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Impact of Lifestyle Intervention on Lost Productivity and Disability: Improving Control With Activity and Nutrition

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Learning Objectives

- Discuss the evidence for benefits of lifestyle interventions in workers with chronic health conditions, including effects on health, absenteeism, and disability.
- Outline the design and characteristics of the "modest-cost" lifestyle intervention evaluated in this study.
- Review the study intervention's effects on missed work and disability among employees with diabetes and obesity, including the role of depression.

Abstract

Objective: *To evaluate the effectiveness of a lifestyle intervention (LI) in reducing work loss and disability days.* ***Methods:*** *One year randomized controlled trial of health plan members* (n = *147) with type 2 diabetes and obesity. Members were randomized to modest-cost LI or usual care (UC). Outcomes were group differences in cumulative days either missed at work or with disability using Mann-Whitney* U*-tests and Poisson regression models.* ***Results:*** *LI reduced the risk of workdays lost by 64.3%* ($P \leq 0.001$) *compared to UC (annual accumulation: UC: 3.49 days vs LI: 0.92 days,* $P = 0.01$). *LI decreased the risk of disability days by 87.2%* ($P = 0.0003$) *compared to UC (annual accumulation: UC: 5.3 days vs LI: 0.94 days,* $P \leq 0.001$). *Similar trends were observed among the subset of people with depression.* ***Conclusion:*** *LIs reduce work loss and disability days associated with diabetes and obesity.* (J Occup Environ Med. *2009;51:139–145*)

Absenteeism and disability are indirect indicators of health and are costly not only to patients but also to employers. Diabetes and obesity are associated with elevated rates of lost productivity and disability.[1,2] In 2007, people with diabetes lost 15 million days of work due to diabetes, costing the US economy approximately 2.6 billion dollars.[1] In 1994, there were 239 million excess restricted activity days and 89.5 million excess bed days attributable to obesity.[3] There has been a substantial amount of research evaluating the impact of health promotion programs on worksite absenteeism.[4–7] Most studies suggest that people who are involved in health promotion programs have lower absenteeism rates compared with people not involved. Health promotion programs, however, often lump diverse health programs together, such as smoking cessation and weight loss, making it challenging to estimate the independent effect of a specific program. In addition, people who participate in health promotion programs at worksites may be more interested in their health which may introduce selection bias. Lastly, many of the worksite studies were quasi-experimental; they included comparison groups but did not use randomization to make group assignments. Although quasi-experimental designs have many strengths, such as being conducted in the real world setting, having large sample sizes and longer evaluation periods, there remains the possibility that the intervention and control

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groups are not comparable for known and unknown confounding variables and this possibility threatens the internal validity of the study. Randomized controlled trials maximize the probability that the groups receiving the different interventions are comparable.

For these reasons, the influence of lifestyle interventions (LI) on disability and work loss among people with chronic health conditions remains unsettled. Previously, we have shown that a modest cost, moderate intensity lifestyle program that could easily be incorporated into the worksite or medical model was effective in improving clinical and quality of life outcomes[8] and decreasing health care costs[9] compared to usual medical care for people with diabetes and obesity. The purpose of this analysis was to evaluate the impact of a LI compared to usual medical care on days missed at work and days with disability and physical limitations due to obesity and diabetes. We hypothesized that a LI that improves health risks such as weight loss and blood glucose control as well as improving health related quality of life would also decrease productivity losses and disability.

Research Design and Methods

The Improving Control with Activity and Nutrition (ICAN) study was a randomized clinical trial conducted from 2001 to 2003. The University of Virginia health sciences institutional review board approved the study. All patients gave written informed consent.

Study Design

To be eligible, Southern Health Services Inc, health plan members had to have type 2 diabetes (identified from health care claims using ICD-9 codes 250.XX, 357.2 362.0, 362.02, or 366.41, and confirmed by physician), diabetes medication use, body mass index (BMI) $\geq$27 kg/m^2, age $\geq$20 years, and be able to comprehend English. The inclusion criteria were developed to provide a high risk population whose health potentially impacted financial outcomes such as health care costs and productivity given a relatively small sample size for outcomes (health care costs) that typically require larger sample sizes. Exclusion criteria were pregnancy, cognitive limitations or medical reasons precluding dietary and physical activity modifications. Interested and eligible participants were randomly assigned to either a LI or usual care (UC) groups using random permuted blocks with randomly chosen block sizes of 2 or 4. Further details of the screening and recruitment process have been described elsewhere.[8]

Lifestyle Intervention and Control Groups

Lifestyle Intervention. One registered dietitian met with participants individually, in groups, and by phone for assessment, education, goal setting, and support following the standard of care for medical nutrition therapy.[10] Goals were individually tailored but based on national dietary recommendations.[11,12] The dietitian measured weight and waist circumference, followed laboratory results. Individual sessions occurred six times throughout the year, totaling 4 hours. Participants attended six, 1-hour small group sessions. Brief monthly phone contacts provided additional self management support tailored to individual participants needs.

Control Group (Usual Medical Care). UC participants received standardized written educational material.[13] Both groups received usual medical care from their physicians as clinically appropriate. Participants did not receive any special study-related visits with their physicians.

Program Costs. Net cost of the program was $328 per person per year.[9] Costs were calculated by applying standard unit costs to the resources used (educational material and patient care unit time). Unit costs were the actual cost of educational material. Salary and overhead were based on published costs from the Diabetes Prevention Program.[14] All costs were adjusted to 2002 U.S. dollars using the consumer price index (in accordance with the intervention year). Net program costs subtract UC program costs from the LI program costs.

Outcome Measures

The outcome measures were days absent from work and days with disability and physical limitations (henceforth referred to as disability days) due to body weight or diabetes. Days missed at "work" take a societal view, counting days as productive days regardless of employment status. At baseline, 4, 6, 8, and 12 months, participants were asked the following questions, "In the past X months, how many days of work have you missed due to sickness related to your diabetes or weight (please include days missed of work because of medical appointments or hospital or emergency care)?" and, "In the past X months, how many days have you been disabled or physically limited due to your diabetes or weight?" Participants reported their days absent from work and with disability for the time since the previous assessment. At baseline, participants reported their days for the 4 months prior to the start of the study. Participants were given five response categories: None, 1 to 2 days, 3 to 5 days, 6 to 8 days, and >9 days. Categorical responses were transformed into continuous numbers by using the median of each category (0, 1.5, 4, 7 days). The highest category (>9 days) was assigned a value of 10 days. Cumulative 12-month work lost and disability days were calculated by summing the numerical responses at 4, 6, 8, and 12 months.

Independent Variables

At baseline, participants reported age, gender, income and education level and the year diabetes was diagnosed. Depression and other health problems that were diagnosed and treated were self-reported at baseline

only. Participants were asked, "Tell us what other health problems that you have been diagnosed and treated for." Each health condition was a unique variable. In addition, a composite of health conditions excluding depression and diabetes was created and defined as the sum of 13 listed health conditions (high blood pressure, heart disease, high cholesterol, hypothyroid, reflux, difficulty breathing while sleeping, difficulty getting pregnant, eye disease associated with diabetes, kidney disease, loss of feeling in legs and feet, foot ulcer, amputation, urinary incontinence). Participants were free to write-in "other" health conditions, however, write-in conditions were not included in the tabulation of "health conditions."

Statistical Analysis

Because the primary outcome measures had skewed distributions, unadjusted differences in mean cumulative days missed between groups were evaluated using Mann-Whitney *U*-tests at 4, 6, 8, and 12-months. A repeated measures model using Poisson regression was used to evaluate the impact of group while adjusting for baseline depression (main model). In separate models, age, gender, duration of diabetes diagnosis and number of medical complications were individually added into the main model. Parameters of the Poisson regression models were estimated using Generalized Estimating Equations.[15] Generalized Estimating Equations accommodates complex missing patterns, where any number and any order of missingness among the potential five measurements per study participants were allowed across time and accounts for lack of independence of the repeated measures within each participant. Incidence rates (IR) and incidence rate ratios (IRR) are reported. Statistical analyses used SPSS 14.0[16] and R 2.4.1.[17]

Results

One hundred forty-seven participants were randomized into UC (n = 73) or LI (n = 74). After three patients withdrew before baseline assessment, the population was comprised of 72 UC participants and 72 LI participants. The 1-year retention rate was 82% (n = 118).

Baseline Characteristics

At baseline, groups were similar on all demographic and clinical measures except for presence of depression (Table 1); more people in the UC group reported being diagnosed and treated for depression at baseline compared to those in the LI group (P = 0.003). Depression was self-reported among 24.3% of the study population. Mean HbA1c suggested moderately good control (7.7%, SD, 1.6) and the average number of years with diagnosed diabetes was 7.3 (SD, 6.4). Study participants had, on average, 2.2 (SD, 1.5) health conditions other than diabetes.

Work Days Lost

Workdays lost at each assessment period (for a time interval of 2 to 4 months) is presented in Table 2. Between-group differences in cumulative workdays lost due to diabetes and obesity were observed by 4 months ($P \leq 0.05$), and were statistically significantly different at each assessment point (Fig. 1). After adjusting for depression, the average IRs for workdays lost were 0.38 days per year for the UC group and 0.14

TABLE 1
Baseline Characteristics of Participants by Randomization Group

Variables	UC Group	LI Group
Categorical variables: *N* (%)	72 (50)	72 (50)
Female no.	42 (58%)	45 (62%)
Caucasian no.	53 (74%)	61 (85%)
Smoking status-never	40 (56%)	41 (57%)
Former	30 (42%)	27 (38%)
Current	2 (3%)	4 (6%)
Marital status-never	9 (13%)	4 (6%)
Married	50 (69%)	55 (76%)
Divorced	11 (15%)	9 (13%)
Other	2 (2%)	4 (5%)
Highest level of education		
High school, HS diploma/GED	24 (34%)	21 (29%)
Some college, completed college, technical school	37 (51%)	39 (54%)
Post-graduate/professional degree	11 (15%)	12 (17%)
Annual income		
<$24,999	9 (13%)	9 (12%)
$25,000–$74,999	50 (69%)	49 (68%)
$75,000–$99,000	8 (11%)	8 (11%)
≥$100,000	5 (7%)	6 (8%)
Medical conditions (%)		
Hypertension	42 (58%)	48 (67%)
High cholesterol	35 (49%)	30 (42%)
Heart disease	13 (18%)	7 (10%)
Depression	25 (35%)	10 (13%)
Continuous variables: mean (SD)		
Age, year	53.4 (8.0)	53.3 (8.6)
Weight, kg	106.7 (24.3)	107.1 (25.5)
Body mass index, kg/m^2	37.5 (6.4)	37.6 (7.7)
Years with diabetes	7.7 (7.3)	6.9 (5.6)
Glycosylated hemoglobin, %	7.5 (1.5)	7.9 (1.6)
Number of medical conditions*	2.1 (1.4)	1.9 (1.3)
Reported work days lost	0.75 (1.8)	0.74 (2.1)
Reported disability days	1.06 (2.8)	0.85 (2.6)

*Number of health conditions does not include depression and is the sum of the presence of high blood pressure, heart disease, high cholesterol, hypothyroid, reflux, difficulty breathing while sleeping, difficulty getting pregnant, eye disease associated with diabetes, kidney disease, loss of feeling in legs and feet, foot ulcer, amputation, urinary incontinence.

TABLE 2
Mean (SD) and Ranges of Work Days Lost and Days With Disability and Physical Limitations Due to Diabetes and Obesity at Each Assessment Period and Cumulatively During the Intervention Year

Assessment Point	Time Period Assessment Measured	UC Group		LI Group	
		Mean (SD)	Range	Mean (SD)	Range
Work days lost					
Baseline	4 mo	0.75 (1.8)	0–10	0.74 (2.1)	0–10
4 mo	4 mo	0.66 (1.7)	0–10	0.05 (0.27)	0–1.5
6 mo	2 mo	0.89 (2.2)	0–10	0.22 (0.79)	0–4
8 mo	2 mo	0.59 (1.9)	0–10	0.11 (0.39)	0–1.5
12 mo	4 mo	1.3 (2.8)	0–10	0.59 (1.8)	0–10
Cumulative for year	12 mo	3.5 (7.1)	0–40	0.92 (2.3)	0–11
Disability days					
Baseline	4 mo	1.1 (2.8)	0–10	0.85 (2.6)	0–10
4 mo	4 mo	1.06 (2.7)	0–10	0.02 (0.20)	0–1.5
6 mo	2 mo	1.2 (2.8)	0–10	0.25 (1.3)	0–10
8 mo	2 mo	1.3 (3.0)	0–10	0 (0)	0
12 mo	4 mo	1.75 (3.4)	0–10	0.70 (2.4)	0–10
Cumulative for year	12 mo	5.3 (10.1)	0–40	0.94 (3.3)	0–20

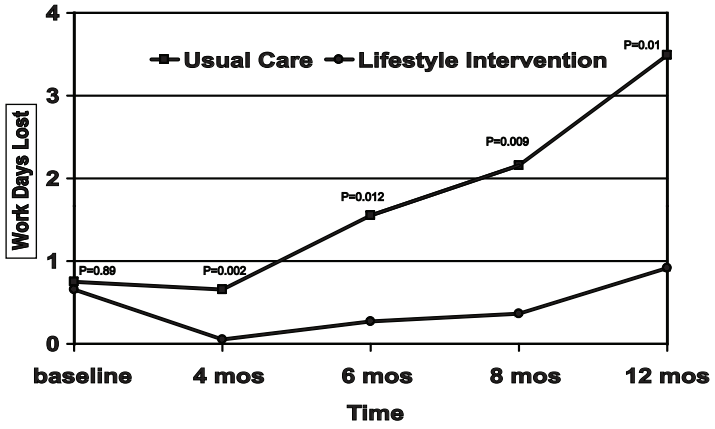

Fig. 1. Mean cumulative number of days missed from work due to obesity or diabetes by group.

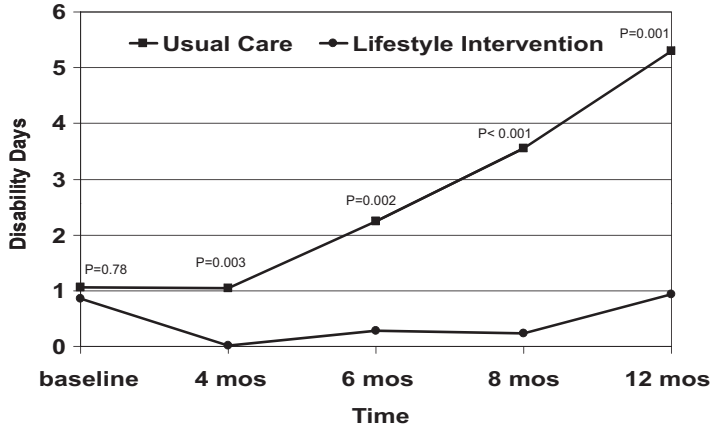

Fig. 2. Mean cumulative number of days with disability and physical restrictions due to diabetes and obesity by group.

days per year for the LI group. The addition of a LI decreased the probability of workdays lost by 64.3% (IRR = 0.36, $P \leq 0.01$) (95% CI = 20.3% and 84%), after controlling for baseline depression. We detected no significant effect of age, gender, duration of diabetes, or number of comorbidities on the impact of workdays lost.

Disability and Physical Limitation Days

Disability days at each assessment period (for a time interval of 2 to 4 months) is presented in Table 2. Between-group differences in disability and physical limitation days due to diabetes and obesity were observed by 4 months ($P = 0.003$) and were statistically significantly different at each assessment point (Fig. 2). After controlling for depression, the average IRs for disability days were 0.47 days per year for those in the UC group and 0.06 days per year for those in the LI group. The addition of a LI decreased the probability of disability days lost by 87.2% (IRR = 0.13, $P = 0.003$) (95% CI = 49.9% to 96.7%) after controlling for depression. We detected no significant effect of age, gender, duration of diabetes, or number of medical conditions on the impact of disability days lost due to diabetes and obesity.

Work Lost and Disability Days by Depression and by Group

Poisson regression coefficients confirmed that baseline depression was a strong predictor of workdays lost and disability days due to diabetes and obesity. Independent of group assignment, participants with baseline depression were at 5.4 times the risk of losing workdays ($P = 0.001$) and 7.4 times the risk of having disability days ($P = 0.001$) compared to those without depression.

To visualize the influence of LI and depression on workdays lost and disability days, we stratified the sample by depression and intervention

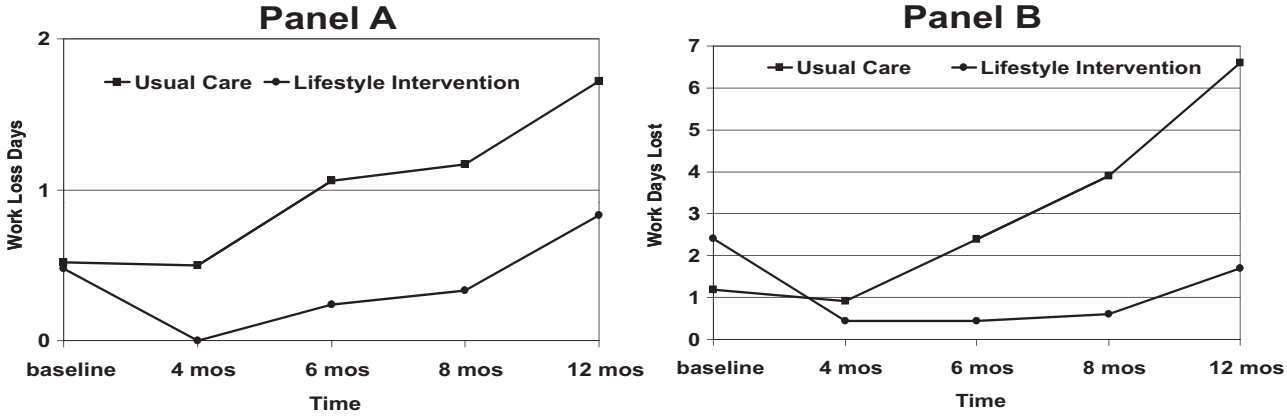

Fig. 3. Mean cumulative work days lost over the intervention year by group and presence of baseline depression. Panel A, participants who were not depressed at baseline. Panel B, participants who were depressed at baseline.

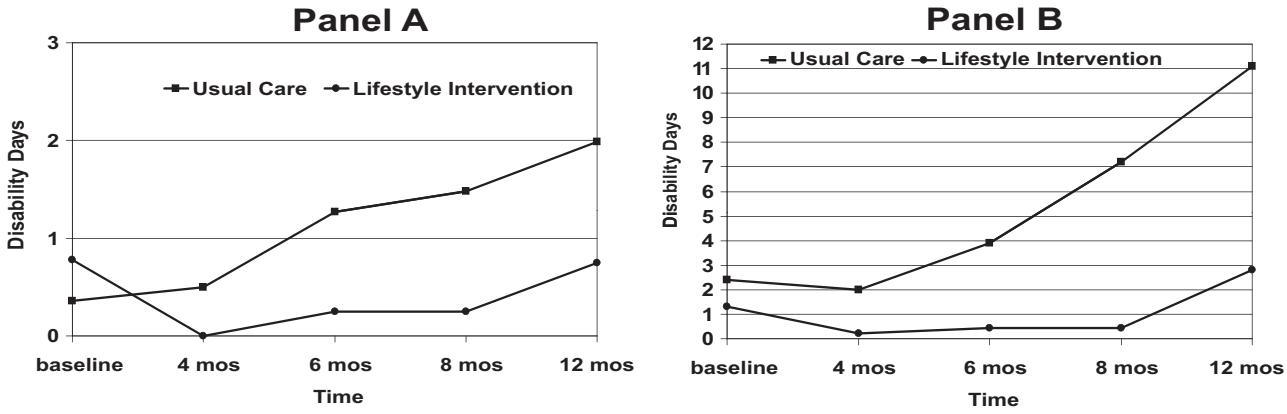

Fig. 4. Mean cumulative disability days lost over the intervention year by group and presence of baseline depression. Panel A, participants who were not depressed at baseline. Panel B, participants who were depressed at baseline.

group; due to small sample size in some strata, statistical significance testing was not performed. Figure 3 illustrates the impact of the LI on lost workdays among participants without (panel A) and with (panel B) baseline depression. Among participants without depression, LI participants averaged 0.83 (SD, 2.2) days per year whereas UC participants accumulated an average of 1.7 (SD, 3.8) days per year missed at work (Fig. 3, panel A). For those with depression, LI participants averaged 1.7 (SD, 3.0) days per year and UC participants accumulated an average of 6.6 (SD, 10.2) days per year missed at work due to diabetes and obesity (Fig. 3, panel B).

Figure 4 illustrates the impact of LI on disability and physical limitation days among participants without (panel A) and with (panel B) baseline depression. Among participants without depression, LI participants accumulated 0.75 (SD, 3.2) disability days per year whereas UC participants accumulated 2.0 (SD, 5.2) disability days per year. (Fig. 4, panel A). For those with depression, LI participants accumulated 2.8 (SD, 4.4) disability days per year whereas UC participants averaged 11.2 (SD, 13.5) disability days per year (Fig. 4, panel B).

Variables Associated With Lost Productivity and Disability Days

Cumulative workdays lost, while not associated with baseline body mass index (BMI, $P = 0.14$), was associated with 12-month weight change (Spearman $r = 0.20$, $P < 0.05$), 12-month change in HbA1c ($r = -0.23$, $P \leq 0.05$), and baseline and 12-month change in health-related quality of life (Spearman $r = -0.35$, $P \leq 0.001$, and $r = -0.24$, $P \leq 0.01$, respectively). Health indicators such as breathing difficulty (Spearman $r = 0.31$, $P < 0.01$), baseline general health (Spearman $r = 0.31$, $P < 0.01$) and baseline bodily pain (Spearman $r = 0.23$, $P < 0.05$) were also associated but not the number of health conditions besides diabetes and depression.

Disability days were associated with baseline and 12-month weight change (Spearman $r = 0.18$, $P < 0.05$, and $r = 0.2$, $P < 0.05$, respectively) as well as baseline and change in health-related quality of life (Spearman $r = -0.52$, $P \leq 0.001$, and $r = -0.18$, $P \leq 0.05$,

respectively). Health indicators such as breathing difficulty (Spearman $r = 0.47$, $P < 0.01$), baseline general health (Spearman $r = 0.45$, $P < 0.01$), bodily pain (Spearman $r = 0.32$, $P < 0.01$), number of health conditions besides diabetes and depression (Spearman $r = 0.31$, $P < 0.001$), presence of coronary heart disease (Spearman $r = 0.19$, $P < 0.05$) were also associated with cumulative disability days.

Discussion

We found that the provision of a registered dietitian-led LI to people with diabetes and obesity reduced the risk of having lost workdays by 64.3% (95% CI = 20.3% and 84%) and disability days by 87.2% (95% CI = 49.9% to 96.7%), compared to those receiving usual medical care. These results provide further support for the addition of LIs to usual medical care for people with diabetes and obesity by reducing workdays lost and disability days as well as improving glycemic control, health-related quality of life, and health care utilization.[8,9] In addition, these results suggest that the addition of a LI for people with both diabetes and depression may be useful in reducing lost productivity and disability among this population[1,3,18]; however, larger studies are needed to verify this tentative observation.

Depression coexists in approximately 10% to 30% of people with diabetes.[19,20] In our study, depression coexisted in 24% of our sample. Both diabetes and depression are associated with substantial amounts of workdays lost and disability days.[1,18] In our study, participants with depression had five times the amount of workdays lost and more than seven times the amount of disability days as compared to participants without depression. In the stratified sample, the addition of a LI to usual medical care dampened the impact of depression on lost work and disability days, maintaining levels closer to the nondepressed subset who received usual medical care. The biological or psychological mechanism of how LI impacted productivity and disability remains unclear. Although weight loss was associated with an improvement in lost work and disability days, it is unclear whether the impact on productivity and disability is due to the weight loss alone or some other variable that was associated with both the intervention and weight loss such as improvement in quality of life. Our sample size precluded more complex modeling of these associations. Further study is needed to identify which factors of the intervention had the greatest impact on productivity and disability.

It has been shown that physical activity and other healthy lifestyle behaviors are associated with less depression and improved quality of life.[21,22] Further study is needed to explore how behavioral LIs impact productivity and disability.

It is challenging to compare the magnitude of the effect of the ICAN lifestyle program to other programs with respect to productivity and disability because of the differences in experimental design and methods. Worksite health programs while not typically having a control group and sometimes representing multiple interventions suggest that involvement in health promotion programs reduces absenteeism from 9% to 20%[4,5,7] and disability by 14% to 24%.[6,23] Using a similar metric for evaluating percent change, the ICAN lifestyle program produced a 52% reduction in lost productivity and a 62% reduction in disability days among non-depressed participants. It is likely that our program generated larger effects because we targeted people with high health-risks versus a healthier population. In addition, we asked participants to include days missed due to medical appointments, hospital or emergency care, and our definition of disability included days with physical limitations. Although these definitions most likely increased the absolute number of "days," they contribute to time without productive work and they were applied to both groups.

The main limitations of our analysis include self-reported outcome measures, limits to generalizability, and a relatively small sample size. Participants self-reported their days missed at work and disability days. Self-report of workday absences and disability days is standard practice in clinical trials[24] where work-related data is unavailable; however, it may be an overestimate of actual lost productivity and disability since people who take a half-day off from work to go to a doctor's appointment may have reported this as a full day. Our results may not be generalizable to multi-ethnic or uninsured populations since most participants were white and employed, but they do relate to a large percentage that constitute the US workforce. As with all clinical trials, volunteers may be healthier and more motivated to change behavior compared to eligible non-volunteers. However, LIs are always voluntary in practice and likely to be attractive to more motivated patients. Finally, the relatively small sample of 144 participants at baseline, with 118 completing the study, was insufficient to perform statistical testing after stratification by intervention group and presence of depression, or to discriminate and interpret between a complex interaction of covariates.

Our health care system is strained by the increasing prevalence and severity of chronic diseases such as diabetes and obesity. The societal and economic impact of diabetes and obesity in the workplace is significant, and this program offers one approach to reduce the morbidity and impairment in productivity of two major chronic conditions. Evidence-based and cost-effective interventions can help stem the tide of obesity and diabetes. Although LI is the cornerstone treatment of diabetes[12] and obesity,[11] access to providers of lifestyle care is severely limited by lack of reimbursement.[25] Given the growing costs of both diabetes and obesity

and the substantial burden to employers, a modest cost, evidence-based LI program which may reduce disability and workdays lost should be a welcome addition to usual medical care.

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