

**LONG-TERM MAINTENANCE OF HEALTHY LIFESTYLE PRACTICES IN DPP  
TRANSLATION: EVALUATION OF ADHERENCE, BARRIERS, AND STRATEGIES**

by

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**ABSTRACT**

The Diabetes Prevention Program (DPP) demonstrated that type 2 diabetes can be prevented or delayed through behavioral lifestyle modification. Due to the success of the DPP lifestyle intervention, multiple effective translation efforts have been completed in the community; however long-term data regarding healthy lifestyle practices after such intervention is lacking. The current study aimed to assess long-term adherence and barriers to healthy lifestyle goals among participants who had completed a DPP translation study. In addition, participants' perception regarding strategies for long term maintenance of healthy lifestyle practices was assessed.

A total of 156 individuals who attended  $\geq 4/16$  of the adapted DPP program core sessions and had not formally withdrawn from the study were contacted and asked to complete a brief survey; 73 (47%) individuals completed the survey and 65 (42%) had data for all assessment time-points (baseline, 6MO, 12MO and follow-up 24-36MO). Mean weight loss for this group at 6-months from baseline was 6.2 kg (-6.6%), and at 12-months was 6.1 kg (-6.4%); self-reported weight at follow up was 4.8 kg (-5.1%). Approximately 62% of participants reported increased physical activity levels at 6-months from baseline (+95.0 min/week (60.0, 135.0)), 60% at 12-months (+90.0 min/week (60.0, 150.0)), and 48% at follow-up (+90 min/week (45.0, 225.0)).

Frequently reported barriers for maintaining or reaching healthy eating and physical activity goals were self-motivation and time/scheduling issues; injury/illness was another frequently reported barrier for physical activity. The strategies reported most frequently as useful for long-term maintenance of healthy practices included in-person meetings and self-monitoring of fat/calorie intake.

These results suggest that although weight loss and increased physical activity continued to be observed over time in this group, some weight regain and decrease in physical activity occurred. The current study is important from a public health perspective as it is the first DPP-based translation follow-up study to provide long-term information about adherence and perceived barriers in individuals who have completed an adapted DPP intervention 24-36 months from baseline. This information and the strategies identified will aid in development of programs to promote long-term healthy lifestyle practices after completing a community DPP intervention.

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## **PREFACE**

I would like to thank my mentor Dr. Kaye Kramer for her wisdom, guidance, and support throughout the Master's program, and for providing me with the unique opportunity to develop and carry-out my own research study. I would also like to thank my essay committee members Dr. Andrea Kriska and Dr. Vincent Arena for their insight and thoughtful comments. Additionally, a big thank you goes to my colleagues at the Diabetes Prevention Support Center for all of their help along the way.

Finally, I would like to thank my family for their unconditional love, support, and encouragement. A special thank you to my parents for all of the sacrifices they made for me while I was growing up and throughout my studies, without them I would not be where I am today.

## **1.0 INTRODUCTION**

The prevalence of diagnosed diabetes in the United States (US) has increased by approximately 176 percent since 1980, making diabetes one of the most serious public health concerns of our time [1]. Most recent US statistical data estimates that 29.1 million individuals have diabetes, of which 21 million have received a formal diagnosis [2]. Furthermore, the number of individuals with diabetes is projected to more than double in the upcoming decades [3]. The driving force behind this increase is type 2 diabetes, which is the most common form of diabetes and accounts for 90-95% of all cases [2]. Symptoms of type 2 diabetes may not be immediately present and often go unnoticed for a long period of time. If left untreated, further health complications may develop such as cardiovascular disease, complications with vision including blindness, kidney disease, amputations (type 2 diabetes accounts for approximately 60% of non-traumatic lower-limb amputations), and other disabilities [2].

In addition to these serious health consequences, diabetes also poses a significant economic burden in the US. In 2012 an estimated \$245 billion was spent on direct and indirect diabetes-related expenditures. Included were \$176 billion in medical costs, i.e. hospital inpatient care, prescription medications towards treatment, anti-diabetic agents and diabetic supplies, and \$69 billion in non-medical expenditures including reduced productivity during work, inability to work, and lost productivity related to diabetes-related mortality [4]. If the current trends continue at the same pace these expenditures are projected to rise in billions of dollars by the year 2034 [4,5].

While the number of people with diabetes is alarming, of even greater concern are the additional 86 million adults in the US estimated to be at increased risk for developing type 2 diabetes with a condition called pre-diabetes [2]. Pre-diabetes is defined as having impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT), categorized by elevated blood glucose levels, which are above the defined normal threshold but below the defined threshold for a formal diagnosis of diabetes [6]. Pre-diabetes generally has no observable symptoms thus an individual may be unaware of having this condition. A diagnosis of pre-diabetes is determined through blood tests to evaluate the concentrations of glycated hemoglobin (Hemoglobin A1C or HbA1C) and/or fasting blood glucose, and/or a 2-hour, 75g glucose load, oral glucose tolerance test (OGTT).

Criteria used to define pre-diabetes varies slightly. According to the American Diabetes Association, pre-diabetes is considered when glycated hemoglobin is between 5.7 and 6.4 percent [7, 8], fasting plasma glucose concentrations are between 100 and 125 mg/dL or 5.6 and 6.9 mmol/L, and/or an OGTT is between 140 and 199 mg/dL or 7.8 and 11 mmol/L [7, 8].

Alternatively, according to the World Health Organization, pre-diabetes is considered when glycated hemoglobin is between 5.7 and 6.4 percent [9], fasting plasma glucose concentrations are between 110 and 125 mg/dL or 6.1 and 6.9 mmol/L, and/or an OGTT is between 140 and 199 mg/dL or 7.8 and 11 mmol/L [9].

Another condition that increases the risk for developing type 2 diabetes is the metabolic syndrome [10], which is a constellation of risk factors that includes elevated plasma glucose concentration and insulin resistance, abdominal obesity, high blood pressure, elevated triglycerides, and reduced high-density lipoprotein (commonly referred to as “good” cholesterol, HDL). Following the National Cholesterol Education Program Adult Treatment Panel III, a diagnosis is determined when 3 out of these 5 components are met [11]. Currently, 22.9% of adults in the US are estimated to have the metabolic syndrome [11].

In response to the increase in prevalence of type 2 diabetes, health policy makers have asked that additional efforts be made toward the prevention of type 2 diabetes [12]. Early research studies attempted to demonstrate effective strategies for delaying or preventing the onset of type 2 diabetes via drug therapy [13, 14, 15, 16, 17], but were generally not successful in part due to limited sample sizes. More recently, several notable randomized clinical trial (RCT) research studies provided strong evidence for the prevention or delay of development of type 2 diabetes through behavioral lifestyle modification [18, 19, 20, 21, 22], some of which compared lifestyle modification to drug therapy [20, 22].

One of the largest of these studies, the Diabetes Prevention Program (DPP), was a national, multi-center, RCT study funded by the National Institutes of Health (NIH) designed to evaluate strategies to prevent or delay the onset of type 2 diabetes [20]. The DPP utilized three study arms: an intensive lifestyle modification program, standard lifestyle modification and treatment with the anti-diabetic drug metformin (850 mg twice daily), or standard lifestyle modification and treatment with a placebo (taken twice daily). The lifestyle modification study arm was a 24-week, 16-lesson curriculum, which focused on achieving a healthy diet, exercise, and behavior modification to help participants achieve outlined program goals: 7% weight loss and 150-minutes of moderate intensity physical activity (PA) per week.

In total, 3,234 high risk (with IGT), non-diabetic adults, participated in the DPP study. Participants were eligible for this study if the following inclusion criteria were met:  $\geq 25$  years old, body mass index (BMI)  $\geq 24$  ( $\geq 22$  in Asians), and a fasting plasma glucose concentration of 95-125mg/dl and a two hour 75-g oral glucose load of 140-199 mg/dl. These values followed the 1997 American Diabetes Association (ADA) guidelines for elevated glucose. Alternatively, participants were not eligible for the study if the following exclusion criteria were met: taking glucose tolerance altering medication or illnesses that would ultimately risk the health or safety of the participant during the study [20].

Following the success of the DPP lifestyle intervention there have been many translation efforts conducted in various communities in the US. Translation efforts based on the original DPP lifestyle intervention include settings such as African American churches [23, 24, 25, 26, 27, 28], the YMCA [29, 30, 31, 32], universities [31], worksite [33, 34, 35, 36, 37], healthcare settings [38, 39, 40, 41, 42, 43, 44, 45, 46], and community centers [47, 48, 49, 50, 51], with ethnically/racial diverse study populations encompassing including African American, White, Native American, and Hispanic/Latino ethnic backgrounds. These translation interventions generally focused on improvements to weight, physical activity, diet, and type 2 diabetes associated risk factors.

Variations in intervention length existed in these translation efforts, with interventions ranging from 1.5 months [28], 2-4 months [23, 24, 25, 26, 27, 39, 41, 48, 49, 51], 6-12 months [30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 42, 44, 50], and 15-28 months [29, 45, 46, 47].

In general, these DPP translation efforts have reported varying levels of success in achieving lifestyle change goals in the short-term; however, few have studied long-term maintenance of healthy lifestyle goals. To date, only 6 DPP translation studies have followed participants for 24 months or more from baseline commencement of intervention [29, 33, 45, 46, 47, 49], with the longest follow up being 28 months from baseline [29]. For this reason, little is known regarding adherence and barriers to long-term maintenance of healthy lifestyle practices in maintaining such goals.

To the author's knowledge, only one study to date has examined this issue. Vanderwood et al. conducted a follow-up survey 24 months from baseline that assessed barriers to achieving or maintaining the weight loss goal outlined in the original intervention. Emotional eating, stress, exercise, eating out, work, and coping, were found to be significant barriers towards maintaining the weight loss goal [43]. Barriers for achieving physical activity goals were not reported.

The purpose of the current research study was to assess adherence to weight loss and physical activity goals at 24-36 months from baseline for participants who completed a one-year adapted DPP lifestyle intervention program. In addition the study aimed to determine potential barriers to reaching/maintaining the weight and physical activity goals and to also identify strategies to promote long-term healthy lifestyle practices. It is anticipated that this data will be very useful in understanding long-term maintenance of healthy lifestyle practices for at-risk individuals in community diabetes prevention efforts, and will facilitate the development of strategies to sustain such behavior.

## **2.0 STUDY METHODS**

### **2.1 STUDY DESIGN**

The current study was a follow-up study to the Diabetes Prevention Translation Project: the Healthy LIFESTYLE Program (Kriska, PI R18 DK081323-04), and utilized a simple cross-sectional study design. Through administration of a brief survey to participants who completed the original research study, the follow-up study assessed participant adherence to lifestyle goals outlined in the original intervention program, and barriers to dietary and physical activity goals. In addition participant feedback regarding strategies for long term maintenance of healthy lifestyle practices was collected.

### **2.2 THE HEALTHY LIFESTYLE STUDY**

The Healthy Lifestyle study was a group-based translation research study that utilized a delayed RCT study design. The purpose of the study was to evaluate an adaptation of the original DPP lifestyle intervention administered to participants in a version of his or her choice (standard face-to-face group format or a DVD version of the same lifestyle intervention program content) in diverse community settings: a worksite and three community centers.

The study randomized participants into one of two study arms: an immediate intervention group, which began intervention following the baseline assessment visit, or a delayed intervention group (control), which began intervention 6-months following the baseline assessment visit. The Healthy Lifestyle study utilized the Group Lifestyle Balance (GLB) program, a direct adaptation of the original DPP lifestyle intervention [52]. The GLB program is a one year program with the same goals as the original DPP; a 7% weight loss and engaging in 150 minutes/week of moderate intensity physical activity. Delivery of the GLB intervention included either a standard form of delivery, i.e. attending 12 weekly face-to-face group meetings provided by a trained lifestyle coach or delivery via DVD, in which participants watched a DVD and received weekly telephone calls from a trained lifestyle coach as well as monthly face-to-face meetings, for the first 12 sessions. After the initial 12 sessions, both intervention groups transitioned to monthly face-to-face group meetings, with a total of 22 sessions provided over the course of the year.

Recruitment and data collection took place in Allegheny County, Pennsylvania in two different settings: three community centers and one worksite. Each of the community centers offers various resources to community members ranging from educational and fitness classes to recreational areas.

Participants were eligible for the Healthy Lifestyle Study if they met the following inclusion criteria: non-diabetic but found to have either pre-diabetes [7, 8] and/or the metabolic syndrome [11] at the study screening, were  $\geq 18$  years old at the time of screening, BMI  $\geq 24$  kg/m<sup>2</sup> ( $\geq 22$  kg/m<sup>2</sup> for Asian background), or taking hyperlipidemia medications with either/or: a) systolic blood pressure  $\geq 130$  mmHg, b) diastolic blood pressure  $\geq 85$  mmHg, c) history of diagnosed hypertension, d) waist circumference  $> 40$  inches for males and  $> 35$  inches for females.

Participants were excluded from the Healthy Lifestyle Study if they were observed to meet diabetes threshold during screening, taking medications for pre-diabetes or other conditions for less than 3 months prior to screening, planning on leaving the Pittsburgh area prior to completion of the study, advised by their physician to not participate, or (women only) were lactating or pregnant within 6 weeks of screening.

Participants completed assessments at baseline, 6, 12, and 18 months. At 18 months from baseline (N=171), regardless of the setting, participants in the Healthy Lifestyle Study demonstrated a significant average weight loss of 4.2% (4.0 kg) as well as significant increases in physical activity minutes.

### **2.3 ELIGIBILITY CRITERIA**

For the current follow-up study, participants from both the community and worksite intervention settings were recruited. Participants randomized to both the immediate and delayed intervention groups and only to the immediate intervention group for the worksite and community sites, respectively, were eligible to participate. The immediate only community intervention group was selected because participants in the delayed intervention group were still in the process of completing the intervention during the recruitment phase for this follow-up study.

### **2.3.1 Inclusion criteria**

- Attended  $\geq 4$  of the 16 core sessions in the Healthy Lifestyle Study, following the Centers for Disease Control and Prevention National Diabetes Prevention Program (CDC-DPRP) recognition guidelines [53].
- Had a valid telephone number
- Not formally withdrawn from the Healthy Lifestyle Study prior to the start of the follow-up study

### **2.3.2 Exclusion Criteria**

- Attended  $< 4$  of the 16 core sessions in the Healthy Lifestyle Study
- No valid telephone number
- Formally withdrawn from the original study

## **2.4 PARTICIPANT RECRUITMENT**

In March 2014 a one-page letter introducing the follow-up study and an information sheet, similar to an informed consent document, were mailed to eligible participants. Participants were not required to return the information sheet. Letters were mailed weekly in group mailings, spread over a period of 3 weeks, and included 52 letters per mailing. This was done to ensure an equal amount of time elapsed between mailing the letters and calling participants, and accounted for other factors such as multiple telephone call attempts or other follow-up related items with participants.

The study Principal Investigator (PI) contacted participants approximately 2 weeks following the initial mailing date. In the event that a participant was not available, the PI left a message to return the call. A total of 3 non-responsive telephone call attempts were made before ending contact with a participant.

Approval for this study was granted by the University of Pittsburgh Institutional Review Board (IRB). Additionally, due to the minimal risk nature of this follow-up study, a waiver to document written informed consent was granted by the IRB. Verbal consent was obtained over the telephone and was documented on a separate sheet that was included in the participant's study file.

The primary method of data collection was via the initial telephone call; however, several participants, especially those in the worksite, were unavailable to complete the survey during the initial telephone call. Those interested in participating but not available to complete the survey were offered the opportunity to reschedule for a later date and time within 1-2 weeks of the telephone call or have the survey mailed to them, which included a self-addressed and stamped return envelope. A total of 15 participants were mailed the questionnaire.

## **2.5 HEALTHY LIFESTYLE MAINTENANCE SURVEY**

The survey was developed by the study team specifically for this project and was comprised of three sections, with questions that addressed participants' 1) average frequency over the past three months in engaging in healthy lifestyle behaviors that were originally outlined in the GLB intervention program (4 questions), as well as reasons for not engaging these behaviors (4 sub-questions), 2) perceived barriers to the lifestyle goals (i.e. maintaining or reaching healthy diet and physical activity goals) (2 questions), and 3) opinions about various strategies to assist with maintaining a healthy lifestyle in the long-term, after the GLB program (6 questions). Additionally, the survey also assessed participants' current weight, physical activity, diabetes and health status, and involvement in any weight loss program following the GLB program. A copy of the survey is provided in appendix A.

## **2.6 DATA ANALYSIS**

Data analysis was conducted using Statistical Analysis System 40 version 9.3 software (Cary, N.C.). Baseline, month 12, and follow-up characteristics of participants were compared between those who completed (completers) and did not complete (non-completers) the survey. An independent t-test was used to compare differences between groups for continuous variables age, and weight at baseline, 12 months, percent change, and between baseline and month 12 weight within groups.

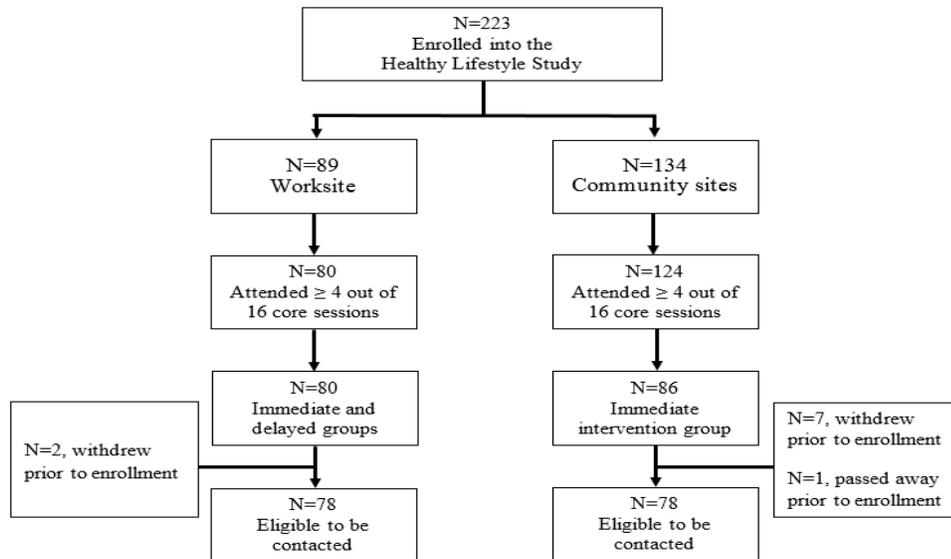
A paired t-test was used to compare baseline and follow-up weight for participants that completed the follow-up survey. The Wilcoxon signed-rank non-parametric test was used to compare the number of minutes per week of physical activity between groups at baseline and 12 months, as well as the absolute difference in physical activity minutes at month 12 from baseline.

A Chi-square test was used to compare the variables gender and education between both groups while a Fischer's exact test was used to the variables ethnicity and diagnosis of diabetes at month 12 because of the low values within each variable. Age at follow-up between completers and non-completers was determined by using a standard date of March 1, 2014, which was start of data collection. Diagnosis of diabetes at month 12 was used for both groups because there was no follow up data available for comparison for non-completers. A descriptive analysis was conducted to determine participant responses to questions asked in the questionnaire.

During data collection, four participants informed the PI they had a serious medical issue occur during the follow-up survey referenced time period, i.e. during the previous three months. As, this may not be an accurate representation of their normal daily life, their responses were not included in the data analysis. Data analysis for weight and physical activity included participants who had complete data for all assessment visits in order to provide a more accurate representation of any observed changes.

### 3.0 RESULTS

A total of 223 participants were enrolled in the Healthy Lifestyle Study from the community (n=134) and worksite (n=89). Among these participants, 204 (92%) attended  $\geq 4$  of 16 core sessions (n=124 community and n=80 worksite), following the CDC-DPRP recognition guidelines [53]. Thirty-eight participants from the community intervention were in the 6-month delayed group and were not included for this follow-up study (n=86 community immediate intervention group and n=80 worksite immediate and 6-month delayed groups). Among the community immediate intervention group, 7 participants were found to have formally withdrawn from the study and 1 passed away prior to the start of this follow-up study. Among the immediate and 6-month delayed worksite intervention groups, 2 participants were determined to have formally withdrawn from the study. The final number of participants who were eligible to be contacted for the follow-up study was 156 (n= 78 at both community and worksite), (Figure 1).



**Figure 1. Recruitment Flowchart**

### **3.1 HEALTHY LIFESTYLE MAINTENANCE STUDY PARTICIPANT CHARACTERISTICS**

Of the 156 participants eligible to be contacted, 73 (46.8%) completed the survey. Table 1 provides characteristics of participants who responded and participants who did not respond to the follow-up survey. Although the two groups were similar in general; those who completed the survey were significantly older ( $p= 0.03$ ), and had a significantly higher percent weight reduction at 12 months ( $p= 0.02$ ) than those who did not complete the survey.

In addition, those who completed the survey reported a significantly higher number of physical activity minutes at baseline ( $p= 0.04$ ) and 12 months ( $p= 0.01$ ); however there were no

significant differences in absolute change in physical activity minutes from baseline to 12 months between groups.

A greater number of participants were female, white, held a college degree (Bachelor's) or higher, and did not have a diagnosis of diabetes at 12 months of the GLB program in both groups.

**Table 1. Participant Characteristics, by Survey Completion Status**

	N	Responded	N	Did Not Respond	P
Age – mean (sd)	73	62.7 (10.6)	83	59.0 (10.6)	0.03
Gender -- n (%)					
▪ Male	73	26 (35.6)	83	34 (41)	0.49
▪ Female	73	47 (64.4)	83	49 (59)	
Education n (%)					
▪ Less than College Degree (Bachelor's)	73	24 (32.9)	83	29 (34.9)	0.79
▪ College Degree (Bachelor's ) or Higher	73	49 (67.1)	83	54 (65.1)	
Ethnicity -- n (%)					
▪ White	73	67 (91.8)	83	79 (95.2)	0.52
▪ Non-White	73	6 (8.2)	83	4 (4.8)	
Diagnosis of Diabetes at Month 12 – n (%)					
▪ No	73	71 (97.3)	83	83 (100.0)	0.22
▪ Yes	73	2 (2.7)	83	0	
Weight(kg) – mean (sd) <sup>∞</sup>					
▪ Baseline	72	93.4 (19.3)*	75	95.8 (19.8) <sup>+</sup>	0.47
▪ Month 12	72	87.5 (18.8)*	75	91.8 (19.0) <sup>+</sup>	0.17
▪ Percent change	72	-6.4 (6.1)	75	-4.0 (5.7)	0.02
Activity (min/week) – median (IQR) <sup>∞</sup>					
▪ Baseline	72	160.0 (52.5, -270.0)	74	95 (30.0, 180.0)	0.04
▪ Month 12	72	197.5 (97.5, 300.0)	74	135.0 (75.0, 180.0)	0.01
▪ Absolute Change	72	40.0 (-27.5, 105.0)	74	25.0 (-40.0, 100.0)	0.64

\*p: <0.001

<sup>+</sup>p: <0.001

<sup>∞</sup>Participants had data available at baseline and 12 Month assessment visit

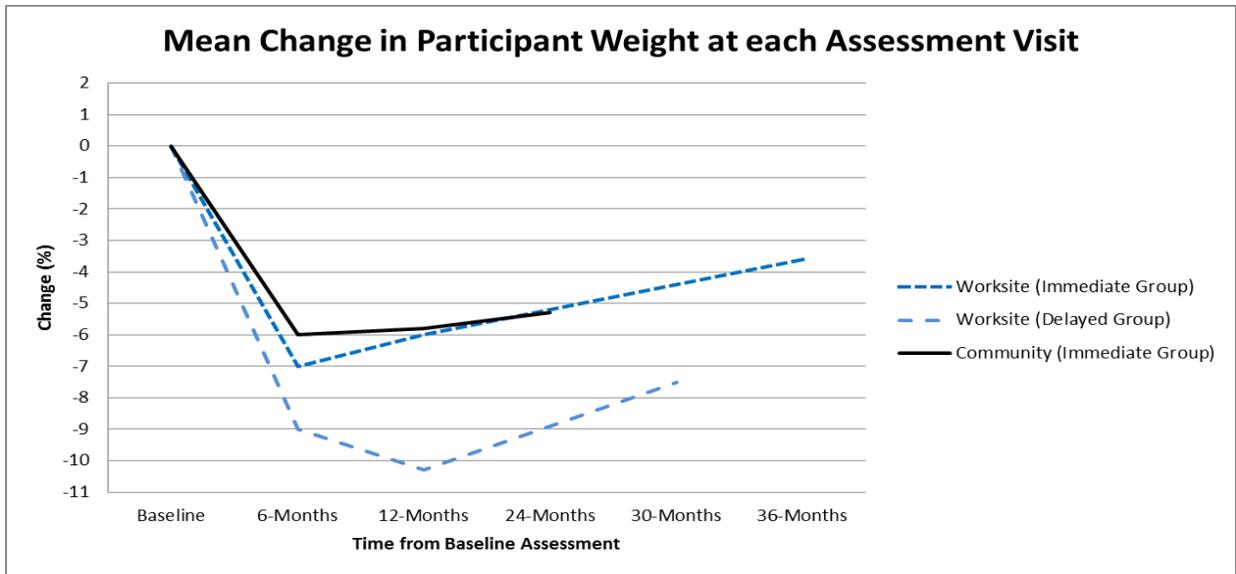
### 3.2 THE HEALTHY LIFESTYLE SURVEY

A summary of participant responses to each question in the questionnaire may be found in Appendix C.

Of the 73 participants who completed the survey, 19 (26%) were from the worksite immediate group (began the program immediately following the baseline assessment visit), 10 (13.7%) were from the worksite delayed group (began the program six months following the baseline assessment visit), and 44 (60.3%) were from the community immediate group. Sixty-five participants (89%) of this group had data for the baseline, 6 and 12 month assessment visits and self-reported follow-up survey. Participant follow up time varied among each group, with those in the immediate worksite group 36 months, those in the delayed worksite group 30 months, and those in the community site 24 months from baseline, respectively.

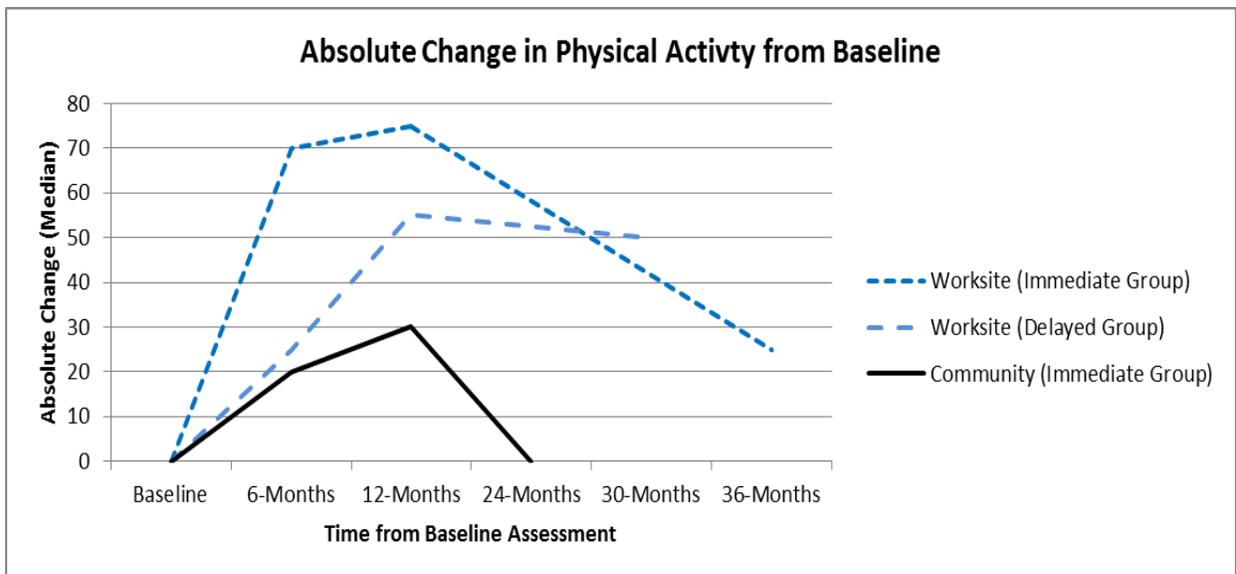
A total of 2 (2.7%) participants reported being diagnosed with diabetes by their physician, since completing the GLB study. Additionally, 19 (26%) reported having a major health event since completing the GLB program.

Overall, participants maintained an average 5.1% reduction in weight at follow-up, with 3.6% in the immediate intervention worksite setting (36 months following baseline), 7.5% in the later intervention worksite setting (30 months following baseline), and 5.3% in the immediate community setting (24 months following baseline). Figure 2 shows the mean percent measured weight change from baseline at the 6 and 12 month assessment visits and self-reported weight at the follow-up assessment by setting/time point for those participants who had complete data for all assessments (N=65).



**Figure 2. Mean Percent Change in Weight from Baseline**

Figure 3 shows the absolute change in physical activity from baseline at the 6, 12, and follow-up assessments, separated by setting, for those participants that had complete data for all assessments (N=65). No significant differences within groups were found for physical activity between baseline and follow-up among the combined and separate settings.



**Figure 3. Absolute Change in Physical Activity (min/week) from Baseline**

Figure 4 demonstrates the average number of reported days of physical activity per week (N=69). A total of 8 (11.6%) participants reported being physically active less than 1 time/month or never. Among the participants who reported being physically active less than 1 time/month or never, 2 (25%) reported a lack of motivation, 4 (50%) reported illness or medical condition, 1 (12.5%) reported another reason, and 1 (12.5%) reported multiple reasons.

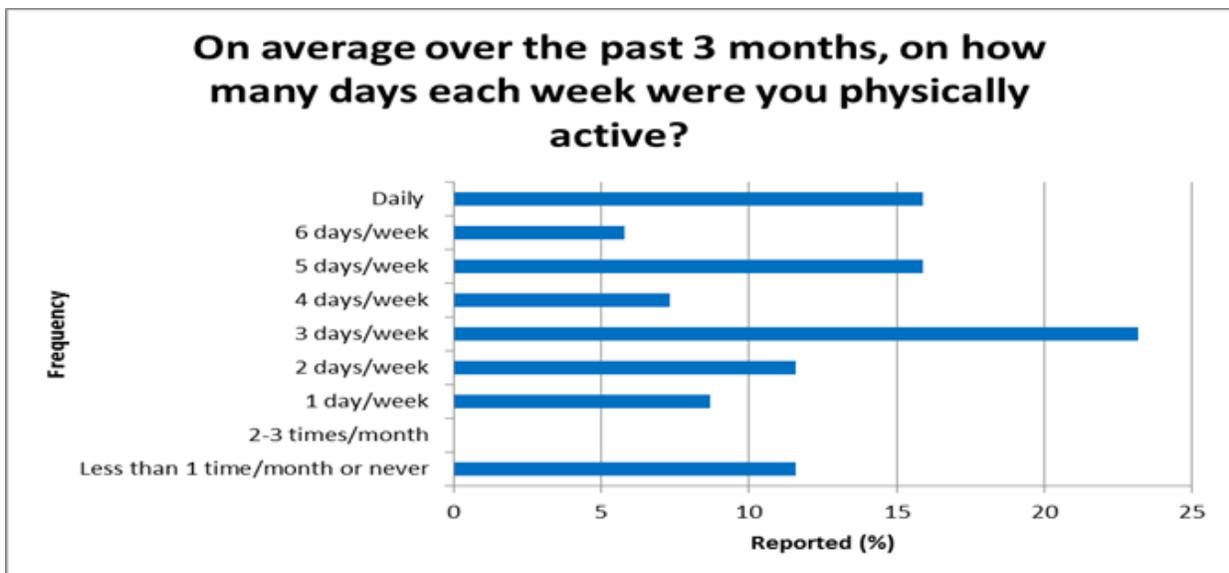


Figure 4. Reported Frequency of Physical Activity during the Week

Approximately 61.5%, 60.0%, and 47.7% of participants reported increased physical activity (minutes per week), from baseline, at 6 months, at 12 months, and at follow-up, respectively (Figure 5).

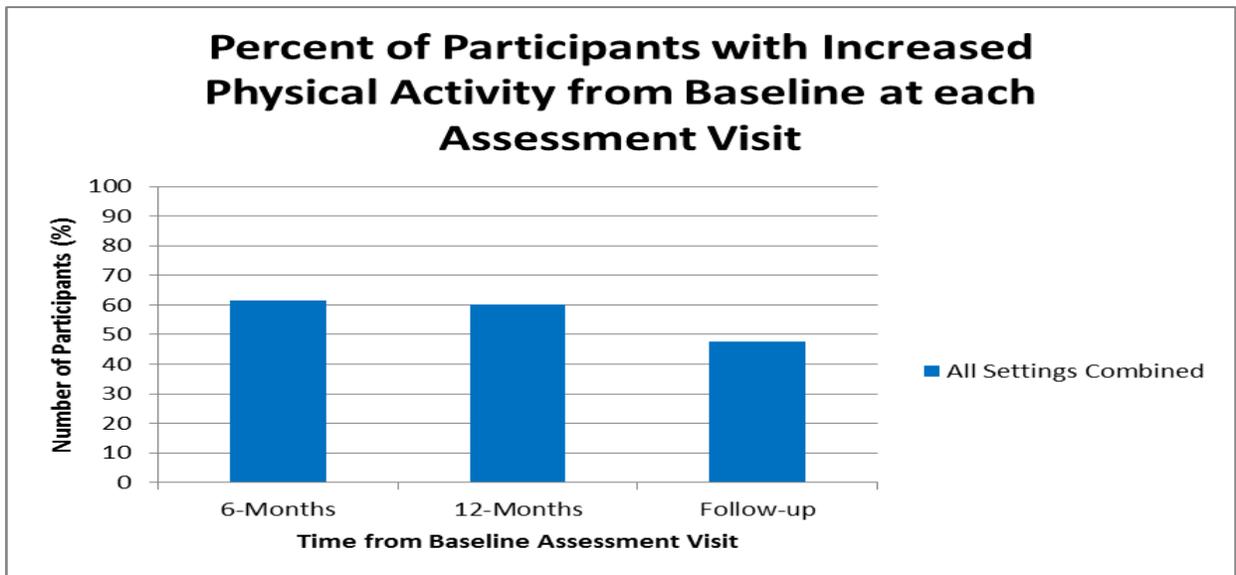


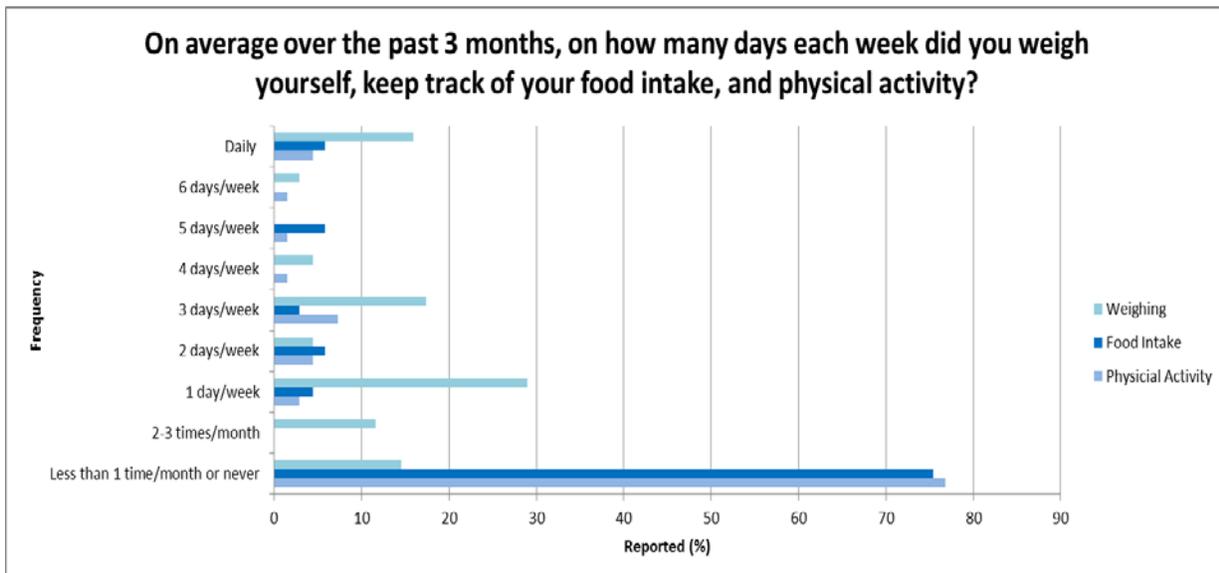
Figure 5. Participants with Increased Physical Activity (min/week) from Baseline

### 3.2.1 Maintenance of Healthy Lifestyle Practices Outlined in the GLB Program

Figure 6 describes the frequency of self-monitoring of weight, eating, and physical activity reported at follow up (N=69). Regarding the question asking participants about self-monitoring of their weight on average over the previous 3 months, the three most frequently reported responses were 1 day/week (29.0%), 3 days/week (17.4%), and daily (15.9%). Ten participants reported weighing themselves less than 1 time/month or never; among this group 4 (40%) reported they do not own a scale, 3 (30%) reported not liking to weigh themselves, and 3 (30%) reported personal issues.

Regarding the question regarding keeping track of their food intake, 52 (75.4%) of those who responded reported keeping track less than 1 time/month or never over the previous 3 months. Among this group, 6 (11.5%) reported not having the time, 12 (23.1%) reported not liking to keep track, and 17 (30.8%) reported other reasons such as having a personal routine, being aware of their food consumption and/or physical activity, and lack of accountability. Additionally, 18 (34.6%) participants reported multiple reasons.

The majority of participants who responded to the question regarding keeping track of physical activity (76.8%) reported keeping track less than 1/time per month or never over the previous 3 months. Among these participants, the most frequently reported reason for this was not being interested in or liking to self-monitor (32.1%). Approximately one-third of those who responded listed other reasons such as lack of motivation or making a schedule to engage in physical activity during the week and adhering to the schedule, multiple reasons (24.5%), and not having the time (7.6%).



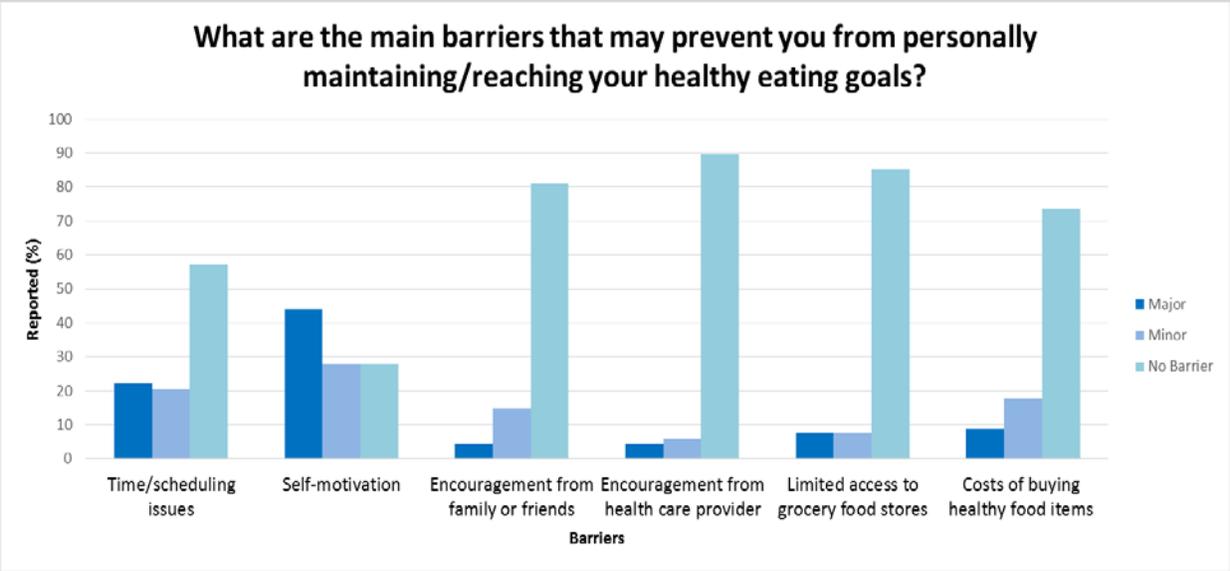
**Figure 6. Reported Frequency of Self-Monitoring Weight, Food Intake, and Physical Activity**

Among the 69 participants, 17 (24.6%) reported to have participated in a weight loss or activity program since completing the GLB program. Of those who did participate in a weight loss or activity program, 2 (11.8%) reported the weight loss program was online-based, 5 (29.4%) reported the weight loss program was group-based, 8 (47.1%) reported the weight loss program was individual-based, and 2 (11.8%) reported another response. A summary of the other programs reported are shown in Table 15, which may be found in Appendix C.

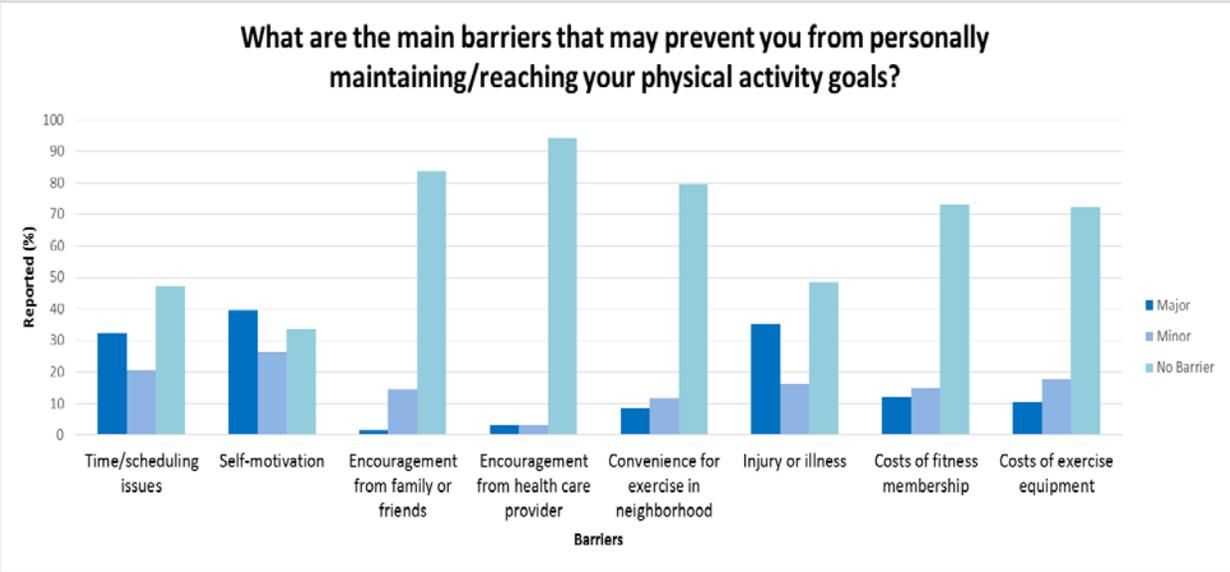
### **3.2.2 Barriers to Maintaining/Reaching Healthy Eating and Physical Activity Goals**

Among all barriers reported, self-motivation was the most frequently reported barrier in reaching or maintaining both healthy eating (72.0%) and physical activity goals (66.2%). Additionally, 42.7% of participants reported time/scheduling issues as barriers to healthy eating. Most participants reported no other barriers in reaching or maintaining healthy eating goals (Figure 7).

In addition to self-motivation, 53.0% of participants also reported time/scheduling issues and 51.5% reported injury or illness as barriers to reaching or maintaining physical activity goals. Most participants reported no other barriers in reaching or maintaining physical activity goals (Figure 8).



**Figure 7. Reported Barriers to Maintaining or Reaching Healthy Eating Goals**

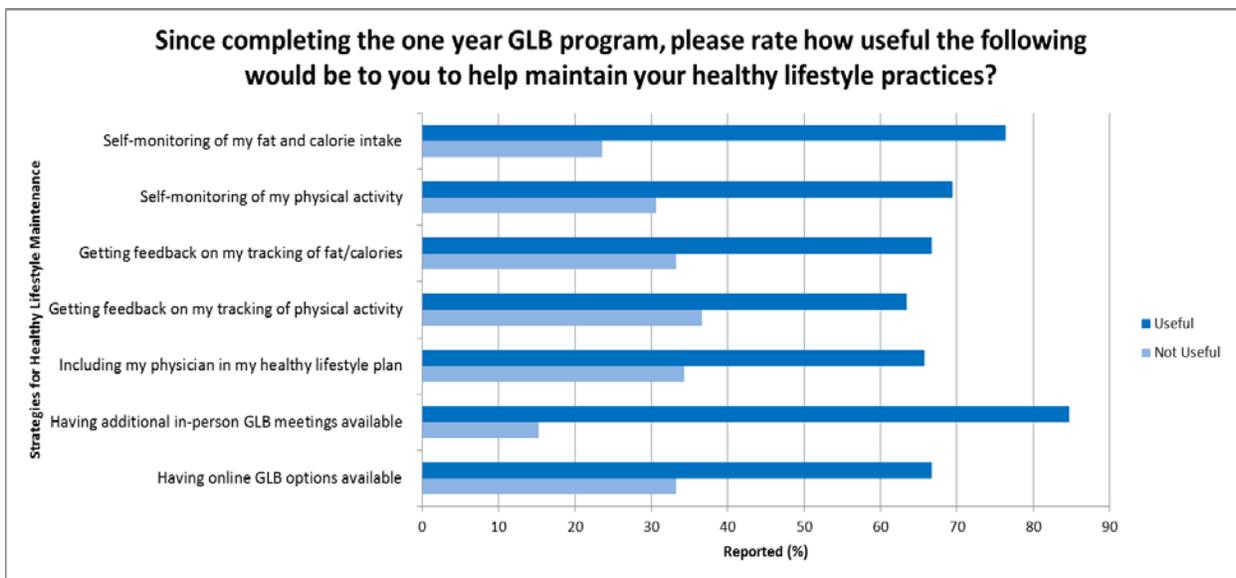


**Figure 8. Reported Barriers to Maintaining or Reaching Physical Activity Goals**

### 3.2.3 Strategies to Assist with Maintaining a Healthy Lifestyle Long-term

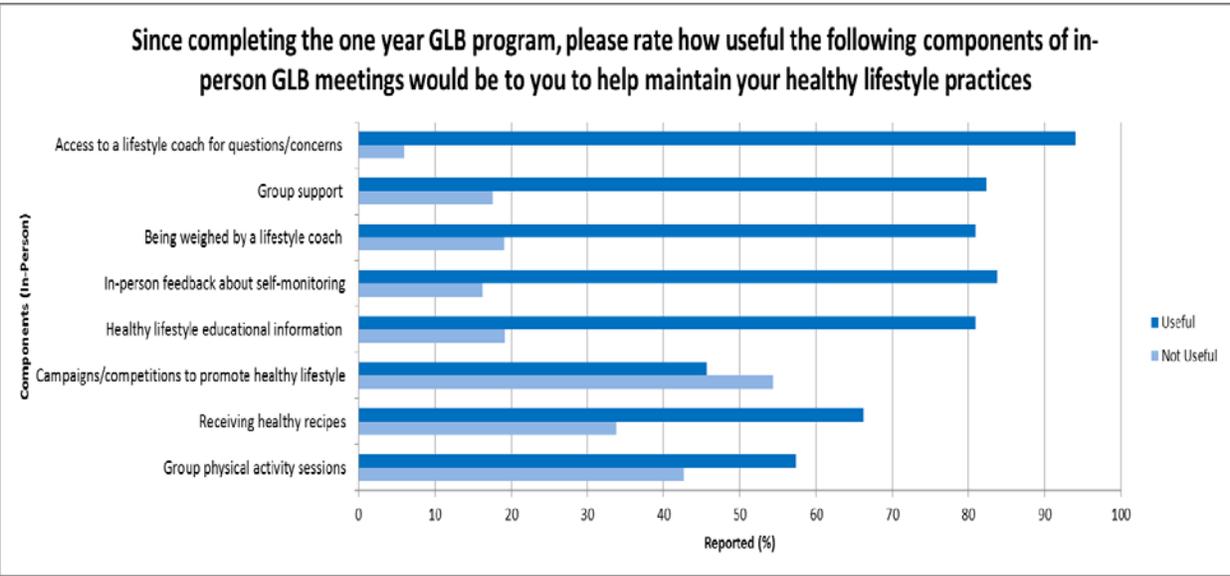
Figures 9-13 provide a summary of the descriptive analysis to questions 9-13 in the questionnaire, which asked participants about their perception regarding various strategies to assist with maintaining a healthy lifestyle.

The two most frequently reported strategies for helping participants maintain healthy lifestyle practices since completing the GLB program were, having additional in-person GLB meetings available (83.8%) and self-monitoring of their fat and calories (76.5%), (Figure 9).



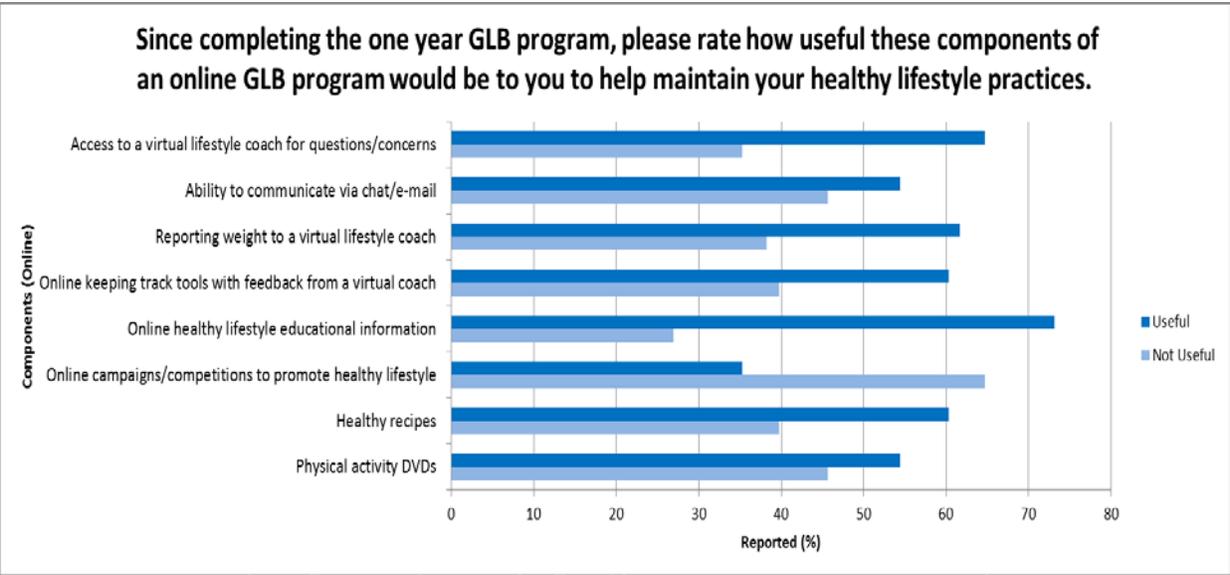
**Figure 9. Reported Opinions towards Useful Strategies for Maintaining a Long-term Healthy Lifestyle**

The two most highly rated components of an in-person GLB program that would be useful to participants in helping maintain healthy lifestyle practices were: access to a lifestyle coach for questions/concerns, (94.1%), and in-person feedback about self-monitoring (83.8%), (Figure 10).



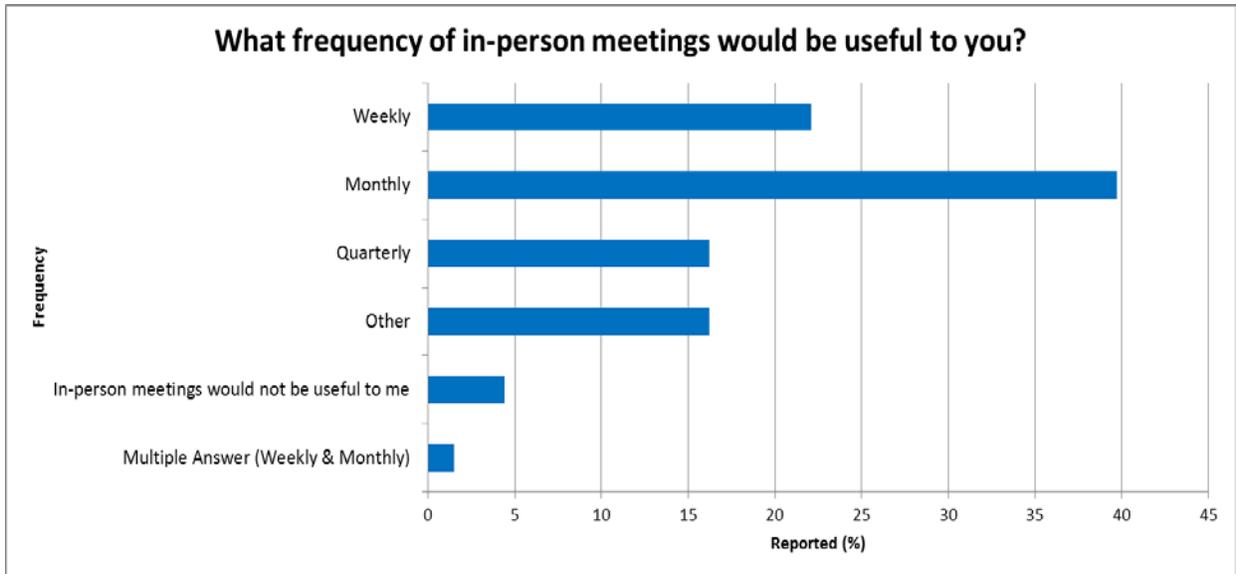
**Figure 10. Reported Opinions about Useful Components of an In-Person Meeting for Maintaining a Long-term Healthy Lifestyle**

For an online GLB program, the two most highly rated components were: online healthy lifestyle educational information (73.1%), and access to a virtual lifestyle coach for questions/concerns (64.7%), (Figure 11).

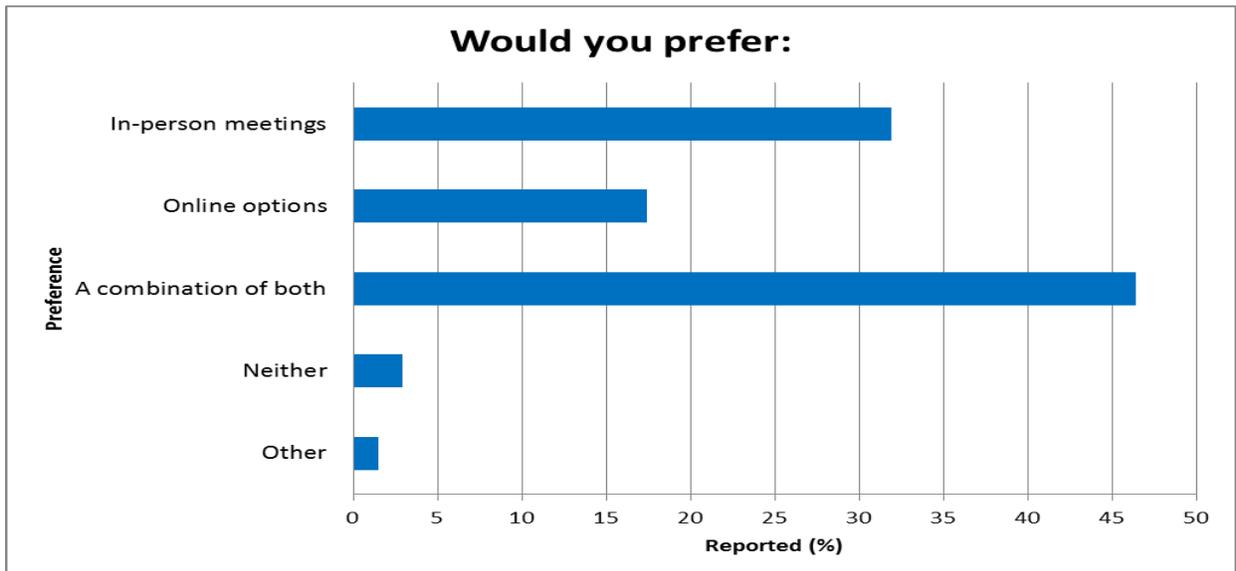


**Figure 11. Reported Opinions about Useful Components of Online Program for Maintaining a Long-term Healthy Lifestyle**

Most participants reported that monthly in-person meetings would be useful to them (Figure 12) and that they would prefer a combination of in-person meeting and online options (Figure 13).



**Figure 12. Reported Preferred Meeting Frequency that would be Useful for Maintaining a Long-term Healthy Lifestyle**



**Figure 13. Reported Meeting Preferences that would be Useful for Maintaining a Long-term Healthy Lifestyle**

## 4.0 DISCUSSION

The results of this follow up study provide information regarding long-term maintenance of healthy lifestyle practices in DPP translation in the community. When considering that the number of individuals with diabetes in the US is projected to almost double in the upcoming decades [3], it is important to better understand the barriers to maintaining healthy lifestyle practices that exist in the community setting for individuals at risk for developing type 2 diabetes, and to develop strategies to help them sustain a long-term healthy lifestyle.

In this follow-up study, participants who completed the survey were, on average, significantly older, had a greater percent reduction in weight at 12 months from baseline, and engaged in more minutes of physical activity during the week at baseline and at 12 months, than participants who did not complete the survey. These differences between groups may suggest that participants who completed the survey were more motivated toward developing healthier habits, i.e. reaching healthy eating and physical activity goals, and finding methods for sustaining long-term healthy lifestyles. Additionally, because these participants were significantly older, it is possible that they may be more likely to be retired therefore, might possibly have more time available to devote to engaging in healthier lifestyle behaviors.

While several DPP translation studies have demonstrated success in helping individuals develop healthy lifestyle habits and reduce risk factors for developing type 2 diabetes, only a few have followed participants long-term, i.e. up to 24-28 months from the study baseline assessment [29, 33, 45, 46, 47, 49]. The current follow-up study is one of the first DPP translation efforts to focus on participants who were 24-36 months from baseline. Among long-term DPP translation studies, several have offered a follow-up program, which provided participants with access to resources to assist them with maintaining a healthy lifestyle [29, 45, 46, 47, 49].

Two follow-up studies, conducted by Aldana et al. [33] and Vanderwood et al. [43], were found to be similar to this follow-up study in terms of setting, participant characteristics, and study follow-up time. Aldana et al. implemented and evaluated a 12-month DPP based intervention program into a worksite setting. The study investigators assessed participants at baseline, 6-months, 12-months, and 24-months thorough in-person assessment visits. Over half (59.4%) of the participants from the original study responded at 24-months, which was higher than the response rate for this follow-up study. This difference may be attributed to a few factors; the length of follow-up time was shorter than this study follow-up time, assessment visits were in-person opposed to a telephone call, and participants understood from the beginning of the study that they would be asked to provide outcome data up to 24 months. Among those that responded a greater proportion of participants were female, white, and had a significantly greater mean weight loss at 12-months. Vanderwood et al. implemented and evaluated a 12-month group-adapted DPP intervention (16-weeks of weekly core sessions and 36-weeks of monthly post-core sessions) into 4 health care facilities with recognized diabetes self-management programs, in urban and rural communities.

The study investigators assessed participants at baseline, 4-months (end of core sessions), 12-months (end of post-core sessions) and then again followed-up with participants at 24-months via a mailed survey. Forty percent of participants responded to the follow-up study, which was similar to this study. Among those that responded to the follow-up study, a greater proportion of participants were older, female, and had a greater mean weight loss at 12-months, which may also reflect a greater percent of weight loss. In addition, age was also found to be significantly different between completers and non-completers, with those who completed the survey being significantly older. Ethnicity and diagnosis were not reported.

#### **4.1 MAINTENANCE OF HEALTHY LIFESTYLE BEHAVIORS**

Over 70% of participants reported that they did not self-monitor their food intake and/or physical activity and cited not having the time, or not liking or being interested in keeping track as the main reasons. Additionally, 14.5% of participants reported not self-monitoring their weight. Based on this summary of data, it suggests that participants stop self-monitoring behaviors after the end of the one-year program because of more of a general disinterest for self-monitoring instead of external factors preventing them from self-monitoring.

It is interesting to note that approximately half of the follow up study participants were found to engage in more physical activity (min/week) at follow-up than at baseline; however, this percentage was lower than that noted at 6 and 12 months, demonstrating a decrease in physical activity over time.

Some of this variation may be explained by seasonality issues. Data collection for the current study began in early spring and participants were asked to report the average number of days per week and amount of time spent participating in physical activity over the previous 3 months, which would have been over the winter and could have been atypical of their normal physical activity. Mean weight at follow-up was statistically lower compared to baseline for the combined setting and also for the individual group settings/follow up time periods. In the same groups, the mean weight loss from baseline decreased over time, which indicates that on average participants, regained some of the weight they lost during the program. This data supports the results of the studies by Aldana et al. and Vanderwood et al. [33, 43]. Weight gain over time was also observed among participants in the original DPP study, on average, at each follow-up visit; however, participants maintained a significant weight loss out to 10 years [54].

## **4.2 BARRIERS TO HEALTHY LIFESTYLE MAINTENANCE**

The most frequently barriers reported for reaching or maintain healthy eating goals were self-motivation and time/scheduling issues. For reaching and maintaining physical activity goals, top barriers reported included self-motivation, time/scheduling issues, and injury or illness. Additionally, for each listed barrier, participants were asked if the barrier was a major or minor barrier, which provided a more detailed summary. Interestingly, when stratified by major/minor barrier, the most reported barriers were also most reported as major barriers. This data suggests that participants perceive that they do not have the time or lack the motivation to completely commit to a healthy lifestyle.

In addition, injury/illness appears to be an important barrier to maintaining physical activity levels long term. Vanderwood et al. in their study assessed barriers to weight maintenance but barriers to maintenance of physical were not assessed. In that study, reported barriers to weight maintenance included emotional eating, stress, exercise, eating out, work, coping, travel, vacation, and family, of which emotional eating, stress, exercise, and eating out were reported as the biggest barriers among those that did not achieve 7% weight loss at follow-up. The barriers identified in the current study and the barriers reported by Vanderwood et al. can provide helpful information when developing long-term healthy lifestyle maintenance programs.

#### **4.3 STRATEGIES FOR MAINTAINING LONG-TERM HEALTHY LIFESTYLE PRACTICES**

Overall, participants reported that they would find the various components of in-person and online options useful in helping them maintain a healthy lifestyle. However, participants were more likely to rate the in-person components as more useful to them in contrast to online components. Moreover, the top two most reported preferences were: combination of in-person and online programs and in-person meetings. This may suggest that participants would be more willing to meet in-person but would also like having online options as an alternative supplemental resource to help them maintain a healthy lifestyle.

Among the components of an in-person meeting, one of the top three reported components in-person feedback about self-monitoring. It is interesting to see in-person feedback on self-monitoring as one of the top three components reported as useful given that over 75% of participants reported not self-monitoring at follow-up. This could indicate that individuals would be more likely to be engaged in self-monitoring if they were provided with feedback.

The top three online components rated as useful were access to a virtual lifestyle coach for questions/concerns, reporting weight to a virtual lifestyle coach, and online healthy lifestyle education information. Interestingly, the component of online self-monitoring tools with feedback from a virtual lifestyle coach was not among the top three most reported.

#### **4.4 LIMITATIONS**

There are several limitations to this study. First, participants who completed the follow-up study may have been more likely to maintain a healthy lifestyle compared to the participants who did not complete the survey. Second, all responses were self-reported and participants could have over- or under- reported their answers, especially answers to the questions assessing their current weight and physical activity, as well as healthy lifestyle behaviors. Additional caution should be exercised when interpreting the reported weight data for the intervention later group because of the relatively small sample size, which may not accurately reflect individual percent weight change.

Third, this study included participants who were predominately older, white, and college educated sample, which may not be a good representation of individuals at high-risk for developing type 2 diabetes and may not be generalizable to other groups. Lastly, the PI of the study was the primary contact for participants, which could have influenced participant answers to the questions.

#### **4.5 PUBLIC HEALTH SIGNIFICANCE**

Overall, the information collected for this study regarding long-term maintenance of healthy lifestyle practices, as well as participant barriers and current lifestyle maintenance is very valuable in terms of moving forward in DPP translation. Although many DPP-based healthy lifestyle interventions have been shown to be effective in improving risk factors for type 2 diabetes among individuals at high-risk in numerous community and worksite settings, only a handful of these studies have included extended periods of follow up. Therefore, very little is known about participant barriers toward reaching or maintaining healthy lifestyle behaviors and assessing strategies for maintaining a healthy lifestyle long-term.

This is one of the first DPP-based translation studies that followed participants up to 36-months from baseline. The data that was collected during this study will help to provide better understanding of how participant behaviors change over time, and will also be useful in developing alternative strategies and effective resources to assist participants with maintaining a healthy lifestyle.

#### **4.6 FUTURE WORK/FUTURE DIRECTIONS**

The information presented here provides a summary of participant responses to a series of questions regarding long-term maintenance of healthy lifestyle practices. Moving forward this report will provide the groundwork for future expanded evaluation of these issues. For example, participant success with long-term maintenance can be investigated further based on post-intervention participation in a weight loss program, reported self-monitoring, or by achievement of program goals at 12 months, similar to Vanderwood et al.. It would also be of value to look at responses to the barriers and strategies questions based on these conditions. These are several of many ideas for future data analysis. Ultimately, the information gathered here will provide a foundation for developing and testing strategies for long-term maintenance of healthy lifestyle practices in those at high risk for developing type 2 diabetes.

## APPENDIX A: HEALTHY LIFESTYLE MAINTENANCE STUDY SURVEY

### Group Lifestyle Balance™ Program Follow-up Survey

Thank you for taking the time to complete this brief survey. Your feedback is very important to us in assessing ways to help people maintain healthy lifestyle practices taught in the GLB program. This survey should take approximately 10-15 minutes of your time. Some questions ask you to select one response while other questions ask for multiple responses and are marked in the survey. If you have any questions about the survey, please contact us at (412) 383-1286.

1. On average over the past 3 months, on how many days each week did you **weigh yourself**? (Check one)

- |                                      |                                      |  |
|--------------------------------------|--------------------------------------|--|
| <input type="checkbox"/> Daily       | <input type="checkbox"/> 4 days/week | <input type="checkbox"/> 1 day/week                      |
| <input type="checkbox"/> 6 days/week | <input type="checkbox"/> 3 days/week | <input type="checkbox"/> 2-3 times/month                 |
| <input type="checkbox"/> 5 days/week | <input type="checkbox"/> 2 days/week | <input type="checkbox"/> Less than 1 time/month or never |

- a. If you do not weigh yourself, can you please tell us why? (Check all that apply)

- |   |  |
|---|--|
| <input type="checkbox"/> Do not own a scale         | <input type="checkbox"/> Do not like to weigh myself |
| <input type="checkbox"/> Scale is inaccurate/broken | <input type="checkbox"/> Other: _____                |

2. On average over the past 3 months, on how many days each week did you **keep track of your food intake**? (Check one)

- |                                      |                                      |  |
|--------------------------------------|--------------------------------------|--|
| <input type="checkbox"/> Daily       | <input type="checkbox"/> 4 days/week | <input type="checkbox"/> 1 day/week                      |
| <input type="checkbox"/> 6 days/week | <input type="checkbox"/> 3 days/week | <input type="checkbox"/> 2-3 times/month                 |
| <input type="checkbox"/> 5 days/week | <input type="checkbox"/> 2 days/week | <input type="checkbox"/> Less than 1 time/month or never |

- a. If you do not keep track of your food intake, can you please tell us why? (Check all that apply)

- |   |   |
|---|---|
| <input type="checkbox"/> Do not have materials to record my food intake | <input type="checkbox"/> Lack encouragement from family and friends |
| <input type="checkbox"/> Do not have the time                           | <input type="checkbox"/> Other: _____                               |
| <input type="checkbox"/> Do not like to keep track                      |   |

3. On average over the past 3 months, on how many days each week were you **physically active?** (Check one)

- |                                      |                                      |  |
|--------------------------------------|--------------------------------------|--|
| <input type="checkbox"/> Daily       | <input type="checkbox"/> 4 days/week | <input type="checkbox"/> 1 day/week                      |
| <input type="checkbox"/> 6 days/week | <input type="checkbox"/> 3 days/week | <input type="checkbox"/> 2-3 times/month                 |
| <input type="checkbox"/> 5 days/week | <input type="checkbox"/> 2 days/week | <input type="checkbox"/> Less than 1 time/month or never |

a. When you are active, how many minutes are you physically active on average?  
\_\_\_\_\_minutes

b. If you are active 1 day/week or less, can you please tell us why?  
(Check all that apply)

- |  |   |
|--|---|
| <input type="checkbox"/> Do not have the time to exercise            | <input type="checkbox"/> Fear of being injured        |
| <input type="checkbox"/> Lack motivation                             | <input type="checkbox"/> Illness or medical condition |
| <input type="checkbox"/> Do not find exercise enjoyable              | <input type="checkbox"/> No fitness centers near me   |
| <input type="checkbox"/> Lack encouragement from family and friends  | <input type="checkbox"/> Other: _____                 |
| <input type="checkbox"/> Neighborhood is not convenient for exercise |   |

4. On average over the past 3 months, on how many days each week did you **keep track of your physical activity?** (Check one)

- |                                      |                                      |  |
|--------------------------------------|--------------------------------------|--|
| <input type="checkbox"/> Daily       | <input type="checkbox"/> 4 days/week | <input type="checkbox"/> 1 day/week                      |
| <input type="checkbox"/> 6 days/week | <input type="checkbox"/> 3 days/week | <input type="checkbox"/> 2-3 times/month                 |
| <input type="checkbox"/> 5 days/week | <input type="checkbox"/> 2 days/week | <input type="checkbox"/> Less than 1 time/month or never |

a. If you do not keep track of your physical activity, can you please tell us why?  
(Check all that apply)

- |  |  |
|--|--|
| <input type="checkbox"/> Not physically active                                     | <input type="checkbox"/> Not interested/do not like to self-monitor my physical activity |
| <input type="checkbox"/> Do not have the time to self-monitor my physical activity | <input type="checkbox"/> Other: _____  |
| <input type="checkbox"/> Do not have materials to record my physical activity      |  |

5. Have you participated in any weight loss or activity programs **since completing the GLB program?** (Check all that apply)

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> Weight Watchers    | <input type="checkbox"/> High protein/low carb | <input type="checkbox"/> Other _____                      |
| <input type="checkbox"/> Telephone coaching | <input type="checkbox"/> Glycemic Index Diet   | <input type="checkbox"/> Did not participate in a program |
| <input type="checkbox"/> TOPS programs      | <input type="checkbox"/> Live Healthy          |   |

a. If you participated in a program, was this program:

- |                                    |                                       |
|------------------------------------|---------------------------------------|
| <input type="checkbox"/> Online    | <input type="checkbox"/> Individual   |
| <input type="checkbox"/> Group     | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> Telephone |                                       |

b. What were the components of this program?

- |   |   |
|---|---|
| <input type="checkbox"/> Physical Activity      | <input type="checkbox"/> Diet supplements |
| <input type="checkbox"/> Diet                   | <input type="checkbox"/> Hypnosis         |
| <input type="checkbox"/> Both diet and exercise | <input type="checkbox"/> Other: _____     |

6. Have you been diagnosed with **diabetes since completing the GLB program?**

- Yes |  No

7. Have you had any **major health events since completing the GLB program?**

- Yes |  No

a. If yes, please describe the major health events: \_\_\_\_\_

8. How much do you currently weigh? \_\_\_\_\_ (pounds)

9. Since completing the one year GLB program, **please rate how useful the following would be to you to help maintain your healthy lifestyle practices?**

	Useful	Not Useful
Self-monitoring of my fat and calorie intake	<input type="checkbox"/>	<input type="checkbox"/>
Self-monitoring of my physical activity	<input type="checkbox"/>	<input type="checkbox"/>
Getting feedback on my tracking of fat/calories	<input type="checkbox"/>	<input type="checkbox"/>
Getting feedback on my tracking of physical activity	<input type="checkbox"/>	<input type="checkbox"/>
Including my physician in my healthy lifestyle plan	<input type="checkbox"/>	<input type="checkbox"/>
Having additional in-person GLB meetings available	<input type="checkbox"/>	<input type="checkbox"/>
Having online GLB options available	<input type="checkbox"/>	<input type="checkbox"/>

10. Since completing the one year GLB program, **please rate how useful the following components of in-person GLB meetings would be to you to help maintain your healthy lifestyle practices:**

	Useful	Not Useful
Access to a lifestyle coach for questions/concerns	<input type="checkbox"/>	<input type="checkbox"/>
Group support	<input type="checkbox"/>	<input type="checkbox"/>
Being weighed by a lifestyle coach	<input type="checkbox"/>	<input type="checkbox"/>
In-person feedback about self-monitoring	<input type="checkbox"/>	<input type="checkbox"/>
Healthy lifestyle educational information	<input type="checkbox"/>	<input type="checkbox"/>
Campaigns/competitions to promote healthy lifestyle	<input type="checkbox"/>	<input type="checkbox"/>
Receiving healthy recipes	<input type="checkbox"/>	<input type="checkbox"/>
Group physical activity sessions	<input type="checkbox"/>	<input type="checkbox"/>
Other: _____	<input type="checkbox"/>	<input type="checkbox"/>

11. What frequency of in-person meetings would be useful to you?

- |                                  |                                      |   |
|----------------------------------|--------------------------------------|---|
| <input type="checkbox"/> Weekly  | <input type="checkbox"/> Quarterly   | <input type="checkbox"/> In-person meetings would not be useful to me |
| <input type="checkbox"/> Monthly | <input type="checkbox"/> Other _____ |   |

12. Since completing the one year GLB program, **please rate how useful these components of an online GLB program would be to you to help maintain your healthy lifestyle practices:**

	Useful	Not Useful
Access to a virtual lifestyle coach for questions/concerns	<input type="checkbox"/>	<input type="checkbox"/>
Ability to communicate via chat/e-mail	<input type="checkbox"/>	<input type="checkbox"/>
Reporting weight to a virtual lifestyle coach	<input type="checkbox"/>	<input type="checkbox"/>
Online keeping track tools with feedback from a virtual coach	<input type="checkbox"/>	<input type="checkbox"/>
Online healthy lifestyle educational information	<input type="checkbox"/>	<input type="checkbox"/>
Online campaigns/competitions to promote healthy lifestyle	<input type="checkbox"/>	<input type="checkbox"/>
Healthy recipes	<input type="checkbox"/>	<input type="checkbox"/>
Physical activity DVDs	<input type="checkbox"/>	<input type="checkbox"/>
Other _____	<input type="checkbox"/>	<input type="checkbox"/>

13. Would you prefer: (check one)

- |  |  |                                      |
|--|--|--------------------------------------|
| <input type="checkbox"/> In-person meetings    |  | <input type="checkbox"/> Neither     |
| <input type="checkbox"/> Online options        |  | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> A combination of both |  |                                      |

14. What are the main barriers that may prevent you from personally **maintaining/reaching your healthy eating goals?**

	Major	Minor	No Barrier
Time/scheduling issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Self-motivation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Encouragement from family or friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Encouragement from health care provider	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Limited access to grocery food stores	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Costs of buying healthy food items	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

15. What are the main barriers that may prevent you from personally **maintaining/reaching your physical activity goals**?

	Major	Minor	No Barrier
Time/scheduling issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Self-motivation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Encouragement from family or friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Encouragement from health care provider	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Convenience for exercise in neighborhood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Injury or illness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Costs of fitness membership	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Costs of exercise equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

16. When considering how to help people maintain healthy lifestyle practices after completing the one year GLB program, please let us know about **anything else that would be useful to you personally to help maintain your healthy lifestyle practices**:

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**APPENDIX B: SUPPLEMENTAL TABLES – PARTICIPANT WEIGHT AND PHYSICAL ACTIVITY STRATIFIED BY  
SETTING**

**Table 2. Mean Weight (kg) and Percent Weight Change from Baseline among Completers with Complete Data for all Assessment Visits – mean (sd)**

Setting	N	Baseline	6 Months	Change (%)	12 Months	Change (%)	Follow-up	Change (%)	p*
Combined	63	93.8 (19.6)	87.6 (19.0)	-6.6 (4.7)	87.7 (19.1)	-6.4 (6.2)	89.0 (19.4)	-5.1 (6.5)	<.0001
Worksite – 36MO (Immediate Group)	18	89.9 (21.9)	83.8 (22.0)	-7.0 (4.8)	84.7 (22.5)	-6.0 (4.8)	87.0 (22.7)	-3.6 (4.6)	0.01
Worksite – 30MO (Delayed Group)	8	102.0 (16.3)	92.4 (11.5)	-9.0 (4.9)	91.1 (13.9)	-10.3 (7.6)	94.3 (17.2)	-7.5 (8.5)	0.04
Community – 24MO (Immediate Group)	37	93.9 (19.1)	88.4 (18.8)	-6.0 (4.6)	88.4 (18.6)	-5.8 (6.5)	88.8 (18.4)	-5.3 (6.9)	<.0001

\*Baseline to Follow-Up

**Table 3. Mean Weight (kg) and Percent Weight Change from Baseline among Completers – mean (sd)**

Setting	N	Baseline	N	6 Months	Change (%)	N	12 Months	Change (%)	N	Follow-up	Change (%)	p*
Combined	73	93.5 (19.1)	69	87.0 (18.9)	-6.6 (4.6)	72	87.5 (18.8)	-6.4 (6.1)	70	88.6 (19.1)	-5.1 (6.6)	< .001
Worksite – 36MO (Immediate Group)	19	90.4 (21.4)	18	83.8 (22.0)	-7.0 (4.8)	19	85.1 (21.9)	-6.1 (4.7)	19	87.9 (22.5)	-3.0 (4.8)	0.03
Worksite – 30MO (Delayed Group)	10	99.9 (15.2)	9	92.3 (10.8)	-8.4 (4.9)	9	89.8 (13.7)	-10.2 (7.1)	10	92.5 (15.8)	-7.4 (7.5)	0.01
Community – 24MO (Immediate Group)	44	93.3 (19.0)	42	87.3 (18.9)	-6.1 (4.5)	44	88.0 (18.6)	-5.7 (6.2)	41	88.0 (18.4)	-5.5 (6.9)	< .001

\*Baseline to Follow-Up

**Table 4. Physical Activity (min/week) and Absolute Change in Physical Activity among Completers with complete data for all Assessment Visits – median (IQR)**

Setting	N	Baseline	6 Months	Difference	12 Months	Difference	Follow-up	Difference	p*
Combined	65	160.0 (45.0, 270.0)	180.0 (120.0, 280.0)	40.0 (0.0, 105.0)	210.0 (105.0, 300.0)	50 (-25.0, 105.0)	140.0 (60.0, 315.0)	0.0 (-40.0, 90.0)	0.16
Worksite – 36MO (Immediate Group)	17	75.0 (0.0, 270.0)	180.0 (120.0, 300.0)	70.0 (60.0, 120.0)	160.0 (90.0, 350.0)	75.0 (0.0, 90.0)	114.0 (45.0, 175.0)	25.0 (-5.0, 90.0)	0.42
Worksite – 30MO (Delayed Group)	9	135.0 (100.0, 150.0)	150.0 (90.0, 175.0)	25.0 (0.0, 40.0)	150.0 (120.0, 240.0)	55.0 (-20.0, 105.0)	150.0 (90.0, 360.0)	50.0 (-45.0, 115.0)	0.29
Community – 24MO (Immediate Group)	39	180.0 (45.0, 300.0)	210.0 (135.0, 315.0)	20.0 (-45.0, 105.0)	240.0 (135.0, 315.0)	30.0 (-40.0, 105.0)	210.0 (60.0, 315.0)	0.0 (-40.0, 60.0)	0.52

\*Baseline to Follow-up

**Table 5. Physical Activity (min/week) and Absolute Change in Physical Activity among Completers – median (IQR)**

Setting	N	Baseline	N	6 Months	Difference	N	12 Months	Difference	N	Follow-up	Difference	p*
Combined	73	160.0 (60.0, 270.0)	70	195.0 (135.0, 315.0)	57.5 (0.0, 105.0)	72	197.5 (97.5, 300.0)	40.0 (-27.5, 105.0)	68	140.0 (60.0, 315.0)	0 (-40.0, 80.0)	0.18
Worksite – 36MO (Immediate Group)	19	75.0 (0, 270.0)	18	195.0 (120.0, 315.0)	72.5 (60.0, 131.3)	19	160.0 (90.0, 350.0)	75.0 (0.0, 90.0)	18	109.5 (30.0, 175.0)	25.6 (-5.0, 90.0)	0.34
Worksite – 30MO (Delayed Group)	10	135.0 (60.0, 150.0)	10	150 (90.0, 175.0)	27.5 (0.0, 40.0)	9	150.0 (120.0, 240.0)	55 (-20.0, 105.0)	10	135.0 (90.0, 360.0)	55 (-45.0, 115.0)	0.19
Comm. – 24MO (Immediate Group)	44	180.0 (60.0, 300.0)	42	217.5 (140.0, 360.0)	30 (-45.0, 105.0)	44	225.0 (135.0, 307.5)	15 (-50.0, 105.0)	40	217.5 (60.0, 337.5)	0.0 (-47.5, 52.5)	0.68

\*Baseline to Follow-up

**APPENDIX C: SUPPLEMENTAL TABLES – PARTICIPANT RESPONSES TO  
SURVEY QUESTIONS**

**Table 6. Participant Responses to Question 1**

<b>Question 1.</b> On average over the past 3 months, on how many days each week did you weigh yourself? (N= 69)	
<b>Frequency</b>	<b>n (%)</b>
Daily	11 (15.9)
6 days/week	2 (2.9)
5 days/week	0 (0)
4 days/week	3 (4.4)
3 days/week	12 (17.4)
2 days/week	3 (4.4)
1 day/week	20 (29.0)
2-3 times/month	8 (11.6)
Less than 1 time/month or never	10 (14.5)

**Table 7. Participant Responses to Question 1a**

<b>Question 1a.</b> If you do not weigh yourself, can you please tell us why? (N=10)	
<b>Reason</b>	<b>n (%)</b>
Do not own a scale	4 (40.0)
Scale is inaccurate/broken	0 (0)
Do not like to weigh myself	3 (30.0)
Other	3 (30.0)

**Table 8. Participant Responses to Question 2**

<b>Question 2.</b> On average over the past 3 months, on how many days each week did you keep track of your food intake? (N= 69)	
<b>Frequency</b>	<b>n (%)</b>
Daily	4 (5.8)
6 days/week	0 (0)
5 days/week	4 (5.8)
4 days/week	0 (0)
3 days/week	2 (2.9)
2 days/week	4 (5.8)
1 day/week	3 (4.4)
2-3 times/month	0 (0)
Less than 1 time/month or never	52 (75.4)

**Table 9. Participant Responses to Question 2a**

<b>Question 2a.</b> If you do not keep track of your food intake, can you please tell us why? (N=52)	
<b>Reason</b>	<b>n (%)</b>
Do not have materials to record my food intake	0
Do not have the time	6 (11.5)
Do not like to keep track	12 (23.1)
Lack encouragement from family and friends	0
Other	16 (30.8)
Multiple Responses	18 (34.6)

**Table 10. Participant Responses to Question 3**

<b>Question 3.</b> On average over the past 3 months, on how many days each week were you physically active? (N= 69)	
<b>Frequency</b>	<b>n (%)</b>
Daily	11 (15.9)
6 days/week	4 (5.8)
5 days/week	11 (15.9)
4 days/week	5 (7.3)
3 days/week	16 (23.2)
2 days/week	8 (11.6)
1 day/week	6 (8.7)
2-3 times/month	0 (0)
Less than 1 time/month or never	8 (11.6)

**Table 11. Number of Participants with Increased Physical Activity from Baseline**

<b>Physical Activity Increase from Baseline (N=65)</b>	
<b>Assessment visit</b>	<b>n (%) -- median (IQR)</b>
Month 6	40 (61.5) -- 217.5 (135.0, 315.0)
Month 12	39 (60.0) -- 240.0 (135.0, 315.0)
Follow-up	31 (47.7) -- 270.0 (105.0, 420.0)

**Table 12. Participant Responses to Question 3b**

<b>Question 3b. If you are active 1 day/week or less, can you please tell us why? (N=8)</b>	
<b>Frequency</b>	<b>n (%)</b>
Do not have the time to exercise	0
Lack motivation	2 (25.0)
Do not find exercise enjoyable	0
Lack encouragement from family and friends	0
Neighborhood is not convenient for exercise	0
Fear of being injured	0
Illness or medical condition	4 (50.0)
No fitness centers near me	0
Other	1 (12.5)
Multiple Responses	1 (12.5)

**Table 13. Participant Responses to Question 4**

<b>Question 4. On average over the past 3 months, on how many days each week did you keep track of your physical activity? (N= 69)</b>	
<b>Frequency</b>	<b>n (%)</b>
Daily	3 (4.4)
6 days/week	1 (1.5)
5 days/week	1 (1.5)
4 days/week	1 (1.5)
3 days/week	5 (7.3)
2 days/week	3 (4.4)
1 day/week	2 (2.9)
2-3 times/month	0 (0)
Less than 1 time/month or never	53 (76.8)

**Table 14. Participant Responses to Question 4a**

<b>Question 4a.</b> If you do not keep track of your physical activity, can you please tell us why? (N=53)	
<b>Reason</b>	<b>n (%)</b>
Not physically active	2 (3.8)
Do not have the time to self-monitor my physical activity	4 (7.6)
Do not have materials to record my physical activity	1 (1.9)
Not interested/do not like to self-monitor my physical activity	17 (32.1)
Other	16 (30.2)
Multiple Responses	13 (24.5)

**Table 15. Participant Responses to Question 5**

<b>Question 5.</b> Have you participated in any weight loss or activity programs since completing the GLB program? (N=69)	
<b>Reason</b>	<b>n (%)</b>
Weight Watchers	1 (1.5)
Telephone coaching	0
TOPS programs	0
High protein/low carb	0
Glycemic Index Diet	0
Live Healthy	1 (1.5)
Other	14 (20.3)
Did not participate in a program	53 (75.4)
Multiple Responses	1 (1.5)

**Table 16. Participant Responses to Question 5a**

<b>Question 5a.</b> If you participated in a program, was this program: (N=17)	
<b>Program Type</b>	<b>n (%)</b>
Online	2 (11.8)
Group	5 (29.4)
Telephone	0
Individual	8 (47.1)
Other	0
Multiple Responses	2 (11.8)

**Table 17. Participant Responses to Question 5b**

<b>Question 5b. What were the components of this program? (N=17)</b>	
<b>Program Components</b>	<b>n (%)</b>
Physical Activity	2 (11.8)
Diet	3 (17.7)
Both diet and exercise	8 (47.1)
Diet supplements	0
Hypnosis	0
Other	3 (17.7)
Multiple Responses	1 (5.9)

**Table 18. Participant Responses to Question 6**

<b>Question 6. Have you been diagnosed with diabetes since completing the GLB program? (N=73)</b>	
<b>Response</b>	<b>n (%)</b>
Yes	2 (2.7)
No	69 (94.5)
Prior to Study	2 (2.7)

**Table 19. Participant Responses to Question 7**

<b>Question 7. Have you had any major health events since completing the GLB program? (N=73)</b>	
<b>Response</b>	<b>n (%)</b>
Yes	19 (26.0)
No	54 (74.0)

**Table 20. Participant Responses to Question 9**

<b>Question 9. Since completing the one year GLB program, please rate how useful the following would be to you to help maintain your healthy lifestyle practices?</b>			
<b>Components – n (%)</b>	<b>N</b>	<b>Useful</b>	<b>Not Useful</b>
a. Self-monitoring of my fat and calorie intake	68	52 (76.5)	16 (23.5)
b. Self-monitoring of my physical activity	68	46 (67.7)	22 (32.4)
c. Getting feedback on my tracking of fat/calories	68	45 (66.2)	23 (33.8)
d. Getting feedback on my tracking of physical activity	67	41 (61.2)	26 (38.8)
e. Including my physician in my healthy lifestyle plan	69	46 (66.7)	23 (33.3)
f. Having additional in-person GLB meetings available	68	57 (83.8)	11 (16.2)
g. Having online GLB options available	68	45 (66.2)	23 (33.8)

**Table 21. Participant Responses to Question 10**

<b>Question 10.</b> Since completing the one year GLB program, please rate how useful the following components of in-person GLB meetings would be to you to help maintain your healthy lifestyle practices			
<b>Components – n (%)</b>	<b>N</b>	<b>Useful</b>	<b>Not Useful</b>
a. Access to a lifestyle coach for questions/concerns	68	64 (94.1)	4 (5.9)
b. Group support	68	56 (82.4)	12 (17.6)
c. Being weighed by a lifestyle coach	68	55 (80.9)	13 (19.1)
d. In-person feedback about self-monitoring	68	57 (83.8)	11 (16.2)
e. Healthy lifestyle educational information	68	55 (80.9)	13 (19.2)
f. Campaigns/competitions to promote healthy lifestyle	68	31 (45.6)	37 (54.4)
g. Receiving healthy recipes	68	45 (66.2)	23 (33.8)
h. Group physical activity sessions	68	39 (57.4)	29 (42.7)
i. Other	14	14 (100.0)	0 (0)

**Table 22. Participant Responses to Question 11**

<b>Question 11.</b> What frequency of in-person meetings would be useful to you?	
<b>Frequency (N=68)</b>	<b>n (%)</b>
Weekly	15 (22.1)
Monthly	27 (39.7)
Quarterly	11 (16.2)
Other	11 (16.2)
In-person meetings would not be useful to me	3 (4.4)
Multiple Answer (Weekly & Monthly)	1 (1.5)

**Table 23. Participant Responses to Question 12**

<b>Question 12.</b> Since completing the one year GLB program, please rate how useful these components of an online GLB program would be to you to help maintain your healthy lifestyle practices:			
<b>Components – n (%)</b>	<b>N</b>	<b>Useful</b>	<b>Not Useful</b>
a. Access to a virtual lifestyle coach for questions/concerns	68	44 (64.7)	24 (35.3)
b. Ability to communicate via chat/e-mail	68	37 (54.4)	31 (45.6)
c. Reporting weight to a virtual lifestyle coach	68	42 (61.7)	26 (38.2)
d. Online keeping track tools with feedback from a virtual coach	68	41 (60.3)	27 (39.7)
e. Online healthy lifestyle educational information	67	49 (73.1)	18 (26.9)
f. Online campaigns/competitions to promote healthy lifestyle	68	24 (35.3)	44 (64.7)
g. Healthy recipes	68	41 (60.3)	27 (39.7)
h. Physical activity DVDs	68	37 (54.4)	31 (45.6)
i. Other	13	13 (100.0)	0 (0)

**Table 24. Participant Responses to Question 13**

<b>Question 13. Would you prefer: (N=69)</b>	
<b>Meeting</b>	<b>n (%)</b>
In-person meetings	22 (31.9)
Online options	12 (17.4)
A combination of both	32 (46.4)
Neither	2 (2.9)
Other	1 (1.5)

**Table 25. Participant Responses to Question 14**

<b>Question 14. What are the main barriers that may prevent you from personally maintaining/reaching your healthy eating goals?</b>				
<b>Barriers – n (%)</b>	<b>N</b>	<b>Major</b>	<b>Minor</b>	<b>No Barrier</b>
a. Time/scheduling issues	68	15 (22.1)	14 (20.6)	39 (57.4)
b. Self-motivation	68	30 (44.1)	19 (27.9)	19 (27.9)
c. Encouragement from family or friends	68	3 (4.4)	10 (14.7)	55 (80.9)
d. Encouragement from health care provider	68	3 (4.4)	4 (5.9)	61 (89.7)
e. Limited access to grocery food stores	68	5 (7.4)	5 (7.4)	58 (85.3)
f. Costs of buying healthy food items	68	6 (8.8)	12 (17.7)	50 (73.5)
g. Other	15	12 (80.0)	3 (20.0)	0

**Table 26. Participant Responses to Question 15**

<b>Question 15. What are the main barriers that may prevent you from personally maintaining/reaching your physical activity goals?</b>				
<b>Barriers – n (%)</b>	<b>N</b>	<b>Major</b>	<b>Minor</b>	<b>No Barrier</b>
a. Time/scheduling issues	68	22 (32.4)	14 (20.6)	32 (47.1)
b. Self-motivation	68	27 (39.7)	18 (26.5)	23 (33.8)
c. Encouragement from family or friends	68	1 (1.5)	10 (14.7)	57 (83.8)
d. Encouragement from health care provider	68	2 (2.9)	2 (2.9)	64 (94.1)
e. Convenience for exercise in neighborhood	68	6 (8.8)	8 (11.7)	54 (79.4)
f. Injury or illness	68	24 (35.3)	11 (16.2)	33 (48.5)
g. Costs of fitness membership	68	8 (11.9)	10 (14.9)	49 (73.1)
h. Costs of exercise equipment	68	7 (10.3)	12 (17.6)	49 (72.1)
i. Other	11	8 (72.7)	3 (27.3)	0

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