

The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) Firefighter Study: Outcomes of Two Models of Behavior Change

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Objective: PHLAME's (Promoting Healthy Lifestyles: Alternative Models' Effects) objective was to assess and compare two means to promote healthy lifestyles. **Methods:** Prospective trial among 599 firefighters randomized by station to 1) team-centered curriculum, 2) one-on-one motivational interviewing (MI), and 3) controls. Assessment included dietary behavior, physical activity, weight, and general well-being at baseline and 12 months. Program effects were determined using an analysis of covariance (ANCOVA) based approach, and models for relationships were evaluated with path analysis. **Results:** Both interventions were acceptable and delivered with high fidelity. The team and MI programs increased fruit and vegetable consumption ($P < 0.01$ and 0.05 , respectively) and general well-being ($P < 0.01$). Significantly less weight gain occurred in both ($P < 0.05$). A cross-sectional model was consistent with mediation differing between interventions. **Conclusions:** Both a team-centered and individual-oriented intervention promoted healthy behaviors. The scripted team curriculum is innovative, exportable, and may enlist influences not accessed with individual formats. (J Occup Environ Med. 2007;49:204–213)

Daily physical activity and appropriate dietary habits have well-established health benefits.^{1,2} Yet, most Americans do not exercise regularly or eat diets rich in fruits and vegetables and low in saturated fats.³ The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) study was one of 15 projects funded by the National Institutes of Health as the Behavior Change Consortium (BCC)⁴ to assess new means to promote healthy eating habits (five or more servings of fruits and vegetables each day and less than 30% of calories from fat), regular physical activity, and appropriate body weights. The PHLAME study compared 1) a team-centered, peer-led scripted curriculum, 2) individual counseling using motivational interviewing techniques, and 3) a testing and results only control condition.

PHLAME's intervention paradigms have different theoretical rationales. The team format incorporates aspects of Social-Cognitive Theory,^{5,6} which describes reciprocal interactions among a person's behavior, cognition, and environmental influences, such as peer norms and vicarious observations. However, that framework does not completely capture a team's influence. A team differs from a typical group and has defining features, including peer bonds, mutual accountability, and shared responsibilities or rewards.^{7–9} Teams can be effective vehicles for changing members' attitudes and behaviors, as evidenced by sport team-based health promotion

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programs.^{10,11} Although businesses have recognized the ability of teams to increase productivity,⁷ this was one of the first large-scale trials of their efficacy for promoting healthy lifestyles.

PHLAME's individual-centered intervention used counselors skilled in motivational interviewing (MI) techniques.¹²⁻¹⁴ Unlike traditional advice, which has limited effectiveness^{15,16} and presupposes knowing a behavior's adverse effects will be accompanied by a desire to change, MI facilitates individuals' identifying their intrinsic motivation and means for change. Even MI's originators found it difficult to identify its theoretical underpinnings,¹⁷ and its closest alignment is with Rogers' phenomenological theory,¹⁸ which views internal motivation as the most potent and enduring.¹⁹ Developed and shown effective when used with addiction,²⁰ MI is being used to promote healthy behaviors,²¹ and 7 of the 15 BCC studies included assessing its utility in that domain.⁴

Our participants were professional firefighters, who have a work structure that is a natural setting for a team-centered program. Typically, three stable shifts, composed of four to ten firefighters, staff a station, with each shift working 24 hours followed by 48 hours off duty. Firefighters also are a high-risk group, with an increased prevalence of obesity, hypertension, dyslipidemia, certain malignancies, and chronic musculoskeletal complaints.²²⁻²⁵ Their cardiovascular risks, combined with episodic intense physical exertion involving extreme heat and life-threatening situations, account for heart attacks causing half of firefighters' on-the-job deaths,²⁶ compared to approximately 10% for other emergency medical services.²⁷ Although firefighters recognize the disparity between their occupational requirements and physical health,²⁸ previous lifestyle interventions largely have been unsuccessful.²⁹

We hypothesized that both a team-centered curriculum and individual

counseling would result in healthier lifestyles than the control condition and hoped that the team format would be as efficacious as state-of-the-art MI. We also assessed potential differences in the change process by examining purported mediators and cross-sectional models of behavior at baseline and follow-up.

Materials and Methods

Participants and Study Design

We asked the department chiefs and union representatives of five fire departments without wellness programs in close proximity to Oregon Health & Science University to participate. We calculated that these departments would provide greater than a 90% chance of detecting primary outcome intervention effects of more than one standard deviation, without covariant adjustment and assuming an intraclass correlation coefficient of less than 0.1. Following department approval, we disseminated study information through personal contact and an informational video and offered participation to all full-time, fit-for-duty professional firefighters. Involvement was voluntary, all information collected was confidential, and participants provided written informed consent. Data were collected in 2002 through 2004, with analyses in 2005. The Institutional Review Board of the Oregon Health & Science University first approved the study in August of 2000.

Fire stations and workgroups (such as those in the Fire Marshall's office) from the five departments were matched in triads based on participant number, mean age, and average station activity. All members of a specific station or workgroup were allocated to the same study condition, and an independent individual unfamiliar with the departments used a program for generating random numbers to assign units from station or workgroup triads to one of the three conditions. For the five departments, 696 individuals met in-

clusion criteria, and the allocation, follow-up, and assessment numbers are presented in Fig. 1. Work assignments generally were stable during the study year and only three MI and six control firefighters became ineligible due to transfer to a team station.

Measures

All participants received the same assessment prior to learning their group assignment at baseline and tests were repeated at one year. To standardize data collection, individuals were evaluated at approximately 8:00 AM and, after obtaining baseline informed consent, participants proceeded to questionnaire completion and physical testing.

Questionnaire. We assessed demographics; knowledge, behaviors, and beliefs concerning nutrition; exercise; body weight; and other potentially influential factors, including workgroup characteristics^{30,31} and overall health.³² Most questions were answered using an anchored seven-point Likert-type agreement scale (strongly agree to strongly disagree). Individual items were assembled into constructs, using our prior work³³ and exploratory and confirmatory factor analyses. Their components and reliability are shown in Table 1. Construct scores were the items summed and divided by their total number. Certain questions from existing surveys used a five-point scale (indicated in Table 1). When a construct contained a single five-point item, the responses were not standardized or centered. Therefore, extreme responses to items using the five-point scale would be weighted slightly less than those using the seven-point scale.

Dietary Instruments. Dietary habits were indexed using validated screening instruments for daily servings of fruits and vegetables³⁴ and percentage of total calories from fat.³⁵ The final instrument contained 116 items. Firefighters completed the surveys while receiving light refreshments during the hour between spec-

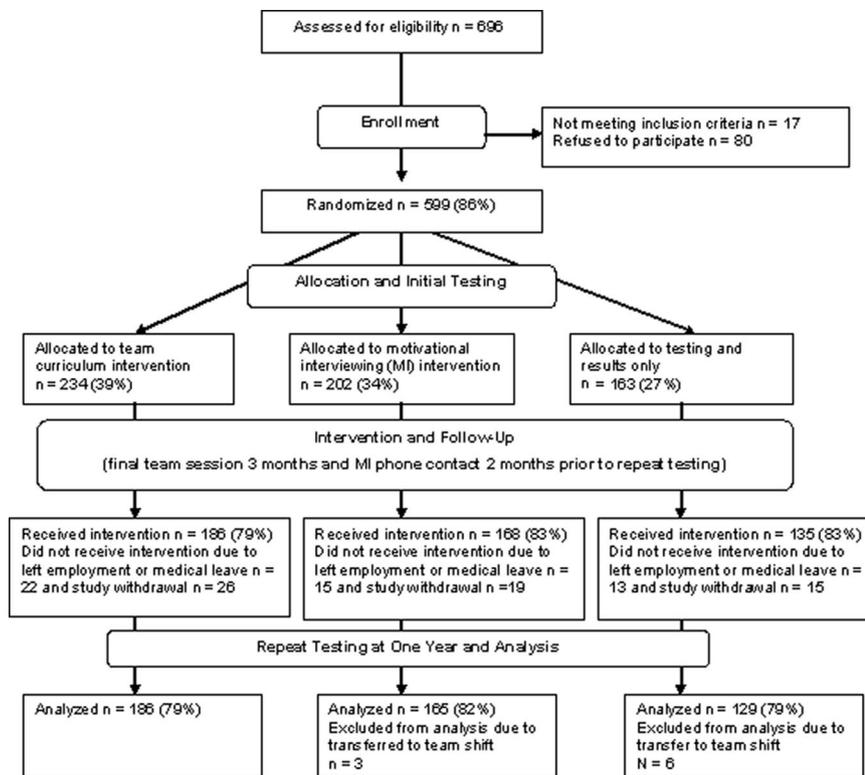


Fig. 1. Participant Enrollment and Outcomes.

imen collection and physical testing; completed surveys were reviewed by research staff to minimize missing items.

Physiological Measures. Research staff, different from those performing the MI counseling and implementing the team program, obtained fitness indices and anthropometric measures (height, weight, body composition, and body mass index). Oxygen uptake was measured during Bruce protocol treadmill exercise to maximal exertion using a SensorMedics 2900 (Viasys Healthcare, Yorba Linda, CA) or a MedGraphics TEEM 100 metabolic cart (Aerosport, Inc., Ann Arbor, MI), with the same instrument used for an individual's pretesting and testing at one year. Maximal exertion was defined as volitional exhaustion, a plateau in heart rate, or a respiratory exchange ratio greater than 1.10. Body composition was calculated from seven-site skin folds, assessed using Harpenden calipers on one side of the body, with values recorded to the nearest 0.1 mm.³⁶ Strength and flexibility measures

recommended by the International Association of Fire Fighters²⁸ also were obtained, including sit-ups/one minute and sit-and-reach.

Interventions

Team-Centered Curriculum. For this condition, each shift at a station or self-identified workgroup became a team, and by mutual consensus, one person became the designated team leader. That individual used a Team Leaders Manual with explicitly scripted lesson plans to facilitate the 11 45-minute team sessions, and the other team members used corresponding workbooks. Prior to the first session, team leaders received a 60-minute orientation to the curriculum's format and overall structure. They practiced leading a session and reviewed scheduling issues.

The team curriculum's 11 45-minute sessions were scheduled in clusters of three, two, three, and three weekly sessions, with the final session occurring approximately 3 months prior to follow-up testing. Between sessions the Manual and

workbooks were stored in a team box (Fig. 2). During weeks without scheduled sessions, longitudinal bridging activities, such as a team member tracking grid, promoted ongoing disclosure of outcome behaviors and reinforced PHLAME's lifestyle objectives. Although three shifts are based at a station, they function independently. It was the anticipated presence of visible bridging activities that led to the randomization by station strategy.

Each 45-minute session was composed of three to six activities. The core content involved nutrition, physical activity, and energy balance. Pilot testing revealed that team participants appreciated the scripted format's ease but wanted some control of specific activities. Approximately 25% of content were scripted electives selected by the team from a menu of additional core topics, such as stress, sleep, dietary supplements, and plyometric training. Activities were designed to be interactive, enjoyable, and consistent with principles of adult education, emphasizing relevance, active learning, and application of new abilities.³⁷ Friendly competition and positive peer pressure were encouraged both among team members and across teams.

During the initial team session, each firefighter received his or her physical, laboratory, and dietary findings from their baseline assessment. These were entered in their workbooks, and participants self-assessed their results and formulated personal goals. The team discussed those goals and means to collaborate on reaching or maintaining their objectives. In subsequent meetings, team members periodically reviewed progress toward their initial goals.

Individual-Centered Motivational Interviewing. PHLAME's second intervention targeted the individual, using a more traditional client and provider format and techniques of MI. Firefighters were randomly assigned to meet with one of six counselors, who were skilled in MI.

TABLE 1
Constructs and Their Survey Item Components*

Outcomes and Potential Mediating Constructs and Their Questionnaire Items	Alpha Reliability (baseline/one-year)
Positive physical activity social support	0.89/0.91
Q1 Coworkers exercise with me regularly	
Q2 Coworkers encourage me to exercise	
Q3 Coworkers offer to exercise with me	
Q4 My coworkers exercise with me	
Physical activity beliefs and understanding	0.91/0.94
Q1 If I get regular exercise, I will feel less depressed	
Q2 If I get regular exercise, I will have improved health	
Q3 If I get regular exercise, I will reduce my risk of illness	
Q4 If I get regular exercise, I will have an increased energy level	
Q5 If I get regular exercise, I will feel less stress	
Q6 Exercising regularly can lower blood pressure	
Q7 Exercising regularly can reduce risk of cardiovascular disease	
Healthy physical activity behavior	0.92/0.93
Q1 I exercise for 30 min most days	
Q2 Days per week of hard physical activities	
Q3 Days per week to strengthen your muscles	
Q4 Days per week of moderate physical activity	
Q5 Days per week that you work up a sweat	
Q6 Days per week that get at least 30 min of exercise	
Q7 Description overall level of physical activity	
Q8 Intentions to exercise regularly (1 through 5)	
Positive dietary social support	0.74/0.72
Q1 Coworkers eat a low fat diet	
Q2 Coworkers eat more than 5 servings of fruits and vegetables each day	
Q3 Estimate of firefighters in my department eating more than 5 servings of fruits and vegetables each day	
Q4 Estimate of firefighters in my department eating a low fat diet	
Dietary understanding	0.91/0.94
Q1 Eating 5 or more servings of fruits and vegetables each day lowers risk of arthritis	
Q2 Eating 5 or more servings of fruits and vegetables each day lowers risk of cardiovascular disease	
Q3 Eating 5 or more servings of fruits and vegetables each day lowers risk for diabetes	
Q4 Eating 5 or more servings of fruits and vegetables each day lowers risk for high blood pressure	
Q5 Eating 5 or more servings of fruits and vegetables each day lowers risk for high cholesterol	
Q6 Eating 5 or more servings of fruits and vegetables each day lowers risk for cancer	
Q7 Eating a low fat diet can lower risk for cardiovascular disease	
Q8 Eating a low fat diet can lower risk for diabetes	
Q9 Eating a low fat diet can lower risk for high blood pressure	
Q10 Eating a low fat diet can lower risk for high cholesterol	
Healthy dietary behaviors	0.81/0.81
Q1 Overall rating diet	
Q2 Generally select healthy food items when eating at restaurants	
Q3 When I cook, I prepare meals that are healthy	
Q4 Intentions to eat low fat (5 point)	
Q5 In the last year, I have tried to eat more fruits and vegetables	
Q6 In the past year, I have tried to eat less fat	
Q7 Do you consistently avoid eating high fat foods (5 point)	
Overall well-being	0.80/0.81
Q1 How would you say your health is (5 point scale)	
Q2 I am as healthy as anybody I know (5 point scale)	
Q3 My health is excellent (5 point scale)	

*Unless otherwise specified, the survey items were answered using an anchored 7-point agreement scale, from 1 = strongly agree to 7 = strongly disagree. Construct scores were items summed and divided by their number.

Counselors traveled to the stations and worksites and met privately with their assigned firefighter while he or she was on duty.

During their first meeting, a firefighter and counselor discussed the

study goals, and a values card-sort activity³⁸ was used to identify the priorities that influenced the firefighter's behaviors. During the next meetings, they reviewed the individual's baseline results, and the

firefighter identified potential health behavior changes. In the fourth meeting, follow-up was negotiated, with the possibility of up to five hours of additional in person or phone contact. At a minimum, MI participants were con-

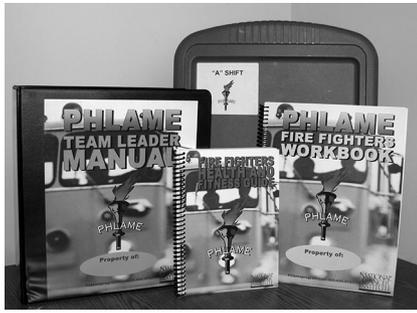


Fig. 2. Team curriculum materials. The team leader manual, team members' workbooks, and associated materials were delivered to a team in the Team Box, where they were stored between sessions.

tacted by phone and offered additional meetings at 6 and 10 months.

The six MI interventionists had varied ages and backgrounds. Although experienced counselors, only two had significant experience with MI, and each completed approximately 90 hours of MI training, including seminars, educational videotapes, personal coaching from an expert trainer, and practice with standardized patients. The Motivational Interviewing Skill Code (MISC) classifies a counselor's verbal utterances into one of 23 mutually exclusive categories and the results are used to calculate indices of MI performance (eg, the ratio of reflections to questions and percent complex reflections [paraphrases plus summaries]).³⁹ An independent skilled MISC coder scored each counselor's practice tapes to establish proficiency. During the study, the counselors met periodically to provide mutual support, debrief challenging interactions, and review MI skills.

Participants in both interventions received a *Firefighters' Health & Fitness Guide*, which was a 160-page booklet developed by the investigators. As neither counselors nor team members were content experts, the booklet was a resource for participants. It contained information about nutrition, physical activity, and selected common health conditions impacted by lifestyle, such as heart disease, hypertension, dyslipidemia, diabetes, and musculoskeletal inju-

ries. The guide also had recommendations and illustrations for physical activities to increase flexibility, endurance, and strength.

Control. Firefighters from control stations and workgroups received only their test results, accompanied by brief explanations and a listing of normal values. Control participants were informed that they were free to use their test results and own initiative to alter their lifestyles.

Fidelity and Adherence

For the MI interactions, counselors audiotaped their meetings and 10% were selected randomly for MISC coding to monitor MI performance. The individual who performed tape coding to establish proficiency also coded these subsequent tapes. There were no significant differences among counselors after training and intra-individually over time. They averaged a reflections-to-questions ratio of 2.2 and 74% of reflections were complex (criteria for competency are a ratio greater than 1 and more than 40% complex reflections).

Adherence to the team-centered, peer-led curriculum was assessed by observing randomly selected teams and session numbers and using the team leaders' scripted lesson plans as behavioral checklists. Work logs were reviewed to track firefighters' station assignment and identify control and MI firefighters who became ineligible due to movement to a team station. The follow-up team survey queried those participants about number of team sessions attended.

Statistical Analyses

Standard descriptive statistics were used to examine baseline characteristics. χ^2 analyses and analysis of variance were applied to assess differences among those not enrolled and drop outs for the three conditions. Program effects were assessed using an ANCOVA-based approach within the Generalized Estimating Equations random effects model framework, which extends General-

ized Linear Models to deal with time dependence and data's hierarchical structure.^{40,41}

A proposed model for relationships among general well-being, diet, and physical activity was evaluated using a path analytic approach with MPLUS, version 2.13 software (Muthén & Muthén, Los Angeles, CA).^{42,43} Group membership was dummy coded into two dichotomous variables indicating either the team-centered curriculum or MI condition; subjects coded zero on both were implicitly in the control condition. Thus, path coefficients are referenced to an implied value of zero for control subjects.

Results

Descriptors for participants are shown in Table 2. The sample included 579 men (97%) and 20 women, with a mean age of 41 years (range of 20–60 years old). A majority were white (91%), married (79%), and reported annual household incomes of \$50,000 or greater (79%). Although the MI condition was slightly older ($P < 0.01$) and had more runs per shift ($P < 0.001$), at baseline no clinically meaningful demographic differences were present. Attrition was not different among conditions nor did it have interaction effects on outcomes, and analyses were performed on those present at one-year follow-up.

Both interventions were feasible, delivered with high fidelity, and acceptable to firefighters, as evidenced by the comparable retention rates in the three conditions. We observed 30.3% of the team sessions. The average session length was 46.3 ± 14.1 (mean \pm SD) minutes, during which $76.4 \pm 18.5\%$ of scripted activities occurred. By self-report, 73% of team participants indicated that they attended 7 or more of the 11 team sessions, and 34% reported attending all the team sessions. For the individual MI meetings, firefighters averaged a total of 4.4 ± 1.5 interactions, with duration of 42 ± 22 minutes per meeting. Following

TABLE 2
Firefighter Characteristics at Study Entry (mean ± SD)

	Team Curriculum	Individual Motivational Interviewing	Testing Only Control	Total
Age (yr)*	39 ± 9	42 ± 9	41 ± 9	41 ± 9
Years as firefighter	15 ± 9	17 ± 8	16 ± 9	16 ± 9
Runs per shift**	3.5 ± 1.1	4.0 ± 1.6	3.4 ± 1.2	3.7 ± 1.3
Male	96%	97%	98%	97%
White	92%	88%	92%	91%
Married	79%	79%	79%	79%

Average runs/shift recorded ranges: 1 = 0 (not station-based); 2 = 1-2; 3 = 3-5; 4 = 6-8; 5 = 9-12, 6 > 12.

*P < 0.01.

**P < 0.0001.

the initial four in-person meetings, follow-up contacts were approximately equally divided between in-person and phone contacts. Use of the *Fire Fighter Guide* was assessed with a follow-up survey item, which asked how much the participant read the guide using an anchored scale from 0 = none to 6 = all. The MI and team groups did not differ significantly, with averages (mean ± SD) of 3.0 ± 2.0 and 3.3 ± 1.7, respectively.

Program Effects

Consistent with recommendations at the time, firefighters were advised that the goal fruit and vegetable

intake was a minimum of five servings per day, with additional benefits for greater consumption. Despite relatively high baseline levels, both intervention groups significantly increased their fruit and vegetable intake (P < 0.01 team and P < 0.05 MI). Significant effects were seen for body mass index, with less weight gain among the two intervention groups (P < 0.05 for each). Both interventions also resulted in significant increases in sit-ups in one minute (P < 0.05 for each), and neither impacted significantly on measured peak oxygen uptake (Table 3).

Paralleling the fruit and vegetable intake findings, healthy dietary be-

havior also significantly increased in both intervention groups (P < 0.005 for each). Only team firefighters significantly increased dietary understanding (P < 0.005) and reported greater dietary social support (P < 0.001). Physical activity beliefs and understanding was high at baseline and did not change. In addition, the index of general well-being significantly improved in both intervention groups (P < 0.01 for each), compared to the control condition.

Cross-Sectional Models

Figure 3 presents the components and path coefficients for a baseline cross-sectional model, which combines dietary and physical activity outcomes in a single overall well-being variable, which is relationship consistent with newer instruments for employee well-being.⁴⁴ Figure 4 is the one-year cross-sectional model with intervention groups added. Baseline paths had similar loading coefficients at one year, suggesting robust underlying relationships. The explained variance in general well-being was substantial at both time points (R² 0.20 at baseline and 0.24 at one year). The overall model fit indices for baseline and one-year models are shown in Table 4.

TABLE 3
Results at Baseline One Year (mean [SEM])

	Team Curriculum		Individual Counseling		Control	
	Baseline	One Year	Baseline	One Year	Baseline	One Year
Daily servings fruits vegetables	5.8 (0.2)	7.4 (0.3)**	5.5 (0.3)	6.2 (0.3)*	5.7 (0.3)	5.8 (0.3)
Percent calories from fat	34.1 (0.5)	31.9 (0.4)	34.9 (0.4)	32.5 (0.4)	35.6 (0.5)	35.6 (0.4)
Healthy dietary behavior	4.14 (0.07)	4.55 (0.07)†	3.96 (0.06)	4.43 (0.08)†	3.99 (0.09)	4.12 (0.09)
Dietary understanding	5.53 (0.07)	5.84 (0.07)†	5.56 (0.07)	5.63 (0.08)	5.57 (0.09)	5.55 (0.09)
Positive dietary social support	3.24 (0.06)	3.60 (0.06)‡	3.41 (0.06)	3.15 (0.06)	3.22 (0.08)	2.68 (0.07)
Peak oxygen uptake (ml/kg/min)	39.6 (0.1)	41.3 (0.1)	39.5 (0.1)	40.9 (0.6)	38.3 (0.6)	39.1 (0.1)
Sit-ups in 1 min	36.3 (0.6)	38.4 (0.6)*	34.5 (0.5)	37.4 (0.8)*	35.1 (0.6)	36.0 (0.8)
Healthy physical activity behavior	3.38 (1.44)	3.61 (1.37)	3.07 (1.40)	3.32 (1.02)	3.19 (1.40)	3.28 (1.45)
Physical activity beliefs and understanding	6.19 (0.06)	6.25 (0.07)	6.00 (0.07)	6.06 (0.06)	6.10 (0.07)	6.08 (0.07)
Positive physical activity social support	3.43 (0.07)	3.48 (0.07)*	3.41 (0.08)	3.48 (0.08)	3.11 (0.08)	3.15 (0.07)
Body weight (lbs.)	195.7 (2.2)	196.6 (2.2)*	192.7 (2.1)	193.9 (2.1)*	196.6 (2.6)	200.0 (2.8)
Body mass index	27.4 (0.3)	27.5 (0.3)*	27.1 (0.3)	27.3 (0.3)*	27.9 (0.3)	28.4 (0.4)
Overall well-being	3.59 (0.06)	3.70 (0.06)*	3.65 (0.06)	3.73 (0.05)*	3.57 (0.06)	3.51 (0.08)

*P < 0.05.

**P < 0.01.

†P < 0.005.

‡P < 0.001.

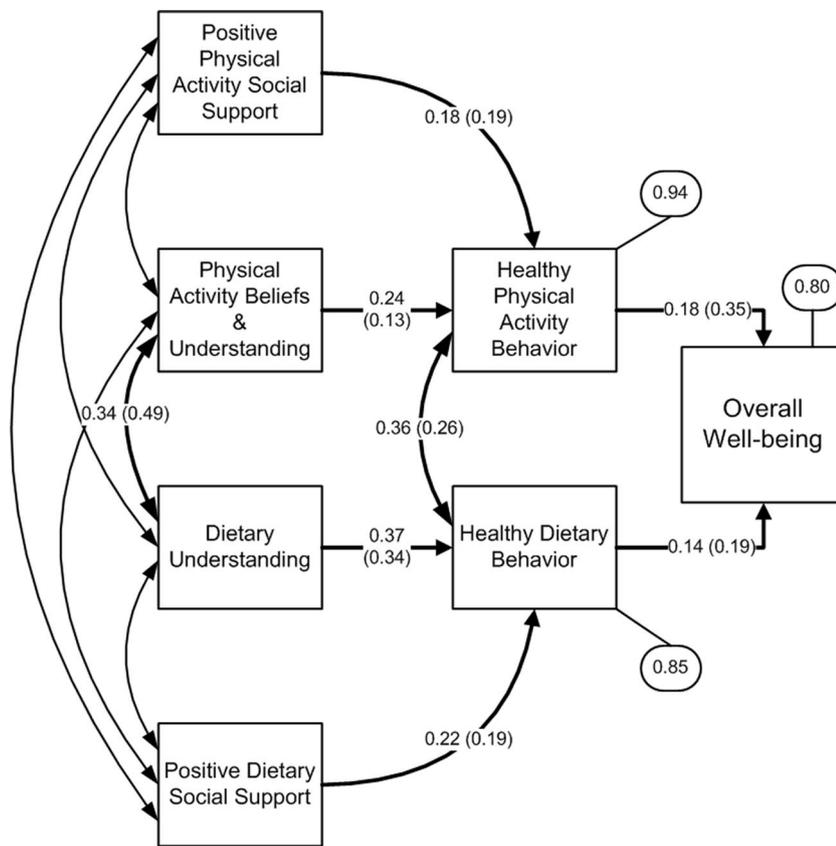


Fig. 3. Baseline cross-sectional model. Constructs (Table 2) are in squares; single headed arrows indicate presumed directional effects. Path coefficients are significant relationships between variables, with standardized values in parentheses and residual unexplained variance in rounded rectangles.

Discussion

Two different behavior change strategies, a team-centered curriculum and individual motivational interviewing, positively impacted nutrition behaviors, were associated with less weight gain and enhanced general well-being compared to a testing and results only control condition.

The intervention effects were observed despite factors that may have attenuated the findings. First, the control group demonstrated positive changes and others have observed testing alone can favorably impact beliefs and behaviors.⁴⁶ Participants also reported an average initial fruit and vegetable intake already at the minimum recommended level. In general, programs to alter diets are more successful among those with illnesses directly impacted by the nutritional change or with the most potential for improvement.⁴⁷ Our di-

etary fat goal may have been undermined because during the study year, the need to avoid fat was questioned⁴⁸ and dietary recommendations changed to emphasize saturated rather than total fat.⁴⁹

The body weight effects are comparable to other successful worksite weight-loss programs,⁵⁰ may reflect greater fruit and vegetable intake's impact on caloric density,^{51,52} and if sustained might favorably impact adults' gradual weight gain.⁵³ Both interventions also increased perceived well-being. Although many health promotion benefits are longer term, worksite wellness has begun to link healthy lifestyles with more immediate benefits on employees' mood, perceived well-being, and productivity.⁴⁴

Our recommendations were for 30 minutes of daily moderate physical activity, aimed at achieving health

benefits rather than an exercise intensity needed to enhance aerobic endurance. Accordingly, lack of an increase in peak oxygen consumption was not unexpected, especially given the above average baseline fitness levels indicated by participants' initial measured peak oxygen uptake.⁵⁴

Traditional counseling has limited efficacy when used to promote healthy nutrition and regular physical activity.^{15,16} Motivational interviewing is a promising alternative and our findings indicate MI can increase healthy behaviors, even among men. The efficacy with the predominantly male participants is of note because in another large health promotion trial, only women seemed to benefit from counseling.⁵⁵

Directly comparing the team curriculum and MI is problematic. In addition to different content and format, the absolute time spent in team sessions was greater than in individually focused MI. Following the initial meetings, MI firefighters determined meeting number and although they could have contact time equivalent to the teams, most chose fewer interactions. The costs of MIs were relatively high and related to counselor training and time. Once formatted, the team materials were relatively inexpensive at approximately 25 dollars per firefighter. The scripted format and self-contained packaging was designed to facilitate fidelity to the curricula and easy exportability.⁵⁶ Its use of peer leaders may be a critical feature, with benefits beyond reducing expense. Although perhaps counter intuitive, peer teachers can be more effective than experienced instructors, by enhancing information relevance and increasing a team's ownership and personal investment in activities.⁵⁷

An addition to intervention format and contact time, the intervention cross-sectional model indicates that the change process may have differed. The team program increased dietary social support, with that construct being comprised of items that

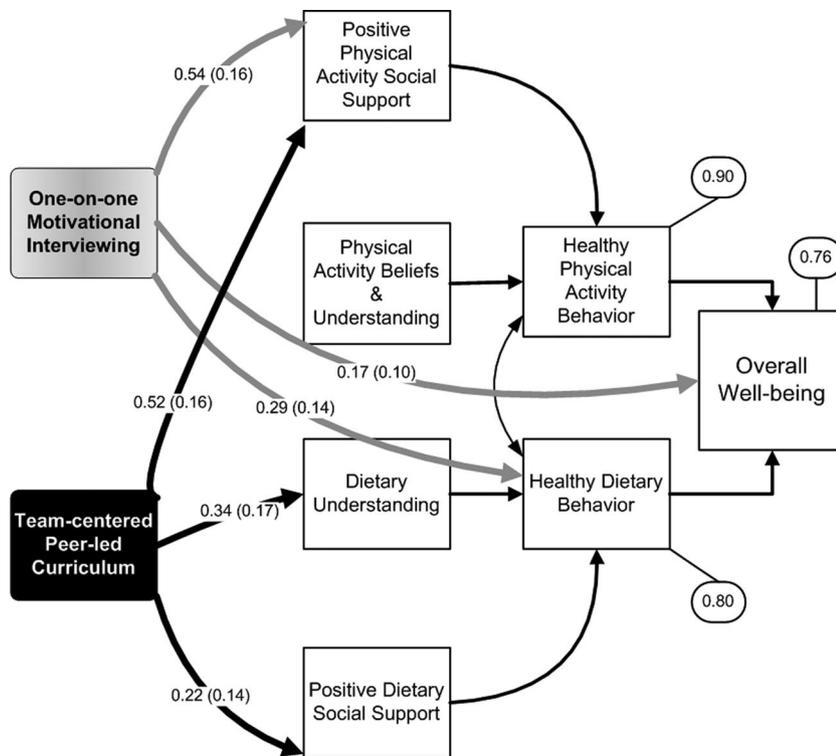


Fig. 4. Intervention model. Path coefficients in Fig. 3 remained significant and those numbers and additional cross-section paths were removed to minimize visual clutter. Only intervention associated significant paths are shown, with standardized coefficient in parentheses and residual unexplained variance in rounded rectangles.

reflect norms and group cohesion^{30,31} and dietary understanding, the latter finding consistent with knowledge as a mediator for other nutrition interventions.^{58,59} Explicit team-based nutrition activities appeared necessary to recruit those positive social influences, as a pre-existing team-oriented work structure and shift-members' simultaneous MI participation did not increase that construct. In contrast, MI directly affected overall well-being or more likely, worked through latent variables

that were not assessed. Although MI is not 'therapy,' in our pilot study, only MI was associated with an improved mood,³³ perhaps related to its fostering self-awareness and making connections among internal cues, behaviors, and subsequent outcomes.⁶⁰ Our models are cross-sectional and do not prove causality. However, the observations are conceptually plausible,⁶¹ bolstered by the study's high participation rate and randomized design,⁶² and provide a conceptual framework for subsequent study.

TABLE 4
Model Fit Indices

	Simple Model		Model With Interventions
	Baseline	One-Year	One-Year
χ^2	17.94	14.37	17.24
Degrees of freedom (df)	8	8	12
χ^2/df	2.24	1.79	1.44
CFI	0.960	0.978	0.989
RMSEA	0.055	0.043	0.032
SRMR	0.039	0.029	0.025

Model fit is acceptable when $\chi^2/df < 3$, CFI > 0.95, RMSEA < 0.06, SRMR < 0.05.⁴⁵

Our study has limitations. Firefighters have a unique work structure, and our participants were almost all men, with a narrow racial and ethnic distribution reflecting local demographics. Clearly, further study of the team-centered paradigm, with additional measures at the team and individual level, are needed before extrapolating these findings to other settings. However, educators and businesses have long lists of team-building activities^{63,64} and incorporating those may make a scripted, peer-led curriculum applicable to other groups. Our findings provide a logical starting point for further inquiry into the team-centered format as an effective, easily exportable, and economically feasible means for health promotion.

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