PROJECT TITLE:
Translating a Weight Management Program to Worksites

GRANT NUMBER
OH009396-03

PROJECT PERIOD:
9/30/2007 – 9/29/2011

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FINAL PROGRESS REPORT
10/1/2011

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LIST OF TERMS AND ABBREVIATIONS

ANOVA	analysis of variance
BMI	body mass index
CDC	Centers for Disease Control
DPP	Diabetes Prevention Program
FYL	*FUEL Your Life*
IPAQ	International Physical Activity Questionnaire
LGM	latent growth modeling
MET	metabolic equivalents
MET-min*wk^{-1}	metabolic equivalent minutes/week
NCI	National Cancer Institute
OHN	occupational health nurse
PHC	peer health coach
UPRR	Union Pacific Railroad

Abstract

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The overall goal of this project was to evaluate the implementation of a worksite weight management program adapted from the Diabetes Prevention Program. The Diabetes Prevention Program was a multicenter clinical trial that found that modest weight loss achieved through dietary changes and increased physical activity levels in a high-risk pre-diabetic population reduced the likelihood of developing diabetes. Implementation research is an important step in the translation of research to practice because it examines how a set of intervention strategies can be used to integrate an evidence-based intervention within a specific setting, without the tightly controlled research infrastructure frequently associated with efficacy and effectiveness trials. The purpose of this study was to adapt and translate the Diabetes Prevention Program for broad-scale implementation in a workplace environment. The translated program needed to be relatively easy to implement, cost-effective, and minimally disruptive of normal site operations. To meet these constraints the translated program, *FUEL Your Life*, was much less intensive than the original DPP intervention. Frequent one-on-one treatment was replaced by a primarily self-study program supported by onsite occupational health nurses and peer health coaches. The *FUEL Your Life* intervention was organized around sixteen lessons presented in a self-study participant manual. Occupational health nurses, peer health coaches, posters at the worksite, and a website for the family provided support for the program. The 6-month intervention period was followed by a 6-month maintenance phase. The *FUEL Your Life* intervention was tested in the employee population at Union Pacific Railroad (UPRR) maintenance facilities. This population has very high levels of overweight and obesity. Overall, participants receiving the intervention maintained their body weight and body mass index while participants in control sites had a 2.6-pound weight gain and increased their body mass index by 0.3. The majority of participants (55%) at the intervention sites lost weight and 11% of participants lost at least 5% of their body weight. Losses as little as 2% of body weight were associated with reduced risk of diabetes in the original DPP clinical trials. Participants receiving the intervention reported decreased consumption of sweetened beverages and less time sitting. There were increases in coworker support for weight management, healthy eating, and physical activity at the treatment sites. There was an increase in readiness to eat a healthful diet among treatment site participants. The *FUEL Your Life* program was well received

by participants with the majority of participants rating the program as 'Very Good' or 'Excellent.' As compared to the original DPP, *FUEL Your Life* was a very low intensity weight loss intervention that resulted in small changes to eating and physical activity behaviors that led to weight maintenance. Increasing intensity of the intervention will likely be required for greater weight loss; however, increased intensity would likely result in increased costs and disruption to work activities. Further research is needed to determine the level of intensity required to achieve meaningful weight loss while balancing time and cost.

SECTION 1

Significant (Key) Findings

In this project, we proposed to evaluate the implementation of a Diabetes Prevention Program (DPP) based weight management program adapted to fit the unique characteristics of work organizations. The intensive clinic based DPP was targeted at individuals with pre-diabetes. Our adaptation, referred to as *FUEL Your Life* in this project, was translated to a general worksite population by reducing the one-on-one contact and using an occupational health nurse and peer health coaches to deliver the translated program. These modifications were an effort to reduce the cost to an organization and to minimize disruption to work activities while reaching a broad set of employees.

Our study aims as originally proposed were to:

1. Determine the effects of the translation of DPP, an evidence-based weight management intervention to a worksite setting on the primary outcome measure of BMI. Secondary outcome measures were nutrition and physical activity levels.
2. Determine the effects of a specific set of strategies used to integrate an evidence-based weight management intervention in a worksite setting.
3. Determine the effects of the translation of the DPP weight management intervention to a worksite setting on the organizational outcomes of health quality of life, productivity, absenteeism, presenteeism, and psychological work adjustment.
4. Assess the impact of the DPP weight management intervention integrated with worksite specific strategies on health-related costs and worker productivity.

The *FUEL Your Life* weight management intervention resulted in weight and BMI maintenance in a predominantly overweight and obese male employed population. This is a key finding because participants at the control sites had a 2.6-pound weight gain and increased their body mass index by 0.3 during the study period. Additionally, 55% of participants at treatment sites lost weight and approximately 11% of participants lost ≥ 5% of their body weight. In contrast, the majority of control site participants had no loss or weight gain (65%).

The effects on weight maintenance were likely due to small changes in diet and exercise. Treatment group participants reported a reduction in sugar-sweetened beverage consumption. While there was no change in percent of calories from fat or fruit and vegetable intake between treatment and control sites during the intervention period, a site analysis revealed that participants at one treatment site, North Platte, demonstrated decreased percent calories from fat and increased fruit servings during the intervention period. Additionally, participants who received the intervention reported less time sitting and there was a trend toward an increase in time spent walking.

The intervention resulted in an increase in coworker support among participants. Family support was rated the highest compared to friend and coworker support, however, there was no change in family support over time among any of the groups. There was no

discernable pattern of changes for job satisfaction, turnover intention, past absenteeism, future absenteeism, or presenteeism between treatment and control participants or across time (baseline – midpoint – final).

Translation of Findings

Many organizations are faced with increasing rates of obesity and overweight among employees. These conditions affect health care costs as well as performance on the job. In this study, we demonstrate that the Diabetes Prevention Program can be translated to a very low intensity weight management intervention for worksites. The low intensity program is not likely to lead to significant weight loss but can prevent weight gain. This is particularly important in worksite studies that seek to reach a wide population of all willing participants. This is in contrast to clinical settings where participation is often limited to only those overweight or obese or who present a specific risk profile. Such was the case in the original Diabetes Prevention Program that limited participation to only pre-diabetic persons. Future studies should examine how increasing the intensity of the translated intervention may affect weight loss outcomes as well as the impact on the organization in terms of time and cost. Additionally research should investigate whether persons should be triaged into a level of care such that those who are obese or overweight with comorbid conditions receive higher intensity interventions. A lower intensity intervention may be used for those who would benefit from weight maintenance.

Outcomes/Impact

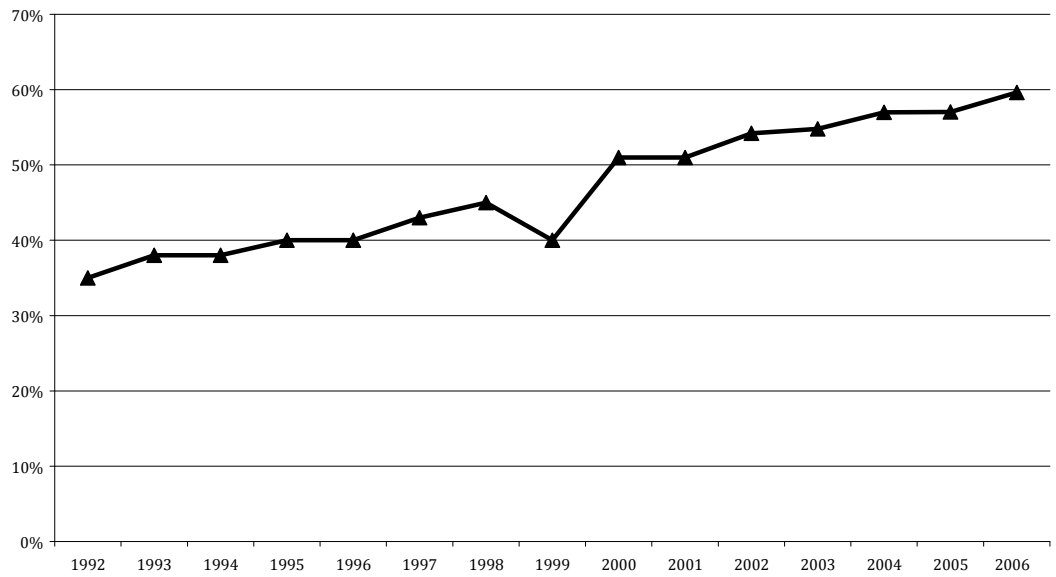
This study was conducted with a predominantly middle-aged, blue-collar male population that exhibited high levels of overweight and obesity. Increased body weight increases their risk for a myriad of health problems including type 2 diabetes, cardiovascular disease, and cancer. Additionally, these individuals are more likely to experience work limitations and cost their employers in terms of increased medical costs, lost productivity, and injury. Despite these risks, blue-collar male populations are rarely the target of weight management interventions. The findings from this research suggest that a low-intensity intervention can lead to weight maintenance. This could potentially reduce the incidence of work limitations, risk of injury, and cost to an organization. Further research is needed to determine if the small effects on body weight demonstrated in this study lead to injury prevention and cost savings.

SECTION 2

Introduction and Background

In 2007, the Workplace Health Group at the University of Georgia was awarded funding from Centers for Disease Control and Prevention (CDC) to translate The Diabetes Prevention Program Lifestyle Balance (DPP) intervention to worksites. The original DPP was a multicenter clinical trial that found that modest weight loss achieved through dietary changes and increased physical activity reduced the likelihood of developing diabetes. DPP targeted individuals who were pre-diabetic and, therefore, at high risk for developing Type 2 diabetes. The translated DPP program, referred to as *FUEL Your Life (FYL)* in this project, was field tested with the cooperation of Union Pacific Railroad (UPRR) at several of its maintenance facilities. UPRR is the largest railroad in North America, covering 23 states across the western two-thirds of the United States. Company data revealed an increasing rate of overweight and obesity among employees (see Figure 1).

Figure 1. UPRR Overweight/Obesity Prevalence Rate from 1992 – 2006 (BMI > 27.3)



Our study aims as originally proposed were to:

1. Determine the effects of the translation of DPP, an evidence-based weight management intervention to a worksite setting on the primary outcome measure of BMI. Secondary outcome measures were nutrition and physical activity levels.
2. Determine the effects of a specific set of strategies used to integrate an evidence-based weight management intervention in a worksite setting.
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4. Assess the impact of the DPP weight management intervention integrated with worksite specific strategies on health-related costs and worker productivity.

It was hypothesized that employees receiving the *FYL* weight management intervention would have significantly greater decreases in BMI and would demonstrate significantly greater increases in healthy eating habits and physical activity levels compared to employees receiving usual care. Additionally, we examined employee perceptions of social support from coworkers, family, and friends for weight management, improved dietary choices and increased physical activity. Finally, we were interested in the impact of the intervention on organizational outcomes including absenteeism, presenteeism, and psychological work adjustment (e.g., job satisfaction, turnover).

Translation of DPP

DPP as originally designed was very time and labor-intensive using frequent one-on-one contact with a master's level trained lifestyle coach to achieve behavior change. This design was not applicable for broad-scale implementation in typical workplace environments. Any intervention designed for worksite settings must be relatively easy to implement, cost-effective, and minimally disruptive of normal site operations. For the translated program to meet these constraints, several modifications to the original DPP program were necessary for feasibility and cost containment. The DPP individual model of treatment (i.e., weekly one-on-one meetings) was changed to minimize disruption to the worksite and to maximize participation. The resulting *FYL* program was primarily a self-study program using a participant manual adapted from the DPP Lifestyle Change participant manual. The *FYL* manual maintained the key concepts of the DPP Lifestyle Balance participant manual, however, formatting, graphics, and pictures were modified to make the manual more tailored to blue collar workers, reader friendly, and appropriate for self-study including questions at the end of the lessons and forms for tracking weight, food intake, and activity level. Additionally, access to an occupational health nurse (OHN) and peer health coaches replaced the lifestyle coaches used in the original DPP.

FYL Intervention

The *FYL* intervention was implemented over six months and was organized around sixteen lessons presented in the *FYL* participant manual. The manual was designed to be completed over 24 weeks, such that participants would complete one lesson weekly for the first eight lessons and then complete one lesson biweekly for the remaining eight lessons. Posters were designed to support key concepts in each lesson and posted in high traffic areas of the worksite to continually remind the employees of the program. Union Pacific Railroad OHNs were located at each site and served as the primary site coordinator and contact for the research team. The OHNs attended a one-hour training session with the research team and received a site coordinator manual outlining their roles and responsibilities. The OHNs were expected to provide six group presentations at staff meetings during the intervention period. These presentations supported the participants' self-study and included the following topics: eating less fat, finding time to be physically active, problem solving, dealing with negative thoughts and slips, aerobic fitness, and preventing and coping with stress. Additionally, the

nurses were given weekly announcements to be read during start of shift employee meetings. Other responsibilities for the OHNs included hanging program posters biweekly, serving as a resource to the health coaches (discussed below), and providing general support for participants.

In addition to the OHNs, peer health coaches were used as part of the intervention. The peer health coaches (PHC) were individuals who worked alongside the participants, were respected and trusted, and were participants themselves. PHCs were recruited by the OHN and efforts were made to include a coach from each shift/schedule. The PHCs were expected to have more frequent informal contact with the participants and were given talking points for each lesson to use in reinforcing the self-study of program participants. Additionally, they were responsible for providing basic information, answering simple questions, providing encouragement and support, and referring participants to the site coordinator or research team for more complex questions or issues. Health coaches participated in a one-hour training session with the research team, received a peer health coach manual, and were offered an incentive for encouraging participation in the study.

To further bolster support, family members of the employees were encouraged to participate. A website was created to provide information about the *FYL* program to participants' family members. A packet of materials were sent home to the family to provide information on how they could support the participants

FYL Maintenance

The *FYL* maintenance period followed the intervention and lasted for an additional six months. To assist participants in maintaining changes during this time, the OHNs presented three group presentations and posters were displayed at the worksite to support the key concepts from the group presentations.

Study Timeline

The intervention phase was preceded by formative research and a pilot study at a small UPRR facility that was not included in the main study. Formative research began in October 2007 with a visit to a Union Pacific Railroad locomotive facility in North Little Rock, Arkansas. The pilot study was conducted from November 2008 – 2009 in Kansas City, Missouri. Data collection and the *FYL* intervention were staggered in the main study beginning April – June 2009 and concluding April – June 2010. See below for a timeline of the study activities.

Figure 2. Timeline of Activities

<table>
<tr><td>Oct – Dec 2007</td><td>Jan – Mar 2008</td><td>Apr – Jun 2008</td><td>Jul – Sep 2008</td><td>Oct – Dec 2008</td><td>Jan – Mar 2009</td><td>Apr – Jun 2009</td><td>Jul – Sep 2009</td><td>Oct – Dec 2009</td><td>Jan – Mar 2010</td><td>Apr – Jun 2010</td></tr>
<tr><td colspan="4">Formative Research</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td></td><td></td><td></td><td></td><td colspan="3"></td><td colspan="2">Main Study – FYL Intervention</td><td colspan="2">Main Study – FYL Maintenance</td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="7">Process Evaluation</td></tr>
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Pilot Study

A pilot study was conducted at an UPPR Locomotive Diesel Shop in Kansas City, Missouri. The pilot study provided an opportunity to field test and refine the materials and implementation strategies that would be deployed in the main intervention study. It was also an opportunity to learn more about the work setting and study population that would assist the research team in successful program implementation and data collection. The data collection instruments and processes were piloted in November 2008 with baseline data collection, after which participants began the 24-week intervention phase. Data were collected at the end of the intervention period (midpoint) and at the end of the six-month maintenance phase of the pilot project (October 2009).

The 167 employees at the pilot study location were predominantly white (85%) males (97%) with an average age of 45 years. Most employees worked in production and manufacturing jobs (80% production, 1% clerical, 17% managerial, 1% maintenance). The facility operates 7 days a week and work is organized into three shifts: 45% of employees work the day shift (7 a – 3 p); 30% of employees work the evening shift (3 p – 11 p); 24% of employees work the night shift (11 p – 7 a). Another 1% of employees work a rotating shift. Employees were recruited into this study by signs posted at the worksite, announcements in regular staff meetings, and word of mouth. All employees were eligible to participate in the pilot project. Participation in all data collection and intervention activities was voluntary. At each data collection, participants received a $10 gift card for completing the survey and height and weight measurements.

Sixty-seven employees participated in baseline data collection and forty employees provided data at all three time points (referred to as the pilot cohort). The pilot cohort was all male and the majority lived with a spouse or partner (69%). More employees participated from day shift (55%) than from the evening shift (32%) or the night shift (13%). The mean body mass index of the pilot cohort was 31.6 (range 21.4 – 49.6) and the mean weight was 217 pounds (range 138 – 378). A large percentage of this population reported that they had been told by a doctor or medical professional that they have high cholesterol (42%) or high blood pressure (16%). See Table 1 for baseline health measures.

Table 1. Baseline Health Measures of Pilot Cohort

# of employees	40
Mean body mass index	31.6
Mean body weight (kg/pounds)	98.5/217
Self-Reported Medical Conditions (%)	
High cholesterol	42%
High blood pressure	16%
Diabetes	3%
Depression	5%
Anxiety	3%
Mean hours of sleep	6.4

Pilot study participants lost a statistically significant amount of weight and had a statistically significant reduction in body mass index (BMI) after the *FYL* intervention (see Table 2). Participants maintained these changes during the maintenance period.

Table 2. Pilot Cohort BMI and Body Weight Change

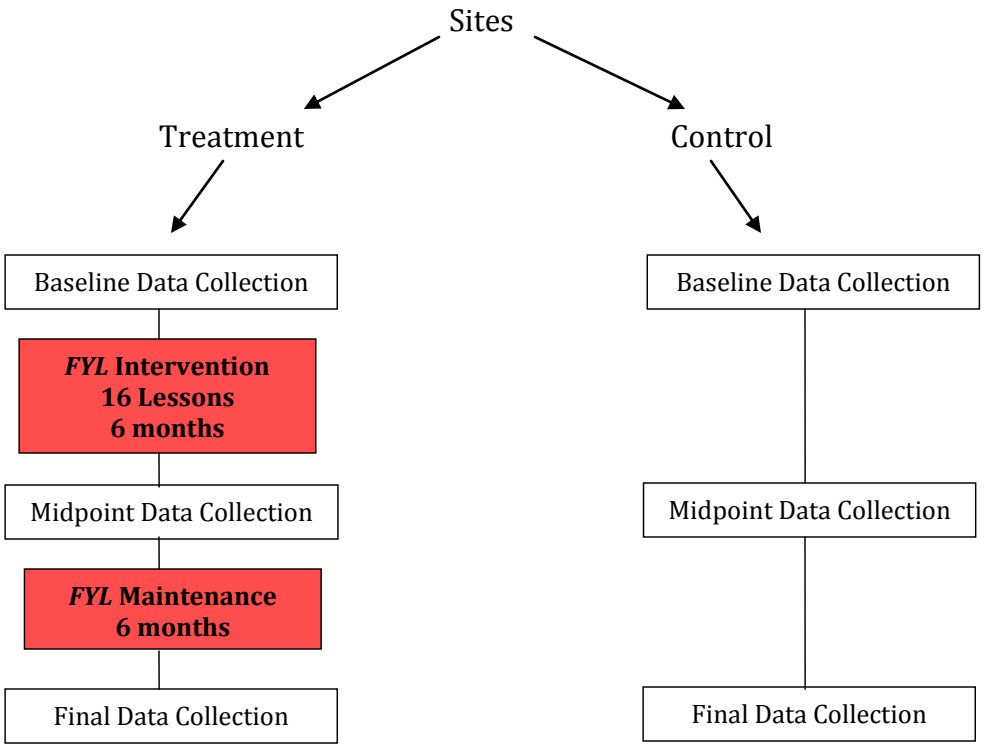
	Baseline	Midpoint	Final	F	p
BMI	31.6	31.2	31.1	5.284	0.027
Weight (kg)	98.5	97.4	96.9	5.146	0.029
(pounds)	216.8	214.7	213.3		

Based on findings from the formative research phase and pilot study, small changes were made to the main study. Minor modifications were made to the participant manual that included reducing the number of post-lesson activities that were required to be submitted to the research team. Additional information was added to the health coach training and *FYL* study website. Finally, a family packet containing information about the *FYL* study was created.

Main Study: *FUEL Your Life (FYL)*

Six sites were selected for the main study in December 2008 and were matched by size and randomly assigned to treatment (Chicago, Houston, and North Platte) and control (Denver, Hinkle, North Little Rock) by a flip of a coin. Data collection and *FYL* implementation at the treatment sites was staggered. The study design is shown in Figure 3. Baseline data were collected at treatment and control sites in spring 2009 (April – June). Following baseline data collection, the treatment sites began the six-month *FYL* intervention. Midpoint data were collected six months later (at the end of the intervention period for treatment sites). Following the midpoint data collection, treatment sites entered the six-month *FYL* maintenance period. Final data collection was completed at all sites in spring 2010 (April – June). At each data collection point (baseline, midpoint, and final), participants completed a survey and had their height and weight measured by a member of the research team.

Figure 3. Main Study Design



Sample Characteristics

All adult (aged 21 or older) locomotive shop employees at the six study sites were eligible to participate. There were 2,819 employees at the six sites: 1,301 employees at control sites and 1,518 employees at treatment sites. At baseline, 916 employees participated in data collection. The average age of participants was 44 years old. Participants were primarily male (94.0%) and predominantly white (see Figure 4). Most were married or living with a partner (Figure 5). More than 75% of participants reported having at least some post-secondary education. More than half of the participants worked 1st shift (54% - 1st shift; 29% - 2nd shift; 17% - 3rd shift). The most frequently reported health conditions were high cholesterol and high blood pressure (see Table 3).

Figure 4. Demographics – Race

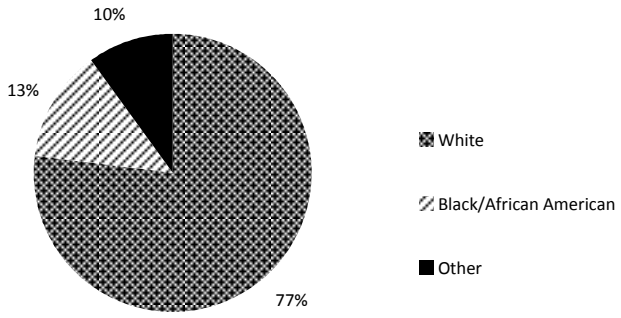


Figure 5. Demographics – Marital Status

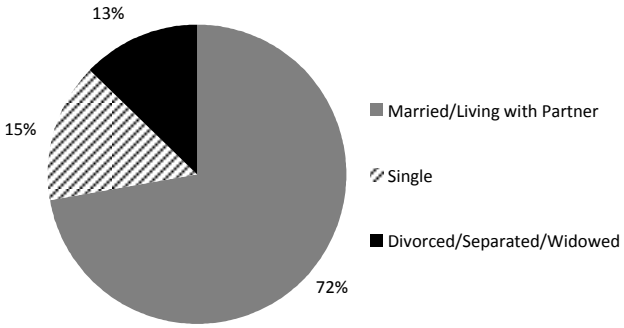
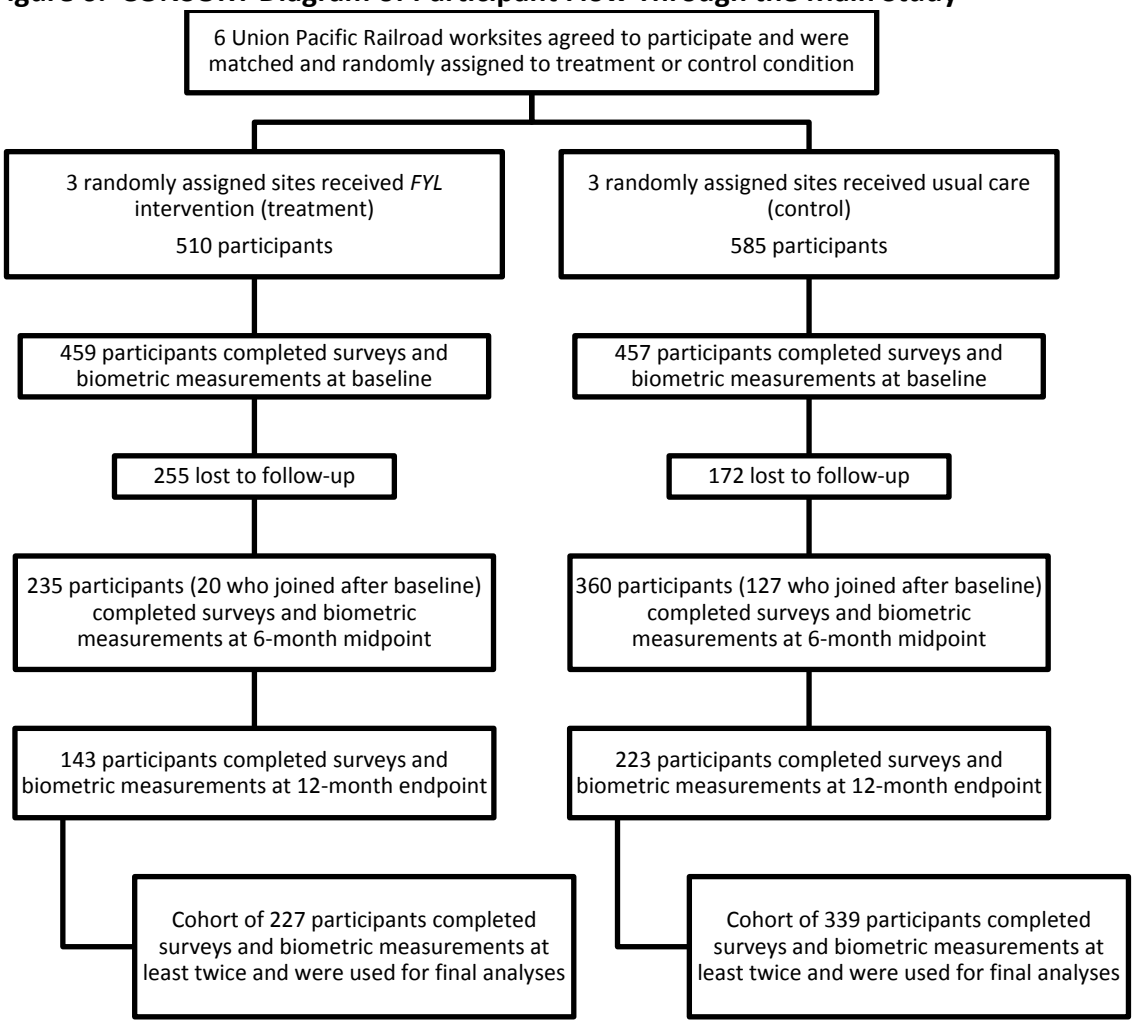


Table 3. Health Risk at Baseline

	Yes
High cholesterol	36.2%
High blood pressure	27.5%
Depression	11.3%
Diabetes	7.9%
Anxiety	5.9%

Figure 6 shows the CONSORT statement for the study. To be included in the outcome analyses, participants must have completed height and weight measurements and survey data during at least two of the three data collection periods. Overall, 566 participants were included in the final analyses.

Figure 6. CONSORT Diagram of Participant Flow Through the Main Study



North Little Rock

North Little Rock was assigned to the control condition and like all control sites, North Little Rock was asked to continue with business as usual. After review of outcomes and process evaluation data, it was determined that North Little Rock performed differently than the other control sites. Process data revealed a set of activities initiated by a highly motivated and relatively new occupational health nurse. This nurse applied previous experience with motivational interviewing to improve the health of the employees. She encouraged employees to lose weight and organized a "Biggest Loser" contest. Therefore, for the final analyses, North Little Rock was separated from the other control sites to provide a more accurate test of the *FYL* intervention.

Data Analyses

The purpose of the analyses was to answer the broad question as to whether the treatment sites differed favorably in some manner from the control sites along the outcome variables. Given the longitudinal nature of the data, a favorable outcome would be, for

example, if the change in BMI across time was statistically significant and negative for the treatment group and stronger in the treatment condition than in the control condition. While the original plan was to compare only the treatment with the control conditions, the current analyses also included the North Little Rock worksite. While repeated measures analysis of variance (ANOVA) is commonly used with longitudinal data, it is a relatively weak analytical tool fraught with challenges relative to more contemporary analytical procedures (Ployhart & Vandenberg, 2010). One such procedure is latent growth modeling (LGM), and it was the primary analytical tool used in the current study.

Among the many advantages of LGM over traditional techniques such as ANOVA is the ability to model the actual change in a variable across time as a latent variable in its own right; that is, there is an actual variable that represents the change in an outcome variable and the change variable in one group may be compared to change variable in other groups. Therefore, not only can we ascertain whether or not change in the focal outcome variable occurred in the FYL, control and unexpected conditions, but we can also evaluate whether the conditions differed significantly from one another in terms of both direction of change and strength of change – attributes that cannot be compared with ANOVA (Bentein, Vandenberg, Vandenberghe, & Stinglhamber, 2005; Chan, 2002; Lance, Meade, & Williamson, 2000; Lance, Vandenberg, & Self, 2000; Ployhart & Vandenberg, 2010). Finally, given that the variances of the outcome variable at each time period are estimated and included in the estimation of the change latent variable for that outcome, means that any violations of sphericity are controlled in the analyses – a statistical assumption that cannot be met using ANOVA.

In summary, LGM was used to estimate whether or not change in the outcome variables occurred with the assumption being that the form of change would favor the treatment condition over the control condition. We did not know what to expect to find in terms of the aberrant control site, North Little Rock. Further, we statistically tested between the groups the strength and direction of change. Change as discussed in the following sections represents the slope such that a positive number represents an upward slope and a negative number represents a downward slope.

Results: Aim 1

FYL was a translation of a clinic based weight management intervention, DPP. To determine the effects of the translation, we examined weight-related outcomes including body mass index (BMI), body weight and percent weight lost. It was hypothesized that employees receiving the *FYL* weight management intervention would have significantly greater decreases in BMI than the control group. Height and weight were measured by a trained member of the research team at each data collection point using a calibrated electronic scale and stadiometer. BMI was computed as body weight (kg) divided by height squared (m^2). Percent weight lost was calculated as (body weight at final measurement – body weight at baseline)/body weight at baseline * 100.

Body Mass Index (BMI)

Body mass index is an indicator of body fatness that correlates with direct measures of body fat. Normal values are between 18.5 – 24.9. Persons who are overweight (BMI 25.0 – 29.9) or obese (BMI 30.0 and above) are at increased risk for many diseases and health conditions including type 2 diabetes, stroke, coronary artery disease, dyslipidemia, and hypertension. Table 5 shows the change in body mass index (BMI) over 12 months for study participants. This population was overweight/obese at baseline. The effects of the *FYL* program on BMI were mixed. Overall, participants at control sites (excluding North Little Rock) had a significant increase in BMI, participants at treatment sites had no significant change in BMI, and participants at North Little Rock had a significant decrease in BMI. Results by site reveal that participants at Chicago had a significant decrease in BMI after the *FUEL Your Life* program. Hinkle, a control site, had a significant increase in BMI over 12 months.

Table 4. Body Mass Index

	Body Mass Index (BMI)			
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**29.9**	**30.2**	**30.2**	**+0.2***
Denver	29.5	29.5	29.4	0.0
Hinkle	30.6	31.1	31.4	+0.4*
TREATMENT (*FYL*)	**31.9**	**31.8**	**31.8**	**-0.1**
Chicago	32.7	32.4	32.3	-0.2*
Houston	32.3	32.5	32.4	+0.1
North Platte	31.2	31.2	31.0	-0.1
OTHER	**30.5**	**30.4**	**30.0**	**-0.2***
North Little Rock	30.5	30.4	30.0	-0.2*

*Statistically significant at $p \leq 0.05$

Body Weight

Table 5 shows the changes in body weight over 12 months. The results follow the same pattern as BMI – control site participants gained weight, North Little Rock participants lost weight, and treatment site participants maintained their weight.

Table 5. Body Weight

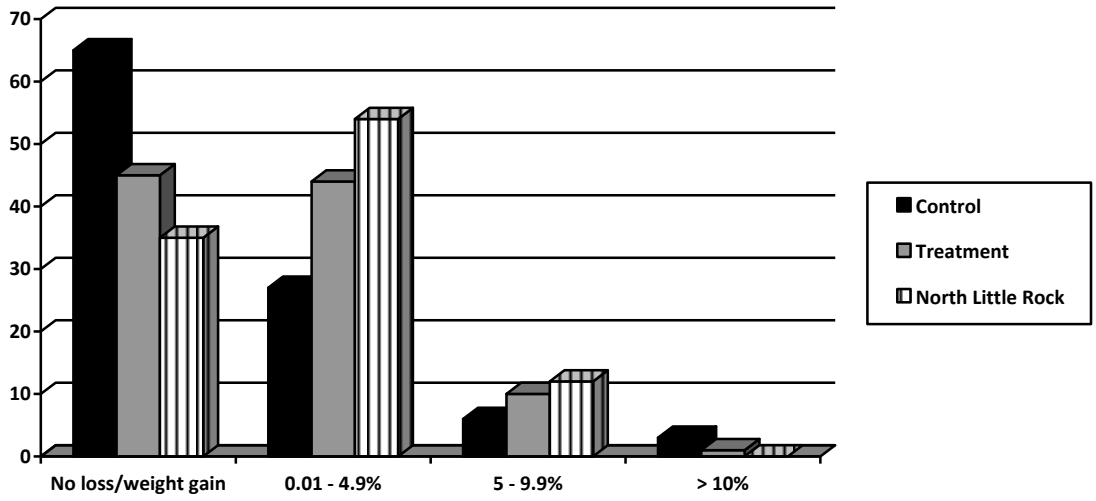
	Weight (pounds)			
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**202.2**	**204.5**	**204.8**	**+1.3***
Denver	196.5	198.3	197.4	-0.3
Hinkle	211.7	214.8	216.8	+2.5*
TREATMENT (*FYL*)	**218.8**	**218.3**	**218.2**	**-0.3**
Chicago	222.3	218.8	220.0	-1.2
Houston	221.3	222.0	222.2	+0.4
North Platte	214.9	214.6	213.5	-0.8
OTHER	**210.5**	**209.8**	**207.6**	**-1.4***
North Little Rock	210.5	209.8	207.6	-1.4*

*Statistically significant at $p \leq 0.05$

Percent Weight Lost

Weight loss was also examined categorically as percent weight lost from baseline to final measurement. Figure 7 shows the percent of participants who lost weight in four categories: no loss/weight gain, 0.01 – 4.9% loss, 5 – 9.9% loss, and ≥10% loss. The majority of control site participants had no loss or weight gain (65%) while 55% of participants at treatment sites lost weight and approximately 11% of participants lost ≥ 5% of their body weight. At North Little Rock, 66% of participants lost weight and approximately 12% lost ≥ 5% of their body weight.

Figure 7. Percent Weight Changes



Weight loss in the original DPP was achieved through dietary changes and increased physical activity. Therefore, we also examined changes in food intake and physical activity levels. Specifically, we examined percent of calories from fat, fruit and vegetable intake, and consumption of sugar-sweetened beverages (i.e. soft drinks, sports drinks, sweetened tea and

coffee). For physical activity, we examined total activity as well as time spent walking and sitting. An individual's usual intake of percentage energy from fat was estimated using the National Cancer Institute (NCI) fat screener. Similarly, fruit and vegetable intake was estimated using a fruit and vegetable screener developed by NCI. Additional dietary questions were adapted from the 2005 California Health Interview Survey to assess added sugar intake. Physical activity in this study was measured using the International Physical Activity Questionnaire (IPAQ), which estimates weekly time spent in vigorous or moderate physical activity and walking in contexts where most physical activity occurs. Activity was measured in metabolic equivalents (METS) expressed as MET-min*wk^{-1}.

Diet

Following the original DPP study protocol, each participant in the *FYL* program was given a fat gram goal that was equivalent to approximately 25% of calories from fat. This level is within current recommendations to consume 20 – 35% of calories as fat. At baseline, the average percent of calories from fat in the study population was 33%. This is similar to a US population average of 34% reported by NCI. There were no differences in percent of calories from fat among the three groups; however, one treatment site, North Platte had a significant decrease in percent calories from fat across time (Table 6).

Fruit and vegetable intake was measured as the number of servings per day. Fruit and vegetable intake was low for this sample with less than one serving of each per day. This level is slightly lower than that reported by NCI, which estimated that adults consume 1.1 servings of fruit/day and 1.5 servings of vegetables/day. Both are far below the recommendation to consume five fruits and vegetables each day. There was a small but significant increase in vegetable intake at the control sites (Table 8). Also, North Platte had a significant increase in fruit servings per day (Table 7).

Sugar-sweetened beverage consumption was measured as the number of servings per month. Figure 8 illustrates the means for each study group at each data collection period. Treatment group (*FYL*) participants had a statistically significant decline in the amount of sugar-sweetened beverages consumed over 12 months.

Table 6. Food Intake – Percent Calories from Fat

		% Calories from Fat		
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**32.3%**	**31.8%**	**31.9%**	**-0.4%**
Denver	31.2%	31.0%	32.0%	-0.4%
Hinkle	33.6%	33.2%	32.3%	-0.9%
TREATMENT (*FYL*)	**33.1%**	**32.0%**	**32.4%**	**-0.3%**
Chicago	33.0%	32.4%	33.2%	-0.1%
Houston	32.2%	32.1%	32.4%	0.2%
North Platte	33.7%	31.7%	32.0%	-0.7%*
OTHER	**32.3%**	**32.8%**	**33.0%**	**0.4%**
North Little Rock	32.3%	32.8%	33.0%	0.4%

*Statistically significant at p≤0.05

Table 7. Food Intake – Fruit Servings per Day

		# Servings per Day – Fruit		
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**0.85**	**0.86**	**0.93**	**0.04**
Denver	0.87	0.92	1.03	0.08
Hinkle	0.79	0.77	0.78	-0.01
TREATMENT (*FYL*)	**0.71**	**0.78**	**0.75**	**0.02**
Chicago	0.69	0.69	0.80	0.05
Houston	0.76	0.82	0.70	-0.03
North Platte	0.69	0.79	0.79	0.06*
OTHER	**0.67**	**0.56**	**0.63**	**-0.03**
North Little Rock	0.67	0.56	0.63	-0.03

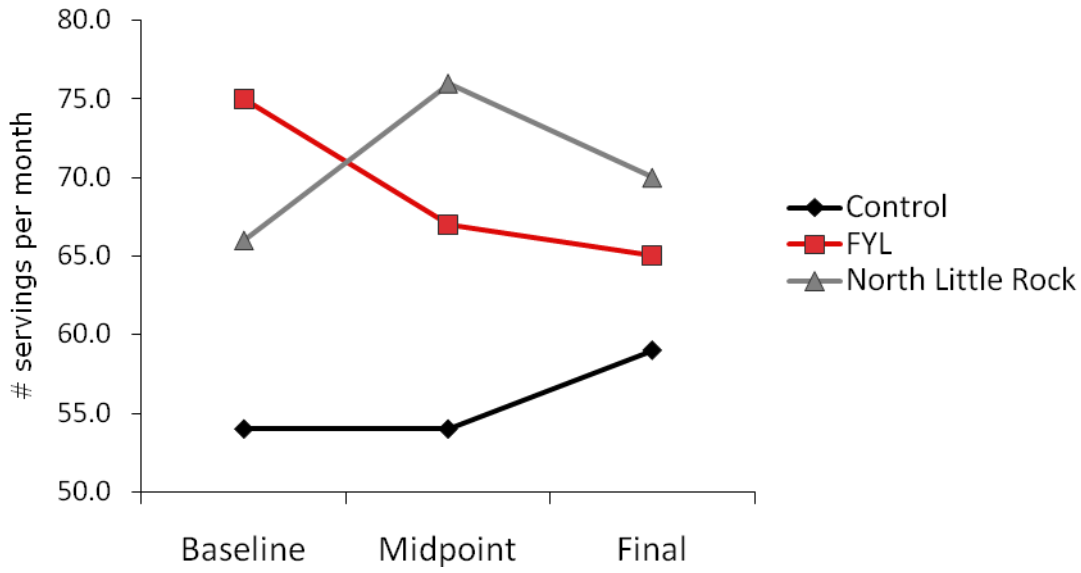
*Statistically significant at p≤0.05

Table 8. Food Intake – Vegetable Servings per Day

		# of Servings per Day - Vegetable		
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**0.78**	**0.83**	**0.90**	**0.06***
Denver	0.76	0.81	0.88	0.07
Hinkle	0.82	0.88	0.92	0.05
TREATMENT (*FYL*)	**0.67**	**0.77**	**0.69**	**0.02**
Chicago	0.66	0.70	0.68	0.01
Houston	0.71	0.85	0.65	-0.04
North Platte	0.66	0.76	0.76	0.06
OTHER	**0.71**	**0.59**	**0.67**	**-0.02**
North Little Rock	0.71	0.59	0.67	-0.02

*Statistically significant at p≤0.05

Figure 8. Sugar-sweetened Beverage Consumption



Physical Activity

Tables 9 – 11 present the physical activity data; however, these results should be interpreted with caution as participants reported high levels of physical activity (>3000 MET-minutes/week) at all three time points. There were no changes in total levels of physical activity measured as MET minutes per week. METs are multiples of the resting metabolic rate and a MET-minute is computed by multiplying the MET score of an activity by the minutes performed. Participants in the treatment group (*FYL*) had a significant decrease in time spent sitting. There was also a trend towards an increase in walking among treatment participants. Houston had a significant increase in time spent walking while North Platte had a significant decrease in time spent sitting.

Table 9. Physical Activity – Total MET Minutes per Week

	MET minutes per week			
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**5058**	**5334**	**5566**	**nsc[+]**
Denver	4606	5326	5475	nsc
Hinkle	6152	5097	5567	nsc
TREATMENT (*FYL*)	**5773**	**5238**	**5913**	**nsc**
Chicago	6981	5895	6534	nsc
Houston	5621	6182	6356	nsc
North Platte	5388	4481	5075	nsc
OTHER	**5477**	**5401**	**6126**	**nsc**
North Little Rock	5477	5401	6126	nsc

[+]nsc = nonsignficant change

Table 10. Physical Activity – Walking Minutes per Week

	Walking – minutes per week			
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**95**	**88**	**92**	**-2**
Denver	87	90	87	0
Hinkle	109	83	100	-5
TREATMENT (*FYL*)	**81**	**92**	**91**	**5**
Chicago	114	110	109	-3
Houston	70	104	103	16*
North Platte	72	74	73	1
OTHER	**82**	**83**	**80**	**-1**
North Little Rock	82	83	80	-1

*Statistically significant at $p \leq 0.05$

Table 11. Physical Activity – Sitting Minutes per Week

	Sitting – minutes per week			
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**281**	**287**	**254**	**-18**
Denver	235	231	221	-9
Hinkle	334	361	301	-24
TREATMENT (*FYL*)	**338**	**271**	**237**	**-46***
Chicago	287	234	231	-25
Houston	385	286	259	-55
North Platte	321	282	223	-51*
OTHER	**253**	**252**	**234**	**-10**
North Little Rock	253	252	234	-10

*Statistically significant at $p \leq 0.05$

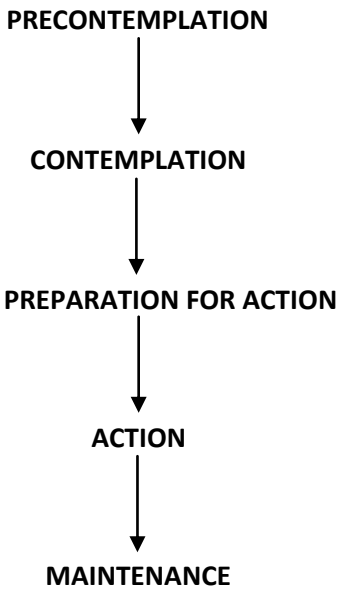
Stage of Change – Healthy Diet and Exercise

In addition to assessing behavior change for diet and exercise, we examined a participant's readiness to change as per Prochaska's transtheoretical model of change. There are five stages of change in this model: precontemplation, contemplation, preparation, action, and maintenance. In precontemplation, there is no intent to change behavior. In contemplation, a person is thinking about making a change but has not made a commitment to take action. Individuals in the preparation stage are intending to take action in the next month. Action is the stage where individuals modify their behavior to overcome a problem. Finally, maintenance is the stage people work to maintain the gains attained during action.

To assess readiness to change eating habits, participants were asked "Do you eat a healthy diet that allows you to maintain or lose weight?" Interestingly, a majority of participants in all conditions reported that they were already in action or maintenance stage. However, there was a statistically significant increase in stage of change for diet for the treatment condition and for North Little Rock (Table 12).

Table 12. Stage of Change – Healthy Eating

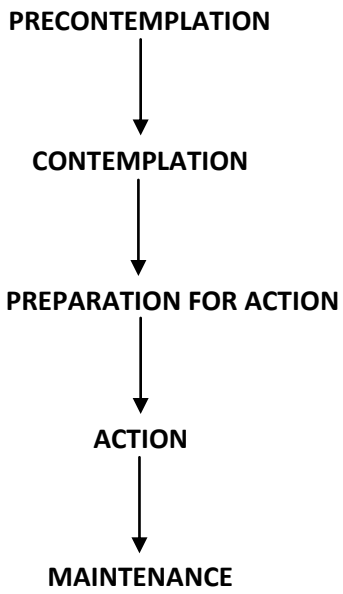
	BASELINE	MIDPOINT	FINAL
No, and I do not intend to begin making healthful food choices in the next 3 months			
Control	4.6%	3.9%	2.2%
Treatment (FYL)	3.1%	3.6%	5.4%
North Little Rock	9.1%	7.6%	7.3%
No, but I intend to begin making healthful food choices in the next 3 months			
Control	13.0%	14.6%	12.1%
Treatment (FYL)	15.8%	14.5%	8.5%
North Little Rock	15.2%	20.5%	9.1%
No, but I intend to begin making healthful food choices in the next 30 days			
Control	16.7%	13.6%	20.9%
Treatment (FYL)	29.6%	20.2%	20.0%
North Little Rock	17.1%	13.5%	12.7%
Yes, I have been making healthful food choices, but for < 3 months			
Control	22.2%	29.1%	28.6%
Treatment (FYL)	21.9%	25.4%	26.2%
North Little Rock	32.3%	21.6%	25.5%
Yes, I have been making healthful food choices for > 3 months			
Control	43.5%	38.8%	36.3%
Treatment (FYL)	29.6%	36.3%	40.0%
North Little Rock	26.2%	36.8%	45.5%



To assess readiness to change exercise behaviors, participants were asked, "Do you exercise regularly?" Similar to stage of change for a healthy diet, a majority of participants at all sites were in the action or maintenance phase at baseline. There were no significant changes over time (Table 13).

Table 13. Stage of Change – Exercise

	BASELINE	MIDPOINT	FINAL
No, and I do not intend to begin exercising regularly in the next 3 months			
Control	12.4%	14.7%	17.5%
Treatment (FYL)	5.5%	8.4%	6.8%
North Little Rock	8.3%	12.3%	13.2%
No, but I intend to begin exercising regularly in the next 3 months			
Control	8.6%	11.8%	11.3%
Treatment (FYL)	14.4%	20.7%	12.8%
North Little Rock	15.9%	16.0%	14.2%
No, but I intend to begin exercising regularly in the next 30 days			
Control	27.6%	25.5%	15.0%
Treatment (FYL)	30.4%	21.2%	21.4%
North Little Rock	21.0%	16.0%	15.1%
Yes, I have been exercising regularly, but for < 3 months			
Control	17.1%	16.7%	28.8%
Treatment (FYL)	18.8%	19.6%	19.7%
North Little Rock	22.9%	20.9%	19.8%
Yes, I have been exercising regularly for > 3 months			
Control	34.3%	31.4%	27.5%
Treatment (FYL)	30.9%	30.2%	39.3%
North Little Rock	31.8%	35.0%	37.7%



Results: Aim 2

The *FYL* intervention was designed to encourage social support at the worksite thru the use of peer health coaches and, to a lesser degree, at home, by educating family members on how to be supportive of a participant's weight loss efforts. We examined participant perception of social support from family members, friends, and co-workers. Mean scores for support in three domains (healthful food choices, physical activity, and weight management) were totaled using a 1 to 5 scale (1 = not at all supportive, 5 = extremely supportive). These data are shown in Tables 14 – 16. Family support was rated the highest compared to friend and coworker support, however, there was no change in family support over time among any of the groups. There were significant changes in coworker support among participants at the treatment sites and among participants at North Platte.

Table 14. Social Support - Family

		Family Support		
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**3.4**	**3.5**	**3.5**	**0.1**
Denver	3.3	3.4	3.6	0.1
Hinkle	3.5	3.5	3.5	0.0
TREATMENT (*FYL*)	**3.4**	**3.4**	**3.4**	**0.0**
Chicago	3.3	3.4	3.6	0.2
Houston	3.5	3.5	3.3	-0.1
North Platte	3.5	3.4	3.5	0.0
OTHER	**3.4**	**3.3**	**3.4**	**0.0**
North Little Rock	3.4	3.3	3.4	0.0

Table 15. Social Support - Friend

		Friend Support		
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**2.8**	**2.6**	**2.9**	**0.0**
Denver	2.8	2.6	2.9	0.0
Hinkle	2.8	2.6	2.9	0.1
TREATMENT (*FYL*)	**2.8**	**2.8**	**2.9**	**0.1**
Chicago	2.8	2.8	2.9	0.1
Houston	3.1	2.9	3.1	0.0
North Platte	2.6	2.8	2.7	0.1
OTHER	**2.7**	**2.8**	**2.8**	**0.1**
North Little Rock	2.7	2.8	2.8	0.1

Table 16. Social Support - Coworker

		Coworker Support		
Study Sites	Baseline	Midpoint	Final	Change
CONTROL	**2.3**	**2.3**	**2.6**	**0.1**
Denver	2.3	2.5	2.3	0.1
Hinkle	2.4	2.2	2.8	0.1
TREATMENT (*FYL*)	**2.4**	**2.5**	**2.6**	**0.1***
Chicago	2.3	2.5	2.3	0.0
Houston	2.9	2.8	3.0	0.1
North Platte	2.2	2.4	2.4	0.1*
OTHER	**2.3**	**2.3**	**2.5**	**0.1**
North Little Rock	2.3	2.3	2.5	0.1

*Statistically significant at $p \leq 0.05$

Results: Aim 3

The benefits of participating in health promotion programs often spill-over into other areas of work behavior and organizational adjustment such as job satisfaction, turnover intentions, and productivity. To assess such effects, several familiar and widely used measures of work-related behavior were included as part of the participant questionnaire.
Table 17 presents a summary of these work and organizational measures. Job satisfaction was measured using a single question ("Thinking about all the things that make up your job, how satisfied are you with your current job.") on a 5-point rating scale (1 = very dissatisfied, 5 = very satisfied). Turnover intention was measured in response to the question "What is the probability that you will leave your current job for another job with another organization in the next 3 months?" where 1 = 0% (not at all likely) and 6 = 81 – 100% (very likely). Absenteeism was measured both past (i.e., "during the last 4 weeks, how many days were you absent when you had been scheduled for work because you were truly sick") and future (i.e., "what is the probability that your absence in the next 4 weeks will be the same as your response to the last question"). For past absenteeism, responses were scored 1 – 5; 1 = no times missed when scheduled to work, 5 = four or more times missed when scheduled to work. For future absenteeism, the responses ranged from 1 (0%, not at all likely) to 6 (81 – 100%, very likely). Presenteeism refers to decreased productivity while on the job. Presenteeism was assessed using the presenteeism measure from the Health and Performance Questionnaire (World Health Organization). Table 17 contains scores for relative presenteeism: the ratio of actual performance to the performance of most workers at the same job. Scores can range from 0.25 to 2.0, with *higher* scores reflecting greater relative productivity (less presenteeism).

Overall, there was no pattern of discernable changes either between treatment and control participants or across time (baseline – midpoint – final).

Table 17. Organizational Variables

	BASELINE	MIDPOINT	FINAL	CHANGE
JOB SATISFACTION				
Control	3.8	3.5	3.5	-0.1*
Treatment (FYL)	3.6	3.5	3.8	0.1
North Little Rock	3.9	3.8	3.8	0.0
TURNOVER				
Control	1.3	1.2	1.3	0.0
Treatment (FYL)	1.4	1.4	1.5	0.0
North Little Rock	1.2	1.3	1.4	0.1*
PAST ABSENTEEISM				
Control	1.3	1.5	1.3	0.0
Treatment (FYL)	1.3	1.2	1.3	0.0
North Little Rock	1.4	1.3	1.3	0.0
FUTURE ABSENTEEISM				
Control	3.2	3.2	3.5	0.1
Treatment (FYL)	3.0	3.1	2.9	0.0
North Little Rock	2.9	3.0	3.1	0.1
PRESENTEEISM				
Control	1.2	1.2	1.2	0.0
Treatment (FYL)	1.3	1.3	1.3	0.0
North Little Rock	1.3	1.3	1.2	0.0

*Statistically significant at $p \leq 0.05$

Results: Aim 4

Through discussions with Union Pacific Railroad management it was determined that the majority of employees were enrolled in health insurance plans offered by the railroad unions rather than those offered by Union Pacific Railroad. Health care claims data from the railroad unions were not accessible to the research team and, therefore, a return on investment analysis (ROI) could not be completed, however, self-reported healthcare utilization measures were included in the participant survey. We are currently investigating this data.

Process Evaluation

Process data were collected from participants at the treatment sites to assess program implementation and satisfaction with the *FYL* intervention. The most common reasons for participating in *FYL* were to lose weight (40%) or to eat healthier (24%) (Figure 9). Only 5% of participants reported that they participated to exercise more. Participants rated the *FYL* program very positively (Figure 10). In fact, the majority of participants rated the *FYL* program as 'Very Good' or 'Excellent.'

FYL was self-directed and required participants to be essentially self-motivated. We assessed participant engagement in the intervention by asking participants to report the frequency, with which they reviewed lessons in the participant manual, checked the *FYL* website, talked with a PHC, and talked with their family about the *FYL* program. These data are

shown in Table 18. Approximately 16% of participants reviewed the lessons weekly. Many participants did not access the website or the PHC. Approximately 13% of employees reported having someone other than their coworkers participating in the program with them (data not shown) and approximately 29% of participants talked with their family about the program monthly.

Figure 9. Primary Reason for Participating In *FYL*

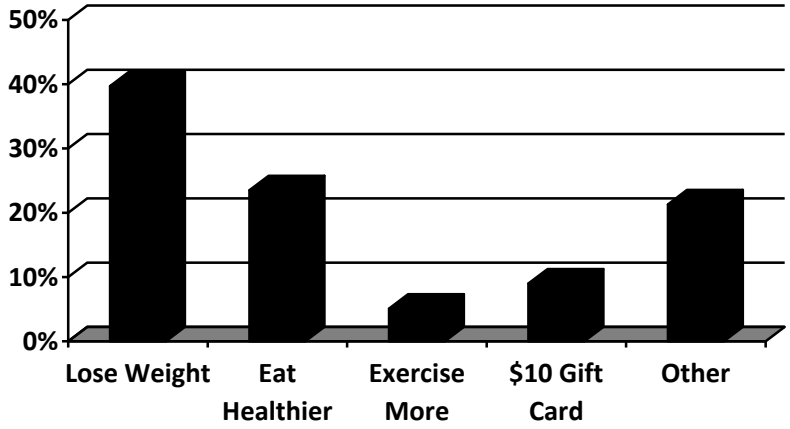


Figure 10. Overall Rating of the *FYL* Program

Table 18. Participant Engagement

How often did you…	Daily	Weekly	Monthly	Seldom	Never
Review the lessons in the *FYL* manual	6.6%	16.2%	12.2%	50.8%	14.2%
Check the *FYL* website	0.0%	4.0%	4.0%	30.8%	61.1%
Talk with a PHC about the *FYL* program	1.5%	4.6%	6.1%	28.9%	58.9%
Talk with your family about the *FYL* program	4.0%	10.1%	14.6%	45.2%	26.1%

Summary and Conclusions

We adapted an intensive clinic-based weight management intervention that targeted individuals at high risk for developing Type 2 diabetes to a general worksite population. Frequent one-on-one treatment was replaced by a primarily self-study program supported by onsite occupational health nurses and peer health coaches. The translated program, *FUEL Your Life (FYL),* was positively received by participants.

Our target population was predominantly overweight and obese middle-aged male employees at Union Pacific Railroad (UPRR) maintenance facilities. The pilot study at a small Union Pacific worksite showed a small but significant impact of the *FYL* intervention on weight loss and BMI. After some minor modifications to study measures and materials, *FYL* was tested in six UPRR maintenance facilities. Intervention effects on the primary outcome of BMI were mixed: control site participants gained weight while treatment site participants maintained their weight. The majority of participants at treatment sites (55%) lost some weight while approximately 11% of participants lost at least 5% of their body weight. There were additional modest changes in diet and exercise behaviors in the treatment group, including a significant reduction in sugar-sweetened drink consumption and a decrease in the time spent sitting. Additionally, participants at one site, North Platte, had a decrease in the percent of calories from fat, an increase in fruit servings, and a decrease in the minutes spent sitting; however, these changes did not produce significant reductions in BMI or body weight. Houston, another treatment site, also showed an increase in time spent walking but no changes in BMI or body weight.

Despite the high incidence of overweight and obesity in this population, most participants reported high levels of physical activity. Many participants reported being in the action or maintenance stages for both diet and exercise, suggesting that they felt they were already making healthful food choices and exercising regularly. Overall, most participants indicated that they participated in *FYL* to lose weight or eat healthier; however, few participants indicated that they participated to exercise more.

The original Diabetes Prevention Program was a high intensity/high cost weight loss intervention that resulted in a mean weight loss of ~ 10 pounds. The present attempt to translate DPP into a widely applicable and sustainable workplace health promotion intervention (*FUEL Your Life) produced weight maintenance but not weight loss effects in the treatment group.* Weight maintenance is an important finding considering the control site participants had a 2.6-pound weight gain. It is also important to note that the majority of participants in the

treatment group lost weight and 11% of participants lost at least 5% of their body weight. In the original DPP clinical trial losses as little as 2% of body weight were associated with reduced risk of diabetes. Increasing intensity of the intervention is likely to lead to greater weight loss; however, increased intensity would likely result in increased costs and disruption to work activities. Further research is needed to determine the level of intensity required to achieve meaningful weight loss while balancing time and cost.

INCLUSION ENROLLMENT TABLE


Inclusion Enrollment Table.doc

PUBLICATIONS

Presentations at Scientific Meetings and Conferences

Wilson, M.G., DeJoy, D.M., Padilla, H.M., Davis, M., Vandenberg, R.J., Eldredge, C. (2011). Effectiveness of a worksite Diabetes Prevention Program: Results of Fuel Your Life. American Public Health Association 139th Annual Meeting, Washington, DC, October 29 – November 2.

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Wilson, M.G., DeJoy, D.M., Bowen, H.M., Davis, M., Bynum, B., Vandenberg, R.J. (2010). Fuel Your Life: Results from a worksite Diabetes Prevention Program. American Public Health Association 138th Annual Meeting, Denver, CO, November 6-10.

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Manuscripts In Preparation

Translating DPP to the Workplace: Formative Research and Pilot Study Results

Translating the Diabetes Prevention Program to worksites: Results from Fuel Your Life

Physical work demands, work processes, and safety climate: Moderating effects of BMI

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