5)	2.04 (33)	0.025	0.27
Diastolic blood pressure	82.2 (10.5)	83.0 (10.8)	−0.56 (33)	0.289	0.08
Blood pressure medication†	0.0 (0.2)	0.1 (0.3)	−1.44 (33)	0.081	0.28
Left hand grip Strength (mean)	50.4 (13.9)	50.1 (14.7)	−0.69 (33)	0.249	0.04
Rt. hand grip Strength (mean)	52.6 (13.8)	52.9 (15.0)	−0.26 (33)	0.397	0.02

N = 34; 1 participant left out of analyses due to nonwork-related injury/hospitalization.
*One-tailed values were calculated by dividing two-tailed *P* values in half.
†Blood pressure medication was a dichotomous variable with 0 = "no" and 1 = "yes."

TABLE 8. SF12 - Health and Wellness (Pre- to 12Week Post-Tests)

	Measurement Session				
	Pre-Test M (SD)	12Wk-Test M (SD)	*T* Statistic (*df*)	*P* *	Cohen *d*
Physical functioning	54.8 (4.6)	54.5 (6.6)	0.37 (34)	0.356	0.04
Role physical	54.9 (4.2)	53.9 (5.1)	1.14 (34)	0.132	0.23
Bodily pain	54.2 (5.4)	55.1 (4.3)	−1.14 (34)	0.132	0.18
General health	44.1 (9.2)	46.0 (8.8)	−1.69 (34)	0.051	0.21
Vitality	49.8 (9.1)	53.2 (7.5)	−2.42 (34)	0.011	0.42
Social functioning†	54.8 (3.9)	53.4 (5.4)	1.71 (34)	0.048	0.31
Role emotional	53.2 (4.8)	53.2 (5.5)	0.00 (34)	0.500	0.00
Mental health	51.0 (7.6)	49.9 (9.4)	0.66 (34)	0.258	0.12
Overall physical health	52.7 (5.7)	53.4 (7.0)	−0.81 (34)	0.213	0.10
Overall mental health	51.1 (6.6)	51.1 (7.4)	0.11 (34)	0.496	0.00

*One-tailed values were calculated by dividing two-tailed *P* values in half.
†Significant effect was in the opposite and negative direction.

TWH intervention programs can address multiple needs such as those of the construction industry by providing a more holistic focus, and their reach often ensures a lengthy intervention. The length of time to build a self-sustaining lifestyle change is certainly an important issue for TWH and population health. This intervention required a time commitment of the supervisors of about 7 hours, and 5 minutes per employee (x the number of employees) per day for 12 weeks (5 hours per employee over the 12 weeks of the ''Get Healthier'' portion of the intervention). The burden on all employees was 6 hours (for supervisors this was added to their 7-hour burden noted above). Not included in the intervention was 6 hours for data collection over the 14 weeks. Company recruitment proved challenging, as only a few were willing to participate in the intervention and that may have been due to the time commitment. However, a lower dose might have been less effective and a greater dose (more time devoted to intervention training/education or self-monitoring) might have been more effective. The benefit can be great if the intervention prevents injuries, improves health, and reduces unhealthy lifestyle behaviors, the ambitious goal of TWH, and conversely the more restricted or targeted the goal, the less the potential benefit. These are key gaps in the thin TWH literature, and the durability of changes in safety, health, and well-being is also an open question in most of the TWH studies.[17,18] This study adds one additional TWH intervention to that literature.

Discussion of Specific Intervention Components

Computer-Based Training

Following the computer-based supervisor training, knowledge increased significantly from 78% to 98% (effect size $d = 2.92$), and the supervisors rated the computer-based training positively. This effect size is larger than all but one of the ''most engaging safety training interventions'' in the systematic review of training studies by Burke et al.[52] The training had some intended impacts, as it led to a significant increase in supervisor self-reported family-supportive behaviors toward employees ($d = 0.72$) and a trend in one measure of safety climate ($d = 0.27$). Employee self-reported family-supportive behaviors from supervisors did not change significantly ($P = 0.08$, $d = 0.385$). Using a similar supervisor training regimen and team effectiveness training (not used here), Hammer et al[53] reported significantly increased safety compliance and an improvement in systolic blood pressure after a similar supervisor training program that supported work-life balance.

Behavioral Self-Monitoring

Self-monitoring with the iPhone enterprise app *HabiTrak* was completed for the duration of the intervention, although the average number of counts and submissions for health and safety behavior declined as the weeks progressed. At least part of this can be attributed to declining use of the app and not necessarily a decrease in actual contacts with employees. Relative to other workplace applications of self-monitoring, supervisors in our program self-monitored for a relatively long period of time. Supervisors may have lost interest in the application or become fatigued in its use. Future research is needed to guide decisions about the ''dose'' of self-monitoring in workplace interventions. Evidence is currently insufficient to recommend the ideal frequency and duration of self-monitoring for maximum acceptability and effectiveness.[26] Participants rated *HabiTrak* between 3.0 and 4.0 out of 5 for ''liked'' and ''usefulness.'' Qualitatively, most participants agreed that *HabiTrak* helped to promote more awareness of their own behavior, a goal of the intervention. There was a consensus verbalized by participants that accumulating ''health'' counts was more challenging than ''safety'' counts. Research in occupational settings has shown that self-monitoring can be a reliable and valid method for changing behaviors.[54,55] Its use in occupational health and safety interventions has increased targeted behaviors in various occupations,[26] including home care workers in a TWH intervention.[56] It should be noted that the *Habitrak* behavior counts were self-reported and could have been biased. However, self-monitoring does not necessarily need to be accurate to produce behavior change.[57]

Scripted Training in Small Groups: Get Healthier Cards and Activities

The scripted lifestyle education proved successful, both in terms of popularity (ie, generating positive ratings of 2.0 on a 3-point scale, as well as laudatory qualitative comments by participants) and as an educational resource in that knowledge increased with small to large effect sizes ($d = 0.18$ to 1.59) per Cohen.[50] There were several significant self-reported impacts on behavior recommended by the Get Healthier scripted training, reductions in consuming sugary snacks ($d = 0.46$) and drinks ($d = 0.46$), increases in exercising 30 minutes per day ($d = 0.50$), strengthening and toning of muscles ($d = 0.59$), and sleep duration by 0.6 hours (36 minutes) of sleep/day, a substantial amount of sleep time. These are all positive changes recommended by the Get Healthier scripted training. There was also an improvement (reduction) in systolic blood pressure ($d = 0.27$). That some behaviors did change based on

validated self-report surveys suggests that this intervention may be enough to make a difference in one health biometric.

This small group scripted training format has been effective in improving overall wellbeing and diet (viz., dietary knowledge, fruit and vegetable consumption, and other healthy dietary behaviors) in firefighters[44] and it improved life satisfaction, negative affect (reduction), knowledge of safety and health topics, consumption of fruit and vegetables, as well as reduced high-density lipoprotein cholesterol in home care workers who used scripted training as well as self-monitoring and goal setting.[41]

Limitations

As a pilot study, a primary limitation is the single group pre-post (quasi-experimental) research design with a small sample size. As small sample sizes increase the probability of type II errors (incorrect retention of null hypothesis), the intervention outcomes should be viewed as estimates of effect sizes for future replications or for planning sample sizes in future efficacy trials. Because the sample consisted largely of supervisors, the results may not be generalizable to commercial construction crews that lack a strong supervisory presence. In addition, most of our outcomes were self-reported and are subject to potential bias. Lastly, the collection of the measures immediately following the intervention does not provide an evaluation of the impact of the intervention beyond its immediate effects at 14 weeks.

CONCLUSION

Safety, health, and well-being are inextricably linked,[7] leading to the value proposition for companies and their employees of adopting TWH programs, should they prove effective. This TWH intervention improved supervisors' knowledge about team building, work–life balance, and behavioral supervision skills, and that knowledge likely served as the foundation for observed changes in behavior. Behavioral self-monitoring supported transfer of knowledge into practice at the worksite, and also captured reports of the changes in frequency of contacts with employees. The scripted healthy lifestyle (Get Healthier cards) education improved knowledge, was highly rated, and provided additional social commitment and motivation for making changes. Overall, as a TWH intervention, the package of supervisor training, self-monitoring, and scripted healthy lifestyle education (led by the participants) and practice led to several significant positive changes, suggesting it is a feasible and promising approach.

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REFERENCES

1. International Labour Organization. Employment by Economic Activity and Occupation. 2015.
2. CPWR - The Center for Construction Research and Training. The Construction Chart Book: The U.S. Construction Industry and its Workers; 2013.
3. Bureau of Labor Statistics. Employer-Reported Workplace Injuries and Illnesses - 2014. U.S. Department of Labor; 2015.
4. Health and Safety Executive - UK. Health and Safety in Construction Sector in Great Britain, 2014/15. 2015.
5. Bodner T, Kraner M, Bradford B, Hammer L, Truxillo D. Safety, health, and well-being of municipal utility and construction workers. *J Occup Environ Med*. 2014;56:771–778.
6. World Health Organization. *WHO | Obesity and Overweight.* WHO: World Health Organization; 2016.
7. Young B, Swedlow A. *Obesity as a Medical Disease: Potential Implicaitons for Worker's Compensation.* Oakland, CA: California Workers' Compensation Institute; 2013.
8. Sacks R, Whyte J, Swissa D, Raviv G, Zhou W, Shapira A. Safety by design: dialogues between designers and builders using virtual reality. *Constr Manage Econ*. 2015;33:55–72.
9. Webster M. RR1082: The Effectiveness of HSE's Regulatory Approach: The Construction Example. 2017.
10. Olson R, Varga A, Cannon A, Jones J, Gilbert-Jones I, Zoller E. Toolbox talks to prevent construction fatalities: empirical development and evaluation. *Saf Sci*. 2016;86:122–131.
11. Occupational Safety and Health Administration. Commonly Used Statistics. United States Department of Labor; 2015. Available at: https://www.osha.gov/oshstats/commonstats.html. Accessed February 28, 2018.
12. Mullan B, Smith L, Sainsbury K, Allom V, Paterson H, Lopez A-L. Active behaviour change safety interventions in the construction industry: a systematic review. *Saf Sci*. 2015;79:139–148.
13. van der Molen HF, Lehtola MM, Lappalainen J, et al. Interventions to prevent injuries in construction workers. *Cochrane Database Syst Rev*. 2012;12:Cd006251.
14. Yu I, Yu W, Li Z, et al. Effectiveness of participatory training in preventing accidental occupational injuries: a randomized-controlled trial in China. *Scand J Work Environ Health*. 2017;43:226–233.
15. CDC - National Center for Chronic Disease Prevention. At A Glance 2016 Workplace Health Promotion: Using the Workplace to Improve the Nation's Health. 2017. Available at: aag-workplace-health.pdf. Accessed February 28, 2018.
16. CDC - National Institute for Occupational Safety and Health. CDC - NIOSH Total Worker Health. 2017.
17. Anger WK, Elliot DL, Bodner T, et al. Effectiveness of total worker health interventions. *J Occup Health Psychol*. 2015;20:226–247.
18. Feltner C, Peterson K, Palmieri Weber R, et al. The effectiveness of total worker health interventions: a systematic review for a national institutes of health pathways to prevention workshop. total worker health(R). *Ann Intern Med*. 2016;165:262–269.
19. Hammer LB, Truxillo DM, Bodner T, Rineer J, Pytlovany AC, Richman A. Effects of a workplace intervention targeting psychosocial risk factors on safety and health outcomes. *BioMed Res Int*. 2015;2015:836967.
20. Okechukwu CA, Krieger N, Sorensen G, Li Y, Barbeau EM. MassBuilt: effectiveness of an apprenticeship site-based smoking cessation intervention for unionized building trades workers. *Cancer Causes Control*. 2009;20:887–894.
21. Kirkpatrick JD, Kirkpatrick WK. Kirkpatrick's Four Levels of Training Evaluation: Association for Talent Development; 2016.
22. Austin J, Alvero AM, Fuchs MM, Patterson L, Anger WK. Pre-training to improve workshop performance in supervisor skills: an exploratory study of Latino agricultural workers. *J Agric Saf Health*. 2009;15:273–281.
23. Hammer LB, Kossek EE, Anger WK, Bodner T, Zimmerman KL. Clarifying work-family intervention processes: the roles of work-family conflict and family supportive supervisor behaviors. *J Appl Psychol*. 2011;96:134–150.
24. Kossek EE, Wipfli B, Thompson R, Brockwood K. The Work, Family, and Health Network organizational intervention: core elements and customization for diverse occupational health contexts. In: Leong FT, Eggerth DE, Chang CH, Flynn MA, Ford JK, Martinez RO, editors. *Occupational Health Disparities: Improving the Well-being of Ethnic and Racial Minority Workers*. Washington, DC: American Psychological Association; 2017. p. 181–215.
25. Hammer LB, Kossek EE, Zimmerman K, Daniels R. Clarifying the Construct of Family-Supportive Supervisory Behaviors (FSSB): A Multilevel Perspective. In: Perrewé PL, Ganster DC, editors. *Exploring the Work and Non-Work Interface (Research in Occupational Stress and Well-being, Volume 6)*. Emerald Group Publishing Limited; 2007. p. 165–204.
26. Olson R, Winchester J. Behavioral self-monitoring of safety and productivity in the workplace: a methodological primer and quantitative literature review. *J Organ Behav Manage*. 2008;28:9–75.
27. Griffin MA, Neal A. Perceptions of safety at work: a framework for linking safety climate to safety performance, knowledge, and motivation. *J Occup Health Psychol*. 2000;5:347–358.
28. Kuorinka I JB, Kilbom A, Vinterberg H, Biering-Sorenson F, Andersson G, Jorgensen K. Standardized Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon*. 1987;18:233–237.
29. Neal A, Griffin MA. A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. J Appl Psychol 2006; 91:946–953.
30. Dennerlein JT, Hopcia K, Sembajwe G, et al. Ergonomic practices within patient care units are associated with musculoskeletal pain and limitations. *Am J Ind Med*. 2012;55:107–116.

31. Zohar D, Luria G. A multilevel model of safety climate: cross-level relationships between organization and group-level climates. *J Appl Psychol*. 2005;90:616–628.
32. Cammann C, Fichman M, Jenkins GD, Klesh J. *Michigan Organizational Assessment Questionnaire. Assessing Organizational Change: A Guide to Methods, Measures, and Practices.* New York: Wiley-Interscience; 1983, 71–138.
33. Hammer LB, Ernst Kossek E, Bodner T, Crain T. Measurement development and validation of the Family Supportive Supervisor Behavior Short-Form (FSSB-SF). *J Occup Health Psychol*. 2013;18: 285–296.
34. Netemeyer RG, Boles JS, McMurrian R. Development and validation of work-family conflict and family-work conflict scales. *J Appl Psychol*. 1996;81:400–410.
35. Hammer LB, Kossek EE, Yragui N, Bodner T, Hanson G. Development and valifation of a multidimensional measure of family supportive supervisor behaviors (FSSB). *J Manage*. 2009;35:837–856.
36. Chin WW, Salisbury WD, Pearson AW, Stollak MJ. Perceived cohesion in small groups: adapting and testing the perceived cohesion scale in a small-group setting. *Small Group Res*. 1999;30:751–766.
37. Ware JEJ, Kosinkski M, Keller SD. A 12-item short-form health survey: construction of the scales and preliminary tests of reliability and validity. *Med Care*. 1996;34:220–233.
38. Sallis JF, Grossman RM, Pinski RB, Patterson TL, Nader PR. The development of scales to measure social support for diet and exercise behaviors. *Prev Med*. 1987;16:825–836.
39. Bohannon RW, Maljanian R, Goethe J. Screening for depression in clinical practice: reliability and validity of a five-item subset of the CES-Depression. *Percept Mot Skills*. 2003;97:855–861.
40. Diener E ER, Larson RJ, Griffin S. The satisfaction with life scale. *J Person Assess*. 1985;49:71–75.
41. Olson R, Wright RR, Elliot DL, et al. The COMPASS pilot study: a total worker Health intervention for home care workers. *J Occup Environ Med*. 2015;57:406–416.
42. Thompson FE, Subar AF, Smith AF, et al. Fruit and vegetable assessment: performance of 2 new short instruments and a food frequency questionnaire. *J Am Diet Assoc*. 2002;102:1764–1772.
43. Buxton OM, Quintilliani LM, Yang MH, et al. Association of sleep adequacy with more healthful food choices and positive workplace experiences among motor freight workers. *Am J Public Health*. 2009;99:S636–S643.
44. Elliot DL, Goldberg L, Kuehl KS, Moe EL, Breger RKR, Pickering MA. The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) firefighter study: outcomes of two models of behavior change. *J Occup Environ Med*. 2007;49:204–213.
45. Sorensen G, Stoddard AM, Stoffel S, et al. The role of the work context in multiple wellness outcomes for hospital patient care workers. *J Occup Environ Med*. 2011;53:899–910.
46. Buysse DJRC, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res*. 1989;28:193–213.
47. Netzer NCSR, Netzer CM, Clark K, Strohl KP. Using the Berlin Questionnaire to identify patients at risk for the sleep apnea. *Ann Intern Med*. 1999;131:485–491.
48. Buxton OM, Cain SW, O'Connor SP, et al. Adverse metabolic consequences in humans of prolonged sleep restriction combined with circadian disruption. *Sci Transl Med*. 2012;4:129ra143.
49. Rajaratnam SM, Barger LK, Lockley SW, et al. Sleep disorders, health and safety in police officers. *J Am Med Assoc*. 2011;306:2567–2578.
50. Cohen J. *Statistical Power Analysis for the Behavioral Sciences.* Hillsdale, NJ: Lawrence Earlbaum Associates; 1988, 20–26.
51. Wilson K, Senay I, Durantini M, et al. When it comes to lifestyle recommendations, more is sometimes less: a meta-analysis of theoretical assumptions underlying the effectiveness of interventions promoting multiple behavior domain change. *Psychol Bull*. 2015;141:474–509.
52. Burke M, Sarpy S, Smith-Crowe K, Chan-Serafin S, Salvador R, Islam G. Relative effectiveness of worker safety and health training methods. *Am J Public Health*. 2006;96:315–324.
53. Hammer LB, Johnson RC, Crain TL, et al. Intervention effects on safety compliance and citizenship behaviors: evidence from the work, family, and health study. *J Appl Psychol*. 2016;101:190–208.
54. Olson R, Wipfli B, Wright RR, Garrigues L, Nguyen T, Lopez de Castro B. Reliability and validity of the Home Care STAT (Safety Task Assessment Tool). *Appl Ergon*. 2014;45:1157–1166.
55. Nelson RO, Hayes SC. Theoretical explanations for reactivity in self-monitoring. *Behav Mod*. 1981;5:3–14.
56. Olson R, Thompson SV, Elliot DL, et al. Safety and health support for home care workers: the COMPASS randomized controlled trial. *Am J Public Health*. 2016;106:1823–1832.
57. Olson R, Austin J. Behavior-based safety and working alone: the effects of a self-monitoring package on the safe performance of bus operators. *J Organ Behav Manag*. 2001;21:5–43.

