IDENTIFYING BARRIERS TO LIFESTYLE MODIFICATION THROUGH EVALUATION OF A COMMUNITY-BASED DIABETES PREVENTION PROGRAM

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ABSTRACT

Obesity and its associated chronic diseases substantially decrease life expectancy and quality of life. Research such as the Diabetes Prevention Program (DPP), a large national clinical trial, has shown that modification of lifestyle factors, particularly through moderate weight loss, reduced fat and calorie intake, and increased physical activity significantly reduces the risk factors for obesity, type 2 diabetes, and cardiovascular disease. Due to the success of the DPP, a group-based version of the DPP lifestyle intervention, the Group Lifestyle Balance Program (GLB), was developed to administer in community settings. Maintaining the lifestyle goals of the GLB is important for long-term participant success and disease prevention. The purpose of this project was to identify important barriers that inhibit participants from maintaining healthy lifestyle changes following completion of the GLB community intervention. The GLB Program was delivered at two community sites as part of a student learning practicum, which involved twelve weekly group meetings. At the conclusion of the program, participants were asked to complete a survey examining their self-monitoring habits, opinions of the GLB program, and personal barriers to sustaining lifestyle change. Descriptive statistics, including ranking of barrier factors, were used to identity which factors impede long-term participant success. A total of sixteen participants took part in the program and twelve agreed to complete the survey. Most participants

reported the completion of daily self-monitoring, of weight and food intake, but less than half reported daily physical activity monitoring. Lack of self-motivation and time were both ranked highest among barriers that prevented participants from reaching and/or maintaining healthy eating and physical activity goals. Personal barriers identified through this survey project, such as lack of self-motivation and time, were consistent with previous literature regarding long-term weight loss maintenance.

PUBLIC HEALTH STATEMENT: Future lifestyle intervention studies can use this knowledge of common barriers to improve participant goal achievement and long-term healthy lifestyle maintenance.

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PREFACE

I would like to express my sincere gratitude to my academic advisor, Dr. Nancy Glynn, for her guidance, support, and patience at every step of my graduate education. I would also like to thank my internship preceptor, Dr. Kaye Kramer, for her help and support during both my practicum experience and essay writing process. Additionally, I would like to thank my essay committee member, Dr. Thistle Elias, for her thoughtful comments. Finally, I would like to thank my family for their continuous support and encouragement throughout my studies.

1.0 INTRODUCTION

Obesity and its associated chronic diseases are public health problems resulting in substantial consequences to both individuals and society. Obesity is directly associated with an increased risk of multiple chronic diseases, including type 2 diabetes and cardiovascular disease, which cause devastating health consequences and increased mortality. Due to the strong correlation between obesity and chronic disease, interventions that promote healthy weight loss and chronic disease risk reduction are imperative for improving public health. Research studies, such as the Diabetes Prevention Program, have shown that lifestyle interventions that focus on moderate weight loss, improved dietary habits, and increased physical activity are effective for weight loss and chronic disease prevention. However, limited research has been done regarding the long-term effects of such clinical trial interventions when translated to a community setting. Specifically, more research is needed regarding the barriers that prevent participant adherence in the community to evidence-based lifestyle intervention programs. The purpose of this project was to identify the barriers and challenges that impede participants from achieving and maintaining the goals of a community lifestyle intervention program. This information will be useful to public health practitioners interested in developing strategies to promote participant adherence and maintenance of the healthy lifestyle goals of community-based obesity and chronic disease risk reduction programs.

1.1 SCOPE OF THE OBESITY PROBLEM

Obesity is a significant public health problem that contributes to numerous chronic diseases and preventable deaths in the United States. According to the National Health and Nutrition Examination Survey (NHANES), over one-third (34.9%) of adults in the United States are obese.[1] Obesity-related chronic conditions, such as cardiovascular disease, type 2 diabetes, and some types of cancer, result in decreased life expectancy and diminished quality of life. Despite a body of comprehensive literature about the negative health consequences of obesity, rates have continued to rise in the United States throughout recent decades. The etiology of obesity is complex and involves interactions between genetics, hormones, social and environmental factors, and individual behavior. For example, lifestyle habits have shifted as a result of societal development, leading to rising obesity rates in the United States. Modern transportation, communication, and entertainment have significantly reduced the need for physical activity, allowing for a more sedentary lifestyle than previous generations.[2] Evidence shows that overall mortality rates, particularly for cardiovascular disease, are negatively impacted by the amount of time spent inactive.[3] Furthermore, dietary habits in the United States have changed as a result of modern development and urbanization. Americans now consume an average of 3,800 calories per day, which is the highest per capita calorie consumption recorded in the last fifty years.[4] Additionally, fat, sugar, sodium, and meat consumption is considerably higher than previous years. The modern food system has also created a social environment centered on the overconsumption of nutrient-poor and processed foods, and dining away from home, leading to meals with higher fat and calorie content.[5] Current dietary and lifestyle habits reflect the need for interventions that extend beyond individual behavior to address the social and environmental contributors to obesity.

1.2 OBESITY TRENDS

Of all the high-income countries, the United States has the highest rates of obesity, which have more than doubled in adults and children in the last fifty-years.[6] Although current obesity rates remain higher than in the past, recent estimates have shown a more gradual increase or plateau of obesity rates in the last several years.[7] However, given the health risks and persistent high prevalence of obesity among certain groups, it is important to continue to analyze obesity rates in the United States. For instance, obesity has significant differences based on race and ethnicity, gender, age, geographic region, and socioeconomic status, making it an important focus of public health research. Obesity prevalence across racial and ethnic groups is shown in Table 1.

Table 1. Obesity Rates Across Racial and Ethnic Group

Racial or Ethnic Group	Obesity Percentage
African American	49.5%
Native Hawaiians/Pacific Islander	43.5%
American Indian/Alaskan Native	39.9%
Hispanic	39.1%
Caucasian	34.3%
Asian American	11.6%

Adapted from NHANES 2009-2010 [8]

Obesity in the United States is highest among African Americans, although the majority of other racial and ethnic groups have analogous rates. Specifically, African American women have the highest rate of obesity (57.6%) and obesity-related chronic diseases such as cardiovascular

disease, cancer, and stroke than any other minority group.[9] Although Asian Americans have relatively low obesity rates compared to other groups, the obesity prevalence among Asian Americans continues to surpass that of previous generations, indicating that obesity is a persistent problem in all racial groups.[10] Lack of access to affordable nutritious food and safe places to exercise, along with inequities in access to good quality healthcare contribute to higher rates of obesity among racial and ethnic minorities.[11]

In 2012, obesity rates were similar among men (33.5%) and women (36.1%) of all racial and ethnic groups, with women having slightly higher obesity prevalence than men.[12] Obesity rates for men are similar across all socioeconomic strata, while higher income women are less likely to be obese than lower income women.[13] Additionally, middle age adults have higher obesity rates (39.5%) compared to older (35.4%) and younger adults (30.3%). [14]

Considerable differences in obesity prevalence also occur geographically across the United States. In general, Southeastern states have higher obesity prevalence than the West Coast, Midwest, or Northeast. However, most of these data come from self-reported surveys that can bias the geographic distribution of obesity prevalence.[15] Therefore, obesity rates may be underestimated in certain regions of the country. Despite this potential bias, state-level obesity estimates reveal an increase in obesity in all states over the last two decades. In 1990, state estimates of obesity prevalence were less than 15% in all states. However, in 2010 thirty-six states had obesity rates over 25%, and twelve states had obesity prevalence over 30% of their populations.[16]

Rates of childhood obesity have also risen in the United States throughout recent decades. Currently, one out of six children and adolescents (age 6-19) are obese (16.9%). Among this same age group, boys (18.6%) have higher obesity rates than girls (15.0%). Additionally, African

American (25.7%) and Hispanic (22.9%) youth have higher obesity rates than their Caucasian peers (15.2%).[17] Furthermore, among preschool age children (age 2-5), one in eight are classified as obese (12%).[18] Childhood obesity significantly increases the likelihood of adult obesity, as well as lifelong physical and mental health conditions such as type 2 diabetes, cardiovascular disease, and depression.[19]

1.3 OBESITY-RELATED MORBIDITY

Considerable evidence demonstrates that obesity is associated with a high risk of chronic diseases, such as asthma, osteoarthritis, cancer, cardiovascular disease, and type 2 diabetes.[20] Asthma affects nearly 300 million individuals worldwide, and numerous studies have shown an increased risk of asthma symptoms and severity in obese children and adults.[21] Obesity-related morbidities, such as chronic systemic inflammation, reduced lung capacity, and sleep-disorder breathing has been shown to exacerbate asthma symptoms.[22] Likewise, obesity and asthma share similar predisposing factors including genetics, physical activity, and dietary habits. Similar to obesity, asthma disproportionately affects vulnerable populations, such as African Americans, Hispanics, and low-income individuals, and children.[23]

Obesity also increases the risk of osteoarthritis, a highly prevalent joint disorder that most commonly affects the hands, knees, hips, back, and neck. Osteoarthritis is one of the leading causes of pain and disability worldwide, and affects nearly 37% of adults over ago 60.[24] Excess weight places significant stress on joints, leading to accelerated cartilage deterioration and arthritis-associated pain. Data from NHANES has shown that obese women are four times and

obese men are five times more likely to suffer from knee osteoarthritis than non-obese individuals.[25]

Obesity is also associated with increased risk of some cancers, including esophageal, pancreatic, colorectal, breast, kidney, thyroid, liver, and gallbladder.[26] Not only does obesity increase the risk of developing cancer, but it is also linked to worse prognosis, reduced survival, poor response to treatment, and faster metastasis.[27] A World Health Organization report concluded that 3.6% of all cancer cases worldwide in 2012 were directly associated with obesity.[28] Additionally, this report stated that excess weight and lack of physical activity were significant causes of cancer in the United States.[29]

According to the Centers for Disease Control and Prevention (CDC), cardiovascular disease ranks as the highest (34%) cause of preventable death in the United States.[30] Obesity increases blood cholesterol, blood pressure, and triglyceride levels which increases the risk of heart attack, stroke, aneurysm, and arterial deterioration.[31] Additionally, obesity depletes beneficial high-density lipoprotein (HDL) cholesterol levels, which helps lowers the risk of heart disease and stroke when maintained at high levels in the body.[32]

Finally, overweight and obesity are highly related to type 2 diabetes. Type 2 diabetes is a chronic condition that occurs when the body either cannot produce enough or effectively use insulin, leading to inefficient metabolism of glucose.[33] Nearly 28 million American adults have type 2 diabetes, and around 86 million struggle with prediabetes.[34] Type 2 diabetes is associated with nerve, kidney, eye, and extremity damage, along with increased risk of heart attack and stroke.[35] Factors such as genetics, family history, age, sex, and race can increase the risk of weight gain and fat storage, as well as the risk for type 2 diabetes.[36] Prediabetes is characterized by elevated blood glucose levels, not high enough for a diabetes diagnosis, but detrimental to

overall health.[37] Without lifestyle modification, such as weight loss, improved nutrition, and increased physical activity, individuals with prediabetes have a 15-30% increased risk of developing type 2 diabetes within five years. [38]

1.4 LIFESTYLE MODIFICATION RESEARCH

Research has shown that modest changes in weight, dietary patterns, and physical activity habits can significantly reduce risk factors for type 2 diabetes and cardiovascular disease.[39-41] Interventions focusing on modifying lifestyle factors also increase the likelihood of long-term healthy lifestyle maintenance.[42] Behavioral lifestyle modification, designed to help individuals make healthy lifestyle changes, has been used to help individuals develop the skills necessary to achieve and maintain a healthy lifestyle. The concept of behavioral lifestyle modification originates from the principles of classical conditioning, which has determined that overeating and physical inactivity are often prompted by precursory events, or cues, that becomes strongly associated with food consumption or lack of exercise.[43, 44] Common food and physical inactivity cues may include watching television or boredom. Therefore, lifestyle modification can help individuals identify their personal cues that lead to maladapted eating and physical activity patterns, in order to form healthier habits.

Research has indicated behavioral weight modification programs should include the following components for optimal success: self-monitoring, stimulus control, goal setting, behavioral contracting, and social support.[45] Self-monitoring consists of maintaining food diaries, as well as physical activity and weight logs in order to increase awareness of current health behaviors. Literature regarding the importance of self-monitoring during behavioral modification

programs is abundant. For example, research has shown that self-monitoring for the first six months of attempted weight loss is positively associated with successful weight loss outcomes.[46] Furthermore, an obesity drug therapy trial showed that individuals who maintained a food diary lost twice as much weight as those who did not self-monitor, independent of the drug therapy.[47] Successful self-monitoring requires honesty, consistency, and timeliness of recording in relation to a target behavior, such as eating or exercising.[48] Self-monitoring also enhances participant self-efficacy by increasing the ability to manage common weight loss barriers.[49]

Stimulus control focuses on altering the environment that influences eating and exercise patterns, then modifying that environment to create better habits. Stimulus control is also helpful for avoiding high-risk situations, such as dining away from home or attending a party, which may prompt maladaptive eating or sedentary behavior.[50] Alterations to the food environment may include purchasing more fruits and vegetables in lieu of processed foods, reducing plate sizes to encourage more reasonable food portions, and practicing mindful eating without environmental distractions.[51] Setting realistic, achievable, and measurable short and long-term goals is also imperative for behavioral weight loss interventions.[52] Examples of achievable goals include losing small amounts of weight or gradually increasing physical activity levels.

Additionally, behavioral contracting, or the reinforcement of successful behaviors in the form of encouragement or small incentives, can be very beneficial to weight loss. Lastly, social support has been shown to be an important component for long-term sustainable lifestyle modification. For instance, recent research has shown that including family members or friends in a weight loss program resulted in an additional 6-pound weight loss compared to programs that did not include active social support.[53]

Understanding the components of successful lifestyle modification programs is important for long-term weight management and chronic disease risk reduction. Successful weight loss maintenance is often defined as intentionally losing at least 10% of initial body weight and maintaining that weight loss for at least one year.[54] Loss of 10% of initial body weight was included due to the significant improvement this magnitude of weight loss has on chronic disease risk factors, particularly for type 2 diabetes and cardiovascular disease.[55] Additionally, the Institute of Medicine has previously defined successful weight loss as management for at least one year.[56] Also, sustainable weight management beyond one year is imperative for reducing chronic disease risk factors and improving overall health. Therefore, there is a need for more research to assess and promote longer healthy lifestyle behavior maintenance intervals.

One example of an evidence-based behavioral lifestyle intervention study that includes the aforementioned lifestyle components, as well as extended participant follow up intervals, is the Diabetes Prevention Program (DPP). The DPP was a large national, multicenter clinical trial that examined whether moderate weight loss through lifestyle modification or drug treatment could prevent or delay the onset of type 2 diabetes in prediabetic individuals. Over 3,200 participants were randomly assigned to one of three groups: lifestyle modification, standard care with drug therapy, or standard care with placebo. Participants in the lifestyle modification group received intensive individual counseling in diet, physical activity, and behavior modification by trained lifestyle coaches. The goals of the intensive lifestyle intervention were to reduce calorie and fat intake, lose 7% of initial body weight, and achieve 150 minutes per week of moderate intensity physical activity. The 7% weight loss goal is within the range of clinically meaningful weight loss for improvement of type 2 diabetes and cardiovascular risk factors. The drug therapy group received two daily doses of the oral diabetes drug metformin, while the third group

received a placebo pill. Both of these groups also received standard information on diet and exercise, but did not receive any intensive behavioral counseling.

Results of the DPP showed that the behavioral lifestyle intervention was more efficacious at preventing or delaying the onset of type 2 diabetes regardless of age, sex, or race, than the placebo and was shown to be more effective than the drug intervention. At the conclusion of the DPP, 50% of the lifestyle intervention participants achieved the 7% weight loss goal while 74% achieved the physical activity goal.[57] To assess the long-term effects of the DPP on chronic disease prevention and weight management, about 88% of original DPP participants were followed over an average of ten years in the Diabetes Prevention Program Outcomes Study (DPPOS). Specifically, the DPPOS studied whether type 2 diabetes and diabetes-related complications (e.g. kidney disease, cardiovascular disease, blindness) could be prevented or delayed over time. Due to the benefits of the DPP lifestyle intervention, all treatment groups were offered group-based lifestyle intervention sessions. The original lifestyle intervention group also received lifestyle sessions and coach support, along with annual follow-ups. The metformin group continued their drug regimen, although they were unmasked to their treatment assignment.[58] Results of the DPPOS showed that over approximately a 10-year period, diabetes incidence was reduced by 34% in the lifestyle modification group, compared to the placebo group.[59] Additionally, the lifestyle intervention group succeeded in maintaining long-term weight loss, although minimal weight gain (average of 5 pounds) was reported since the end of the DPP. Nonetheless, no other behavioral weight loss studies have reported this amount of weight loss over such a long time period. Most literature on weight loss programs demonstrate that short-term weight loss is more achievable than long-term maintenance, but the DPPOS results show how evidence-based behavioral modification can increase long-term success.[60]

1.5 TRANSLATION OF THE DIABETES PREVENTION PROGRAM INTO COMMUNITY PRACTICE

The Diabetes Prevention Program demonstrated that the incidence of type 2 diabetes could be reduced in prediabetic individuals through moderate weight loss and lifestyle changes. Since the publication of the successful DPP results, there have been several evaluations of real-world adaptations of the lifestyle intervention implementation in the community setting. Several community models of the DPP have been successful at reducing chronic disease risk among various settings, including YMCAs, churches, underserved minority communities, primary care settings, and worksites. [61-69]

One study, called the Diabetes Education & Prevention with a Lifestyle Intervention Offered at the YMCA (DEPLOY), was implemented into two urban YMCA facilities to determine the feasibility of implementing a DPP model into the community. Each YMCA site was randomized to receive either the group-based DPP model or standard individual diabetes and weight control counseling. The YMCA model consisted of 16 weekly meetings with groups of 8-12 participants that focused on healthy lifestyle goal setting, self-monitoring, and problem-solving techniques delivered by trained YMCA staff. Success of the program was measured by attendance rates, participant weight loss, and change in total cholesterol levels throughout the program. The DEPLOY study showed that even with moderate program attendance (around 50%), participants were able to achieve weight loss and lifestyle changes comparable to the DPP, even after one year. Given the availability of YMCAs across the U.S., along with the benefits of a group-based DPP model on lifestyle modification, this study showed that community fitness facilities can be effective settings for widespread dissemination of the DPP lifestyle intervention.[61]

Translational DPP research has also been conducted within faith-based settings, most notably within African American Baptist churches through the Fit Body and Soul (FBAS) Program. FBAS sought to determine the feasibility and acceptance of implementing a faith-based diabetes prevention program into African American communities. Each church was randomized to receive either FBAS or a standard health program. FBAS consisted of 12 weekly group sessions delivered by trained church health professionals with the goal of at least 7% initial body weight reduction and increased physical activity. This study was unique for its use of church leaders to deliver the intervention, instead of community health workers. The successful translation of the DPP into this church setting shows the need for more research into faith-based DPP implementations, such as through studying different sized churches or other religious denominations.[62]

Additional DPP translation has been implemented in underserved minority communities, such as the Latino population. One example, the Lawrence Latino Diabetes Prevention Project (LLDPP), aimed to reduce the risk of diabetes among low-income Latino communities since Latinos have high rates of both obesity and type 2 diabetes. The lifestyle intervention consisted of 13 weekly group-based sessions as well as three home visits that focused on increasing self-efficacy, promoting healthier diets, and increasing physical activity. Additionally, all interventions and study assessments were completed in Spanish with sensitivity to literacy abilities. The LLDPP had a surprisingly high program retention rate (93%), which demonstrates another successful DPP community program.[63]

Another adaptation of the DPP lifestyle intervention that has been widely implemented and evaluated is the DPP Group Lifestyle Balance program (GLB). The DPP GLB curriculum was developed by faculty who led the original DPP Lifestyle Resource Core and now comprises

the Diabetes Prevention Support Center of the University of Pittsburgh. The DPP GLB curriculum was directly adapted from the successful lifestyle intervention of the DPP, and has been designed for group-based implementation at the community level. Along with nutrition and physical activity education, the GLB also addresses overcoming self-defeating thoughts, planning for behavioral "slips", navigating social and environmental weight loss challenges, and increasing participant self-efficacy through positive reinforcement.[64] The recognition of such lifestyle factors in the GLB curriculum is important for long-term participant success and behavior change. Key features of the GLB program are outlined in Table 2.

The DPP GLB has been evaluated in several community settings, including clinical practice, rural communities, medically underserved urban communities, and worksites, and has been shown to reduce weight and improve risk factors for type 2 diabetes and cardiovascular disease, regardless of the intervention modality.[65- 69] A recent study by Kramer et al. evaluated the effectiveness of the DPP GLB program in a workplace setting, using a randomized delayed control design. Two-thirds of the participants started the intervention immediately after enrollment, while one-third began 6 months later. Participants were able to choose the modality of the GLB intervention, either coach-led group-based sessions or home-based self-directed DVD sessions with telephone coach support. Results of this study found that participants completing the intervention immediately after enrollment had greater weight loss and physical activity levels than the delayed intervention group. However, after receiving the intervention, the delayed intervention group was also successful at reducing risk factors for type 2 diabetes and cardiovascular disease. In this study, the immediate and delayed groups were combined to evaluate changes in weight over time, with the combined group of participants followed for 18 months from enrollment, approximately 6 months after the conclusion of the intervention. At 18

months, although still significantly improved from baseline, study participants had regained some of their weight. [69]

Table 2. Key Components of the Group Lifestyle Balance (GLB) Program

- **Goals**: Lose 7% of initial body weight and achieve 150 minutes of moderate physical activity per week
- **Curriculum**: One-year program consisting of 1-hour group-based sessions focusing on nutrition, physical activity, and behavioral modification (stress management, problem solving, etc.) The program includes 12 core weekly sessions, followed by 4 bi-weekly core transition sessions, and 6 monthly post-core support sessions, for a total of 22 sessions offered over the course of the year.
- Participants are given recommended daily fat and calorie goals based on starting weight to achieve safe weekly weight loss of 1-2 pounds
- The program focuses on self-monitoring weight, physical activity, and dietary intake through the participant's preferred method (e.g. paper diary, web-based tracking, mobile application, electronic activity monitor)
- The intervention is delivered by trained lifestyle coaches who provide ongoing support and feedback to participants

1.6 BARRIERS TO LIFESTYLE MODIFICATION

Maintaining healthy lifestyle habits is important for long-term weight loss success and chronic disease prevention. Since weight loss is one of the most effective methods to reduce type 2 diabetes and cardiovascular disease risk factors, it is important to understand the factors that either promote or inhibit weight loss success. Literature reveals that relapse is often substantial in

behavioral weight loss interventions for a variety of reasons, such as psychological, social, and environmental influences.[70] Barriers to weight loss adherence can be explained through the social-ecological framework, which considers the intertwined relationship between an individual and their environment. Although individuals are responsible for making lifestyle choices, the surrounding social environment largely determines personal behavior.

Individual barriers to weight loss adherence include self-defeating thoughts, lack of readiness to change behavior, lack of self-motivation, lack of proper nutrition or exercise education, lack of time, physical limitations or injury, and socioeconomic limitations.[71] To overcome personal weight loss barriers, individuals must set realistic goals, focus on building new habits, and develop problem solving skills to navigate inevitable weight loss obstacles.

Interpersonal factors include relationships with family, friends, colleagues, or community members that influence personal behavior. Due to the challenges involved in making and maintaining lifestyle changes, positive social relationships are imperative for improving self-esteem and achieving weight loss goals. For instance, research has shown that social support, defined as help and encouragement from other people, is directly correlated with long-term weight loss maintenance.[72]

Community level factors such as the availability of healthy food and exercise facilities and neighborhood safety and walkability strongly influence obesity rates, especially in minority populations.[73] Residents of low-income, minority, and rural neighborhoods have less access to supermarkets and healthy food, which contributes to poor dietary habits in these communities.[74] Likewise, these communities often have higher availability of fast-food restaurants and convenience stores, which only offer high-calorie foods. Research has also indicated a negative association between perceived neighborhood safety and obesity. Individuals who believe their

neighborhood is unsafe have body mass indices nearly twice that of those who believe their neighborhoods are safe.[75] Furthermore, neighborhood safety influences other obesity factors including stress hormones, blood pressure, and blood glucose levels. Additionally, neighborhood characteristics such as the presence of sidewalks, enjoyable scenery, traffic flow, population density, urban sprawl, and availability of public spaces impact community obesity prevalence.[76] For example, residents of pedestrian-friendly neighborhoods weigh an average of 6-10 pounds less than those living in less walkable areas.[77]

Societal level factors include local, state, and federal policies that impact individual health behaviors. Widespread public health and legislative regulations have the potential for long-term impact on obesity trends and prevention strategies in the United States. For example, in 2001, the Surgeon General's "Call to Action to Prevent and Decrease Overweight and Obesity" identified obesity prevention as a crucial national public health priority.[78] Since this report, a wide range of government policies and programs have been implemented including nutrition labeling on packaged foods, calorie labeling on menus, social networking campaigns, as well as federal efforts to increase access and affordability of nutritious foods.[79] Despite these efforts, obesity has remained one of the country's most significant public health burdens. Results from federal legislation to improve lifestyle habits are lacking, which indicates the difficulty of implementing population-based public health policy in the United States. Although policy level obesity and chronic disease prevention are essential, it is more feasible to focus on modifiable risk factors at the individual and environmental levels in order to impact immediate change.

1.6.1 BARRIERS ASSOCIATED WITH PARTICIPANT MAINTENANCE OF THE DIABETES PREVENTION PROGRAM LIFESTYLE INTERVENTION

Research is limited regarding modifiable barriers that impede weight loss, dietary, and physical activity goals in community adaptations of the Diabetes Prevention Program. Recognition and evaluation of such impediments is necessary to improve participant adherence and increase successful translation of the DPP into diverse communities settings. For example, a study by Venditti et al. evaluated the interaction between participant barriers and lifestyle coaching techniques during the lifestyle intervention of the DPP. This study found that problems with self-monitoring, poor time management, low self-motivation, problem social cues, and injury or illness were common barriers to weight loss goal adherence during the program.[80] Another study conducted by Vanderwood et al. assessed participant barriers to weight loss maintenance following the completion of a group-based Diabetes Prevention Program offered at several community hospitals. Researchers found that emotional eating, stress, lack of physical activity, and eating out frequently were the most common barriers to weight loss reported by participants in a follow-up survey.[81] Additional research focusing on improving participant weight loss self-efficacy has shown that moderate increases in self-efficacy correlates to both short and long-term weight loss in community-based Diabetes Prevention Programs.[82] Improved self-efficacy during the program was defined as increasing an individual's confidence to maintain a low-fat diet and improve dietary restraint to prevent eating beyond physical satiety.[83] Specifically, this study focused on improving individual-level barriers such as stress, emotional eating, and self-esteem in order to impact a participant's willingness to change their unhealthy behavior.[84]

1.7 PUBLIC HEALTH SIGNIFICANCE

The consequences of obesity and obesity-related chronic diseases result in significant health burdens in the United States. These burdens manifest in the form of premature death, disability, loss of productivity, and social stigmatization of obese individuals. Obesity is not only problematic because of the implications it has on chronic diseases, but also its effect on healthcare costs. In 2005, the United States spent $190 billion on obesity-related health care expenses, which is nearly double that of previous estimates.[85] Researchers have estimated that by 2030, if obesity rates continue to rise, obesity-related medical costs could increase by $48-66 billion per year in the United States.[86] The magnitude of this economic burden and the effects of obesity on health and quality of life have indicated the need for multifaceted public health approaches to mitigate the complexity of the obesity epidemic. Abundant research has shown that lifestyle modification can significantly improve obesity and chronic disease risk factors. However, a better understanding of the modifiable barriers to weight loss adherence in lifestyle modification programs is still needed. The success of such programs can influence further obesity prevention research, which is of major public health importance.

1.8 OBJECTIVE

The objective of this project was to identify and describe barriers that may inhibit healthy lifestyle maintenance following completion of a community-based Group Lifestyle Balance intervention provided through a student service learning experience. Specifically, this project assessed community participant adherence to the GLB program and identified participant-

perceived challenges that may prevent achievement and/or maintenance of healthy lifestyle goals, through use of a post-intervention survey. Results of the survey were then compared to factors influencing long-term behavioral modification found in the current literature. Results of this project will be useful in guiding the development of future strategies and programs for long-term DPP healthy lifestyle modification programs in the community.

2.0 METHODS

2.1 STUDY POPULATION

The study population consisted of Pittsburgh, PA residents who participated in a 12-week Group Lifestyle Balance program offered at the Jewish Community Center of Squirrel Hill and the University of Pittsburgh School of Social Work, from May to August 2015. The program was offered as part of a student service learning opportunity in the Department of Epidemiology, Graduate School of Public Health. Participants were recruited using print and email advertisements at both sites. Individuals who responded to the advertisements were assessed for eligibility via telephone by staff at the Diabetes Prevention Support Center of the University of Pittsburgh. Adults age 18 and older, with no history of diabetes, a Body Mass Index (BMI) of at least 24 kg/m^2 (22 kg/m^2 for Asian) were eligible if they reported having at least one risk factor for type 2 diabetes including:

- Elevated blood sugar levels (FBG ≥100mg/dL and <126mg/dL)
- High blood pressure (>140/90 or on medication)
- Large waist measurement (>40 inches men, >35 inches women)
- Abnormal blood fat levels (on med OR Trigs > 150 mg/dl OR HDL <50 women, <40 men)
- History of diabetes while pregnant or baby weighing 9 pounds or more
- Family history of diabetes (parents or siblings)

- Physical inactivity (less than 3 times/week)
- Race (African American, Hispanic-American, Native American, Asian-American, Pacific Islander)
- Polycystic Ovary Syndrome
- History of Vascular Disease

BMI was calculated from self-reported height and weight derived during the telephone screening. A series of questions based on the Canadian Society for Exercise Physiology's Physical Activity Readiness Questionnaire (PAR-Q) was also administered during the telephone interview to assess whether participants could safely begin a physical activity routine.[87] Individuals who answered "yes" to any of the PAR-Q questions were required to obtain their health care provider's permission to participate in the program. A total of twenty-seven individuals responded to the study advertisement; twenty-three were eligible for participation and enrolled in the study.

2.2 INTERVENTION DELIVERY AND MEASURES

Students from the University of Pittsburgh's Graduate School of Public Health were trained and certified as Group Lifestyle Balance coaches to administer the 12-week core component of the one-year program. Sessions were held weekly and each lasted for approximately one hour. Each session focused on a different healthy lifestyle topic such as goal setting, self-regulatory skills, healthy eating and meal planning, planning for physical activity, managing social/environmental cues, problem solving, and increasing motivation. Participants were instructed on one of the key components of this behavioral lifestyle intervention: learning to self-monitor their weight, eating

and physical activity. Lifestyle coaches mediated the sessions, encouraged group discussion, and offered advice about common weight loss and lifestyle modification challenges. Prior to the start of each session, participants were weighed privately on-site and asked to submit their self-monitoring journals from the previous week. Coaches reviewed all participant self-monitoring journals and offered encouragement and suggestions on incorporating healthy eating and physical activity into everyday life. Participants were encouraged to lose 1-2 pounds per week as well as gradually and safely increase their physical activity duration and intensity. At the end of each session, participants were instructed to continue to self-monitor their weight, food intake, and physical activity.

In addition, a survey regarding participant self-monitoring behaviors, personal barriers to goal achievement and long-term healthy lifestyle maintenance was adapted from a previously developed survey, and administered to participants at the completion of the 12 core sessions of the GLB program. Participant health behaviors, which included self-monitoring of weight, physical activity, and food intake before and throughout the course of the GLB program, were assessed. Participants were also asked to report their total weight loss over the 3-month GLB program. Additionally, participants were asked to rate the usefulness of several aspects of the program curriculum including self-monitoring activity, lifestyle coach feedback, group support, and educational materials. Lastly, participants were asked to assess personal or social barriers that inhibited their weight loss achievement throughout the program.

2.3 STATISTICAL ANALYSIS

Once the data were collected, they were tabulated and analyzed using Microsoft Excel. Descriptive statistics, including frequency and percentage response distribution was used to analyze participant survey responses. Weight loss goal achievement was analyzed using the mean weight loss across the study population. The frequency of self-monitoring behavior for weight, food intake, and physical activity were also assessed. Lifestyle modification barriers were evaluated based on ranking of the most common factors.

3.0 RESULTS

Descriptive characteristics of the GLB participants are represented in Table 3. Twenty-three participants were enrolled in the GLB intervention, and sixteen (70%) completed the 12-week core curriculum. Participants enrolled in the program (n=23) had an average baseline weight of 220 pounds, while those who completed the intervention (n=16) had an average baseline weight of 197 pounds. Of the sixteen participants completing the intervention, twelve (75%) responded to the follow-up survey. The survey respondents (n=12) had an average baseline weight of 185 pounds. Participants who completed the program (n=16) lost an average of 7 pounds, while the survey respondents lost an average of 8 pounds over the three-month period. Furthermore, two survey respondents achieved the GLB weight loss goal of 7% of their initial body weight. Of the survey respondents (n=12), 58% reported achieving the physical activity goal of 150 minutes per week, which is an improvement from the 25% of participants who were physically active at least 150 minutes per week prior to the program.

Nearly 70% of the intervention group was recruited from the Jewish Community Center of Squirrel Hill. Both the intervention group and survey respondents were 75% female and 25% male. Participant age ranged from 45-72 years, and 56% of participants were over age 60. Baseline participant body mass index (BMI) ranged from 25-38 kg/m^2, with an average BMI of 30.25 kg/m^2. Additionally, baseline assessments indicated that 75% of participants reported

having a large abdominal circumference at the start of the program. Additionally, nearly 70% of survey respondents reported a family history of type 2 diabetes.

Table 3. Descriptive Characteristics of Group Lifestyle Balance Participants

		Total Participants (N=16)		Survey Participants (N=12)	
		N	***%***	***N***	***%***
Recruitment Site	Jewish Community Center	11	69%	9	75%
	School of Social Work	5	31%	3	25%
Sex	Male	4	25%	3	25%
	Female	12	75%	9	75%
Age Group	40-49	2	13%	2	17%
	50-59	5	31%	2	17%
	60-69	6	37%	5	41%
	≥ 70	3	19%	3	25%
Baseline BMI	<30 kg/m^2	7	43%	6	50%
	≥ 30 kg/m^2	9	57%	6	50%
Large Baseline Abdominal Circumference (>40 inch men >35 inch women)	Yes	12	75%	10	83%
	No	4	25%	2	17%
Family History of Type 2 diabetes	Yes	11	69%	8	67%
	No	5	31%	4	33%

Participants were asked about their self-monitoring habits before and throughout the duration of the Group Lifestyle Balance program, summarized in Table 4. Before the program, 33% of participants frequently monitored their weight. However, during the program 83% of participants frequently monitored their weight progression over the three months. Only 8% of participants frequently monitored their physical activity prior to the GLB program, while no

participants frequently kept track of their dietary intake. Throughout the program, 83% of participants monitored their physical activity and 75% kept track of their food intake.

Table 4. Frequency of Participant Self-Monitoring Behaviors Before & Throughout the Group Lifestyle Balance Program (N=12)

	Weight		**Physical Activity**		**Food Intake**	
	Before	***Throughout***	***Before***	***Throughout***	***Before***	***Throughout***
Frequently (7 times/week – 4 times/week)	4 (33%)	10 (83%)	1 (8%)	10 (83%)	0 (0%)	9 (75%)
Infrequently (3 times/week –1 time/week)	4 (33%)	2 (17%)	2 (17%)	2 (17%)	2 (17%)	2 (17%)
Rarely (Few times/month-never)	4 (33%)	0 (0%)	9 (75%)	0 (0%)	10 (83%)	1 (8%)

Participants were also asked to assess the common barriers that impeded their adherence to healthy eating and increased physical activity during the program (Figure 1). Self-motivation ranked as the most common barrier to both healthy eating and physical activity achievement. Specifically, 92% of survey respondents reported that lack of self-motivation prevented them from adopting and maintaining a more nutritious diet. Additionally, lack of time was ranked as a significant barrier to GLB goal achievement. Social factors, such as lack of support from family and friends, were also common barriers for the survey respondents, although not as prevalent as more internal influences.

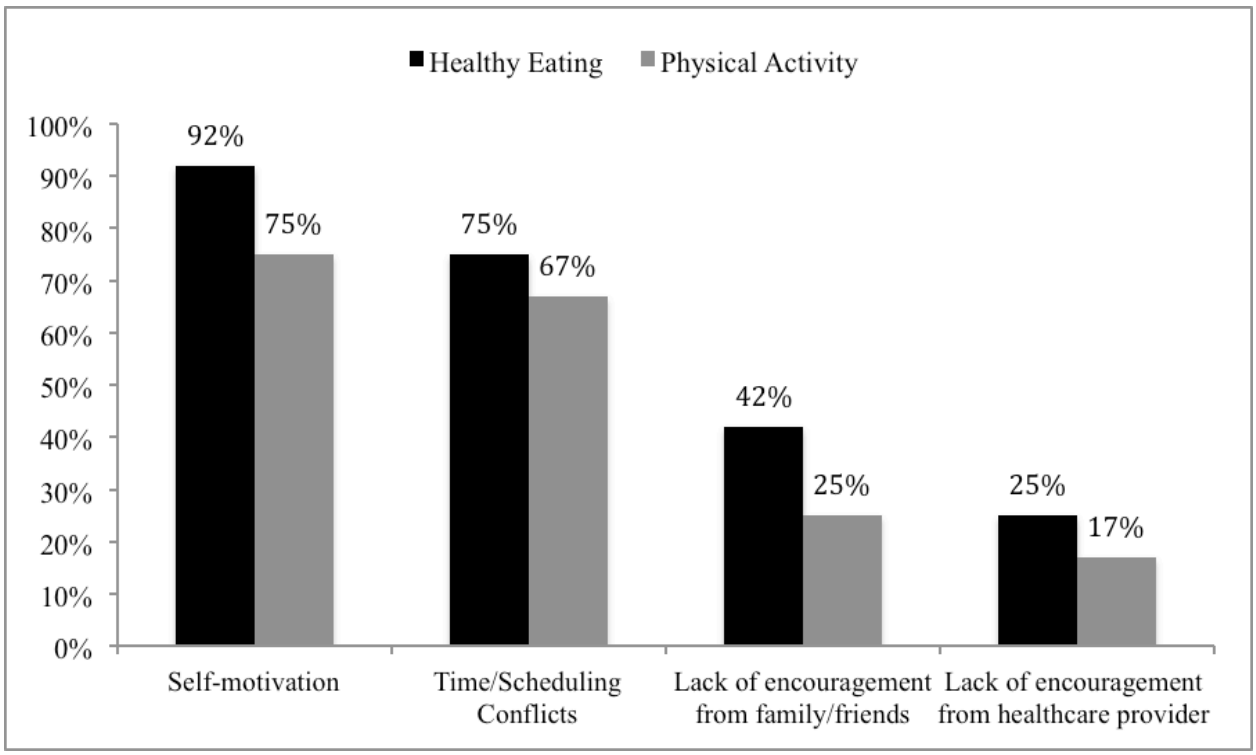

Figure 1. Self-reported Barriers to Group Lifestyle Balance Goal Achievement (N=12)

Participants were also asked about options that would assist their long-term healthy lifestyle maintenance, such as personal habits or support from GLB coaches and/or healthcare providers (Table 5). All survey respondents indicated that self-monitoring of food intake and physical activity would be most helpful for their long-term weight management and behavior modification. Lastly, participants were asked their preference for GLB meeting style from the following options: in-person, online, combination of in-person and online, or neither. Half of the respondents indicated a preference for in-person meetings, while 42% preferred a combination of in-person and online curriculum options and 8% exclusively preferred an online curriculum.

Table 5. Frequency of Options Participants Rate as Beneficial for Long-Term Healthy Lifestyle Goal Maintenance (N=12)

Factor	Frequency (%)
Self-monitoring of fat/calorie intake and physical activity	12 (100%)
Having additional in-person GLB meetings	10 (83%)
Having additional online GLB meetings	7 (58%)
Receiving feedback from GLB coaches	7 (58%)
Including healthcare provider in lifestyle plan	6 (50%)

4.0 DISCUSSION

The most frequently reported barriers for reaching and maintaining both healthy eating and physical activity goals were internal factors, specifically lack of self-motivation. Additionally, absence of social support was also ranked as a barrier throughout the Group Lifestyle Balance program, but to a smaller extent. The majority of survey respondents adhered to the program and monitored both their weight and physical activity, while three-quarters of participants monitored their food intake. Only a small number of participants achieved the 7% weight loss goal, but participants lost an average of 7 pounds throughout the intervention period.

The results of this survey reflects other research in which self-motivation has been cited as a major barrier to weight loss management.[88] Although research is limited regarding barriers in DPP translation, several studies have also found that lack of self-motivation, lack of time, infrequent self-monitoring, and lack of social support are major barriers to participant weight loss achievement.[80-83] Apart from DPP barriers research, results from this project also agree with other research addressing barriers to adopting a healthier diet or physical activity routine. For example, a study by Satia et al. found that dietary change was negatively impacted by low self-esteem, lack of motivation, and negative social pressure. Negative social pressure and low self-esteem were also significantly associated with unhealthy dietary patterns, especially higher fat intake, than those with higher self-esteem and positive social encouragement.[89] Additionally, studies of physical activity adherence have revealed that lack of self-motivation is a main barrier

to maintaining an exercise routine.[90] For example, a study by Leijon et al. analyzed whether barriers to physical activity adherence differed between participants assigned to either a self-directed, home-based program or a coach-led, facility-based physical activity program. Despite the additional social support offered to the facility-based group, participants in both groups reported low self-motivation as the most common barrier to their non-adherence.[91] Although participants of the Leijon et al. study and those in this study population reported lack of social support as a less significant barrier, research has shown that lifestyle modification requires not only individual change, but also social support for sustained healthy behaviors.[92] Furthermore, social support, including positive encouragement and social accountability, is vital for long-term weight loss maintenance.[93] Since long-term weight assessments were not performed in this project, it is difficult to determine if lack of social support would have become a more significant barrier to weight maintenance for this study group over a longer follow-up period.

The strengths of this project include the promotion of the successful DPP lifestyle intervention to participants at risk of developing type 2 diabetes. Additionally, very few studies have assessed participant barriers to goal achievement in community-based weight loss or diabetes prevention interventions. This survey project also aimed to identify challenges to achieving and maintaining the healthy lifestyle goals of a community-based DPP, as well as identify strategies to promote long-term healthy lifestyle maintenance. These results will be beneficial for guiding the development of new strategies to promote sustainable healthy lifestyle modification.

This survey project has several limitations based on the observational design, reliance on self-report and modest sample size. Due to the observational design, no causal relationship between self-monitoring habits or personal barriers and goal achievement can be inferred.

Additionally, self-reported data from the survey and voluntary entry into the community GLB program introduces biases, which lowers the reliability and validity of the study results. Survey respondents could have misrepresented their self-reported answers for weight, self-monitoring habits, and diet or physical activity achievement. Survey responders also weighed an average of 12 pounds less than non-responders at the start of the program. Therefore, participants who did not complete the survey may have found the program goals more difficult to achieve due their heavier initial weights. Participants completing the survey could have also been more likely or willing to maintain a healthy lifestyle than those not completing the survey. The sample size was also small, relatively homogenous, and underrepresented men. Due to these limitations, results from this survey are not generalizable to all individuals who participate in behavioral lifestyle intervention studies. Future studies should focus on strategies to diversify the intervention group by encouraging more participation from men, younger adults, and minority groups, to better represent the general population.

Furthermore, this survey only addressed individual level barriers to weight loss achievement, which limits the scope of the results. Additional bias may be present due to barriers that were not measured in this project. The Jewish Community Center group had better overall adherence rates, in both attendance and weight loss, than the University of Pittsburgh group. Since the Jewish Community Center group had fitness memberships with the organization, it is possible that these participants were more motivated to complete the program or maintain a physical activity routine. The University of Pittsburgh sessions were held at the participants' worksite during normal business hours. Perhaps the demands and stress of the workplace contributed to poorer adherence among this group. Nonetheless, this survey is useful for determining specific participant opinions about the GLB program in more depth than quantitative

measures. Furthermore, these findings will be useful for tailoring future lifestyle modification programs according to participant preferences to best accommodate their ideas and needs to maximize success.

Future studies should analyze the causal relationships between personal, modifiable barriers and hindrance of goal achievement in behavior modification programs. Although the importance of self-monitoring for behavior change is well established, there is a need to determine the necessary dose and modality required to achieve successful outcomes. One example to assess self-monitoring is through the incorporation of technology into obesity and chronic disease prevention interventions. Implementation of internet-based curriculums, mobile applications, and electronic activity monitors (EAMs) into weight loss interventions have been shown to be a cost-effective and convenient way to combat obesity through healthy lifestyle promotion. One such study highlighted a combined intervention using a mobile application, in-person DPP curriculum, and pedometer usage to promote sustainable diabetes prevention.[94] However, no study has been well-powered enough to determine the efficacy of technology-driven self-monitoring compared to other interventions. Therefore, future studies should assess the efficacy, feasibility, and acceptability of technology-based weight management interventions.

The burden of mortality, morbidity, and disability attributable to chronic diseases is continually growing in the United States. Chronic diseases associated with lifestyle factors such as weight, diet, and physical activity habits result in devastating burdens on both individual and societal well-being. Therefore, the prevention and management of chronic diseases is imperative to improve overall public health. Much research has shown that lifestyle modification interventions can effectively reduce several modifiable risk factors for chronic disease, specifically excess weight, poor nutrition, and inadequate physical activity. Therefore, it is

imperative for public health practitioners to better understand the challenges that inhibit successful lifestyle modification. By understanding such barriers in advance, this knowledge can be incorporated into future public health interventions to eliminate challenges and increase successful long-term healthy lifestyle maintenance.

APPENDIX A: DEFINITIONS OF KEY TERMS

BODY MASS INDEX (BMI): A measurement of weight (in kilograms) divided by the square of height (in meters). Most obesity data sources, including NHANES, use body mass index (BMI) as an indicator of obesity because BMI is a reliable way to categorize body fat levels based on predetermined endpoints. However, BMI is not an ideal measurement of obesity because it does not directly assess body fat levels. Due to its widespread use in clinical and research settings, BMI is easier to measure than other obesity indicators, and is well proven to predict disease risk.[95] Specifically, high BMI has been shown to be strongly associated with a higher risk of cardiovascular disease and premature death.[96]

ELECTRONIC ACTIVITY MONITOR: A wearable device that objectively measures lifestyle physical activity and can provide visual or verbal feedback via monitoring display and/or application to elicit continual self-monitoring activity behavior [97]

METABOLIC SYNDROME: Defined by the following clinical indicators: [98]

- Waist circumference > 40 inches for men and > 35 inches for women
- Triglycerides > 150mg/dL
- HDL cholesterol > 40 mg/dL for men and > 50 mg/dL for women
- Blood pressure ≥ 130 / ≥ 85 mmHg
- Fasting blood glucose ≥ 110 mg/dL

OBESITY: Defined as abnormal or excess fat accumulation in adipose tissue to the extent that health may be impaired [99]; also classified as BMI ≥ 30 kg/m^2 [100]

OBESITY (CHILDREN): Classified as BMI > 95th age and sex-specific percentile for ages 2-19 [101]

PREDIABETES: Classified as the following clinical indicators: [102]

- AlC: 5.7% - 6.4%
- Fasting plamsa glucose (FPG): 100-125 mg/dL
- Oral Glucose Tolerance Test (OGTT): 140-199 mg/dL

SEDENTARY BEHAVIOR: Simply defined as increased time spent sitting or participating in activities requiring low energy expenditures, such as watching TV, sitting at workplace desk, automobile commuting, or using a computer/other electronics [103]

TYPE 2 DIABETES: Classified as the following clinical indicators: [102]

- AlC: ≥ 6.5%
- Fasting plamsa glucose (FPG): ≥ 126 mg/dL
- Oral Glucose Tolerance Test (OGTT): ≥ 200 mg/dL

APPENDIX B: SUPPLEMENTAL GROUP LIFESTYLE BALANCE FORMS

Screening for GLB Service Learning Practicum

1. Verify eligibility for GLB Program

Diabetes?	Yes	No
Age < 18 years old?	Yes	No
BMI < 24 (<22 for Asian)	Yes	No
If all of above answered "NO" continue:		
Elevated blood sugar levels (FBG ≥100mg/dL and <126mg/dL)	Yes	No
High blood pressure (>140/90 or on medication)	Yes	No
Large waist measurement (>40 inches men, >35 inches women)	Yes	No
Abnormal blood fat levels: (On med OR Trigs ≥ 150 mg/dl OR HDL <50 women, <40 men)	Yes	No
History of diabetes while pregnant or baby weighing 9 lbs or more	Yes	No
Family history of diabetes (parents or siblings)	Yes	No
Physical inactivity (less than 3 times/week)	Yes	No
Race (African American, Hispanic-American, Native American, Asian-American, Pacific Islander)	Yes	No
Polycystic Ovary Syndrome	Yes	No
History of Vascular Disease	Yes	No

No diabetes, age ≥ 18 and BMI ≥ 24 kg/m^2 (22 kg/m^2 for Asian) plus one other risk factor = Eligible for GLB

2. If eligible: Request contact information:

Name:_____ e-mail: _____

Address: _____

Home Phone: _____ Work Phone: _____ Cell: _____

3. PAR-Q:

1.	Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?	Yes	No
2.	Do you feel pain in your chest when you do physical activity?	Yes	No
3.	In the past month, have you had chest pain when you were not doing physical activity?	Yes	No
4.	Do you lose your balance because of dizziness or do you ever lose consciousness?	Yes	No
5.	Do you have a bone or joint problem (e.g. back, knee, or hip that could be made worse by a change in your physical activity?	Yes	No
6.	Is your doctor currently prescribing drugs (e.g. water pills) for your blood pressure or heart condition?	Yes	No
7.	Do you know of any other reason why you should not do physical activity?	Yes	No

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 Group Lifestyle Balance (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 questionnaire. Please let us know if you have any questions while completing the survey.

1. On average while you were taking part in the GLB program, how many days each week did you **weigh yourself?** (Check one)

❑ Daily	❑ 4 days/week	❑ 1 day/week
❑ 6 days/week	❑ 3 days/week	❑ 2-3 times/month
❑ 5 days/week	❑ 2 days/week	❑ Less than 1 time/month or never

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

❑ Do not own a scale	❑ Do not like to weigh myself
❑ Scale is inaccurate/broken	❑ Other:_____

2. On average while you were taking part in the GLB program, how many days each week did you **keep track of your food intake?** (Check one)

❑ Daily	❑ 4 days/week	❑ 1 day/week
❑ 6 days/week	❑ 3 days/week	❑ 2-3 times/month
❑ 5 days/week	❑ 2 days/week	❑ Less than 1 time/month or never

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

❑ Do not have materials to record my food intake	❑ Lack encouragement from family and friends
❑ Do not have the time	❑ Other:_____
❑ Do not like to keep track	

3. On average while you were taking part in the GLB program, how many days each week were you **physically active?** (Check one)

❑ Daily	❑ 4 days/week	❑ 1 day/week
❑ 6 days/week	❑ 3 days/week	❑ 2-3 times/month
❑ 5 days/week	❑ 2 days/week	❑ Less than 1 time/month or never

a. When you are active, how many minutes are you physically active on average? _____ (minutes)

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

- ❑ Do not have the time to exercise
- ❑ Lack motivation
- ❑ Do not find exercise enjoyable
- ❑ Lack encouragement from family and friends
- ❑ Neighborhood is not convenient for exercise
- ❑ Fear of being injured
- ❑ Illness or medical condition
- ❑ No fitness centers near me
- ❑ Other: _____

4. On average while you were taking part in the GLB program, how many days each week did you **keep track of your physical activity?** (Check one)

- ❑ Daily
- ❑ 6 days/week
- ❑ 5 days/week
- ❑ 4 days/week
- ❑ 3 days/week
- ❑ 2 days/week
- ❑ 1 day/week
- ❑ 2-3 times/month
- ❑ Less than 1 time/month or never

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

- ❑ Not physically active
- ❑ Do not have the time to self-monitor my physical activity
- ❑ Do not have materials to record my physical activity
- ❑ Not interested/do not like to self-monitor my physical activity
- ❑ Other:_____

5. How much weight did you lose **throughout the course of this program**?
_____ (pounds)

6. Since completing the 3-month 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	❑	❑
Self-monitoring of my physical activity	❑	❑
Getting feedback on my tracking of fat/calories	❑	❑
Getting feedback on my tracking of physical activity	❑	❑
Including my physician in my healthy lifestyle plan	❑	❑
Having additional in-person GLB meetings available	❑	❑
Having online GLB options available	❑	❑

7. Please rate how useful the following components of <u>in-person GLB meetings</u> would be to you to help maintain your healthy lifestyle practices:

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

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

❑ Weekly
❑ Monthly
❑ Quarterly
❑ Other _____
❑ In-person meetings would not be useful to me

9. Please rate how useful these components of <u>an online GLB program</u> would be to you to help maintain your healthy lifestyle practices:

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

10. Would you prefer: (check one)

❑ In-person meetings
❑ Online options
❑ A combination of both
❑ Neither
❑ Other _____

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

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

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

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

13. When considering how to help people maintain healthy lifestyle practices after completing the 3-month GLB program, please let us know about **anything else that would be useful to you personally to help maintain your healthy lifestyle practices**:

_____

_____

_____

_____

Questions regarding behavior *before* participating in the program:

14. Before participating in the GLB program, did you keep track of your weight?
❑ Yes ❑ No

a. If yes, how often did you weigh yourself? (Check one)

❑ Daily	❑ 4 days/week	❑ 1 day/week
❑ 6 days/week	❑ 3 days/week	❑ 2-3 times/month
❑ 5 days/week	❑ 2 days/week	❑ Less than 1 time/month or never

15. Before participating in the GLB program, did you keep track of your physical activity?
❑ Yes ❑ No

a. If yes, how often did you self-monitor your physical activity? (Check one)

❑ Daily	❑ 4 days/week	❑ 1 day/week
❑ 6 days/week	❑ 3 days/week	❑ 2-3 times/month
❑ 5 days/week	❑ 2 days/week	❑ Less than 1 time/month or never

16. Before participating in the GLB program, did you keep track of your food intake?
❑ Yes ❑ No

b. If yes, how often did you self-monitor your food intake? (Check one)

❑ Daily	❑ 4 days/week	❑ 1 day/week
❑ 6 days/week	❑ 3 days/week	❑ 2-3 times/month
❑ 5 days/week	❑ 2 days/week	❑ Less than 1 time/month or never

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