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Impact of a community-based lifestyle intervention program on health-related quality of life

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Abstract

Background—The presence of risk factors for type 2 diabetes and cardiovascular disease, or the conditions themselves, contributes to lower health-related quality of life (HRQoL) among adults. Although community-based lifestyle intervention programs have been shown to be effective for improving risk factors for these diseases, the impact of these interventions on HRQoL has rarely been described.

Purpose—To examine changes in HRQoL following participation in the Group Lifestyle Balance program, a community translation of the Diabetes Prevention Program lifestyle intervention for adults with pre-diabetes and/or the metabolic syndrome.

Methods—Participants enrolled in the 12-month, 22-session intervention program (N=223) completed the EuroQol Health Questionnaire (EQ-5D-3L) at baseline, 6, and 12 months. Linear mixed effects regression models determined change in EQ-5D-Visual Analog Scale (VAS) and Index scores post-intervention.

Results—Mean EQ-5D-VAS improved by +7.38 (SE=1.03) at 6 months and by +6.73 (SE=1.06) at 12 months post-intervention (both; $p<0.0001$). Mean changes in EQ-5D Index values were +0.00 (SE=0.01; *NS*) and +0.01 (SE=0.01; $p<0.05$), respectively. Adjusted for age, baseline score, and achieving intervention goals, mean change in EQ-5D-VAS was +11.83 (SE=1.61) at 6 months and +11.23 (SE=1.54) at 12 months (both; $p<0.0001$). Adjusted mean change in EQ-5D Index value was +0.04 (SE=0.01) at 6 months and +0.05 (SE=0.01) at 12 months (both; $p<0.01$).

Conclusions—Participation in a community lifestyle intervention program resulted in improved HRQoL among adults with pre-diabetes and/or the metabolic syndrome. These benefits to

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Informed Consent: Participants provided written and informed consent prior to enrolling in the study.

HRQoL, together with improved clinical and behavioral outcomes, should increase the appeal of such programs for improving health.

Keywords

Physical activity; weight; type 2 diabetes prevention

Introduction

Adults with increased risk for type 2 diabetes and cardiovascular disease (CVD) report lower health-related quality of life (HRQoL) than healthy adults [1–6]. As an example, individuals with elevated blood glucose report reduced HRQoL relative to individuals with normal glucose whether diabetes is present [2,3] or not [4,7]. Low physical activity (PA) levels and obesity, which contribute to risk for type 2 diabetes and CVD [8,9], have also been shown to be related to poorer HRQoL [10,7]. Thus, improving PA levels, weight, and type 2 diabetes and CVD risk factors as part of a behavioral lifestyle intervention should result in an improved HRQoL among adults at risk for cardio-metabolic diseases.

By increasing participants' PA levels and achieving successful weight loss [11], the Diabetes Prevention Program (DPP) lifestyle intervention was able to reduce the incidence of type 2 diabetes and the metabolic syndrome among adults with impaired glucose tolerance [12,13]. In addition to decreasing the development of type 2 diabetes, the DPP lifestyle intervention resulted in improved HRQoL among participants in areas of general health, physical function, body pain, and vitality [14]. Participants in the lifestyle intervention continued to experience HRQoL benefits up to 3 years following enrollment [15].

The DPP lifestyle intervention has since been modified and translated in a variety of community settings, including health-care facilities, senior centers, churches, and workplaces. Although these community intervention programs have been shown to be successful for weight loss [16–18] and increasing PA levels [19–22], little is known as to whether participants in these programs also experience improvements in HRQoL. This investigation evaluated HRQoL among participants in the Healthy Lifestyle Project, a randomized trial of a behavioral lifestyle program adapted from the DPP lifestyle intervention for translation in the community setting. Specifically, it tested the secondary hypothesis that participants in the lifestyle intervention experience beneficial changes in HRQoL after 6 months compared to wait-control counterparts. Further analysis examined whether beneficial changes in HRQoL occurred after 12 months of intervention, complementary to observed changes in the primary outcome of weight and other secondary outcomes of physical activity and risk factors for type 2 diabetes and CVD that have been previously reported [23,24].

Methods

This investigation extends previous work of an NIH funded intervention trial, the Healthy Lifestyle Project (PI: Dr. A. Kriska), evaluating the effectiveness of a DPP-based lifestyle intervention translated for use in diverse community settings. The study intervention program, Group Lifestyle Balance™ (GLB) [25,21], is a 12-month, 22-session adaptation

of the DPP lifestyle intervention that was developed by members of the original DPP Lifestyle Resource Core who are now faculty of the University of Pittsburgh Diabetes Prevention Support Center (DPSC). The DPP-GLB curriculum is approved for application to the CDC National Diabetes Prevention Recognition Program [26,27], which establishes standards and operating procedures for lifestyle interventions to assure program quality. The study investigators partnered with a local worksite and three senior community centers to implement the DPP-GLB Program. The study protocol was approved by the University of Pittsburgh Institutional Review Board.

Study Design

The Healthy Lifestyle Project employed a randomized six-month delayed wait-control design. Participants were randomized to begin the DPP-GLB Program immediately (*immediate*) or after a 6 month delay (*delayed*) in a 2:1 ratio by intervention site. This design mimics the real-life circumstances faced by community-based programs where resources may limit the frequency and capacity of programming and participants may experience a delay before a program is available for them to enter. A randomization sequence using block lengths of six was generated with a SAS 9.3 (SAS Institute, Inc., Cary, NC) program by a single study researcher. Allocation assignments were placed in a sealed envelope by a second study researcher who was blinded to the randomization sequence and distributed the sealed envelopes to each participant at the end of their baseline assessment visit.

Study Population

Recruitment and screening were conducted at a large corporate worksite and three senior community centers in socio-economically diverse neighborhoods in the Pittsburgh metropolitan area between September 2010 and December 2011 [28,29]. Interested adults (age ≥ 18 years) completed a fasting fingerstick for glucose and lipids and anthropometric measurements to determine eligibility. Eligible adults had a BMI ≥ 24 kg/m² (≥ 22 kg/m² for Asians) and pre-diabetes (American Diabetes Association criteria; [30]) and/or the metabolic syndrome (National Cholesterol Education Program ATP-III criteria; [31]), or treatment for hyperlipidemia (i.e. taking a cholesterol-altering medication) and at least one additional component of the metabolic syndrome. Individuals with a previous diagnosis of type 1 or type 2 diabetes or with screening values in the diabetes range [30] were excluded and directed to their primary care physician for follow-up care. Women who were pregnant, planning to become pregnant, or breast feeding at the time of screening were not eligible. Eligible and interested individuals provided written informed consent before enrolling in the study.

Intervention

The 12-month, 22-session DPP-GLB program has been described previously [25,32] and materials and implementation support are available online (www.diabetesprevention.pitt.edu). In brief, the DPP-GLB program promotes goals of increasing PA to at least 150 minutes of moderate intensity per week and achieving a 7% weight loss. Individuals were given calorie goals (1,200–2,000 kcal/day) and fat gram goals

(33–55 grams/day) based on starting weight to facilitate the loss of 1–2 pounds per week, but goals could be modified to support progress. Participants were encouraged to self-monitor diet, PA, and weight information daily for which they received regular feedback and coaching throughout the 12 month program.

At time of randomization, participants were given the option of completing the first 12 weekly DPP-GLB sessions in face-to-face groups or to participate via individually-viewed DVD with follow-up contact with a lifestyle coach. The remaining 10 bi-weekly and monthly sessions were delivered as face-to-face groups. All sessions/contacts were facilitated by a DPSC trained lifestyle coach employed by the study, two of which were registered dietitians and one was an exercise specialist. Each face-to-face session lasted approximately 60 minutes and each telephone contact was approximately 15 minutes long. General health information was mailed to *delayed* participants intermittently during the six month wait-control period. After the 6 month wait, *delayed* participants received the DPP-GLB program in its entirety.

Assessment

All measures were collected by trained research staff following a standard protocol at randomization (baseline), and at 6 and 12 months from start of intervention. Assessors were not blinded to participant randomization assignments. Participants in the *delayed* arm attended one additional assessment visit at 6 months following randomization, repeating baseline measures, to capture changes in outcomes at the end of the 6 month wait-control period. For the purposes of this evaluation, pre-intervention assessment visit refers to randomization (baseline) and post-intervention assessment visits refer to the time since an individual's start of the intervention (6 and 12 month), regardless of randomization assignment. Participants received a \$25 gift card for each clinical assessment visit completed, but did not receive compensation for attending intervention sessions.

Health-Related Quality of Life

Participants completed the self-administered EuroQol (EQ-5D-3L) Health Questionnaire [33] to capture current health states at time of assessment. The instrument has been used in a variety of patient populations [34–36] and is comparable to other widely used HRQoL assessment instruments [36,34,37]. On the EQ-5D-3L, participants indicated whether they had “no”, “some”, or “extreme” problems in five different health dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The descriptive measure was scored as one Index value, calculated using the Crosswalk Index Value Calculator for the United States available from EuroQol (www.euroqol.org). The index values are anchored at a health state of “no” problems in the 5 dimensions=1 and dead=0. The EQ-5D-3L has been previously evaluated by Dolan et al. for logical consistency (extent to which better health states receive a higher index score; 83–92%), construct validity, and test-retest reliability (Pearson's $r=0.55-0.83$) [38]. The mean U.S. EQ-5D Index value has been estimated from a national sample of approximately 53,600 non-institutionalized adults to be 0.87 [35]. Participants were also asked to rate their current health state on a visual analog scale (EQ-5D-VAS) of 0 “worst imaginable health state” to 100 “best imaginable health state”.

The U.S. average for the EQ-5D-VAS is estimated to be 79.2 based on a national sample of 13,600 non-institutionalized adults [10].

Perceived Health

In a sub-sample of community center participants, a second self-administered survey that was developed by the current study researchers asked participants to indicate if they felt their health state had worsened, remained the same, or improved during the prior 6 months. This question was used to determine if indicators of current health state on the EQ-5D reflected usual health during the intervention time frame.

Weight

Participants were weighed in light clothing and without shoes on a digital physician scale (DETECTO® PD100).

Physical Activity

Research staff administered the Modifiable Activity Questionnaire (MAQ) to capture detailed estimates of past-month leisure PA, calculated from frequency and duration of 40 common recreational activities. Each activity was weighted in metabolic (MET)-equivalents using a compendium of physical activities [39], and leisure PA was expressed in MET-hours per week. The MAQ is a reliable and valid instrument for use in adult populations [40–45].

Statistical Analysis

Univariate linear regression models and Mantel-Haenszel Chi-square test for trend compared change in variables of interest during the 6 month wait-control period between the two intervention arms. Pearson's correlation coefficient was used as an indicator of the test-retest reliability of the EQ-5D-VAS ($r=0.54$) and Index ($r=0.52$) scores for the wait-control arm ($n=71$). Pre-post intervention changes in HRQoL were calculated as the difference in EQ-5D-VAS and Index values between the post-intervention assessment visit (6 and 12 months) and study randomization (baseline) for each individual. Repeated measures analyses with participant defined clusters were conducted using mixed-effects linear regression models. Intention-to-treat analysis using all available participant data points from completed assessments (baseline, 6 and 12 months) was used to generate restricted maximum likelihood-based estimates for change in the outcome measures. Residuals were examined to verify that model assumptions were fulfilled. The intraclass correlation coefficient (ICC) for within-subject clusters ranged from 0.32–0.83 for the outcomes modeled. A within-subject covariance structure was selected with compound symmetry having the best fit to account for the within-subject clustering of data and provide robust estimates of standard errors for fixed effects [46].

In unadjusted and multivariate adjusted regression modeling, socio-demographic factors including age, sex, and educational attainment; program features including intervention site and delivery mode (face-to-face group or DVD), and indicators of meeting the programs goals for 7% weight loss and 150 minutes of PA were tested for effects on estimated change in EQ-5D-VAS and Index values. A binary indicator for calendar season at time of

assessment visit (summer or winter) was included in the models to adjust for observed seasonal impact on both PA level and estimates of PA change during intervention in this sample (unpublished data). Covariates were selected for testing in adjusted models based on univariate effects ($p < 0.25$) and goodness of fit evaluated by AIC and BIC criteria. Intervention site was included as a random effect in the unadjusted and adjusted models due to within-site clustering of the data for the outcomes reported ($ICC = 0.03-0.18$). In a stratified analysis, separate unadjusted linear mixed models were used to estimate the mean change in EQ-5D-VAS score and Index score for individuals who reported a baseline value above/below the reported U.S. averages [10,35].

Distributions of perceived change in health over the previous 6 months were evaluated with Bowker's Test of Symmetry under the null hypothesis of symmetric cell proportions in a 3×3 contingency table. An alpha of 0.05 was used to determine statistical significance. All analyses were performed in SAS 9.4 (SAS Institute, Inc., Cary, NC).

Results

The Healthy Lifestyle Project enrolled a total of 223 participants from the worksite and three community centers. Successful changes in weight and PA levels have been documented across all intervention sites [24,47,23], allowing the combination of participants from the four intervention sites for these analyses. In total, 93.7% of participants were non-Hispanic Whites, 62.3% of participants were female, 65.9% reported working full- or part-time, and 63.2% of participants reported obtaining at least a college degree. The mean baseline age was 58.4 [standard deviation (SD) 11.5] years and the mean baseline weight was 208.8 (SD=41.8) pounds. The median baseline self-reported PA was 7.88 [Interquartile range (IQR) 2.19–16.69] MET-hours per week. Overall, participants reported a mean baseline EQ-5D-VAS value of 71.5 (SD=16.6), which is slightly lower than the estimated U.S. average of 79.2 [10]. The overall mean baseline EQ-5D index value was 0.91 (SD=0.09) at baseline, indicating a generally healthy sample based on the estimated U.S. average of 0.87 [35]. Furthermore, 39% of the sample reported “no” problems in the 5 questionnaire dimensions (EQ-5D index value of 1.00). Demographic and clinical characteristics of the *immediate* and *delayed* arms were similar at baseline.

6-Month Wait-Control Comparisons

The delayed wait-control design allowed for comparisons between the *immediate* and *delayed* arms at the end of the first 6 months, during which time the *immediate* participants received 6 months of lifestyle intervention and the *delayed* participants served as wait-controls. After 6 months of intervention for the *immediate* participants, they achieved significantly greater improvements in weight, PA levels, EQ-5D-VAS, and EQ-5D Index scores than *delayed* participants (Table 1). The model-estimated least squares mean (standard error) intervention effects were -9.23 (1.37) lbs. for weight, $+6.72$ (2.44) MET-hours/week for PA, $+6.55$ (2.10) points for EQ-5D-VAS, and $+0.03$ (0.01) points for EQ-5D Index score (all; $p < 0.05$). Similarly, 61.3% of participants in the *immediate* arm compared to 14.3% of participants in the *delayed* arm reported an improvement in usual health over the past 6 months on the self-reported perceived health survey (between group $p < 0.0001$).

Pre-Post Intervention Behavioral and Health-Related Quality of Life Changes

Immediate and *delayed* randomized arms were combined to evaluate pre-post intervention changes in weight, PA level, and HRQoL since the behavioral and clinical outcomes improved similarly in both randomized arms at 6 and 12 months from start of intervention relative to baseline (data not shown). Retention at post-intervention assessment visits was 91.5% (n=204) at 6 months and 84.8% (n=189) at 12 months. Baseline HRQoL, PA level, and weight did not differ between those who did or did not attend follow-up assessments.

The DPP-GLB lifestyle intervention resulted in significant improvements in participant health behaviors at 6 and 12 months post-intervention. Participants achieved a significant reduction in mean weight of -11.9 (SD=11.3) pounds (-5.7%) and -11.1 (SD=13.9) pounds (-5.4%) at 6 and 12 months, respectively (both; $p<0.0001$). Overall, 35.5% of participants achieved the 7% weight loss goal at 6 and 12 months, respectively. Participants increased mean leisure PA by +7.01 [standard error (SE)=1.74] MET-hours/wk at 6 months and by +6.16 (SE=1.74) MET-hours/wk at 12 months (both; $p<0.0001$) after adjusting for season. Self-reported PA levels indicated that 75.4% and 67.2% met the PA goal at 6 and 12 months, respectively. During the intervention, participants also experienced improvements in type 2 diabetes and cardiovascular disease risk factors including waist circumference, hemoglobin A1c, total and HDL cholesterol, triglycerides, and systolic and diastolic blood pressure, which have been previously reported [48,24].

Examining changes in HRQoL reported on the EQ-5D-VAS, participants experienced a significant unadjusted model-estimated mean increase of +7.38 (SE=1.03) points at 6 months and +6.73 (SE=1.06) points at 12 months (Fig. 1). As the baseline EQ-5D-VAS values represented adults with varying levels of HRQoL, further analysis was conducted to examine the changes in HRQoL for those who started with low EQ-5D-VAS scores (defined here as having an EQ-5D-VAS score below the estimated U.S average of 79.2). When limited to participants with low baseline EQ-5D-VAS scores, the improvement in the score was not only significant but nearly doubled in magnitude with increases of +13.69 (SE=1.26) points at 6 months and +12.27 (SE=1.32) points at 12 months (Fig. 1).

The observed changes in EQ-5D Index values during intervention were minimal. The unadjusted model-estimated mean change in EQ-5D-index value was +0.00 (SE=0.01) points at 6 months ($p=0.65$) and +0.01 (SE=0.01) points at 12 months ($p=0.05$). When limited to participants who reported lower baseline EQ-5D index values (defined here as below the estimated U.S. average of 0.87), significant improvements of +0.04 (SE=0.01) points at 6 months ($p<0.0001$) and +0.05 (SE= 0.01) points at 12 months ($p<0.0001$) were observed.

During the intervention, the sub-sample of community center participants who completed the self-report survey also indicated significant improvements in perceived change in health over the prior 6 months (Fig. 2). At 6 and 12 months, 67.5% and 59.8% of participants reported 'improved' health, respectively ($p<0.0001$).

Adjusted Estimates of Pre-Post Intervention Health-Related Quality of Life Changes

In order to examine how HRQoL was impacted by behavioral modifications, mean estimates of change in EQ-5D-VAS and Index values were adjusted for meeting program goals of 7% weight loss and 150 minutes moderate intensity PA, as well as potentially modifying demographic factors, program features, and respective baseline EQ-5D scores. In multivariate linear mixed model analysis (Table 2), the adjusted mean change estimate for the EQ-5D-VAS score was +11.83 (SE=1.61) points at 6 months and +11.23 (SE=1.54) points at 12 months (both; $p<0.0001$). There were significant and independent effects of meeting the 7% weight loss [+5.21 (SE=1.36)] and 150 minute per week PA [+3.74 (SE=1.37)] goals on improvement in EQ-5D-VAS (both; $p<0.01$). Program features, including intervention site and delivery mode (face-to-face group or DVD), did not significantly affect the estimated changes in EQ-5D-VAS scores observed.

In stratified analysis of the estimated mean change in EQ-5D-VAS, age and baseline EQ-5D-VAS score (as demonstrated in Figure 1) were significant covariates ($p<0.01$), and there was a significant interaction between age and baseline score ($p=0.03$). Specifically, the group of individuals with a lower baseline EQ-5D-VAS score (<79.2) were significantly younger [56.1 (SD= 10.8) years] than those with higher (≥ 79.2) baseline scores [62.2 (SD= 11.5) years; between group $p<0.0001$]. Among participants reporting lower baseline EQ-5D-VAS scores, those less than age 60 experienced greater improvement compared to those over age 60 [mean age effect= +7.65 (SD=2.20); $p<0.01$]. Among individuals with higher baseline EQ-5D-VAS scores, both age groups reported similar change during intervention [mean age effect=+1.22 (SD=1.86); NS]. The effects of sex and educational attainment on change in EQ-5D-VAS were not significant ($p>0.05$).

In multivariate linear mixed model analysis (Table 2), the adjusted mean change estimate for EQ-5D Index values was +0.04 (SE=0.01) at 6 months and +0.05 (SE=0.01) at 12 months (both; $p<0.001$). There were significant independent effects of reported baseline Index score above the estimated U.S. average [-0.08 (SE=0.01); $p<0.0001$] and of age greater than or equal to 60 years [-0.03 (SE=0.01); $p=0.01$]. In this adjusted model, the effects of achieving program goals for 7% weight loss or 150 minutes per week of moderate PA on change in EQ-5D Index values were not statistically significant.

Discussion

This investigation is one of the first to describe changes in HRQoL among participants in a community DPP-lifestyle intervention program using a randomized-control design. Participants who took part in the intervention reported significantly greater improvements in HRQoL compared to their delayed wait-control counterparts at 6 months. In addition, combining both randomized groups, participants in the DPP-GLB lifestyle intervention program experienced improved HRQoL as well as significant weight loss and increased physical activity at 6 and 12 months post-intervention. These results indicate that there are additional benefits to community lifestyle intervention programs beyond the improvement of risk factors for type 2 diabetes and CVD, and demonstrate a considerable potential to improve public health when such programs are delivered in community settings.

Measured by the EQ-5D-VAS, participants in this effort showed significant improvement in HRQoL at 6 and 12 months when compared to baseline. Limiting the analyses to participants whose baseline EQ-5D-VAS scores were below the reported U.S. average of 79.2 at baseline [10], the magnitude of improvement almost doubled compared to that which occurred in the participants as a whole. An interesting finding of this study was that older adults who reported lower EQ-5D-VAS at baseline had less improvement as a result of intervention than younger adults did, suggesting that they may have been in poorer health than their younger counterparts who also reported lower baseline scores. There is no reported standard Minimally Important Difference (MID) for EQ-5D-VAS for those with pre-diabetes, however values for other conditions range from 7–12 [49,50]. It is thus likely that the estimated mean EQ-5D-VAS increases at 12 months of 6.73 among all participants, and 12.27 among those with lower scores at baseline, signify overall meaningful improvements in HRQoL at the group level, with variation at the individual level.

In contrast to the EQ-5D-VAS, there was minimal improvement in EQ-5D-index values after 12 months of intervention. The incremental change observed may be due to the relatively high baseline value of 0.91 in this sample compared to the estimated U.S. average of 0.87 [35]. Additionally, the EQ-5D has been shown to be less responsive when many individuals report no health problems in the 5 dimensions (i.e. EQ-5D index value of 1.00) [51,34], which was seen in this sample. However, significantly greater improvement in the EQ-5D index value of 0.05 was observed during the intervention when analyses were limited to the subset of participants with lower index values at baseline. Although an MID has not been reported for pre-diabetes, the EQ-5D index value MID reported for other conditions ranges from 0.00–0.15 [50,36,51,37], with an average of 0.07 across conditions [37]. Further use of the EQ-5D-3L as an instrument to assess HRQoL in persons with pre-diabetes and/or the metabolic syndrome is needed to better understand what changes in EQ-5D index values translate to clinically meaningful improvements in HRQoL in this population.

The results of this study are similar to two previous reports in which HRQoL was measured by different instruments. In a 6-month therapeutic lifestyle intervention for middle aged women with the metabolic syndrome, Oh et al. reported improved HRQoL, assessed by the Medical Outcome Study Short Form-36 (SF-36) in lifestyle intervention participants relative to the control group [52]. Cezaretto et al. demonstrated success of a lifestyle intervention for improving HRQoL in a 9-month program for individuals with pre-diabetes or the metabolic syndrome. Investigators reported significant improvements in several of the SF-36 domains for the intensive lifestyle intervention group, compared to baseline, with greater improvement in the intervention group than the control [53]. Additionally, Cezaretto et al. reported that changes in SF-36 scores correlated with improvements in diabetes risk factors. Coupled with the findings from the current investigation, it can be suggested that lifestyle intervention shows promise for improving HRQoL among individuals with pre-diabetes and the metabolic syndrome.

Though the findings of this study are supportive of the role of behavioral lifestyle changes in improving HRQoL, some limitations must be addressed. First, the EQ-5D-3L captures current health states in 5 specific dimensions, and may not represent overall health. In an attempt to examine the relationship to usual health, a second perceived health survey was

administered in the community center setting that captured more global health, with similar improvements noted. Second, an expected within-subject cluster effect and a smaller within-site cluster effect on the outcomes reported was observed over time. Although accounted for in the regression models, some residual cluster effects in the data may have impacted the model estimates and standard errors presented. Additionally, the interpretation of the findings may be affected by healthy volunteer bias [54]. Participants who volunteered to attend the community-based lifestyle program may have had generally better health and therefore better HRQoL than those who did not volunteer. However, the sub-analysis which demonstrated that those with lower baseline HRQoL had greater improvements on the EQ-5D-VAS and Index measures provides evidence that the lifestyle intervention may be equally as effective, if not more effective, for those who did not volunteer due to poorer health.

Conclusion

Identifying programs that reduce the risk for chronic disease and positively impact HRQoL may be beneficial in improving health in an aging U.S. population. With the physiologic benefits of type 2 diabetes and cardiovascular disease risk reduction through lifestyle change well-established in clinical [12,55] and translational settings [19,56,21,57,58], these findings help strengthen the case for increasing the use of HRQoL assessment tools in community lifestyle interventions. Building on these results, future studies should include measurement of HRQoL and explore relationships between HRQoL and specific clinical and behavioral outcomes in translational diabetes prevention programs.

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Fig. 1.
Linear Mixed Model Estimated Pre-Post Intervention Mean Health Rating (EQ-5DVAS) at 6 and 12 Months

†Solid horizontal line indicates reported U.S. Average=79.2

Figure 2.
Participants' Pre-Post Intervention Perceived Health Change Over the Past 6 Months
Reported at Baseline, 6, and 12 Months (N=117)

Table 1

Model-estimated Least Squares Mean Change in Weight, Physical Activity, and Health-Related Quality of Life Outcomes for Participants Enrolled in Intervention Compared to 6 Month Wait-Control

	Immediate-start (n=138)		Delayed-start (n=71)		Between Group	
	Baseline; Mean (SD)	6 Month Change; Mean (SE)	Baseline; Mean (SD)	6 Month Change; Mean (SE)	Intervention Effect; Mean (SE)	p-value
Weight (lbs)	208.4 (44.3)	-11.2 (0.80)	207.2 (38.1)	-1.93 (1.12)	-9.23 (1.37)	<0.0001
Leisure PA (MET-hours per week; MAQ)	14.30 (17.30)	+18.75 (1.76)	10.09 (11.17)	+12.23 (2.44)	+6.72 (3.01)	0.03
Health Rating (EQ 5D- VAS)	71.8 (17.0)	+7.36 (1.23)	70.7 (16.7)	+0.8 (1.71)	+6.55 (2.10)	0.002
Index Value (EQ-5D)	0.90 (0.09)	+0.01 (0.01)	0.92 (0.08)	-0.01 (0.01)	+0.03 (0.01)	0.03

EQ-5D, EuroQol 5 Dimension; MAQ, Modifiable Activity Questionnaire; MET, metabolic equivalent; SD, standard deviation; SE, standard error; VAS, Visual Analog Scale

Table 2
Fixed Effects^a for Linear Mixed Effects Regression Models Estimating Changes in Health-related Quality of Life

Model	Parameter	EQ-5D-VAS		EQ-5D-Index Value	
		6 Months	12 Months	6 Months	12 Months
Unadjusted	Intercept	+7.38 (1.03) *	+6.73 (1.06) *	+0.00 (0.01)	+0.01 (0.01) *
	Intercept	+11.83 (1.61) *	+11.23 (1.54) *	+0.04 (0.01) *	+0.05 (0.01) *
	Age 60+ years	-7.47 (1.97) *		-0.03 (0.01) *	
	Baseline Score Above Average ^b	-16.02 (2.12) *		-0.08 (0.01) *	
	Age * Baseline Score Interaction	+6.21 (3.08) *		0.00 (0.02)	
	Achieve 7% Weight Loss Goal	+5.21 (1.36) *		+0.00 (0.01)	
Adjusted	Achieve 150 minute per week Physical Activity Goal	+3.74 (1.37) *		+0.01 (0.01)	

^aFixed Effects presented as mean change estimates with standard errors (parentheses)

^bReported U.S. averages: EQ-5D-VAS=79.2; EQ-5D Index Value=0.87

* $P < 0.05$