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# A New Health Promotion Model for Lone Workers: Results of the Safety & Health Involvement For Truckers (SHIFT) Pilot Study

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***Objective:*** *This study was designed to evaluate the effectiveness of a new health promotion model for lone workers.* ***Methods:*** *A single group pre- or posttest design was used to evaluate intervention effectiveness for reducing body weight and increasing healthful and safe behaviors. Truck drivers (n = 29) from four companies participated in a 6-month intervention involving a weight loss and safe driving competition, computer-based training, and motivational interviewing.* ***Results:*** *Objectively measured body weight reduced by 7.8 lbs ($\Delta SD = 11.5$, $\Delta d = 0.68$, $P = 0.005$), and survey measures showed significant reductions in dietary fat and sugar consumption. An objective measure of safe driving also showed significant improvement, and increases in exercise motivational stage and walking fitness approached significance.* ***Conclusions:*** *Results suggest that the new intervention model is substantially more engaging and effective with truck drivers than previous education-based tactics.* (J Occup Environ Med. *2009;51:1233–1246*)

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Individuals who spend significant time alone or traveling for work have limited access to effective occupational health and safety programs. Such "lone workers" are employed across a variety of industries, and examples include professional drivers and pilots, home care workers, loggers, mobile service and repair technicians, traveling consultants and salespeople, and telecommuters. Occupations with high travel demands tend to limit workers' healthy food choices and opportunities for exercise. Lone workers also have diminished exposure to social and organizational factors that can promote healthy lifestyle behaviors, such as supportive supervision, organizational training, and peer social modeling, support, and reinforcement. Moreover, lone workers are employed in some of the most dangerous and demanding occupations, such as commercial truck driving. The plight of commercial truck drivers exemplifies the challenges of promoting health and safety with dispersed working populations. Previous education-based approaches for promoting weight loss and healthy lifestyle habits among truck drivers have been minimally effective. This project evaluated a new approach for promoting health with truck drivers that may generalize to other lone working populations. The evidence-based intervention components included group competition, computer-based training, and motivational interviewing (MI). Results suggest that the model is significantly more effective and socially engaging than previous education-based tactics.

## The Health and Safety Problem

The organization of truck driving work puts drivers at-risk for health and safety problems. Although new hours of service regulations instituted in 2004 reduced collision rates and driver injuries,[1] the regulations still allow long work hours. A long-haul driver may spend up to 11 hours of driving and 14 hours on-duty per day, and up to 70 total driving hours in an 8-day period.[2] Long driving hours limit opportunities for exercise, and truck stop food options encourage diets low in fruits and vegetables and high in saturated fat and calories. The isolated nature of the work means that drivers must perform most physical tasks without assistance or social reinforcement for following safety procedures, and productivity pressures such as pay-by-the-mile may encourage excessive driving speed and working when fatigued. Truck drivers have less than half the crash rate per mile traveled as passenger car drivers,[3] but high total hours of exposure to highway hazards places drivers at increased risk of dying on the job relative to most other occupations.[4]

The unique demands of truck driving currently result in elevated levels of occupational fatalities, injuries, and lifestyle-related illnesses. Truck drivers account for 15% of all workplace fatalities in the United States and consistently rank among the top three occupations in total nonfatal injuries and illnesses.[4,5] Heavy and light commercial truck drivers together account for 8% of all workplace musculoskeletal disorders.[6] Death certificates from the Owner Operator and Independent Driver Association suggest that drivers may be dying 10 to 12 years earlier than the average American (T. Weakly [Director of operations for the Owner Operator and Independent Driver Association Foundation], personal communication, January 2006). Although there is a need for improved surveillance data regarding the prevalence of driver health and safety problems,[7] existing evidence suggests that truck drivers may have overweight and obesity rates (body mass index $\geq$25 and $\geq$30, respectively) 16% to 17% higher than the general US population (73% vs 56% in 1993 and 82% vs 66% in 2003; see Refs. 8–10). In addition to being linked with heart disease (the number one killer of Americans), obesity is associated with increased prevalence of hypertension, dyslipidemia, type 2 diabetes, stroke, gallbladder disease, osteoarthritis, sleep apnea and respiratory problems, and several major cancers.[11] The association between physical inactivity, unhealthy body weight, and sleep disorders (see Refs. 12–14) is a special safety concern in trucking because obese drivers and those with sleep disorders have a 2-fold higher crash rate per mile than comparison drivers.[15] Diabetic drivers also have an increased crash risk (odds ratio = 1.68; Ref. 16).

The health crisis among truck drivers is a significant social burden. For drivers, health conditions such as diabetes can increase the frequency of required Department of Transportation physical examinations and jeopardize employment.[17] For employers, medical and drug-related health care costs per employee increase by $202.3 annually for every unit of body mass index >25.[18] For society, medical costs associated with overweight and obesity reached 78.5 billion in the United States in 1998 (99.5 billion in 2007 dollars), with half of the costs covered publicly by Medicaid and Medicare.[19] In the safety domain, the average cost of a large truck crash is more than $90,000 and more than $4000,000 if a fatality occurs (in 2007 dollars; Ref. 20). Eighty-three percent of fatalities in large truck crashes are passenger car drivers, pedestrians, or cyclists,[21] and the total annual cost of truck crashes to the US economy is $31.1 billion (in 2007 dollars; Ref. 20).

## Previous Weight Loss Interventions for Truck Drivers Have Been Minimally Effective

The health crisis among truck drivers is a multilevel and complex social problem that is influenced by parent social cultures, transportation infrastructures, organizational cultures, and the legal and traditional factors that determine the organization of truck driving work. Although the organization of truck driving work is a recognized threat to worker health and safety, worksite health promotion programs remain an essential component of a comprehensive response to this important social problem. Unfortunately, previous weight loss and lifestyle interventions for truck drivers have been minimally effective.[22,23] Holmes et al[22] implemented a nutrition intervention during 6 months that included health assessments with feedback, printed information (eg, exercise and fat grams charts), and regular provision of "healthy snack bags." Over-the-road drivers ($n$ = 15) received the intervention and were compared with a control group of short-haul drivers ($n$ = 15) from the same terminal. Intervention participants showed statistically significant within-group improvements ($P < 0.05$) on two of nine measures (weight loss, 3.98 pounds; total cholesterol, 24.54 points), but neither of these changes were significantly different from the control group. In a second study with a single treatment group, Roberts and York[23] evaluated the "Gettin' in Gear" intervention, which addressed the topics of (1) diet and weight; (2) family and relationships; (3) fatigue and stress; and (4) exercise. Drivers ($n$ = 128) from seven organizations participated, but only 54 completed the study (58% attrition). The intervention lasted for 6 months and included four packets of written and audio training materials, coaching letters, driver-initiated telephone health counseling, snack packs (with two subsamples), and gym memberships (with all but one organization).

Statistically significant ($P < 0.05$) improvements occurred on 2 of 10 physical assessments (aerobic fitness; strength fitness) and on two of four lifestyle surveys with unknown reliability and validity (diet and weight; exercise). Mean weight loss was not statistically significant. Drivers showed no significant gains in health knowledge, did not use free fitness memberships, and few if any used telephone counseling.

In summary, previous education-oriented interventions for truck drivers have relied on passive training without providing significant motivational support and have been limited in effectiveness. Although some improvements in driver health behaviors and fitness results were observed, the effects of these programs on weight loss were either small or not significant. High attrition and small or mixed effects will not encourage trucking companies to adopt occupational health promotion programs, despite evidence that such programs are sorely needed. It is therefore essential to develop and evaluate new approaches to promoting health among drivers.

## A New Evidence-Based Approach

To address the gap in the literature, we set out to design a new approach to worksite health promotion for truck drivers. We searched for evidence-based tactics that could be adapted for an isolated and dispersed working population with the overarching goal of creating a program that would generate significant social motivation for individuals to learn and change behaviors. Several proven intervention tactics were incorporated into our program. These included weight loss competition, computer-based training, behavioral self-monitoring (BSM), and MI. Before this project, none of these tactics had been adapted for or evaluated with truck drivers.

*Weight Loss Competitions.* Team weight loss competitions reliably produce two or three times the amount of weight loss observed in the Holmes et al[22] study of truck drivers (as mentioned above), produce very low levels of attrition and are especially effective with male workers. Although the Holmes et al nutrition education intervention produced a mean weight loss of about 4 lbs, team weight loss competitions commonly produce average weight loss ranging from 10 to 18 lbs (see Refs. 24–26). The social and financial incentives in team competitions also produce low study attrition, which is a powerful consideration given high voluntary turnover in trucking and excessive attrition (58%) observed in a previous study of truck drivers.[23] For example, attrition averaged only 2.6% (range, 0%–13%) across 10 different weight loss competitions reported Stunkard et al (study 2).[26] Team competitions are also especially effective with male workers (see Ref. 25), and 95% of truck drivers are men.[27] This enhanced effectiveness may be due in part to increased competitive and aggressive tendencies in men[28] and/or to higher historical male participation rates in competitive team sports.[29]

*Behavioral Computer-Based Training.* Behavioral computer-based training is twice as effective as passive training in booklets.[30,31] Passive training formats in a previous intervention for truck drivers produced no significant improvements in health knowledge.[23] A recent meta-analysis supports replacing passive educational booklets with more engaging training tactics. Burke et al[32] reviewed the effectiveness of training tactics that were, by their classification, more or less engaging. Passive methods such as lectures, booklets, and videos were classified as less engaging; computer-based training or programmed instruction were classified as moderately engaging; and behavioral modeling and role playing were considered most engaging. In the studies reviewed, engaging methods were nearly three times more effective than less engaging methods. Although truck drivers cannot easily participate in the most engaging face-to-face training formats, moderately engaging computer-based training is a next-best alternative.

*Behavioral Self-Monitoring (BSM).* BSM techniques, where individuals repeatedly observe, evaluate, and record aspects of their own behavior, are widely applied by physicians and psychologists to enhance motivation for change.[33–35] BSM is increasingly applied in workplace interventions to enhance worker productivity and safety.[33] Evidence suggests that BSM is particularly effective in combination with common intervention tactics such as goal setting, training, and feedback. For example, Olson and Winchester[33] reviewed 24 studies of workplace interventions that included self-monitoring and found that the standardized effect size for 66 intervention phases was large by Cohen's[36] standards (mean weighted $d = 2.2$; 95% CI = 1.7, 2.7; Cohen's standards are small $d = 0.20$, medium $d = 0.50$, and large $d = .80$), as was the mean effect size for interventions targeting driving and other safety behaviors ($d = 1.8$). Self-monitoring techniques can be easily administered at the individual level and are therefore well suited for involving isolated workers like truck drivers in health promotion programs.

*MI.* MI has emerged as an alternative and more effective approach to health coaching than traditional office-based counseling, which lacks proven effectiveness for promoting exercise and healthy eating.[37–39] Originally developed to reduce problem drinking and self-harming behaviors,[40,41] MI is described as "a client-centered, directive method for enhancing intrinsic motivation to change by exploring and resolving client ambivalence."[42] MI techniques have been operationally defined,[43] and examples of techniques include reflective listening, asking open-ended questions, and encouraging change talk. The guiding principles are to express empathy, develop discrepancy, avoid argumentation, roll with resistance, and support self-efficacy.[41,42] Burke et al[44] conducted a meta-analysis of 31 controlled clinical trials of MI treatments. Standardized differences between treatment and control group means ranged from $d = 0.25$ to $d = 0.56$, with effects on exercise and diet averaging $d = 0.53$ (95% CI = 0.32, 0.74). MI is a good fit for truck drivers because it can be delivered anywhere a worker can receive cell phone service.

### Enabling Technological Trends in the Trucking Industry

Between 1996 and 2003, laptop computer use among truck drivers grew from 4.7%[45] to 21%.[46] Fitting a linear trend to these data, it is estimated that 35% of truck drivers now regularly use laptop computers on the road. Wireless internet access is also booming, with affordable wireless cell phone cards for laptop computers, corporate wireless initiatives specifically targeting truck stops,[46] and projections that wireless hotspots would triple in the United States between 2005 and 2008.[47] With regard to measurement of driving behaviors, newly manufactured trucks are equipped with engine computers that generate objective measures of driving performance; however, only 36% of safety managers at the safest carriers in the United States use these data to deliver frequent performance feedback and consequences to drivers.[48] Examples of measures recorded by engine computers include percentage of time driving over a preset speed criterion (overspeed), average driving speed, severe decelerations (hard braking), idle time, and fuel efficiency.

### Summary of the Introduction

Truck drivers experience unacceptable levels of fatalities, injuries, and lifestyle-related health problems. Previous education-based health promotion interventions for truck drivers have been limited in effectiveness. Several proven intervention tactics are well suited for isolated workers but had not been adapted for or evaluated with truck drivers before this study. These gaps in the literature are a significant barrier to increasing the lifespan and quality of life of more than 3 million interstate truck drivers in the United States. This project addressed these research gaps by evaluating a new evidence-based intervention model, based on a weight loss and safe driving competition, with four regional trucking companies.

## Methods

### Participants and Setting

Four trucking carriers based in the Pacific Northwest region of the United States were recruited to participate. These carriers will be referred to as Companies A, B, C, and D throughout the manuscript. The companies ranged in size from small (single terminals supporting 40 to 100 total drivers), medium (a few terminals supporting 200 to 400 total drivers), to large (many terminals across the United States supporting 1500 to 3500 total drivers). Driver recruitment focused on a regional terminal within each company.

During initial recruitment through posters and company communications, a total of 60 drivers from the four companies expressed an interest in participating. Of those volunteers, 57 were successfully prescreened for cardiac risk and eligibility (body mass index [BMI] >26), and 50 drivers were classified as eligible. Because of limited funds for the pilot study, each company was limited to 10 total participants. Company D had an excess of eight volunteers who were put on a waitlist. Of the remaining 42 prescreened and eligible drivers, 33 completed the informed consent process (31 enrolled in the intervention and 2 waitlisted drivers consented and completed the preintervention assessment in hopes of ultimately being enrolled in the intervention). Two drivers enrolled in the intervention failed to complete the full assessment due to time constraints, which resulted in a final sample of 29 drivers who were successfully assessed and enrolled in the intervention. Participants had a mean age of 48.4 (SD = 10.1), a mean BMI of 38.9 (SD = 7.1), and were predominantly White ($n$ = 28) men ($n$ =23).

### Experimental Design

A single group pre- or posttest design was used to evaluate the effectiveness of the intervention, which was implemented during a 6-month period for each individual driver. Drivers met with researchers for a 2-hour health assessment at the beginning and end of the program, and carriers provided objective engine records of participants' driving behaviors. The study began in May of 2008 and concluded in January of 2009.

### Primary Outcome Measures

Primary outcome measures were changes in body weight and prevention behaviors in the domains of diet, exercise, and safety. Body weight was measured with a Detecto analog scale (350 lb capacity) and a digital Health-o-meter scale when higher capacity was required (500 lb capacity). Dietary behaviors were measured with validated surveys of daily consumption of fruit and vegetable servings[49] and dietary fat[50] and with a survey of high-saturated fat/high-sugar food consumption (from an unpublished survey used in the "Gear Up for Health" study[51]). Exercise behaviors were measured with the 7-day Physical Activity Recall (PAR) interview[52] and also with portions of an exercise motivational stage-of-change questionnaire (adapted from Refs. 53 and 54). Safety behaviors were measured with objective engine computer records of percent driving time overspeed (≥66 mph) and hard braking events (sudden decelerations ≥7 mph/s) and also with driver self-ratings of percent time speeding (relative to posted legal limits instead of the engine computer criterion), number of hard brakes (based on subjective judgment instead of the engine computer criterion), safety belt use, and percent compliance with hours of service regulations.

## Other Measures

The pre- and post-intervention health assessment included supplemental clinical, fitness, and psychosocial measures. Clinical measures included resting heart rate; blood pressure; neck, waist, and hip circumference; three-site skin fold measures of percent body fat (skinfold locations tailored to participant sex); and 8-hour fasting blood tests for lipids, triglycerides, and glucose. Fitness measures included strength (maximum pushups and timed curl-ups to a metronome beat[55]; grip strength measured with a Jamar hydraulic hand dynamometer); flexibility (YMCA version of the sit-and-reach test[55]); and the 6-minute walk test.[56] Psychosocial measures included an overall self-rating of health state from the EQ-5D[57]; self-efficacy (adapted from the exercise self-efficacy scale[58]) and motivational stage-of-change[53,54] for each behavioral domain (diet, exercise, safety); the trucker strain monitor[59]; and health and safety climate surveys focused on rating company and fleet manager priorities (health climate scale adapted from Ref. 60 and safety climate scale adapted from Ref. 61). In addition to behavioral and psychosocial measures, the assessment survey collected basic demographics and work/health history (injuries, crashes, and moving violations; illnesses and medications).

## Data Collection Methods

Health assessments were conducted in a 1992 Fleetwood Bounder Recreational Vehicle outfitted for field research, which was parked at the Jubitz Travel Center located in Portland, OR. Fasting blood samples were collected by a health clinic located at Jubitz and analyzed at a Clinical Laboratory Improvement Amendments certified laboratory. After the blood draw, drivers were provided with snacks and water or juice while they completed blood pressure, body measurements, fitness, and survey assessments. Four researchers (one woman, three men) were trained in administering body measurements and fitness tests before testing in the field by an employee from the University clinical research center and/or the first author and were evaluated for reliability. Three testers and the first author were trained before the onset of the study, and an additional tester (fourth author) was trained before post-intervention testing. Inter-rater reliability was estimated by computing an inter-class correlation (ICC) for each measure (each rater in training took turns serving as a subject and was evaluated by peer raters). The ICCs for body measures and fitness tests were all above 0.93 except for skinfold measures of abdomen (0.73), thigh (0.42), and chest (0.31). Therefore, before meeting with participants in the field, researchers completed additional skinfold testing trials with coaching on technique and immediate feedback about level of agreement until inter-rater scores were more consistent.)

At the end of assessment sessions, drivers received norm-referenced feedback about assessment results, set a participatory weight loss goal, were coached in completing computer-based training, and given a business card with critical study information (hotline phone number, study Web site address, and suggested deadlines for training units). Measures of percent time overspeed, hard braking, and moving violations were requested from each participating company about once per month during the study.

## The Intervention

After reviewing the research literature and designing the intervention model, the intervention Web site and computer-based training were developed with support from a 1-year training grant from the Northwest Center for Occupational Health and Safety (see Acknowledgments). Intervention development activities during this period included consulting with industry stakeholders (eg, trucking safety professionals, Oregon Trucking Associations, workers compensation insurance providers); consulting with an exercise physiologist to develop exercises tailored to the demands of truck driving; collaborating with a webmaster to develop the intervention Web site; collecting video-taped interviews and exercise demonstrations with drivers for use in the training; and designing, programming, and pilot testing four computer-based training units with drivers in the field.

After the Web site and training materials were completed, the intervention procedures for this study were planned. For practical application and easy recall, the intervention model was named Safety & Health Involvement for Truckers (SHIFT). SHIFT was described to participants as "a competition and training certification program designed to help drivers achieve and maintain a healthy body weight and work injury and crash free." The foundation of the intervention was a weight loss and safe driving competition with incentives for achievement. The competition was supported with computer-based training, BSM, MI, and a program Web site. To supplement existing participant and company computing resources, each team was provided with a stationary computer in the drivers' lounge and a roving laptop computer with unlimited wireless internet for use on the road. Training was also installed on drivers' personal laptop computers as desired.

*Weight Loss and Safe Driving Competition With Incentives.* Participants were grouped into natural teams based on the company they worked for. These four teams competed against each other during a 6-month period. Only a few participants within each company team knew each other before the study, and there was no formal chance for teammates to meet in person. Therefore, to encourage the development of socially interacting and dependent teams, the intervention protocol stipulated that each participant be given a list of their teammates' names and phone numbers.

The team competition was focused on the overall average percentage of weight loss goals achieved and engine computer and company records for percent time overspeed, hard braking, and moving violations. Participatory weight loss goals were set with individual drivers at the pre-intervention assessment and limited to the range of 10 to 50 lbs (to discourage unhealthy extreme weight loss rates). Participants were prompted by company communications, such as Qualcomm™ satellite text messaging to provide body weight updates using the study telephone hotline every 2 weeks. Researchers used self-reported body weights and company driving safety reports to send biweekly individual and social comparison feedback during the competition. This feedback was available on a password protected part of the Web site and sent in the regular mail and included an individual weight loss chart showing progress toward the personal goal; an individual safe driving feedback table showing individual, team, and study-wide scores; and a group competition feedback chart showing team progress in percentage of weight loss goals achieved and team safety rankings (see Fig. 1 to view the group competition feedback chart). Incentives included individual $200 cash prizes and embroidered jackets for the winning team members. All participants were eligible for $10 gift certificates for each training unit completed, $100 gift certificates for fitness gear for those who completed the entire program and earned "SHIFT Certification," and lottery-style incentives to encourage completion of both pre- and post-intervention health assessments (single drawings for $100 and $1000, respectively).

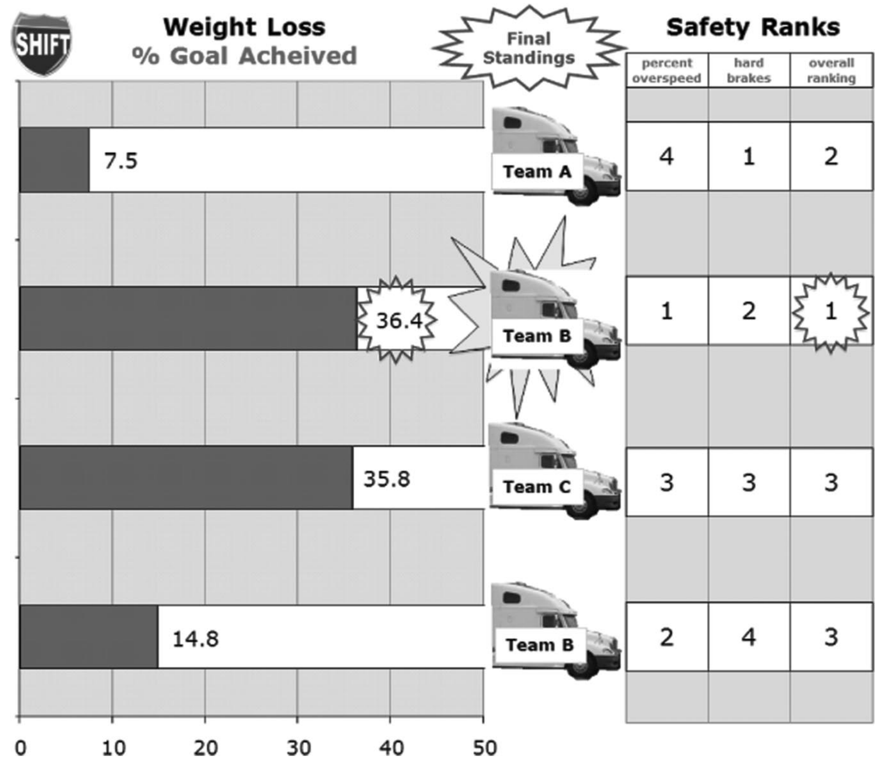


**Fig. 1.** The final biweekly group competition feedback chart.

*Computer-Based Training With BSM.* Computer-based training units covered the topics of (a) program overview, (b) exercise, (c) diet, and (d) safety. The four units were implemented in cTRAIN software (NwETA; Lake Oswego, OR), which is based on effective behavioral learning principles and validated with blue-collar populations.[62,63] Each unit also included numerous video-recorded interviews with drivers sharing personal health and safety experiences. The general topical structure of units was informed by the Transtheoretical Model of Behavior Change.[64] Each unit began with information tailored for learners in the contemplative and preparatory stages (hazards and risks, why change is important) and then proceeded with information tailored for learners in the action and maintenance stages (technical knowledge and self-management strategies). Technical content was adapted from current scientific and authoritative sources (eg, Centers for Disease Control, Harvard School of Public Health, Large Truck Crash Causation Study). Although the duration of each training unit was self-paced by participants, it is estimated that 3 to 4 hours were required to complete all four. The training included a substantial amount of content, with the four units including a total of 63 subtopics, which were sets of related content screens followed by 2 to 4 quiz screens ($M$ = 42.3 per unit); plus pre- and posttests for knowledge gains ($M$ = 84.6 total pre- or posttest questions per unit).

Transfer of training was supported with 1 week BSM assignments. For each training unit, drivers chose a target behavior to self-monitor from two options, such as steps per day or exercise minutes per day. These assignments, called "Habit-Tracking" in practice, involved counting behaviors each day and charting totals relative to an assigned goal. To receive credit for training and earn SHIFT Certification, drivers had to pass knowledge tests on the program Web site with 80% correct and mail completed Habit-Tracking assignments to the research team.

*MI.* Each driver was offered up to four MI sessions with a health coach employed by Health Future Health Management Services. Health coaches called drivers at appointment times and followed a safety protocol that required drivers to be parked in a safe location during the session. In the first session with each driver, the health coach reviewed the pre-intervention assessment results and explored personal priorities for what the individual wanted to get out of the program. These first sessions tended to last between 30 and 45 minutes, with subsequent follow-up sessions lasting for shorter periods of time.

*SHIFT Program Web Site*. The SHIFT program Web site (www.ohsushift.com) included an overall description of the program (Home page); daily behavioral goals in the areas of diet, exercise, and safety (Goals page); biweekly electronic postings of the status of the team competition and individual feedback (Competition page); knowledge tests for training certification (Training and Testing page); links to other health and safety websites (Links page); and a description of the scientific evidence for intervention components (SHIFT Science page). Access to Competition and Training/Testing Pages were password protected.

## Results

### Primary Outcomes: Changes in Body Weight and Prevention Behaviors

Seventy-five percent of the sample completed the post-intervention health assessment (22 of 29). Mean weight loss was statistically and clinically significant, with drivers losing an average of about one unit of body mass index ($\Delta M = -7.8$ lbs, $\Delta SD = 11.5$, $P = 0.005$, $\Delta d = 0.68$). This effect size for body weight is a medium to large effect by Cohen's standards (small $d = 0.20$, medium $d = 0.50$, large $d = 0.80$; Ref. 36). Ninety percent of participants lost weight, with 55% losing 5 or more lbs (max = 36 lbs). Participants who failed to complete post-intervention assessments had a self-reported average weight loss of 5.7 lbs based on last "phoned-in" updates, which suggests that attrition had a minimal impact on weight loss findings. Drivers from Company B won the weight loss and safe driving competition by achieving 36.4% of their original weight loss goals and having the best average group ranking for lowest percent time overspeed and lowest number of hard braking events per 10,000 miles driven ($M$ rank = 1.5; see Fig. 1 to view the final weight loss and safe driving feedback chart, including scores for other teams in competition outcomes). One company did not provide moving violations data, so this metric was not used in determining the competition winner.

Survey data suggested that weight loss was largely due to reduced consumption of high-saturated fat/high-sugar foods (percent calories from fat scale[50]; high-fat/high-sugar food scale is an unpublished measure from the "Gear up for Health" study[51]). Percent calories from fat reduced from 36.6 to 32.8 ($P = 0.01$, $d = 0.89$). The survey scale for high-saturated fat/high-sugar foods asked participants to select 1 of 10 food frequency intervals that best described their consumption over the past month. Based on group interval means, sugary drink frequency reduced from "5 or 6 times a week" to "1 or 2 times a week" ($P = 0.01$, $d = 0.50$); sugary snack frequency reduced from "1 or 2 times a week" to "1 to 3 times in the past 4 weeks" ($P = 0.03$, $d = 0.60$); and fast food frequency reduced from "1 or 2 times a week" to "1 to 3 times in the past four weeks" ($P = 0.03$, $d = 0.47$). The results of PAR interviews were used to estimate kilocalories per kilogram of body weight burned per week through moderate or more intense physical activity (Active kcals/kg/wk). The majority of participants reported that their physical activity for the week before one or more of their PAR interviews was atypical (more than normal or less than normal). Therefore, PAR data were analyzed with all interviews included but also for the subset of participants who reported that both their pre- and post-intervention interviews reflected "typical" levels of physical activity. The analysis of kcals burned among participants with "typical" weeks before interviews suggested that exercise levels remained relatively stable during the intervention. However, given the small $n$ for the typical PAR analysis, we also examined dimensions of the exercise stage-of-change data, which asked participants to report whether they currently (past 30 days) engaged in 30 minutes of moderate exercise on most days each week. According to these data, the intervention doubled the number of participants (from 6 to 12) who reported engaging in regular moderate exercise on most days each week (see Table 1 to view statistics for pre and post body measurements and prevention behaviors).

Each of the four companies provided driving data for participants during the intervention period, but the time intervals within reports were variable. To illustrate, for the intervention period, Company A provided a single cumulative report, Company B provided biweekly noncumulative reports, and Companies C and D provided one or two reports per driver in various formats. For the purposes of the competition, companies were rank ordered on overall group averages for driving measures, with Company B winning the competition with the best average rank (1.5 average; ranked 1 and 2 for overspeed and hard braking, respectively). However, we were interested in whether the competition produced improvements in driving safety relative to pre-intervention levels. To answer this question, we requested pre-intervention driving data from participating companies, and Companies C and D responded.

Because of the variance in the duration and number of driving data intervals available for each driver per phase, the repeated measures analysis of driving safety data from Companies C and D was limited to a comparison of pre-intervention and

**TABLE 1**
Statistics for Primary Outcomes: Body Measurements and Prevention Behaviors

| Variable | N | M (Pre) | M (Post) | ΔM | ΔSD | t | p | Δd |
|---|---|---|---|---|---|---|---|---|
| Body measurements | | | | | | | | |
| Body weight (lbs) | 22 | 271.25 | 263.46 | −7.79 | 11.53 | 3.17 | <0.01 | 0.68 |
| Body mass index | 22 | 38.85 | 37.89 | −0.96 | 1.49 | 3.01 | <0.01 | 0.64 |
| Waist-to-hip ratio | 22 | 0.94 | 0.92 | −0.02 | 0.05 | 2.83 | 0.08 | 0.46 |
| Waist circ (cm) | 22 | 118.55 | 115.14 | −3.41 | 5.65 | 2.83 | 0.01 | 0.60 |
| Neck circ (cm) | 22 | 47.09 | 41.71 | −5.38 | 21.39 | 1.18 | 0.25 | 0.25 |
| % Body fat | 22 | 35.46 | 36.26 | +0.80 | 4.34 | −0.87 | 0.40 | 0.18 |
| Dietary behaviors | | | | | | | | |
| Sugary snacks* | 22 | 2.55 | 1.32 | −1.23 | 2.51 | 2.30 | 0.03 | 0.49 |
| Sugary drinks* | 22 | 4.22 | 2.59 | −1.63 | 2.57 | 2.98 | <0.01 | 0.63 |
| Fast food* | 22 | 2.32 | 1.45 | −0.87 | 1.75 | 2.31 | 0.03 | 0.50 |
| % Calories from fat | 21 | 36.57 | 32.79 | −3.78 | 6.15 | 2.81 | 0.01 | 0.61 |
| Fruit and veg serv/d | 20 | 3.05 | 4.09 | +1.04 | 3.94 | −1.18 | 0.25 | 0.26 |
| Meals from home/wk† | 22 | 2.31 | 2.68 | +0.37 | 1.53 | −1.12 | 0.27 | 0.24 |
| Exercise behaviors | | | | | | | | |
| Active kcals/kg/wk (all)‡ | 19 | 23.32 | 15.42 | −7.89 | 18.38 | 1.87 | 0.08 | 0.43 |
| Active kcals/kg/wk (typ)‡ | 7 | 13.14 | 9.29 | −3.85 | 23.44 | 0.44 | 0.68 | 0.16 |
| Safety behaviors | | | | | | | | |
| Hard brakes/10,000 mi§ | 10 | 0.00 | −0.61 | −0.61 | 0.70 | 2.78 | 0.02 | 0.88 |
| % Time overspeed§ | 11 | 0.00 | −0.92 | −0.92 | 1.86 | 1.65 | 0.13 | 0.50 |
| Hard brakes/self‖ | 21 | 0.00 | −0.30 | −0.30 | 1.66 | 0.84 | 0.41 | 0.18 |
| % Time overspeed/self‖ | 19 | 0.00 | −0.17 | −0.17 | 0.81 | 0.91 | 0.38 | 0.02 |
| % Time safety belt use | 22 | 87.32 | 90.39 | +3.07 | 31.74 | −0.45 | 0.66 | 0.10 |
| % Compliance with HOS | 22 | 98.33 | 97.12 | −1.21 | 10.00 | 0.57 | 0.58 | 0.12 |

*Scale for food serving frequency: 0, never; 1, 1 to 3 times in the last 4 wk; 2, 1 or 2 times a week; 3, 3 or 4 times a week; 4, 5 or 6 times a week.

†Scale for home meal frequency: 0, never; 1, 1 or 2 per week; 2, 3 or 4 per week; 3, 5 or 6 per week.

‡A large number of participants reported atypical physical activity for the week before physical activity recall interviews. Therefore, results are reported for the entire sample (all) but also for the participants who reported having typical wk before both interviews (typ). Active kcals/kg/wk = kilocalories burned per kilogram of body weight per week in moderate, hard, or very hard physical activity.

§Objective engine computer records of safe driving behaviors analyzed as *z* scores for Companies C and D. % Time Overspeed = time driving ≥ 66 mph; Hard brake = sudden deceleration ≥ 7 mph/s.

‖Self-estimated daily time overspeed and hard braking frequencies analyzed as *z* scores. Self-estimated Overspeed, % time driving over posted speed limits. Self-estimated Hard Brakes, how often drivers "hit the brakes hard" each day.

Δindicates change; HOS, hours of service regulations.

intervention phase means for each participant, weighted by miles driven. Although base rates for overspeed and hard braking events were exceedingly low, participating companies requested that actual means for driving measures be kept confidential. Therefore, participants' mean scores were transformed into *z* scores using group pre-intervention means and the pooled group standard deviations for pre-intervention and intervention phases ([individual score − pre-intervention mean]/pooled SD). Using this approach, percent time overspeed reduced from a mean *z* score of 0.00 to −0.92 ($t[10] = 1.65$, $P = 0.13$, two-tailed; $\Delta SD = 1.86$, $\Delta d = 0.50$). A floor effect for overspeed was observed for some drivers because the majority of trucks involved in the study had speed governing systems, which means that drivers could only exceed ≥66 mph engine computer speeding threshold if they were coasting downhill. In addition, Company C implemented speed governing for some trucks near the onset of the study, which means the reduction in overspeed may have been partially due to the effects of a mechanical intervention. Hard braking data were not subject to the same interpretation problems and were entirely free to vary. Hard brakes per 10,000 miles driven reduced from a mean *z* score of 0.00 to −0.61 ($t[9] = 2.78$, $P = 0.02$, two-tailed; $\Delta SD = 0.70$, $\Delta d = 0.88$). Drivers' self-reported performance for similar driving and other safety behaviors can be viewed in Table 1.

## Clinical, Fitness, and Psychosocial Outcomes

Clinical and fitness data were measured directly by researchers. Waist circumference reduced ($P = 0.01$) and a reduction in waist-to-hip ratio approached significance ($P = 0.08$). Clinical measures (eg, blood pressure, fasting lipid levels) and strength measures (eg, pushups, curl-ups) were relatively stable (ns), but scores on a 6-minute walking test[19] approached significance (+28.6 m, $P = 0.06$). A significant decrease in flexibility was observed on the sit-

**TABLE 2**
Statistics for Secondary Outcomes: Clinical, Fitness, and Psychosocial Variables

| Variable | $N$ | $M$ (Pre) | $M$ (Post) | $\Delta M$ | $\Delta$SD | $t$ | $p$ | $\Delta d$ |
|---|---|---|---|---|---|---|---|---|
| Clinical | | | | | | | | |
| Blood Trig. (mg/dL) | 17 | 159.35 | 141.65 | −17.70 | 53.37 | 1.37 | 0.19 | 0.33 |
| Total cholesterol (mg/dL) | 17 | 196.00 | 196.76 | +0.76 | 23.82 | −0.13 | 0.90 | 0.03 |
| HDL cholesterol | 17 | 47.12 | 47.18 | +0.06 | 5.17 | −0.47 | 0.96 | 0.01 |
| LDL cholesterol | 17 | 116.89 | 121.30 | +4.41 | 19.32 | −0.94 | 0.36 | 0.23 |
| Blood glucose (mg/dL) | 17 | 95.81 | 110.44 | +14.63 | 31.89 | −1.84 | 0.09 | 0.46 |
| Systolic blood pressure | 22 | 131.82 | 129.64 | −2.18 | 9.26 | 1.11 | 0.28 | 0.24 |
| Diastolic blood pressure | 22 | 81.45 | 80.41 | −1.04 | 8.07 | 0.61 | 0.56 | 0.13 |
| Fitness | | | | | | | | |
| 6-min walk test (m) | 22 | 525.05 | 553.66 | +28.61 | 67.16 | −1.99 | 0.06 | 0.43 |
| Fatigue before walk test* | 22 | 1.75 | 0.73 | −1.02 | 2.16 | 2.22 | 0.04 | 0.47 |
| Fatigue after walk test* | 22 | 3.31 | 2.07 | −1.24 | 2.03 | 2.85 | 0.01 | 0.61 |
| Grip strength (lbs) | 22 | 102.20 | 97.57 | −4.63 | 12.10 | 1.80 | 0.09 | 0.38 |
| Pushups | 22 | 3.36 | 4.46 | +1.10 | 4.15 | −1.23 | 0.23 | 0.27 |
| Curl-ups (all)† | 22 | 14.23 | 8.95 | −5.27 | 18.64 | 1.33 | 0.19 | 0.28 |
| Curl-ups (valid)† | 17 | 6.41 | 8.23 | +1.82 | 7.46 | −1.01 | 0.33 | 0.24 |
| Sit and reach (in)‡ | 22 | 12.59 | 9.71 | −2.88 | 4.94 | 2.74 | 0.01 | 0.58 |
| Psychosocial | | | | | | | | |
| Overall health state | 21 | 62.05 | 67.10 | +5.05 | 14.38 | −1.61 | 0.12 | 0.35 |
| Exercise stage§ | 22 | 3.36 | 3.86 | +0.50 | 1.19 | 1.98 | 0.06 | 0.42 |
| Diet stage—fruit and veg§ | 20 | 2.91 | 2.91 | 0.00 | 1.02 | 0.00 | 1.0 | 0.00 |
| Diet Stage—fat§ | 21 | 3.48 | 3.57 | +0.09 | 0.99 | −0.44 | 0.67 | 0.09 |
| Safety stage§ | 21 | 3.48 | 3.81 | +0.33 | 1.68 | −0.91 | 0.38 | 0.20 |
| Exercise self-efficacy | 22 | 47.31 | 48.79 | +1.48 | 21.49 | −0.32 | 0.75 | 0.07 |
| Diet self-efficacy | 22 | 69.09 | 67.88 | −1.21 | 17.96 | 0.32 | 0.75 | 0.07 |
| Safety self-efficacy | 22 | 87.61 | 85.70 | −1.91 | 18.79 | 0.48 | 0.64 | 0.10 |
| Work strain-sleep | 21 | 12.29 | 12.33 | +0.04 | 2.78 | −0.08 | 0.94 | 0.01 |
| Work strain-fatigue | 21 | 17.27 | 16.82 | −0.45 | 2.78 | 0.77 | 0.45 | 0.16 |

*Fatigue was assessed with a Borg scale ranging from 1 (nothing at all) to 10 (very, very severe [maximal]).

†Timed curl-up test was administered with incorrect procedures at baseline for five participants (confirmed verbally by the tester); all, analysis for all participants; valid, analysis for correctly tested participants.

‡Sit-and-reach results may have been affected by temperature differences during testing periods (pretest, Summer; posttest, Winter) and by suspected variance in knee position allowed by a tester during pretesting.

§Scale for stage of change: 1, precontemplation; 2, contemplation; 3, preparation; 4, action; 5, maintenance.

Δindicates change.

and-reach test. Although it is possible that flexibility worsened during the study period, it is likely that lower posttest scores were partially due to temperature differences during testing. While pretesting occurred during the Summer, posttesting occurred during the Winter with only a small space heater to warm the RV. Overall health state, work-related strain, and self-efficacy in each domain remained stable (ns). As noted above in the discussion of exercise results, the number of individuals in the "action" and "maintenance" motivational stages for exercise doubled from 6 to 12 (see Table 2 to view statistics for pre- and postclinical, fitness, and psychosocial outcomes). All psychosocial scales showed acceptable reliability at the pre-intervention assessment with the exception of the trucker strain monitor, which produced 0.66 and 0.43 alphas for work-related fatigue and sleep strain, respectively. Alpha levels for self-efficacy scales at the same time period were 0.94, 0.95, and 0.83 for exercise, diet, and safety, respectively.

Organizational safety climate is generally defined as a measure of workers' shared perceptions about organizational safety values, procedures, practices, and reward structures.[65] In an analogous fashion, organizational health climate may be defined as workers' shared perceptions about organizational values, procedures, practices, and reward structures that support worker health and well being. Health and safety climate constructs are considered group-level phenomena and are therefore not presented in Table 2 with individual results. Although the sample was too small to conduct multilevel analyses of the effects of group-level climate on individual behaviors and study outcomes, a description of climate results is valuable because only few studies have evaluated safety climate within trucking samples (see Refs. 60 and 66), and no trucking studies have evaluated health climate. All climate survey subscales (adapted from Refs. 60 and 61) showed acceptable internal consistency (alpha range, 0.71 to 0.93), and within-group correlations[67] for each company exceeded the traditional arbitrary criterion ($r_{WG} \geq 0.70$) to justify group-

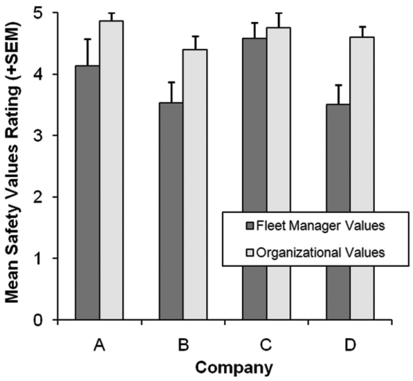


**Fig. 2.** Group mean ratings of fleet manager versus company safety values.

level aggregation (within-group correlations ranged from 0.89 to 0.98). The within-group consistency of climate ratings is notable because it suggests that lone workers, although they are isolated from peers, are able to develop shared perceptions about organizational priorities. Drivers provided separate ratings of safety climate for organizational and supervisory levels of analysis, which allowed for comparisons across levels (health climate was a one-level scale). Results showed that drivers rated fleet managers' (supervisors) safety values significantly lower than overall organizational safety values ($M = 3.8$ vs 4.6; $P < 0.01$), which suggests that timeliness pressures in the trucking industry may encourage fleet managers to favor production at the expense of driver health and safety (see Fig. 2). Although an individual-level analysis of climate data violates the conceptual nature of the construct, we computed exploratory individual level correlations between safety climate ratings and self-reported safety behaviors. Results supported the criterion-related validity of a climate construct with a trucking sample. For example, climate level was positively correlated with self-reported percent time wearing a safety belt ($r = 0.50$, $P = 0.006$).

### Participation and Process Outcomes

Participation in health coaching was excellent. The 29 drivers enrolled in the study completed an average of 3.9 sessions each out of 4 possible. Approximately 30% of the sample ($n = 9$) completed all training and Habit-Tracking assignments and earned "SHIFT Certification," which was associated with enhanced intervention effectiveness ("Certified" participants achieved twice the weight loss as "non-Certified" participants, $M = 12.9$ vs 5.9 lbs). To place this achievement in context, each "Certified" driver completed approximately 3 to 4 hours of computer-based training, 169 certification test questions with ≥80% correct, 3 weeks of Habit-Tracking, and 4 health coaching sessions during the intervention period. The entire sample ($n = 29$) passed a total of 55 knowledge tests with ≥80% correct (chance probability was 33% correct) and completed 35 Habit-Tracking assignments. These participation rates represent 47% total compliance with prescribed training (55 tests completed out of 116 expected from the whole sample) and 40% total compliance with prescribed Habit-Tracking (35 completed out of 87 expected from the whole sample). Pre- and posttraining test scores were available for all drivers who completed training on OHSU computers (14 total tests), and the resulting effect size for knowledge gains was $\Delta d = 2.69$ (increased from 65.5% to 91.9% correct). This effect size is large by Cohen's standards (small $d = 0.20$, medium $d = 0.50$, large $d = 0.80$; Ref. 36).

*Process Adjustments and Practical Challenges.* Overall, participants achieved only a moderate percentage of their original weight loss goals. To illustrate, the winning team achieved an average of just 36.4% of their original weight loss goals. Drivers tended to set ambitious goals at the pre-intervention assessment, and health coaches reported that some participants became discouraged about their body weight despite making major lifestyle changes. Therefore, 60 days before the end of the study, each participant who was "off pace" of their original weight loss goal was offered a chance to set a new and more realistic goal for the final 2-month period. The new goal was limited to 2 lbs maximum loss per week, and subsequent individual feedback charts showed drivers' progress toward the new adjusted goals. Group feedback remained based on drivers' original goals. Only 17 of the 22 finishing participants provided both a pre- and post-intervention fasting blood sample, which suggests that this requirement was difficult for truck drivers to complete. In addition, at the time the study was initiated the cTRAIN software had not been field tested with the Windows Vista operating system. Unexpected incompatibilities between cTRAIN and Vista resulted in delays and frustration for some drivers who had to wait for software fixes to finish their training. Some drivers with the least computing experience required extra computer coaching in person or on the phone, and were generally less successful at completing the training. During exit interviews, drivers expressed a desire for better and more frequent communication with their fellow teammates during the competition. Drivers also shared that company and supervisor support for their participation in the program faded over time.

*Attrition.* Attrition reasons were documented for the 7 of the 29 enrolled drivers (25%) who failed to complete posttesting and included family demands ($n = 1$); a route change and limited support from a fleet manager to alter the new route to return for posttesting ($n = 2$), voluntary job turnover ($n = 1$), and no reason provided ($n = 3$).

## Discussion

### Contributions and Strengths

This study represents the first adaptation and evaluation of several evidence-based health promotion tactics with a sample of truck drivers. The resulting intervention model was more effective than previous education-based tactics for producing weight loss ($\Delta d = 0.68$), improvements in prevention behaviors (five significant behavior changes; $\Delta d$ 0.49 to 0.88), and knowledge gains ($\Delta d = 2.69$). Participation in health coaching was exceptional, and a third of the sample met a demanding criterion to earn training certification (3 to 4 hours of training, 169 test certification questions with $\geq$80% correct, 3 weeks of Habit-Tracking, and 4 coaching sessions). The levels of participation and learning produced by the intervention are notable considering the absence of knowledge gains and failure of health coaching observed in a previous study with truck drivers.[23] The level of weight loss, which averaged approximately one unit of BMI, was both clinically and statistically significant. There are multiple health benefits for reducing BMI, and health economic research suggests that employers may save approximately $200 in annual health care costs per employee per unit of BMI lost.[18] The study also adds to previous evidence that providing drivers with regular social comparison feedback about driving behaviors improves performance (see Ref. 68). In sum, the results of this study strongly suggest that the combination of competition, computer-based training, BSM, and MI is a promising health promotion intervention model for truck drivers. The approach may also prove to be a valuable tactic for involving other populations of lone workers in health promotion programs.

The study included several methodological strengths that may be repeated in future health promotion efforts with truck drivers. The strategy of delivering the intervention on laptop computers and cell phones is a strength that should allow for future widespread dissemination of the program within the trucking industry. The study also included several measurement strengths, including objective measures of body weight and driving safety, the use of standardized fitness testing methods, and the predominant use of previously published and validated survey measures of psychosocial constructs and behavior change. The use of a convenient centralized testing location (ie, a popular regional truck stop) was probably important for successfully enrolling and retaining drivers from multiple companies.

## Limitations and Future Research

Limitations of this study suggest directions for future research. The experimental design did not include a control group, which limits our ability to rule out extraneous variables, other than the intervention, that could have impacted study outcomes. In future studies, a control group would increase confidence that effects observed were due to the intervention and also that effects observed were superior to those produced by usual treatment during the same time period. Because of the pilot nature of the study, the design lacked a follow-up testing phase, and the intervention did not provide support for long-term maintenance of weight loss. In the future, it will be important to provide follow-up and support for weight loss maintenance due to the prevalence of weight regain among participants in weight loss programs. Measurement reliability problems may have influenced results for few secondary study measures, including variance in reliability observed on the three-site skinfold test during prestudy training sessions, a confirmed protocol deviation for timed curl-ups, low observed alpha levels for the trucker strain monitor, and the potential effects of differences in temperature and participant knee position across testing periods on sit-and-reach test results (see Table 2 footnotes). The PAR was also limited in utility due to the high number of participants who reported atypical weeks of physical activity before interviews. In the future, alternate exercise measures or more frequent PAR interviews would be recommended to avoid this problem. Before and during this study, the authors experimented with Actical accelerometers (Respironics, Inc., Bend, OR) to gather more objective measures of physical activity among truck drivers. However, thus far, we have found no reliable method for removing the error variance generated by vehicle vibrations.

Several practical issues are relevant to future research and practice. Although the cost of health coaching per participant was similar to the predicted health care savings associated with an observed weight loss of about one BMI (coaching cost = $220; estimated savings = $200), the intervention included additional costs due to incentives and time involved maintaining the feedback process. To maximize return on investment in the future, research is needed to determine whether effects could be produced with fewer health coaching sessions, a more automated or less intensive feedback process, or alternative incentive strategies. For example, in some weight loss competitions, participants contribute personal cash to a pool for the grand prize winning team.[26] In addition, drivers with the lowest levels of computer literacy tended to complete fewer computer-based training units than those with greater computer experience levels. Future computer-based interventions with truck drivers may be enhanced in effectiveness by providing novice computer users with more intensive training in basic computing skills. We considered providing audio CDs to ensure that all drivers had relatively continuous access to training content; however, fewer drivers would have completed the more interactive and more effective computer-based training. Audio CDs are certainly convenient for occupational drivers, but a previous study that provided drivers with audio CD produced no gains in health knowledge.[23] Future research should investigate the pros and cons of providing training in both audio and computer-based training formats. On the basis of exit interviews with drivers, the intervention did not succeed at producing high levels of communication and social support among teammates in the competition. In other words, the intervention seemed to be experienced mostly on an individual basis, with only incidental social contact between teammates. The study protocol planned for drivers to be provided with a list of teammates' names and phone numbers at the outset, but drivers reported either losing this information or not remembering receiving it from researchers. The Web site included team message boards, but this feature was not used by participants. The low levels of communication within teams may have limited the power of the social competition, and larger effects may be observed in the future if methods are developed to encourage greater social support and communication among teammates. In exit interviews, drivers commented that support from management for their participation in the program waned over time. In addition, supervisors were rated as having lower safety values than their host organization across all four participating companies. These observations strongly suggest that supervisors be involved in the intervention process so that drivers experience sustained organizational and supervisory support for participation.

## Conclusion

Truck drivers experience unacceptable levels of fatalities, injuries, and lifestyle-related health problems. Previous approaches to health promotion among drivers have relied on traditional education-oriented formats, failed to provide significant motivational support, and subsequently produced small and mixed effects. Competition, computer-based training, BSM, and MI are alternative evidence-based tactics that are well suited for lone workers but had never been adapted and evaluated with truck drivers. Results of this study suggest that this multicomponent intervention model is more engaging and effective than previous efforts with truck drivers. The approach may also prove useful for engaging other populations of lone workers in health promotion programs.

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