A LONGITUDINAL STUDY OF WOMEN COACHING WOMEN THROUGH MOTIVATIONAL INTERVIEWING AND THE INTERRELATIONSHIPS BETWEEN DEPRESSION, HEALTH BEHAVIORS, AND CHANGES IN OBESITY

by

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STATEMENT OF DISSERTATION APPROVAL

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ABSTRACT

Some evidence supports the development of holistic interventions that address the overlap between obesity and depression, the both of which have increased burden among women in marginalized communities. Additional understanding about the interrelationships between obesity, health behaviors, and depression could improve the effectiveness of interventions and promote both obesity- and depression-related wellness. Objectives: 1) Evaluate the competency of wellness coaches in utilizing motivational interviewing and its impact on participant factors. 2) Assess how intensity of wellness coaching, fruit/vegetable consumption, and physical activity behaviors are associated with improved depression screen over 12 months. 3) Assess how fruit/vegetable consumption, physical activity behaviors, and depressive symptoms are associated with clinically significant improvements in adiposity over 12 months. Methods: The University of Utah, Utah Department of Health, and African American, African immigrant, Hispanic/Latino, American Indian/Alaskan Native, and Pacific Islander communities partnered to develop and conduct a randomized trial of wellness coaching for women. Health behavior change was the primary target, but a comprehensive paradigm enabled evaluation of relationships between health behaviors and both obesity-related factors and depression. Wellness coaches from each community recruited women (n = 485) who were randomized to high- versus low-intensity coaching.

Generalized estimating equations were used to assess interrelationships (odds

ratios) between repeated measurements of health behaviors, depressive symptoms, and ≥5% reductions in baseline body weight and waist circumference. Results: Baseline coach empathy was associated with participant completion of 4-month session. Depression prevalence decreased from 21.7% to 9.5% over 12 months. Women consuming fruits/vegetables ≥ 5 times per day (versus <5) or any physical activity (vs. none) each had higher odds of improved depression screen, especially when women ≥55 years of age consumed more fruits/vegetables. Overweight/obese women who consumed fruits/vegetables ≥5 times/day (vs. <5) had higher odds of losing ≥5% body weight, while more physical activity (vs. <2.5 hours/week) had higher odds only among those with a positive depression screen. Furthermore, at-risk women with a negative depression screen (vs. positive) had higher odds of ≥5% decrease in waist circumference. Conclusion: Health behaviors/outcomes that are considered in a holistic, culturally relevant context could improve wellness and health equities.

This dissertation is dedicated to my children, Gordon, Toshiko, and Adelaide,

who remind me of life's joys; and the memory of my grandmother,

Susan Sunada, who gave voice to the voiceless, and my father,

G. Roger Sunada, who lost himself in the service of others.

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CHAPTER 1

INTRODUCTION

1.1 Purpose

Effective health behavior change interventions and policies are needed to prevent chronic disease and promote mental health,[1] particularly among women who are at an increased risk for depression.[2–4] Evidence for what works in diabetes prevention interventions has included behavioral changes and body weight loss as key factors,[5] but the role of mental health has been considered complex and unsettled.[6] Some research has begun to show how mental health and lifestyle factors interrelate[7–9] and facilitate changes in adiposity,[10] but similar information is limited among racial, ethnic, and indigenous communities.[8,10,11]A community based participatory research[12–15] (CBPR) project, facilitated by Community Faces of Utah and the Coalition for a Healthier Community for Utah Women and Girls (CHC-UWAG), developed[16] and implemented an intervention that was effective in improving obesity-related health behaviors and outcomes in among African immigrant, African American, American Indian/Alaskan Native, Hispanic, and Pacific Islander communities in the Salt Lake area. This CBPR project has provided an opportunity to evaluate three aspects of the interrelationships between wellness coaching, obesity-related behaviors, depression, and changes in adiposity in these unique communities as part of a dissertation.

1.2 Specific Aims

1. To what extent do English-speaking lay women trained as community wellness coaches provide competent motivational interviewing at baseline as evaluated using the motivational interviewing Treatment Integrity code.
    a. Is high fidelity motivational interviewing associated with the participant baseline characteristics (such as age and education), or differences between CWC and participant characteristics (such as differences in age or education)?
    b. Which components of high fidelity motivational interviewing delivered by English-speaking wellness coaches at baseline are associated with participant self-exploration at baseline and study retention, behavior change, and outcomes at 4 months?
2. What is the average effect of wellness coaching on depressive symptoms (based on Patient Health Questionnaire–2 scores) among diverse women over time in a 12-month study?
    a. How are changes in fruit and vegetable consumption and physical activity behaviors associated with the incidence of improved depressive symptoms over time in a 12-month study?
3. How do changes in fruit and vegetable consumption, physical activity behaviors, and depressive symptoms influence the likelihood of achieving clinically significant anthropometric changes in adiposity (i.e., weight loss of 5% and waist circumference change to <35 inches) among women over time in a 12-month study?

Motivational interviewing (MI) is an interpersonal intervention that has been shown to be effective in improving health behaviors primarily when delivered by clinicians, such as psychologists, physicians, dietitians, and nurses.[17,18] Community health workers (CHW) are becoming more common as liaisons between underserved communities and health care systems, but their delivery of MI is less common.[19–24] Evaluation of the competency of MI delivered is also less common, though,[25,26] particulary less common among CHWs.[19–21,27] The first hypothesis of this dissertation is that competent MI delivered by English-speaking CHWs in the CHC-UWAG wellness coaching randomized trial will improve participant retention, behavior change, and depressive symptoms at follow-up.

Women's risk for depressive disorders[2–4] is of high concern since depression is a leading cause of disease burden worldwide[28] and the third greatest cause of disability.[29] Physical activity may be an effective treatment for major depressive disorder.[8,9] Higher levels of fruit and vegetable (FV) consumption may be associated with decreased depression as well.[30,31] Since some barriers to FV intake may increase risk for depression and differ by age,[32–34] education levels,[35,36] obesity,[11,37–39] and across racial/ethnic groups,[35,40,41] the second hypothesis in this dissertation hypothesizes that personal characteristics may influence the beneficial effect of PA behaviors and FV consumption on depression for women in the communities in the CHC-UWAG study.

Weight loss[42] and reductions in central adiposity[43,44] are key predictors of decreased chronic disease incidence,[42] but central adiposity may be more related to symptoms of depression than adiposity stored in other parts of the body.[37,39] Untreated depression may also lead to unplanned weight gain.[45] The third hypothesis of this

dissertation is that physical activity, fruit and vegetable consumption, and depression will impact the likelihood of significant reductions in body weight and waist circumference within the CHC-UWAG wellness coaching program.[10]

The evaluation of these hypotheses could provide greater understanding of the relationships between obesity, depression, and potential mediators (e.g., dieting, lack of exercise) and potential moderators (e.g., socioeconomic status; see Figure 1.1).[35] In other words, this dissertation could show the potential of CHWs to address the commonalities between treatments for both obesity and depression (e.g., physical activity, stress management, social support), while also treading carefully around issues that treat one condition but exacerbate the other.[35] In the case of dieting, this is a very common treatment for obesity, but the stress of dieting, along with repeating dieting and perceived weight cycling, could lead to depressed mood. If these behavior changes are facilitated in a manner that integrates stress management, as could be the case with MI-based wellness coaching through person-centered goal setting and supportive follow-up, both obesity and depression could be treated simultaneously.[35] The aims of this dissertation (e.g., Aim 2) attempt to shed additional light on these relationships within communities which may have differing social norms relating to obesity[46,47] and depression.[48–50]

1.3 Context

Community Faces of Utah (CFU) works to address health disparities through mutual relationships of trust between the University of Utah, the Utah Department of Health, and five culturally diverse communities in the urban Salt Lake County area: African American, African immigrant, American Indian/Alaskan Native, Hispanic/Latino, and Pacific Islander. CHC-UWAG joined together with CFU in

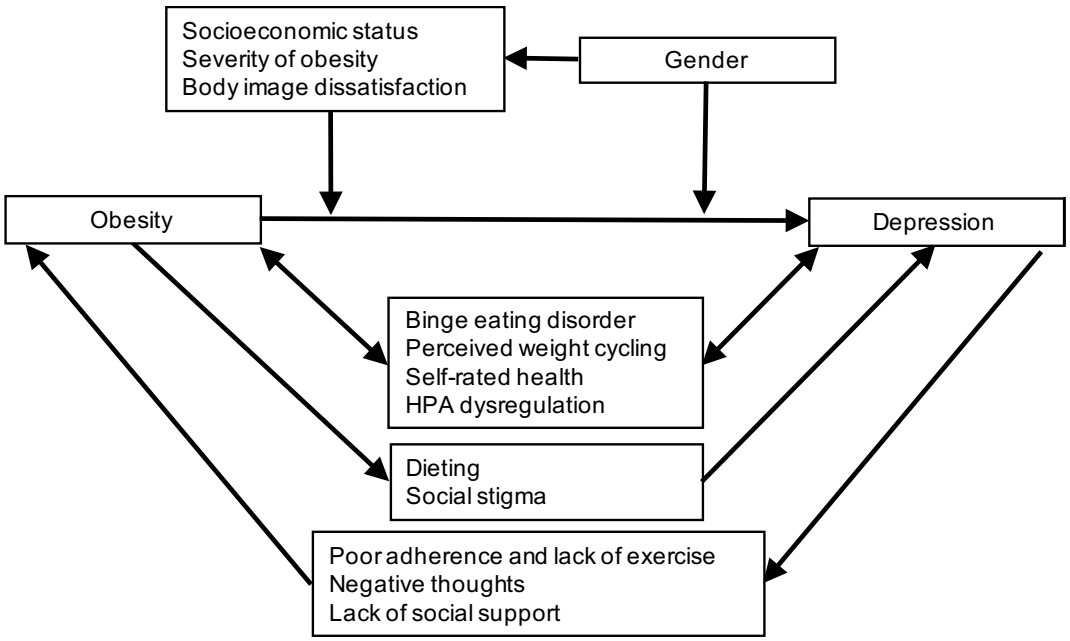

Figure 1.1 Model for Bidirectional Pathway of Causal Links Between Obesity and Depression.[35]

following a thorough CBPR[51–54] process where partners "check our egos at the door," participate in multidirectional learning, value each other's differences and common ground, and trust each other as equitable partners. This included a needs assessment,[55] which underscored the role of women as gatekeepers of health in their families and communities. This led to a randomized trial of a community wellness coaching intervention among women. The primary aim of the CHC-UWAG study was to increase fruit and vegetable consumption and physical activity behaviors among women in CFU communities. In order to reduce the health and ethical risks of a "weight-normative" approach focused on weight loss as a primary goal,[56] CHC-UWAG used a "weight-inclusive" approach[56] that put behavior change within the Seven Domains of Health[57] (i.e., physical, emotional, social, intellectual, financial, environmental, and spiritual) as the main focus of the intervention and evaluation.

CFU leaders selected women from their communities to be trained in MI-based wellness coaching and research protocols to serve as community wellness coaches (CWCs) for their respective communities. CFU requested that each person receive some form of the intervention, so CWCs then recruited and randomly assigned women from their communities to a low-intensity or high-intensity 12-month coaching program. The high-intensity participants had access to monthly group activities and monthly individual coaching sessions in addition to the educational materials. Low-intensity participants, on the other hand, participated in data collection and coaching every 4 months without access to the group activities. CWCs enrolled 496 women who were randomized after consent, baseline data collection, and goal setting.

CHAPTER 2

MOTIVATIONAL INTERVIEWING COMPETENCY, PARTICIPANT ENGAGEMENT, AND HEALTH BEHAVIOR CHANGES IN A COMMUNITY WELLNESS COACHING RANDOMIZED TRIAL WITH A DIVERSE SAMPLE OF UTAH WOMEN

2.1 Abstract

2.1.1 Introduction

In order to better design and implement behavior change interventions that utilize motivational interviewing (MI), the impact of competent use of MI should be evaluated. This is especially needed when MI is employed among community health workers, who may have potential to expand MI's application to new settings.

2.1.2 Methods

A randomized trial among African American, African immigrant, American Indian/Alaskan Native, Hispanic/Latino, and Pacific Islander women employed 10 MI-based community wellness coaches. Four English-language community health workers consented to have their baseline sessions evaluated. Two evaluators, trained in the Motivational Interviewing Treatment Indicator (MITI) Version 4, coded a stratified random sample (n = 45) of recordings. This included the participant self-exploration

global score (Motivational Interviewing Skill Code Version 2) and MITI global scores/behaviors as selected within Self-Determination Theory and based on existing research. MITI global scores and behavior counts were compared with the self-exploration global score, participant completion of 4-month session, fruit/vegetable intake and physical activity behavior change, depression screen (Patient Health Questionnaire–2) improvement, and achieving ≥5% weight loss (i.e., when overweight/obese at baseline) using Chi-square and Wilcoxon Rank-Sum test.

2.1.3 Results

Competent coach scores for cultivating change talk and partnership were associated with higher participant age ($p < .001$ and $p = .010$, respectively) and education ($p = .034$ and $p = .028$, respectively). High scores for cultivating change talk and empathy were associated with substantial participant self-exploration (Wilcoxon $p < .001$ for both scores) and 4-month follow-up session completion ($p = .002$ and $p = .014$, respectively).

2.1.4 Conclusion

Future behavior change studies and interventions should consider evaluating MI and community health workers as means to improve study/intervention retention. The role of participant self-exploration in behavior change outcomes should also be explored further.

2.2 Background

Effective health behavior change interventions are needed to reduce obesity and prevent chronic disease. Motivational interviewing (MI) has been shown to be effective

in helping individuals improve health behaviors, including those relating to obesity, but its use has primarily been implemented and evaluated among clinicians, including psychologists, physicians, dietitians, and nurses.[17,18] Community health workers (CHW) have helped bridge the gap between underserved communities and health care systems, but their use of MI is even less common.[19–24] The true effect of MI on behavior change is often unclear since the competency or fidelity with which it is delivered is rarely measured or documented in randomized trials,[25,26] and particularly among CHWs.[19–21,27] This study was designed to evaluate the competency with which English-speaking CHWs delivered MI within the Coalition for a Healthier Community for Utah Women and Girls study, a community wellness coaching randomized trial. In addition, this study was designed to explore the impact of MI on improvements in obesity-related behaviors, depression, and weight loss among African American, American Indian/Alaskan Native, and Pacific Islander women in the study.

MI is described as a means of improving health behaviors through a "collaborative conversation" based upon respect for autonomy and facilitated through exploration of personal motivations to change.[58] MI is made up of its "underlying spirit" and associated skills.[58] The MI Spirit is a global score, representing the average of three MI components conveyed by the practitioner: collaboration as equitable partners; the acceptance of the autonomy of each client; and evocation of the participant's motivations for change.[58] Empathy, defined as an expressed interest in accurately understanding the client's perspective and experience, is considered foundational to this Spirit and MI skills.[59] MI was originally developed to help individuals change alcohol- and other drug-related behaviors in addiction recovery.[60,61] Since then it has since been applied to

improving physical activity[62] and dietary behaviors,[17,63] obesity,[64] and depressive symptoms among people with comorbid conditions.[65,66]

MI may also be beneficial to participant/patient engagement, such as self-exploration and study/program retention, in a variety of settings.[67,68] As defined in the Motivational Interviewing Skills Indicator (MISC),[69] self-exploration is the voluntary sharing or elaboration of personal insights and may include a shift in self-perception at its deepest level. This has primarily been linked with short-term and long-term (i.e., 12-month) improved alcohol drinking behaviors,[67] as well as an unexpected link with increased drinking.[68] When categorized with other forms of counseling/therapy engagement, self-exploration was identified as a potential mediator of the relationship between MI and improvements in mental health disorders,[70] though results had moderate to high heterogeneity. Another form of participant engagement that may also benefit from MI is study/program retention.[71,72] Program retention has been documented as especially low among people with depression within racial/ethnic/linguistic minority communities.[73–78] A multisite, community-based study[71] that used a less rigorous evaluation of MI competency reported better 28-day program retention among those assigned to MI compared to a standard intervention. As the roles of CHWs expand, and their relationships of trust in communities have been assumed to be strong,[79] additional evaluation of their impact on these aspects of participant engagement could shape recruitment and training.

When evaluated, the competency with which MI is delivered by clinical providers varies across studies. In one systematic review of 15 studies of clinicians using MI to address substance abuse (e.g., alcohol, opioid, marijuana), only two studies reported that

a majority of the practitioners achieved basic competency in MI Spirit after training. Training methods varied, and included self-guided training, workshops alone, and workshops with ongoing coaching and feedback.[80] In another study, even after participating in a multiday workshop, only 22% of Swedish pediatric nurses[81] reached competency thresholds for empathy, declining to only 8% after structured supervision. MI competency was not linked with outcomes in this study.[81] Two studies evaluated MI among physicians outside of the context of formal training.[82,83] One study of physicians caring for obese adolescents[82] explored patient/physician characteristics and their relationship with physician MI competence. In another study that evaluated the counseling skills of primary care physicians as they assisted patients with weight loss, the majority of physicians scored below competency in MI components. Notably, in this study, patients of physicians with competence in MI showed improved obesity-related health behaviors.[83]

Competent adherence to MI principles and skills has been connected with improved health behaviors.[83–85] For example, a meta-analysis of MI in alcohol-related studies showed that MI-consistent practitioner behaviors were associated with increased client language in favor of behavior change (i.e., *change talk)*; in contrast, MI-inconsistent practitioner behaviors were associated with both decreased *change talk* and increased client language in favor of maintaining less healthy behavior (i.e., *sustain talk*), the latter of which was associated with poorer outcomes.[84] Moyers and Miller[85] reviewed research on empathy and found that its consistent use, when compared to lack of empathy and confrontational behaviors, was associated with improved program retention for participants, reduced relapse into addictive behaviors, and other improved outcomes

in addiction therapy. Obesity-related MI research has highlighted statistically significant pathways between MI and behavior change.[86] These included potential pathways from empathy to client change talk to client health behavior change, as well as from empathy directly to behavior change, though these have lacked formal mediation analyses.[86] MI Spirit has also been identified as one of the most consistent mechanisms for increasing change talk, which in turn has been associated with improved obesity-related behaviors.[86] These findings highlight potential MI mechanisms of behavior change, primarily in treating substance use disorders, and underscore the need for additional evaluation of MI components and their impact within obesity-related interventional studies.

CHWs are typically from, and have trusted relationships within, marginalized communities and are also known as *promotoras de salud*, lay health workers, or health navigators.[87] Only a handful of studies describe the use of MI by CHWs to address obesity. In rural Colorado[22] and in rural Alabama,[23] CHWs have used MI to improve coronary heart disease risk factors and diabetes-related outcomes, respectively. CHWs have also administered an MI-based intervention that reduced the stigma associated with care-seeking for depression among older adults, but MI competency was not formally assessed.[24] While each study indicated that contact with a CHW was associated with improved outcome measures, none assessed the competency of MI delivered.

Among the few studies that have assessed MI competency among CHWs using Motivational Interviewing Treatment Integrity (MITI) Version 3,[21,88,89] none have focused on diet and exercise behaviors. These included college students trained to reduce high-risk alcohol consumption,[21] a sexual risk reduction program in Western Cape, South Africa,[88] and an academic achievement program for urban youth.[89] The target behaviors,

CHW characteristics, and outcome measures differed across these studies.

CHWs and participants benefit from coming from the same community, however, intra-community factors that impact social distance (e.g., age and educational differences) could still moderate the effect of coaching,[90] particularly when a community has distinct norms about social distance or hierarchy. If a community is more patriarchal, directive coaching may be expected and perhaps more effective than participant-centered coaching,[91] especially when there is an age or other status difference between CHW and participant.[90] It is unclear whether CHWs serving participants of similar education level or age may be more likely to establish equal partnerships, express higher levels of empathy, or cultivate change talk more effectively.

The first aim of the present study was to describe the competency of English-speaking CHWs delivering an MI-based wellness coaching program. Competency in the MI components of cultivating change talk, partnership, empathy, MI adherent behaviors, and persuading with permission were assessed using the latest version of the MITI instrument, Version 4[92] and the relationship between competency in these areas and CHW/participant differences in age and education was explored. The second aim was to describe how competency in aforementioned MI components at baseline relate to participant retention at 4 months and changes in obesity-related behaviors and depressive symptoms between baseline and 4 months.[65,66] A greater understanding of the competency of CHWs in delivering an MI-based, obesity-focused intervention and how competency in MI components is related to study retention and health behavior change may be used to shape future MI-based interventions.

2.3 Methods

2.3.1 Intervention

The Coalition for a Healthier Community for Utah Women and Girls (CHC-UWAG) study is an equitable partnership between university, government public heath, and community representatives. After jointly identifying obesity prevention among women as a shared priority,[16] community leaders identified CHWs from each of five communities who were called community wellness coaches (CWC). These communities included African American, African immigrant, American Indian/Alaskan Native, Hispanic/Latina, and Pacific Islander. Ten women were trained in wellness coaching using a participatory curriculum and cross-community learning process that included 12 45-minute modules. The content covered the "Outreach, Enrolling, Informing Agent/Counselor" model,[93] coaching skills informed by Self-Determination Theory and MI,[94,95] evidence-based obesity management,[96] administering informed consent, and measuring body height/weight using standardized approaches. CWCs were required to complete several coaching rehearsals and pass a coaching simulation before beginning to enroll study participants. The process and content of interviews, clinical measures, coaching, decisional balance (i.e., listing reasons to change and reasons not to change),[97] data entry, and session audio recording were managed via the Research Electronic Data Capture (REDCap) database. CWCs also participated in monthly meetings to support these skills and address emerging challenges.

From 2011 to 2015, CWCs recruited adult women through community networks and events into the 12-month study. After obtaining consent and enrollment, CWCs administered a baseline interview and coaching session which included personalized goal setting with measurable goals. Participants were then randomly assigned to either high-

or low-intensity coaching in stratified blocks to allow similar numbers in each of the 5 communities. This allowed both arms of the study to have access to some level of intervention as requested by CFU during the CBPR process.[12] The high-intensity participants had access to monthly group activities, monthly individual coaching sessions, and educational materials. Low-intensity participants received the same educational materials but met with the coach only every 4 months and did not have access to the group activities. Data collection occurred at quarterly sessions across the 12 months.

Following completion of the wellness coaching program, community leaders invited the coaches from African-American, American Indian, and Pacific Islander communities who had conducted coaching in English to participate in a brief survey and a formal evaluation of their recorded coaching sessions. Four consented and completed the questionnaire providing information about their age, level of education, employment status inside the community organization, and years of experience as a health educator or health care professional.

The Institutional Review Boards within the University of Utah and Phoenix Area Indian Health Service approved this study.

2.3.2 Participant Measures

Data from baseline and 4-month interviews and coaching sessions were used for this study. CWCs collected participant demographic characteristics during in-person interviews at baseline. These included age, education level, income, and household size. CWCs also collected the following information at baseline and at the 4-month follow-up session. Depression screenings were conducted at baseline and quarterly thereafter, using

the Patient Health Questionnaire–2 (PHQ–2). A positive depression screen and subsequent referral to a health care provider were based on a PHQ–2 score of 3 or higher (out of 6).[98] Fruit and vegetable (FV) intake and physical activity behaviors were measured at baseline and quarterly thereafter. FV intake was measured using Behavioral Risk Factor Surveillance System (BRFSS) FV[99] questions, which includes the number of times fruit, fruit juice, and types of vegetables were consumed per day over the previous month. Participants were asked how much time they spent being physically active or doing exercise in an average week and answers were collected in half-hour increments. Physical activity data were then stratified into inactive, insufficiently active (less than 2.5 hours per week), sufficiently active (2.5 hours or more per week).[100] Participants were weighed and their height was measured by wellness coaches at baseline; weight was measured quarterly thereafter, using standardized procedures and scales. Body mass index (BMI) was calculated based on body weight (kg) / height (cm)^2. Overweight was defined as BMI ≥ 26 for Pacific Islanders and BMI ≥ 25 for others.[101–103] Clinically significant weight loss was defined as 5% or greater weight loss from baseline among those who were overweight or obese at baseline.[42]

2.3.3 Motivational Interviewing Treatment Integrity Global Scores and Behavior Counts

The MITI code is the most commonly used instrument to assess MI competency in research and interventions.[92] The MITI is time efficient relative to more detailed instruments[69] and focuses on coach behaviors in the form of global scores, measured on a 5-point Likert scale, and behavior counts, based on coach utterances.[25,104] The MITI version 4 has been shown to have preliminary validity and reliability among nonprofessional raters.[105]

The MITI 4.2 includes global scores for 4 components, evaluated as overall impressions of the dimensions using a 5-point Likert scale, as well as behavior counts for 10 practitioner behaviors, with each "utterance" within one uninterrupted volley (or turn in a conversation) categorized as one of the MITI behaviors or as "not coded" (e.g., in the case of procedural, noncoaching content).[92] The 4 MI behavior counts included in this evaluation were defined as follows[92]: *Persuade with permission* was counted when an effort to change the participant's opinion or behavior included an explicit request for the participant's permission to persuade her, a request for her perspective, or a preface that allowed the participant to disregard the advice; *Affirm* was a genuine statement that described the participant's efforts, value, or accomplishment; *Seek collaboration* were instances of the CWC seeking consensus, the participant's opinion of information, or her input on the direction of the coaching session; *Emphasize autonomy* were statements that accentuate the participant's freedom or ability to make her own choices (i.e., rather than her self-efficacy). The last three are considered MI adherent behaviors with seeking collaboration having more, and emphasizing autonomy having the most, importance within the theoretical core of MI.[92] The 3 global scores for coaches included in this study were *cultivation of change talk* (i.e., efforts to evoke and deepen change talk), *partnership* (i.e., power sharing with participant that shapes nature of the session), and *empathy* (i.e., evidence of correctly understanding the participant's perspective or experience). One additional global score that is part of the MITI 4.2, *softening sustain talk* (SST), was not included in the analyses since the design of the coaching curriculum rarely allowed for participants to share "sustain talk" (i.e., language favoring barriers to improved behaviors), resulting in high default SST scores per MITI guidelines,[92] thus not

providing sufficient variation to compare across the outcomes of interest.

Cultivating change talk and SST are considered *technical*, while the partnership and empathy are *relational* global scores. The minimum score considered "competent," according to expert opinion, for the average of relational scores is one point higher (i.e., 4 out of 5) than the average for technical scores since the former are considered foundational to MI.[106]

Since the MITI 4.2 requires attention to client utterances of change talk and sustain talk, a single participant global score for *Self-Exploration* was also included. Self-exploration comes from the Motivational Interviewing Skill Code (MISC) 2.5[69] and evaluates the highest period during which the client volunteers personal insights and self-perceptions. Since a threshold has not been established for MISC self-exploration, coders reached consensus that a 4 or 5 on the 5-point scale denoted a substantial shift in self-exploration depth.

2.4 Theoretical Framework

Both MI and Self-Determination Theory (SDT) are rooted in Carl Roger's client-centered approach,[107] are complementary in character, and share features.[108] SDT aims to change behavior through increased motivation, or "psychological energy" directed at a specific goal,[107] which is founded on the three human needs.[90] These needs[107] influence motivation or "psychological energy" directed at a specific goal within the client-centered Self-Determination Theory (SDT), and provided a framework for the following MITI components evaluated in this study (see Figure 2.1):

1. *Competence* or skill building in a manner that
2. emphasizes the *autonomy* of the individual and

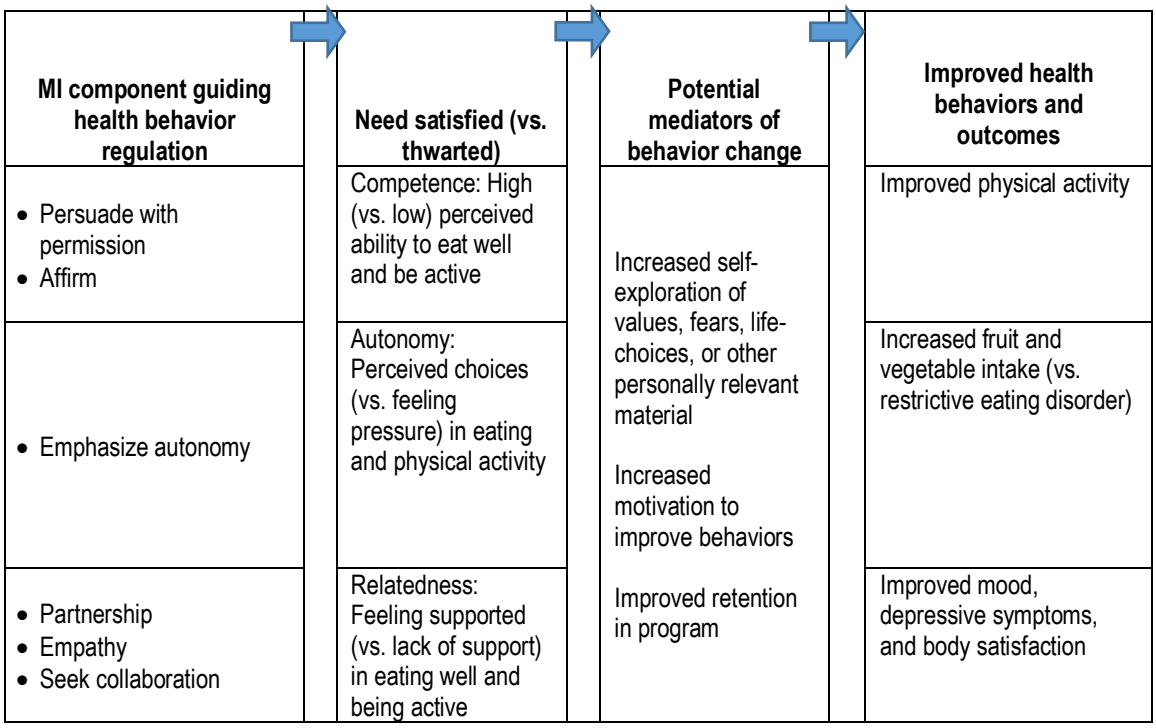

Figure 2.1 Motivational Interviewing (MI) Components, Potential Mediators, and Health Behaviors Informed by Self-Determination Theory and Its Psychological Needs. Adapted from models by Verstuyf et al. and Verstuyf J, Patrick H, Vansteenkiste M, Teixeira PJ. Motivational dynamics of eating regulation: a self-determination theory perspective. *Int J Behav Nutr Phys Act.* 2012;9:21 and Teixeira PJ, Carraca EV, Markland D, Silva MN, Ryan RM. Exercise, physical activity, and self-determination theory: a systematic review. *Int J Behav Nutr Phys Act.* 2012; 9(78):1–30.

3. establishes *relatedness* or connectedness between practitioner and client.

Competent MI practitioners persuade with permission,[92] which may address need 1 by increasing perceived ability to improve eating and physical activity, while also addressing need 2 by asking permission.[109] In addition, competent MI providers also use affirmation, seek collaboration, and emphasize autonomy. Affirmation may potentially enhance need #1. As MI practitioners seek collaboration with clients, this may satisfy needs #2 and #3. Finally, emphasizing autonomy[86] aligns inherently in satisfying need #2. In addition to these practitioner behaviors, the MITI global scores fit within SDT in the following ways: cultivating change talk builds the overarching motivations that the three needs influence; empathy and partnership help fulfill part 3 of SDT's needs.[109] In summary (see Figure 2.1), these MI elements—3 global scores, cultivating change talk, partnership, and empathy; and two sets of behavior counts, MI adherent skills and persuading with permission[109] —were hypothesized *a priori* as satisfying these three needs, thereby promoting participant engagement[110] in the coaching program and increased motivation to change, which would finally lead to improved obesity-related behaviors and outcomes at the 4-month follow-up.

2.5 Coaching Session Data Collection

Audible audio recordings of baseline coaching sessions for each English-language CWC were selected based on a stratified random sample of 20%, or a random quota sample of 10, whichever was greater, based on guidelines.[26] The doctoral candidate and a graduate research assistant were trained as MITI coders. Each completed the online portion of the CWC training, reviewed the MITI version 4.2 manual,[92] participated in a 21-hour in-person training with a MITI coauthor, and confirmed proficiency and

interrater reliability (IRR) with precoded recordings,[113] recordings from a similar rural coaching program, and CHC-UWAG coaching audio clips not included in the random sample before initiating coding the clips for this study. The coders were blinded to the coach's identity, date of the session, and participant demographic information and questionnaire results, except for content that was an explicit part of the coaching session. Each session in the sample was reviewed, coded, and scored using the MITI 4.2.[92] Per guidelines,[26] when an audio clip was less than 20 minutes, the whole clip was reviewed and coded; and when an audio clip was longer than 20 minutes, a random start time was selected and the subsequent 20 minutes were coded.[65] Within the stratified subsample of sessions, 20% were randomly designated to be double coded.[26,105] In order to assess interrater reliability (IRR), coders were notified of recordings which had been double coded each week. At weekly meetings with a MI expert, discrepancies in global scores and behavior counts for double-coded recordings were discussed. Based on MITI training content, coders aimed to have global scores with no more than one point difference.[106] When global scores differed by more than one point, recordings were recoded. Following any recoding, consensus was reached for remaining discrepancies in global scores, while remaining differences in behavior counts were averaged. Intraclass correlation (ICC) was calculated for global scores for both raw scores and dichotomous ratings relative to the competency threshold since both versions were used in the analysis,[114] along with behavior counts. ICCs were based on two-way mixed effects with fixed effects for raters[115] using a macro[116] for SAS.[117] ICCs were evaluated relative to the following guidelines: 0.00–0.40 = poor, 0.40–0.59 = fair, 0.60–0.74 = good, and 0.75–1.00 = excellent.[118] Competency thresholds were based on expert opinion.[92]

2.6 Data Analysis

2.6.1 Demographic, Health Behavior, and Depression Screen Differences

Descriptive characteristics of CWCs were calculated. Participant baseline demographics, health behaviors, and depression screen results were calculated and compared by study arm. Differences in retention, health behaviors, and depression screen results were also compared by randomized group at the 4-month follow-up. These differences were assessed for statistical significance via Chi-square or Fisher's Exact test (when an expected cell count is <5) as appropriate in these and the following analyses.

2.6.2 MITI Scores Relative to Intervention Groups and CWC-Participant Differences

For each session, coaches were categorized as competent or less than competent using thresholds for each global score; very few sessions met the proficiency threshold (i.e., 4 or higher for Technical scores and 5 for Relational scores) for these global scores.[92] Associations between study arm and threshold-based MITI global scores were compared. Participant age and education levels, along with CWC-participant differences in age and education levels were compared by threshold-based MITI global score. Age differences of 20 years or greater were utilized to represent the presence of generational differences between participants and coaches, based on discussion with community leaders. Differences in education levels between coaches and participants were based on the following three categories: less than high school graduate, high school graduate, and college graduate.

2.6.3 Relationship Between MI Scores and Participant Engagement, Behaviors, and Outcomes

The relationships between competent delivery of specific MI components at baseline and the following were evaluated using Chi-square statistics, Fisher's Exact test, and odds ratios: participant self-exploration at baseline, participant 4-month study retention, participant 4-month improvement in depressive symptoms, participant 4-month improvement in FV/PA behaviors, and achievement of 5% or greater weight loss by 4 months (among those who were overweight at baseline). In a posthoc analysis, the relationship between baseline MI threshold-based global scores and 12-month retention was also tested via Chi-square test and odds ratio. These were calculated based on contingency tables with the following categories:

- Depression screen result improved (i.e., from positive to negative) or remained negative (PHQ–2 < 3) versus depression screen result worsened (i.e., from negative to positive) or remained positive (PHQ–2 ≥ 3)
- Increased (≥ 1 time) usual daily FV intake or remained 5 servings or more per day versus decreased (< 1) usual daily FV intake
- Increased usual PA per week (≥ 30 minutes) or remained sufficiently active versus decreased PA per week or maintained insufficiently active level
- Achieved ≥ 5% weight loss versus <5% weight loss (i.e., including weight gain)

Since global scores and behavior counts were ordinal and count data, respectively, distributions were compared across the aforementioned behavioral and outcome categories using the Wilcoxon rank sum test due to the nonparametric nature of the data.

P values were evaluated at the < .05 alpha level based on two-sided tests.

Statistics were calculated using SAS version 9.4.[117]

2.7 Results

2.7.1 Sample Characteristics

2.7.1.1 Coaches

The ages of the CWCs ranged from upper 20s to mid–50s. Three were college graduates, while one was a high school graduate. Two worked part-time and two worked full-time for their community organizations. Aside from working as a CWC, one was self-employed in other work and another was a student. In addition, half had experience in health promotion or related fields.

Of the 222 baseline sessions conducted by the four CWCs, 198 (89%) had audio recordings available. Two CWCs had all recordings available and one CWC had 93% available, while one CWC had only 62% available. A fifth CWC who declined to participate had 88% available. Between 18–22% of each CWC's recordings were randomly selected and evaluated as follows: 15 recordings (20% of CWC's total sessions), 11 recordings (21%), 10 recordings (22%), and 9 recordings (18%). The latter was below 20% and 10 because one MITI evaluation was later dropped due to poor audio quality.

2.7.1.2 Participants at Baseline Assessment

In the overarching study, 485 women were recruited at baseline including 276 participants who were coached in English, 209 participants who were coached in Spanish or Kirundi. Among the English-speaking participants enrolled through the 4 CWCs who consented to this substudy (n = 222), 45 (20.3%) of their baseline sessions were randomly selected and reviewed for analysis. Within the subsample, differences across

study arms in baseline participant characteristics, including age, education, income, and ethnic community, were not statistically significant, though there was a greater proportion of overweight individuals in the high-intensity arm compared to the low-intensity arm (see Table 2.1, $p = .039$). This difference in overweight status by study arm was not observed in the full sample.

Overall, the 45 participants were evenly distributed across age groups in the subsample (see Table 2.1). A small proportion (5 women or 11%) were aged a generation or more (i.e., 20+ years of age) apart from their CWC. The greatest proportion of participants (47%) had received some postsecondary education, while 27% were high school graduates or less, and 27% were college graduates. Over half (51%) reported having education that was lower than that of their CWC, 7% had more education than their CWC, and 42% had the same amount as their CWC.

2.7.1.3 Participants at Follow-Up

No statistically significant differences existed by study arm for PA duration per week, FV servings per day, or depression screening outcomes at baseline, nor for study retention at the 4-month session in the subsample (see Table 2.2). Similarly, among those who were overweight at baseline in the subsample, there was no difference in the proportion who lost 5% body weight by the 4-month session across randomized arms. The proportion of women who completed the 4-month follow-up session was statistically significantly different between arms in the full sample (66% in low-intensity versus 80% in high intensity; $p = .015$), but this difference was not significant within the subsample for this study (62% versus 71%, respectively; Fisher's $p = .55$).

Table 2.1 Baseline Demographic Characteristics for English-Speaking Participants Within a Stratified Subsample and the Full Sample of the Coalition for a Healthier Community for Utah Women and Girls

	Stratified random subsample					Full sample				
	Low intensity		High intensity		Fisher's *p* value	Low intensity		High intensity		Chi^2 *p* value
	n	%	*n*	%		*n*	%	*n*	%	
Randomized arm	21		24			109		113		
Age					.750					.282
18–34	9	43	8	33		48	44	38	34	
35–54	6	29	10	42		36	33	44	39	
55+	6	29	6	25		25	23	31	27	
Education					.744					.840
High school graduate or less	7	33	5	21		28	26	26	23	
Some college or other post-HS	7	33	14	58		49	45	55	49	
College graduate	7	33	5	21		32	29	32	28	
Income relative to Federal Poverty Line (FPL)					.782					.897
< 100% FPL	3	14	6	25		31	30	34	31	
≥ 100% FPL & < 185% FPL	9	43	9	38		35	34	32	30	
≥ 185% FPL	6	29	9	38		36	35	42	39	
	Missing = 3					Missing = 12				
Community					.406					.990
African American	10	48	10	42		50	46	52	46	
American Indian/ Alaskan Native	6	29	4	17		23	21	23	20	
Pacific Islander	5	24	10	42		36	33	38	34	
Body mass index					**.039**					.762
Normal or underweight	6	29	1	4		15	14	14	12	
Overweight or obese	15	71	23	96		94	86	99	88	

Note. Overweight was defined as BMI ≥ 26 for Pacific Islanders and BMI ≥ 25 for others.[101–103] American Indian may include Alaskan Native women. Women participated in community wellness coaching sessions conducted in English within a stratified random sample and full sample of the Utah Coalition for a Healthier Community for Utah Women and Girls study. High school = HS.

Table 2.2 Obesity-Related Lifestyle Behaviors, Depression Screen Results, and Weight Loss for English-Speaking Women Within a Stratified Random Sample and the Full Sample of the Utah Coalition for a Healthier Community for Utah Women and Girls Study

	Stratified random subsample					Full sample				
	Low intensity		High intensity		Fisher's *p* value	Low intensity		High intensity		Chi^2 *p* value
	n	%	*n*	%		*n*	%	*n*	%	
Baseline Session										
Randomized Intervention Arm	21		24			109		113		
Physical activity per week					.901					.370
None	1	5	2	8		9	8	15	13	
Any < 2.5 hours	9	43	12	50		46	42	40	35	
≥ 2.5 hours	11	52	10	42		54	50	58	51	
Fruit and vegetables per day					1.000					.951
< 5 servings	17	81	20	83		83	76	86	76	
≥ 5 servings	4	19	4	17		26	24	27	24	
Depression screen					.225					.314
Negative	16	76	22	92		87	80	96	85	
Positive	5	24	2	8		22	20	17	15	
4-Month Session										
4-month session complete					.546					**.015**
No	8	38	7	29		37	34	22	20	
Yes	13	62	17	71		72	66	91	80	
Physical activity per week					.275					.653
None	2	15	2	12		5	7	6	7	
Any < 2.5 hours	4	31	7	41		25	35	38	42	
≥ 2.5 hours	7	54	8	47		42	58	47	52	
Fruit and vegetable intake					.427					.603
< 5 servings per day	11	85	12	71		51	71	61	67	
>= 5 servings per day	2	15	5	29		21	29	30	33	
Depression screen					1.000					.297
Negative	10	77	14	82		58	81	79	87	
Positive	3	23	3	18		14	19	12	13	
Weight loss among baseline overweight					1.000					.781
< 5%	8	80	14	82		55	86	69	86	
≥ 5%	2	20	3	18		10	14	11	14	
12-Month Session										
12-month session complete					.552					**.017**
No	9	43	8	33		40	37	25	22	
Yes	12	57	16	64		69	63	88	78	

Note. Overweight was defined as BMI ≥ 26 for Pacific Islanders and BMI ≥ 25 for others.[101,102] Fisher's Exact Test *p* value was used when expected counts in a cell were < 5.

2.7.2 Global Scores and Interrater Reliability

MIT 4 global scores (see Table 2.3) ranged from 1 to 4 for cultivating change talk, from 1 to 4 for partnership, and 1 to 5 for empathy. Competency was reached during 24 sessions (53%) for cultivating change talk, 5 sessions (11%) for partnership, 9 sessions (20%) for empathy. Proficiency was only reached during 5 sessions (11%) for cultivating change talk, 0 sessions (0%) for partnership, and 1 session (2%) for empathy.

ICC results for MITI 4 global scores (see Table 2.4) based on the competent thresholds were within 0.60 (good) for cultivating change talk, 1.0 (excellent) for self-exploration, and (0 or less) poor for the relational scores. When ICC was calculated for raw global scores, the empathy ICC improved to 0.51 (fair) while cultivating change talk and self-exploration each declined to 0.51 (fair) and 0.66 (good), respectively. ICC for behavior counts were excellent for emphasize autonomy (0.76) and seek collaboration (0.76), fair for affirm (0.40) and total MI adherent (0.48), and poor for persuade with permission (0.25). In two observations, global scores differed by more than one point and were recoded after ICC calculation and prior to consensus.

2.7.3 MITI Results by Randomized Arm, Age, and Education

The proportion of baseline wellness coaching sessions crossing the competent threshold did not differ by randomization arm for any MITI global score (not shown), nor did the distributions of MITI behavior counts. Around half (24 sessions or 52%) of all sessions were above the competent threshold for cultivating change talk, while relational had smaller proportions with 11% (n = 5) for partnership, 20% (n = 9) for empathy, and only 2% (n = 1) for the relational average. Mean behavior counts per session ranged from 0.8 for emphasize Autonomy to 2.3 for seek collaboration. The mean count for MI

Table 2.3 Motivational Interviewing Treatment Integrity 4 Global Scores and Behavior Counts for Community Wellness Coaching Sessions in the Coalition for a Healthier Community for Utah Women and Girls Study

	Stratified random sample (n = 45)						
	Mean (*SD*)		Range	Sessions (%) meeting competency threshold		Sessions (%) meeting proficiency threshold	
Global Scores							
CCT	2.6	(0.78)	1–4	24	(53%)	5	(11%)
SST	3.8	(0.48)	2–4	44	(98%)	35	(78%)
Technical	3.2	(0.43)	2–4	41	(91%)	5	(11%)
Partnership	2.6	(0.75)	1–4	5	(11%)	0	(0%)
Empathy	2.4	(1.10)	1–5	9	(20%)	1	(2%)
Relational	2.5	(0.74)	1–4	1	(2%)	0	(0%)
Behavior Counts							
Persuade with Permission	1.0	(0.88)	0–3	n/a	n/a	n/a	n/a
Affirm	1.1	(1.32)	0–4	n/a	n/a	n/a	n/a
Collaboration	2.3	(1.74)	0–6	n/a	n/a	n/a	n/a
Emphasize Autonomy	0.8	(1.09)	0–3	n/a	n/a	n/a	n/a
MI Adherent	4.1	(2.48)	0–8	n/a	n/a	n/a	n/a

Note. Motivational Interviewing Treatment Integrity 4 global scores: cultivating change talk (CCT), softening sustain talk (SST), partnership, and empathy. Technical = (CCT + SST) / 2. Technical competency = 3 and proficiency = 4. Relational = (partnership + empathy) / 2. Relational competency = 4 and proficiency = 5. Total Motivational Interviewing (MI) Adherent = Affirm + Seek + Autonomy.

Table 2.4 Intraclass Correlation for Motivational Interviewing Global Scores and Behavior Counts for a Subsample of Wellness Coaching Sessions Within the Coalition for a Healthier Community for Utah Women and Girls (CHC-UWAG)

		CHC-UWAG (n = 10)				Moyers et al. (n = 10)	
		Competency Threshold		Raw scores/ counts		Raw scores/ counts	
Global scores	Cultivating change talk	0.60	[b]	0.51	[c]	0.95	[a]
	Partnership	0.00	[d]	0.12	[d]	0.64	[b]
	Empathy	-0.20	[d]	0.51	[c]	0.79	[a]
	Relational average	0.00	[d]	0.23	[d]	0.51	[c]
	Self-exploration	1.00	[a]	0.74	[a]	—	
Behavior counts	Persuade with permission	—		0.25		0.22	
	Affirm	—		0.40	[c]	0.72	[b]
	Seek collaboration	—		0.76	[a]	0.64	[b]
	Emphasize autonomy	—		0.76	[a]	0.06	[d]
	Total MI adherent	—		0.48	[c]	0.61	[b]

Note. Motivational Interviewing Treatment Indicator Code 4.2 global score thresholds were based on expert-based competency levels. The threshold for Motivational Interviewing Skill Code 2.5 (MISC) SE scores of 4 or 5 and is based on coder opinion in the current study. Double-coded CHC-UWAG recordings were randomly selected within the subsample (10 of 46). Double-coded recordings in Moyers et al.[105] were randomly selected within the sample (10 of 50). Relational = (partnership + empathy) / 2. Total Motivational Interviewing (MI) Adherent = Affirm + Seek + Autonomy. Intraclass correlation was evaluated as follows:[118]

[a] 0.75–1.00 = excellent
[b] 0.60–0.74 = good
[c] 0.40–0.59 = fair
[d] < 0.40 = poor

adherent behaviors was 4.1.

Statistically significant differences were observed between proportions of participants in age and education categories across multiple MITI global score thresholds (see Table 2.5). Older participant age was associated with CWC competency in cultivating change talk (Fisher's $p < .001$) and partnership ($p = .010$). Similar differences were observed for empathy and self-exploration, though not statistically significant. In a similar manner, higher levels of participant education were associated with receipt of MI that included competent levels of cultivating change talk ($p = .034$), partnership ($p = .028$), and self-exploration ($p < .001$). Again, a similar nonsignificant association was observed between participant education and empathy. Age and education differences between CWCs and participants were not associated with receiving competent MI in any of the global score categories (not shown).

2.7.4 MITI Results and Participant Engagement and Behavior Change

Participant self-exploration and study retention were both associated with several components of CWC-delivered MI (see Table 2.6). Substantial self-exploration exhibited by the participant at baseline was associated with CWC competence at cultivating change talk ($p < .001$) and empathy ($p = .005$), as well as partnership, though the latter was not statistically significant ($p = .069$). When the distributions of raw global scores were compared by level of participant self-exploration (less than substantial vs. substantial), cultivating change talk (Wilcoxon Rank Sum $p < .001$) and empathy ($p < .001$) differences were still statistically significant, while partnership was not ($p = .066$). While only one session had a Relational average score that crossed the competent threshold, the

Table 2.5 Associations Between Participant Age/Education and Motivational Interviewing Global Scores in an English-Speaking Stratified Subsample of the Coalition for a Healthier Community for Utah Women and Girls Study

	Age							Education						
	18–34		35–54		55+		Fisher's exact *p* value	HS graduate or less		Some college or other post-HS		College graduate		Fisher's exact *p* value
	n	%	*n*	%	*n*	%		*n*	%	*n*	%	*n*	%	
Cultivating change talk							**< .001**							**.034**
Below competent	14	83	5	31	2	17		8	66	11	52	2	17	
Competent	3	17	11	69	10	83		4	33	10	48	10	83	
Partnership							**.016**							**.028**
Below competent	17	100	15	94	8	67		12	100	20	95	8	67	
Competent	0	0	1	6	4	33		0	0	1	5	4	33	
Empathy							0.164							.084
Below competent	16	94	12	75	8	67		12	100	16	76	8	67	
Competent	1	6	4	25	4	33		0	0	5	24	4	33	
Self-exploration							**.051**							**< .001**
Less than substantial	10	59	6	38	2	17		10	85	7	33	1	8	
Substantial	6	35	10	63	10	83		2	15	13	62	11	92	
Missing	1	6								1	5			
Total	17		16		12			12		21		12		

Note. Motivational Interviewing Treatment Integrity 4.2 global score competency thresholds based on expert opinion. Substantial self-exploration (SE) scores includes Motivational Interviewing Skill Code 2.5 (MISC) SE scores of 4 or 5 and is based on coder opinion in the current study. Fisher's exact test calculated without missing values.

Table 2.6 Associations Between Participant Self-Exploration (SE), 4-Month Follow-up Session Completion, and Wellness Coach Motivational Interviewing Treatment Integrity 4 Global Scores in the Coalition for a Healthier Community for Utah Women and Girls Study

	Baseline *SE*					Complete 4-month Session				
	Below substantial		Substantial		*p	No		Yes		*p
Global Scores	*n*	%	*n*	%	value	*n*	%	*n*	%	value
Cultivating change talk					**< .001**					**.025**
Below competent	14	78	6	23		11	75	10	33	
Competent	4	22	20	77		4	25	20	67	
Partnership					.069					.153
Below competent	18	100	21	81		15	100	25	83	
Competent	0	0	5	19		0	0	5	17	
Empathy					**.005**					.234
Below competent	18	100	17	65		14	94	22	73	
Competent	0	0	9	35		1	6	8	27	
Self-exploration					—					.515
Below substantial	—	—	—	—		7	47	11	37	
Substantial	—	—	—	—		7	47	19	63	
Missing	—	—	—	—		1	7	—	—	
Total	18		26			15		30		

Note. Motivational Interviewing Treatment Integrity 4 global scores: Competent scores for cultivating change talk, partnership, and empathy based on expert opinion. Substantial self-exploration scores include Motivational Interviewing Skill Code 2.5 (MISC) self-exploration scores of 4 or 5. *Fisher's Exact Test *p* value.

distribution of Relational scores was higher for those sessions with substantial participant self-exploration ($p < .001$). Study retention at the 4-month coaching session was more often associated with higher global scores than reaching the competency threshold for these global scores (see Table 2.6).

Those women receiving competent cultivating change talk at baseline had a 5.5 times greater odds (*OR*, 95% *CI*: 1.39–21.71) of completing the 4-month follow-up coaching session, compared to those who received less than competent cultivating change talk. In a posthoc analysis, women receiving competent cultivating change talk at baseline also had a 5.5 times greater odds (5.07 *OR*, 95% *CI*: 1.37–18.79) of completing the 12-month follow-up coaching session, compared to those whose sessions were rated less than competent. Differences in proportions based on 4-month study retention across partnership, empathy, and participant self-exploration threshold-based categories, though similar to differences in proportions for substantial self-exploration, were not statistically significant (see Table 2.6).

In contrast, statistically significant differences in raw MITI global scores at baseline were associated with 4-month study retention (see Figure 2.2). Baseline scores for cultivating change talk, empathy, and relational average were higher among coaches of participants who completed the 4-month session (Wilcoxon Rank Sum $p = .002$, .030, and .014, respectively). Baseline partnership scores were also higher among coaches of those who completed the 4-month session, but the difference was not statistically significant ($p = .168$). The posthoc analysis revealed similarly significant findings for 12-month study retention for cultivating change talk, empathy, relational median scores ($p = .017$, .026, and .029, respectively), though not for partnership ($p = .33$).

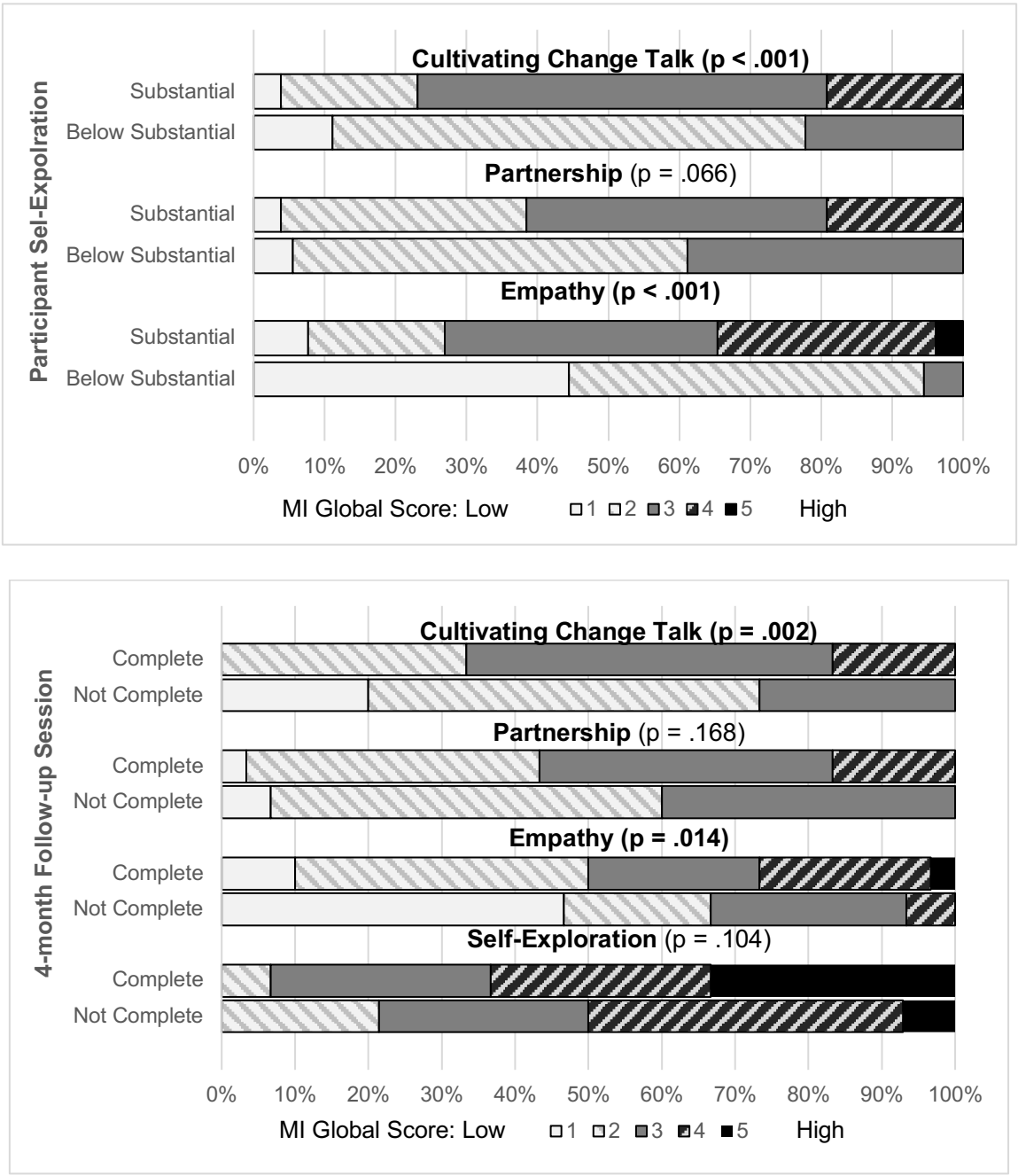

Figure 2.2 Baseline Motivational Interviewing Treatment Indicator 4 (MITI) Global Scores for Community Wellness Coaches by Participant Attributes—Baseline Self-Exploration (SE) and Completion of 4-Month Coaching Session—Among English-Speaking Women in the Coalition for a Healthier Community for Utah Women and Girls Study. *p* values are based on Wilcoxon Rank Sum test. Substantial SE score (Motivational Interviewing Skill Code 2.5 SE score 4 or 5; threshold based on coder opinion) *n* = 26 and Below Substantial (SE score 1–3) *n* = 19 (missing = 1). 4-month complete *n* = 30 and incomplete *n* = 16.

Participant-level self-exploration raw global scores at baseline were not statistically significantly different between those who did and did not complete the 4-month session ($p = .104$, see Figure 2.2) or the 12-month session ($p = .071$). When comparing behavior counts by substantial self-exploration, those with differences that were not statistically significant included Persuade with Permission (Wilcoxon Rank Sum $p = .089$) and MI Adherent ($p = .111$). No difference in the distributions of MITI behaviors between those who completed and those who did not complete the 4-month session was statistically significant (not shown).

When MITI and self-exploration global scores (threshold and median raw) and the distribution of MITI behaviors were compared across those who had improvements (or maintained healthy behaviors or negative depression screen) and those who did not (maintained less healthy behaviors or retained positive depression screen), there were no statistically significant differences at the .05 alpha level (not shown).

2.8 Discussion

Two components of MI stood out among those evaluated in this study: cultivating change talk and empathy. Results indicate a potential connection between these and two aspects of participant engagement[70]: self-exploration and program/study completion. Participants in baseline sessions with CWC competence in cultivating change talk and empathy experienced higher levels of self-exploration and study retention and 4 and 12 months. This provides some support for CHWs' use of MI principles and skills in a variety of settings to foster participation and engagement in programs. Analyses also showed that participant age and education levels may each be related to the MI-competency of wellness coaching delivered by CWCs and self-

exploration exhibited by participants. These could shape future CHW trainings to help them reach their full potential as MI practitioners.

Miller and Rollnick emphasize that while well-prepared manuals[119] and trainings[120] appear to standardize an intervention, the competency (or dose) of the intervention actually delivered still needs to be documented.[25] When attributes of MI counselors and their agencies were compared with MI skills in community substance abuse programs, those with more formal education, disease-oriented model for addiction, and belonging to an organization open to change were all related to higher MI Spirit scores 4 months following training.[121] Some have said that recruitment in MI practitioner trainings should be limited to those with aptitude for learning to convey empathy and establish partnerships with clients.[81] While the number of CWCs were too few in this study to support this conclusion, results from this evaluation can help community leaders and others focus future MI trainings, program curriculum, and systematic coaching feedback among CHW programs.

2.8.1 Community Health Workers as MI Practitioners

To date, the only MITI Version 4-based publication[122] focused on CHWs with more formal education who were trained to reduce risky alcohol consumption. The Vida PURA (or Pure Life - You Can Reduce Your Alcohol Use) program was similar to CHC-UWAG in that both made cultural adaptations to an existing intervention. Vida PURA CHWs reached competence in MI Technical global scores and Relational global scores each 94% of the time, compared to 91% and 2%, respectively, for the current study. The curriculum and training may have better supported the CWCs in cultivating change talk and not prompting sustain talk, though it also appeared to have not supported

the CWCs sufficiently in the Relational global scores. The Vida PURA CHWs may have benefited from key features of their study design, such as *a priori* incorporation of MITI Version 4 evaluation and regular supervision and feedback related to MI competency. The Vida PURA study has not yet published outcomes connected with components of competent MI. While the present study was developed when CHC-UWAG was near completion, it benefited from reducing bias by distinguishing MI/CWC supervisors from MITI coders[105] and blinding MITI coders from the identities and characteristics of CWCs and participants. This also represents an evaluation of MI delivered by CHWs whose training and supervision did not integrate the latest iteration of the MITI.

Other previous studies assessed MI competency among CHWs using the MITI Version 3, although these also did not focus on obesity prevention.[21,88,89] First, college students were trained as peer counselors and used MI to reduce high-risk alcohol consumption.[21] While their training intervention group achieved higher levels of competency for MI behaviors, median MI global scores for all counselors were still below threshold levels for MI competency, and components of MI Spirt were actually associated with an increase in alcohol-related behaviors.[21] In contrast, the median global scores for the current study were above the competency threshold for cultivating change talk for half of the CWCs and never above competency for the relational scores. Second, in a sexual risk reduction program in Western Cape, South Africa, global MI scores and key MI behaviors improved among trained CHWs through refresher courses and regular supervision.[88] In a third example, CHWs in an academic achievement program for urban youth showed improvement in MI proficiency following training, but still remained below competency levels.[89] In the latter study, the authors had not yet reported how

these were associated with outcomes. CHWs and their various settings, backgrounds, and focus areas create unique challenges and opportunities in MI training and evaluation.

Along with these CHW-led, MI-related studies, the CHC-UWAG study builds evidence of CHWs of gaining MI skills that relate to behavior change. The CHC-UWAG curriculum and CWC training appears to have been supportive of cultivating change talk among CWCs, given the higher proportion of sessions reaching competency in this area. In addition, even though partnership, empathy, and relational scores reached competency less often, the comparison of raw global scores allowed for documentation of a positive relationship between these factors and both participant self-exploration and study retention.

This study aimed to evaluate the impact of competent MI on behavior change and depression screening results, but this was an exploratory hypothesis since the study was designed primarily to assess CWC competence in MI and not statistically powered to assess its impact. While the sampling strategy met the standards set for MI evaluation,[92] it may have been statistically underpowered for this research question. In addition, these analyses were further impacted by the low 4-month participation rates in the randomly selected sub-subsample (65%), which was much lower than the 80% retention observed in the larger study at 4 months. Given greater resources, a larger sample could allow for analyses that are powered to address these questions and control for potential confounders, such as study arm, age, education, and thus better describe the relationships between competency in specific MI components and changes in health behaviors and depression at follow-up in these communities. Furthermore, the 4-month gap between baseline and follow-up may have been too long to accurately assess the impact of MI on

depression, since other studies have evaluated the impact as early as 2 and 4 weeks follow-up.[123] Overall, accommodating the communities' request for each individual to receive a form of the intervention is a challenge[12] that limits comparisons in this study to different levels of MI rather than to a control group. Future community engaged studies of CHW-use of MI could identify other ethically and academically sound comparison groups.

2.8.2 Participant Engagement

Self-exploration has been categorized alongside therapy session attendance, treatment compliance, and working alliance as forms of patient engagement. A mediation analysis of two randomized control trials described participant self-exploration, rather than change talk, as a mediator from MI Spirit to improved weekly alcohol drinking behaviors.[124] Although the present study may not have been powered sufficiently to detect relationships between participant self-exploration and other behaviors or outcomes, it shows the potential for CHWs to inspire community members to explore personal values and fears.[69] Future obesity prevention studies could document whether community members expand their self-exploration throughout the intervention and move toward identifying new meanings or shifts in how they perceive themselves, their motivations, and their ability to improve their health.

The second form of participant engagement associated with CWC competency in MI in this study is study retention. The higher levels of retention among those receiving more competent cultivating change talk and empathy in the present study may be related to client-centeredness being appealing to minority populations as well as highlighting the potential impact of empathy on fostering relationships between participants and CWCs.

Other studies in vulnerable populations have had similar success with retention through person-centered approaches. In a pilot randomized trial of peer CHWs compared to masters level staff with both trained to retain youth with HIV in primary care, CHWs had similar mean MITI Version 3 global scores with the masters level staff but higher mean composite behavior scores.[72] Youth living with HIV enrolled in both groups improved their retention in primary care, although the effect size was larger for the CHW group. Other non-MI research that documented successful retention, but overlapped in principle with MI, was in a prospective cohort study among American Indian and Alaskan Native communities in Alaska.[125] In this study, high retention (i.e., 95% completing a 2.5 hour baseline interview and 88% completing the two-year follow up among 3,821 adults) was attributed to CBPR methods including power sharing among researchers and tribal leaders and hiring of local research recruiters. Whether established through CBPR,[125] MI,[72] or both, as in the case of CHC-UWAG, participant engagement and retention, which is critical to the success of longitudinal studies, may be enhanced through building person-centered relationships, perhaps without regard to the health behavior of interest.

Implementing more CBPR and interventions that are CHW-led and MI-based, as some authors[125] argue, requires a paradigm shift in research funding and administration in order to further support such efforts that address health inequities and have supervisory environments that are congruent with MI.[126] Next steps could explore the transferability of these findings through research that randomly assigns participants to either MI-trained CHWs or traditional research facilitators in a variety of settings and research topics where patient engagement is vital, such as those requiring self-

management behaviors or protocol compliance. As evidence builds, ethical review boards and other research institutions could consider incorporating MI principles and skills into required trainings.

2.8.3 Self-Determination Theory Framework

SDT has allowed for hypothesis-driven MI research and has led to interventions with similar components to these MI- and wellness coaching-related mechanisms.[90] SDT's relatedness arguably coincides with MI's empathy and may be fundamental to successful client participation and positive changes, sometimes without regard to theoretical approach of the practitioner, though most research has been among addiction treatment programs.[85] Findings in the present study appear aligned, at least in part, with other obesity-related MI research that have included statistically significant pathways from empathy to behavior change, along with from MI Spirit, which overlaps with cultivating change talk, to behavior change.[86] While CWC efforts to deepen participant change talk were not related to obesity-related behavior change in this small sample, it was related to both participant self-exploration and study retention. The MI Adherent skills of Affirming, Seeking Collaboration, and Emphasizing Autonomy also correspond with SDT's autonomy-supportive counseling,[108,119] which has been associated with improved physical activity,[109,127] though the present study was not powered to assess the association between MI skills and desired participant behaviors or outcomes.

The effectiveness of communication between CWC and participant may also relate to the participant's level of ambivalence about behavior change (e.g., stage of change)[119] or other intrinsic modifiers.[90] These intrinsic modifiers may also include severity of depression, health literacy, stage of change, self-efficacy,[90] and self-

exploration/awareness.[128] Patrick and Williams[107] note that some intrinsic variables have been shown to play a mediating role, such as an SDT intervention increasing health aspirations which then improve tobacco cessation success, and a moderating role, such as when the SDT intervention is more successful among those who already placed a high priority on health.

Literature reviewed for this study did not mention analyses of coach and/or participant ages relating to MITI competency, though MI practitioner's level of formal education has previously not been shown to have a significant impact on the successfulness of MI.[129] The tendency for patients with more education to prefer a participatory role with their health care providers has been well documented.[130] The same was true for younger patients, though the associations in this study are inversed. It may also be feasible that CWCs were better able to Cultivate Change Talk and establish partnership, and participants were likewise better able to self-explore when the participant was older and had more life experience and confidence. Additional research is needed to explore these CWC-participant characteristics and their relationships with MI competency, especially their role as potential confounders of the relationships between MI components and health outcomes.

2.8.4 Participant Characteristics

Associations between receiving competent cultivating change talk and participant age in the present study, along with the similar association between participant education level and participant self-exploration, may both be related to the nuances of the small sample of CWCs. These relationships may also be explained through self-exploration with older and more educated adults being more familiar with self-exploration and thus

better able to participate in MI-related activities. Another obesity-related study found no associations between patient age/education and physician MITI global scores,[82] but, in contrast, MI-adherent behaviors were more common for physicians when patients were women, patients had a higher body mass index percentile, and sessions were longer,[82] none of which were evaluated in the present study. Particular characteristics of individual CWCs and the participants they recruited may have influenced these associations rather than it being related to MI. Future studies could verify these differences through random assignment of participants to either an age-/education-matched CWC or a nonmatched CWC.

Others have adapted to potential age-/gender-related cultural dynamics, such as in a program that aimed to reduce mental health stigma,[131] peer educators were matched to participants by age, neighborhood, and race-/gender-preferences. This dynamic may have manifested itself in the overarching CHC-UWAG study when two non-English speaking CWCs strategically planned a walk in the park. One CWC, who was a grandmother and considered more senior, led the walk; while the other CWC, who was a mother but not a grandmother, provided support. This was anecdotally connected to a more successful activity especially among women who typically place a lower value leisure-time physical activity.[132,133]

2.8.4 Interrater Reliability and Competency Thresholds

Moyers, Rowell, Manuel, Ernst, and Houck [105] described the challenge of achieving high IRR when coders and coded sessions are few, and when clinicians demonstrate skills/behaviors irregularly. While the coders in the present study had greater success in coding emphasize autonomy reliably than those in the Moyers et al.[105]

subsample, relational global scores were scored less reliably. The reasons for poorer reliability may still be comparable. Though the CWCs were trained to adapt to the participant and use MI skills in the process, some were more adept and others, at times, followed the prompts very closely. The latter typically did not receive high scores for building an equal partnership, but when they did occasionally exhibit stronger partnership or empathy skills, the coders may have had more difficulty agreeing on the score relative to the competency threshold.

The MITI 4 training for the two coders in the present study shared similar guidelines to that described by Serrano et al.,[122] which appeared to also impact their ICCs. Aiming to achieve MITI global scores with at least one point agreement on the 5-point Likert scale may have also resulted in ICCs ranging from poor to fair (similar to other CHW MITI studies[21]) and agreement within one point 76% of the time. Using this approach, the present study's coders had agreement within one point for 90% of the individual MITI raw global scores prior to consensus.

Although IRR guidelines recommend reporting IRR for the variables in their transformed state as used in analyses,[114] authors tend to only report the IRR for the raw global scores and do not include IRR the dichotomized variables for MI competency thresholds.[134–137] In addition, in recent literature searches, all but one recent article[122] were based on the previous version of the MITI. While this limits the comparability with other articles, this study assists in building empirical findings for MITI Version 4. Present findings related to threshold-based versions of partnership, empathy, and relational global scores are to be interpreted with caution due to lower IRR scores; but cultivating change talk and self-exploration threshold-based scores, along with raw

empathy scores each had fair or better ICCs. Future research focused on MITI IRR[138] should include IRR for threshold-based analyses. This could assist in replacing the current expert-based thresholds[92] with those that are evidence-based.

2.8.5 Limitations

This study was limited to participants of four CWCs involved in the overarching study. The sampling method for this study allowed for representation of the English-speaking women with CWCs who consented and had baseline audio recordings from the full sample in the overarching study, along with the variance in MI competency inherent to those baseline sessions. Moreover, the sample is not representative of the racial, ethnic, or cultural communities of women predominant in the samples. The sample size calculations followed MITI practical recommendations, though the sample did not include sessions conducted in Spanish or Kirundi due to limited resources including the lack of a MITI equivalent in the latter language.

2.9 Conclusion

This study lays groundwork for larger community-engaged, CHW-delivered interventional studies that incorporate MI principles and the MITI throughout the design, training, implementation, and evaluation process. CBPR-based studies, like this one, may also be conducive to MI, especially when each community, academic, or government representative is respected and valued, including each CHW. This culture of respect could potentially then translate to the relationships between CHWs and participants. Future trainings and evaluations should consider the age and education level of both MI practitioners and their clients in relation to MI delivery and cultural contexts. Self-exploration from the MISC proved to be a natural addition to the MITI when

recordings were reviewed in a single "pass." Incorporation of this participant global score in future MITI studies could enrich research on participant engagement. These findings also have potential to strengthen community and institutional confidence in CHWs as key players in improving health behaviors and reducing health disparities. Future interventions and studies can incorporate the MITI into their curriculum, CHW self and peer evaluations, and initial and follow-up trainings.[88] The use of MI can also be expanded into other contexts, such as those specific to improving study retention and health care service utilization. Finally, these findings will deepen the analyses in the following two aims of this dissertation in exploring relationships between MI-based coaching and depression, obesity-related behaviors, and changes in adiposity.

CHAPTER 3

OBESITY-RELATED LIFESTYLE CHANGES AND DEPRESSION AMONG UTAH WOMEN IN A COMMUNITY-ENGAGED RANDOMIZED TRIAL OF WELLNESS COACHING

3.1 Abstract

3.1.1 Introduction

The increased risk for depression among women necessitates the identification of methods that can promote prevention and management. Obesity and related factors may also increase risk for depression, though this relationship may vary by age or socioeconomic status.

3.1.2 Methods

The Coalition for a Healthier Community for Utah Women and Girls partnered with leaders from the University of Utah, Utah Department of Health, and five communities: African American, African immigrant, American Indian/Alaskan Native, Hispanic/Latino, and Pacific Islander. A holistic context within this partnership allowed for the development and implementation of a wellness coaching randomized trial focused on behavior change with a secondary evaluation of the interrelationships between health behaviors and improved depression. Community wellness coaches recruited and gained consent from women in their communities. Following enrollment, women were then

randomized to either monthly coaching with monthly social activities or quarterly coaching without a social component. Information gathered at quarterly sessions included depression screen and referral based on the Patient Health Questionnaire–2 (score ≥3); fruit/vegetable consumption was based on responses to Behavior Risk Factor Surveillance System questions; and average duration of leisure-time physical activity in the previous month. The relationships between these behaviors and improved depression were evaluated using generalized estimating equations with compound symmetry working correlation and controlling for previous depression screen and related factors.

3.1.3 Results

Depression prevalence declined from 21.7% to 9.5% over 12 months (McNemar's test $p < .0001$; $N = 369$). For women with a baseline positive depression screen, random assignment to high-intensity coaching had higher odds (vs. low-intensity) of completing the 12-month study ($OR = 4.42$, 95% CI 1.51–12.94; $N = 105$). When controlling for previous depression screen and other factors, women consuming fruits/vegetables ≥ 5 times per day (vs. < 5; $p = .027$) and any physical activity (vs. none; $p = .001$) each had higher odds of improved depression screen when controlling for previous depression screen. Greater fruit/vegetable consumption had a greater probability of improved depression screen among women at least 55 years of age compared to younger women (interaction $p = .047$).

3.1.4 Conclusion

Frequency of contact and social support may improve study/program retention for women at risk for depression. Aspects of nutrition and physical activity may reduce risk for depressive symptoms among women, especially older women.

3.2 Background

Women are at an increased risk for depressive disorders,[2–4,139] which are a leading cause of disease burden worldwide[28] and the third greatest cause of disability.[29] Various factors can influence this risk among women, such as obesity,[140] body image ideals,[38] physical inactivity,[141] psychosocial support,[142] pregnancy,[142,143] perimenopause,[144] the built environment,[40] access to quality mental health services,[41] and mental health stigma.[2,131,145,146] In an effort to better understand and address women's health needs,[35] leaders from five unique communities—African America, African immigrant, American Indian/Alaskan Native, Hispanic/Latina, and Pacific Islander—partnered with the University of Utah and the Utah Department of Health. Together, they designed, implemented, and evaluated a randomized trial of community health workers (CHW) as wellness coaches that was holistically oriented and aimed to improve physical activity (PA) behaviors and fruit and vegetable (FV) consumption among women. This randomized trial allowed for a secondary analysis which explored the interrelationships between lifestyle behaviors and improvements in depression screening and expanded knowledge of the broader impact of community-engaged research and interventions.

Health behavior change strategies utilizing MI may benefit depression directly,[70] in addition to improved PA/FV behaviors mediating improved depression.[27,147] When a MI-based approach was used via telephone to promote physical activity over 10 weeks among predominantly non-Hispanic White adults with depression and multiple sclerosis, physical activity increased, depression scores decreased, and both changes were sustained at 24 weeks compared to controls.[148] While these changes were documented individually, their interconnectedness was not evaluated. CHWs, such as peer educators,

may also play a unique role in holistically supporting these changes since they often come from and have trusted relationships with individuals from at-risk communities.[87] While CHWs have been shown to improve depression in the context of chronic disease symptom management,[149,150] few have documented their impact on depression when delivering motivational interviewing (MI)—a person-centered, empathy-based counseling technique.[58] In one instance, when CHWs administered an MI intervention in a rural area, stigma associated with care-seeking for depression among older adults was reduced.[131] Additional evaluation of lengthier MI-based behavior change interventions delivered by CHWs is needed to better describe their potential to improve depressive symptoms.

Other lifestyle interventions have shown improvements in depression through lifestyle change with some success,[7] though the specific types and attributes of lifestyle changes that moderate improvements in depression are still being understood. For example, PA itself may be as effective as pharmacotherapy and/or psychotherapy in treating major depressive disorder (MDD),[8,9] but the type and amount of PA necessary to improve depression have been inconsistently defined. One meta-analysis highlighted flexibility/resistance-based and low-intensity exercise as especially helpful in improving depressive symptoms among those without clinical depression.[8] Another meta-analysis[151] of research focused on improving various outcomes (e.g., obesity and function-related measures) for people with chronic illnesses described an increased effect in the improvement of depression among those meeting guidelines[152] for moderate and vigorous-intensity PA, those with higher baseline depressive symptoms, and when the intended interventional target was improved.[151] These meta-analyses either noted that

ethnicity information was missing from most studies with only a few reporting ethnic differences. [8,151] It is unclear whether the aforementioned modifiers of the effect of PA on depression identified among people with chronic illnesses would differ by ethnicity in a community-based sample.

Progress in understanding the relationship between nutrition and depression is similar, with two recent meta-analyses showing a correlation between increased fruit and vegetable (FV) consumption and decreased depression.[30,31] That FV intake only increased moderately among racial/ethnic minority and low-income groups relative to a larger increase in primarily non-Hispanic White populations across studies in a meta-analysis could be one indicator of systemic barriers to increased FV intake.[153] Some of the barriers to FV intake related to depression vary across socioeconomic and racial/ethnic groups.[35,40,41] Personal characteristics or modifiable features may uniquely influence the beneficial effect of PA behaviors and FV consumption on depression for women in the traditionally underserved communities in the present study.

This study took advantage of an opportunity to deepen efforts of the main community-based participatory research (CBPR) project and aimed to evaluate the impact of the randomized arms of a holistic, CHW-led, MI-based wellness coaching program on depressive screen results among women from diverse communities over 12 months. In addition, the current study aimed to evaluate the impact of repeated measurements of PA behaviors (i.e., time spent in physical activity, participation in muscle strengthening activities) and FV consumption on improvement in depressive symptoms. As part of the second aim, potential modifiers of these effects were hypothesized (i.e., age, education, and obesity severity) and assessed as a means to assist

CHWs, health care providers, community leaders, and other stakeholders in tailoring depression treatments, interventions, and policies to women's needs. Results have potential to improve the design and implementation of interventions that comprehensively improve health behaviors and holistically and ecologically address the increased mental health burden among women.[2–4] This could also allow for the expanded and improved use of CHWs, and enable them and others to view obesity and depression as interconnected.[35] In addition, improving health behaviors and depression may have synergistic effect on quality of life.[154,155] Understanding how they interact may guide the development of more comprehensive prevention and treatment strategies.[1,156]

3.3 Methods

3.3.1 Partnership and Intervention

The Coalition for a Healthier Community for Utah Women and Girls (CHC-UWAG) is a partnership that includes the Utah Women's Health Coalition, University of Utah Center of Excellence in Women's Health, and Community Faces of Utah (CFU). The CFU collaborative includes representatives from the University of Utah, the Utah Department of Health, and leaders from organizations serving the following five communities in the urban Salt Lake County area: African American, African immigrant, American Indian/Alaskan Native, Hispanic/Latino, and Native Hawaiian/Pacific Islander. Using a CBPR process,[157,158] members of CHC-UWAG collaboratively prioritized obesity prevention among women during a needs assessment, and developed and implemented a 12-month intervention program that was studied via a randomized trial.[16] The CBPR process included community leaders, academicians, and public health professionals as equitable partners at each stage.

Over the course of the 5-year study, CFU community leaders selected 10 women from their communities to be trained as CHWs, referred to as community wellness coaches (CWC). CWCs were trained in MI-based coaching, research ethics, and research protocols including interviewing techniques. They also demonstrated competency in measuring waist and hip circumference as well as body height and weight using calibrated scales. CWCs utilized a Research Electronic Data Capture (REDCap) database for data collection and to guide interviews and coaching sessions.

From 2011 to 2015, CWCs used community networks and events to recruit and enroll adult women who consented to participate in the study. CWCs administered a baseline interview, wellness coaching session, helped women set personalized and measurable baseline goals, and randomly assigned women to a high- or low-intensity 12-month coaching program. Per CFU's guidance, all participants received some form of intervention. The high-intensity participants had access to educational materials, monthly group activities, and monthly one-on-one coaching sessions. Low-intensity participants met with the coach every four months without access to the group activities.

Full participation in the high-intensity group was defined as having monthly contact with a CWC during at least nine out of the 12 months. Full participation constituted participating in at least two of the three quarterly follow-up sessions in the low-intensity group. Incentives included $20 gift cards following completion of each quarterly follow-up session, and $40 for completing a 12-month session, and were offered to participants in each arm. Participants provided informed consent to participate in English, Kirundi, or Spanish. Institutional Review Boards at the University of Utah and the Phoenix Area Indian Health Service reviewed and approved this study.

3.3.2 Measurements

In order to screen for depression, two principal cognitive-affective symptoms, depressed mood and lack of pleasure in usual activities during the two weeks prior to the interview were evaluated using the Patient Health Questionnaire–2 (PHQ–2).[98] The PHQ–2 has been validated as a screening tool in international[98] and multiple ethnic contexts,[159,160] in addition to being sensitive to changes in depression in an outpatient setting.[161] A combined PHQ–2 score of 3 or higher, on a scale of 0 to 6, indicates a positive depression screen and prompted referral to a mental health care provider. Participants were referred to mental health providers and other health resources (e.g., those related to language, income, and insurance status) upon positive depression screen and as needed.

FV intake was measured using Behavioral Risk Factor Surveillance System (BRFSS) FV[99] questions, which includes times fruit, fruit juice, and vegetables were consumed per day, week, or month, over the previous month. CWCs explained that each time was a serving and compared servings to everyday objects (e.g.,1 serving of grapes is the size of a tennis ball). PA was evaluated through two questions. Participants were asked how much time was spent being physically active or doing exercise in an average week.[100] PA time was categorized at each quarterly session as sedentary (or "No PA"; reference: 0 minutes per week), insufficiently active (any up to 2.5 hours per week), and sufficiently active (2.5 hours or more per week) based on guidelines for moderate-intensity PA.[162] Participants were also asked a question from BRFSS regarding the frequency of muscle strengthening activities (e.g., yoga, sit-ups, weight machines, free weights, soup cans) during the previous month.[162]

The following factors were identified *a priori* based on existing research as potential confounders of the relationship between PA/FV behaviors and depression: racial/ethnic community,[163,164] age,[32–34] educational attainment (used as a measure of socioeconomic level),[35,165] marital status,[154] and living alone.[166,167] In addition, the presence of self-reported preexisting health conditions was identified as a confounder between PA and depression,[168,169] and food insecurity was identified as a potential confounder between FV and depression.[170] The number of preexisting conditions at baseline was categorized (i.e., none (reference), 1, 2, 3–4, or 5+) based those identified from the following list of conditions which may limit PA: anxiety, arthritis, asthma, cancer, diabetes (or "high sugar", "high blood sugar"), gestational diabetes (or "diabetes only during pregnancy"), gout, headaches, heart disease (e.g., heart attack, myocardial infarction, angina or coronary heart disease), high blood pressure (or hypertension), high cholesterol, stroke history, obesity, osteoporosis, prediabetes, sickle-cell anemia, and sleep apnea. Food insecurity was ascertained by asking participants the number of days in the past 30 days a participant had been concerned about having enough food for herself or her family and categorized as "any days" versus "none".[171] Study time point and randomization arm were also controlled for in the multivariable models. These factors, as well as time, were measured in 4-month increments. The following variables were identified *a priori* as potential interaction terms between each FV and PA predictor variable and depression: education (high school or less versus some college or higher),[35,36] age (below 55 versus 55 or higher),[32,33,172,173] obesity, and central adiposity (waist circumference [WC]: ≥ 35 inches).[38,39] Obesity threshold was defined as a body mass index of 32 or greater for Pacific Islanders, and 30 or greater for all others.[11,37]

3.3.3 Data Quality

As CWCs collected data from participants, they also audio recorded the interview and coaching sessions, which allowed trained graduate assistants to evaluate data quality by identifying extreme outliers and comparing data with audio recordings or seeking clarification from CWCs. Interviews and coaching sessions were evaluated by research assistants for missing or clearly erroneous data and coaches were asked to make corrections prior to being compensated for a particular session. When consistent errors were identified (e.g., number of orange vegetables consumed reported as times per week instead of times per day), these were systematically changed.

3.3.4 Data Analysis

Descriptive statistics for a positive depression screen were calculated with chi-square tests for associations between depression screen and high and low-intensity groups and potential confounders at baseline. McNemar's test was used to evaluate paired associations between depression screen results and time from baseline to follow-up sessions and from previous to current coaching sessions. Because depression may have potentially led to higher loss-to-follow-up, chi-square statistics were calculated to compare differences in incomplete follow-up sessions by study arm and baseline depression screen.

First-order Markov models and average transition estimates (Y_{ij} and Y_{ij-1}) between binary PHQ–2 threshold-based depression screen results were used for all women in the study. Transition models, using a form of generalized estimating equations conditioned on a previous positive depression screen,[174] were then used to calculate the incidence of improved PHQ–2 depression screening by study arm using intention-to-treat analysis.

Sensitivity analysis was also conducted via per protocol. These models used a logit transformation and compound symmetry working correlation matrix for each woman's repeated measures, with negative depression screen as the desired outcome. All transition models controlled for fixed effects of previous negative depression screen, primary exposure, and potential confounders.

The following covariates were fit within separate transition models with aforementioned respective covariates:

1. Randomized arm: high-intensity versus low-intensity
2. FV servings eaten in a day (continuous)
3. FV intake based on thresholds of $\geq$ 5 times per day and <1 times per day
4. Sufficient and insufficient PA versus sedentary (i.e., no physical activity)
5. Muscle strengthening activities per week (continuous)

The presence of effect modification between randomized arm and time was evaluated in each model. Modification of the primary exposure's effect by the aforementioned interaction terms were each evaluated in separate lifestyle behavior models. Odds ratios (*OR*) and 95% confidence intervals (CI) were calculated using a GLM parameterization and LSMEANS across combinations of potential confounders in GEE in SAS.[117] Predicted probabilities for interaction terms in these models were graphed using EFFECTPLOT in SAS,[117] and used to determined which combinations of categories would be evaluated statistically using odds ratios. Statistics were all calculated using SAS[117] (v. 9.4) with significance based on two-sided tests at the .05 alpha level.

3.4 Results

3.4.1 Sample Characteristics

CWCs enrolled 485 women who were randomized after consent, baseline data collection, coaching, and goal setting. At baseline, 105 (21.7%) participants had a positive depression screen at baseline (see Table 3.1). Also at baseline, a higher proportion of women with a positive depression screen ($p < .05$) reported being physically inactive; participating in no muscle strengthening activities; being African immigrants or Hispanic/Latina; having less than a high school education; being divorced, separated, or widowed; and having 2 or more health problems aside from depression. The proportion of women who screened positive for depression was not statistically significantly associated with intervention arm, FV intake categories, age categories, household income relative to Federal Poverty Line (based on household size and year), living alone, or obesity based on BMI or waist circumference.

3.4.2 Retention by Arm and Depression

Of the 485 women randomized at baseline, 386 (79.6%; see Figure 3.1) completed 4-month coaching, 362 (75.0%) completed 8-month coaching, and 370 (76.3%) completed 12-month coaching. A larger proportion of high-intensity coaching participants completed each coaching session (see Figure 3.2), though this difference was only statistically significant at 4 months (chi-square $p = .030$). Neither randomization arm ($p = .42$) nor baseline depression screen results ($p = .98$) individually predicted completion of the 12-month study.

Interaction between these factors, though, did show differences in study completion. Of the women with a baseline positive depression screen and assigned to

Table 3.1 Associations Between Baseline Depression Screen Based on Personal Health Questionnaire–2 and Various Factors in the Wellness Coaching Program of the Coalition for a Healthier Community for Utah Women and Girls

	Negative depression screen		Positive depression screen		Chi-square
	n	%	*n*	%	*p* value
Randomization group					.140
Low intensity	179	47.1%	58	55.2%	
High intensity	201	52.9%	47	44.8%	
Fruit and vegetable intake (past month)					.057
<1 serving per day	29	7.6%	16	15.2%	
Any up to 5 servings per day	239	62.9%	62	59.0%	
≥ 5 servings per day	112	29.5%	27	25.7%	
Usual time being physically active per week					**.002**
None	45	11.8%	24	22.9%	
Any up to 2.5 hours	162	42.6%	50	47.6%	
≥ 2.5 hours	173	45.5%	31	29.5%	
Muscle strengthening activities (past month)					**.042**
None	215	56.6%	70	66.7%	
Any	163	42.9%	33	31.4%	
Missing	2	0.5%	2	1.9%	
Community					**.044**
African	57	15.0%	27	25.7%	
African American	84	22.1%	18	17.1%	
Hispanic/Latina	106	27.9%	32	30.5%	
American Indian/Alaskan Native	58	15.3%	16	15.2%	
Pacific Islander	75	19.7%	12	11.4%	
Age					.573
18–24	51	13.4%	9	8.6%	
25–34	94	24.7%	26	24.8%	
35–44	101	26.6%	30	28.6%	
45–54	65	17.1%	23	21.9%	
55+	69	18.2%	17	16.2%	
Education					**< .001**
Less than high school	47	12.4%	28	26.7%	
High school graduate	101	26.6%	29	27.6%	
Some college or technical school	143	37.6%	40	38.1%	
College graduate or more	89	23.4%	8	7.6%	
Federal poverty level					.672
Income < 100% FPL	161	42.4%	49	46.7%	
100% ≤ Income < 130%	48	12.6%	14	13.3%	
130% ≤ Income < 185%	57	15.0%	16	15.2%	
Income ≥ 185%	86	22.6%	18	17.1%	
Missing	28	7.4%	8	7.6%	

Table 3.1 continued

	Negative depression screen		Positive depression screen		Chi-square
	n	%	*n*	%	*p* value
Marital status					.045
Single (never married)	115	30.3%	24	22.9%	
Married	177	46.6%	46	43.8%	
Living with a partner, but not married	35	9.2%	8	7.6%	
Divorced	30	7.9%	11	10.5%	
Separated	9	2.4%	7	6.7%	
Widowed	14	3.7%	9	8.6%	
Living alone					.795
No	346	91.3%	95	90.5%	
Yes	33	8.7%	10	9.5%	
Missing	1	0.3%	0	0.0%	
Self-reported current health problems					**< .001**
0	164	43.2%	24	22.9%	
1	90	23.7%	22	21.0%	
2	61	16.1%	21	20.0%	
3–4	49	12.9%	17	16.2%	
5+	16	4.2%	21	20.0%	
Days of food insecurity					**< .001**
None	264	70.0%	52	49.5%	
Any	113	30.0%	51	48.6%	
Missing	3	0.8%	2	1.9%	
Body Mass Index					.856
Underweight or Normal Weight (<25)	67	17.6%	18	17.1%	
Overweight (25–29.9)	101	26.6%	27	25.7%	
Obese I (30–34.9)	105	27.6%	25	23.8%	
Obese II (35–39.9)	55	14.5%	19	18.1%	
Obese III (40+)	52	13.7%	16	15.2%	
Waist Circumference					.245
< 35 inches	81	22.6%	18	17.1%	
≥ 35 inches	277	77.4%	86	81.9%	
Missing	22	5.8%	1	1.0%	
Total	**380**	**78.4%**	**105**	**21.7%**	

Note. Personal Health Questionnaire–2 scores < 3 are negative and ≥ 3 are positive. Fruit and vegetable intake based on Behavioral Risk Factor Surveillance System questions. Food insecurity: days individual or family were concerned about lack of food in the last 30 days. Depression excluded from self-reported health problems. Income was relative to Federal Poverty Line per household size and year at baseline. Body Mass Index thresholds were as listed, except for Pacific Islanders when overweight = 26–31.9 and obese = 32–34.9. Missing values not included in chi-square calculations. Bold type: $p < .05$.

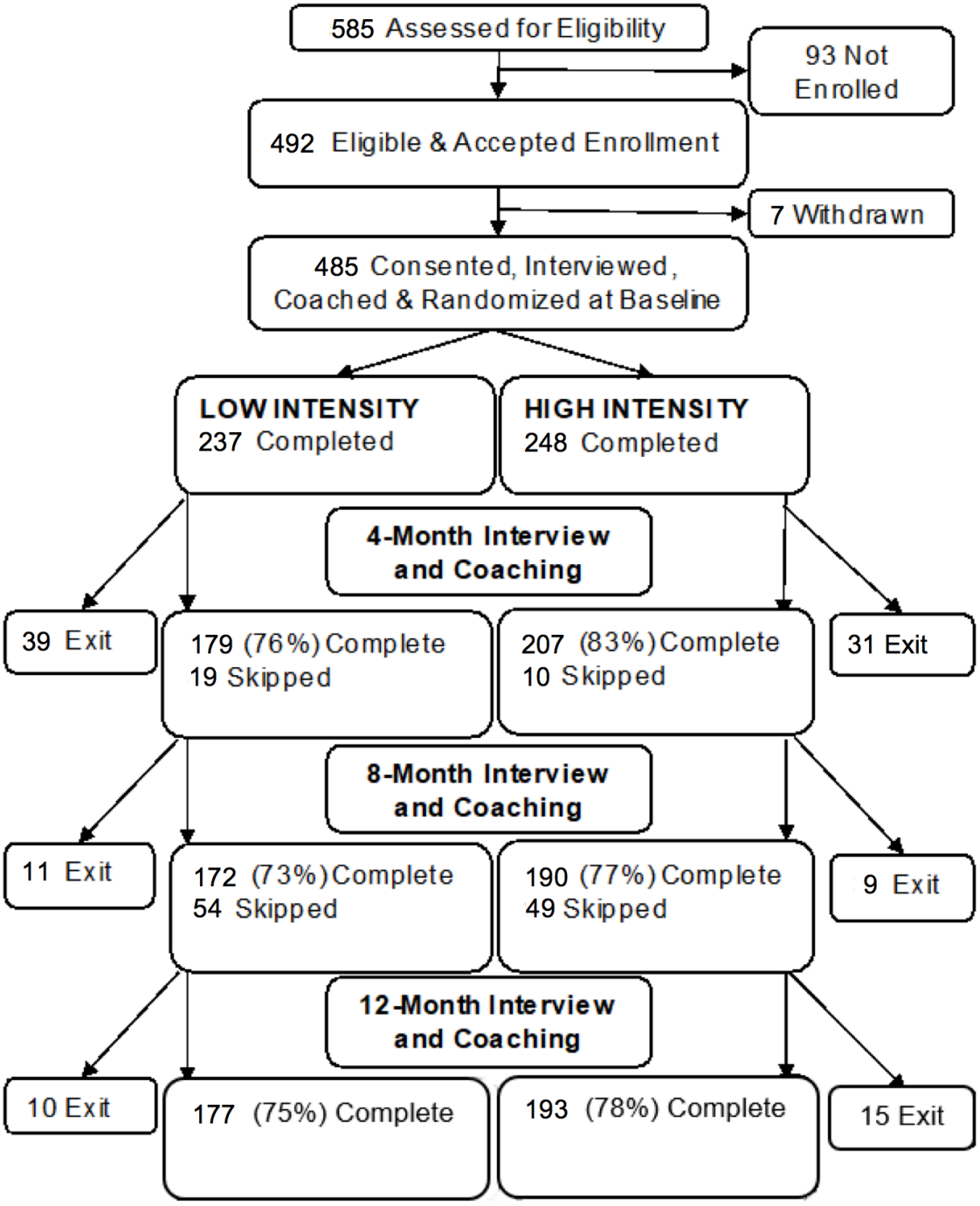

Figure 3.1 Recruitment, Randomization, and Retention for the Community Wellness Coaching Program in the Coalition for a Healthier Community for Utah Women and Girls Study. Denominators for percentages are totals per respective randomized arm at baseline.

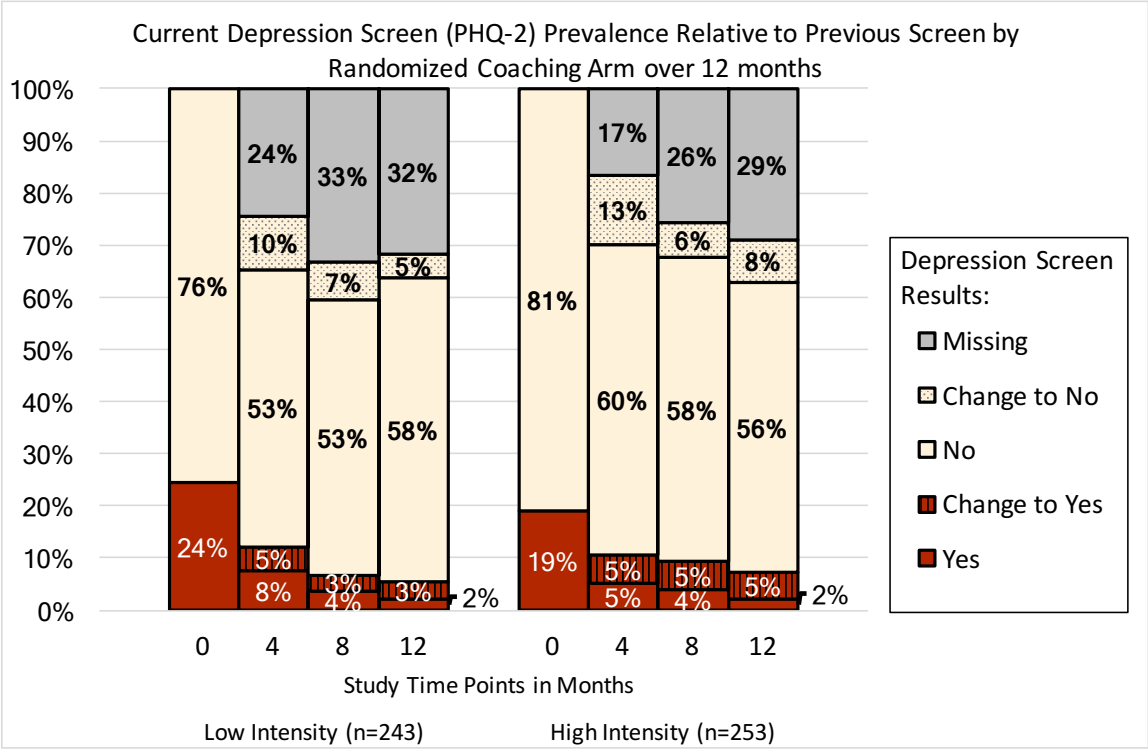

Figure 3.2 Proportion of Depression Screen Results Based on Patient Health Questionnaire–2 (PHQ–2) Relative to Previous Screen Result During Quarterly Coaching Sessions in a Community Wellness Coaching Program Among Women in Racial/Ethnic Minority Communities in Utah. Missing: Skipped session or lost to follow up. "Change to No": Previous positive and current negative. "No": Previous and current positive. "Change to Yes": Previous negative and current positive. "Yes": Previous and current positive. Low-intensity wellness coaching included quarterly sessions. High intensity included monthly sessions with monthly social activities.

high-intensity coaching, nearly all (46, 97.9%, $p < 0.001$) completed the 4-month session. Among women with a baseline positive depression screen who were assigned to low-intensity coaching, 42 women (72.4%) completed the 4-month session. In other words, participants with a positive baseline depression screen had 18 times (*OR* = 17.5, 95% *CI* 2.23 - 137.92) greater odds of completing a 4-month session and 4.4 times (*OR* = 4.4, 95% *CI* 1.51 - 12.94) greater odds of completing a 12-month session if randomized to the high- rather than the low-intensity arm. Among those with a negative baseline depression screen, there were no differences in retention at 4 or 12 months by randomization arm. Among those assigned to low-intensity coaching, though, 38 women (65.5%) with a positive baseline depression screen completed the 12-month session, while 145 women (78.4%) with a negative baseline depression screen completed the 12-month session. Among those women assigned to high-intensity coaching, 42 women (89.4%) who had a baseline positive depression screen completed the 12-month session, while 151 women (75.1%) had a baseline negative depression screen did. For this group, the odds of completing the 12-month session for women with a baseline positive depression screen were 2.8 times (*OR* = 2.78, 95% *CI* 1.04 - 7.42) the odds for women with a baseline negative screen.

3.4.3 Depression Screen Over Time

Statistically significant differences in the proportion of women with a positive PHQ–2 depression screen were observed among participants between baseline (21.7%) and each follow-up session: 4 months (14.3%, chi-square $p = .005$), 8 months (11.9%; $p < .001$), and 12 months (9.5%; $p < .0001$). However, there were no significant changes in the proportion of women with positive scores between 4 and 8 or 8 and 12 months,

among all women or when stratified by randomization arm. Additionally, the proportion of women with a positive depression screen did not differ between high- and low-intensity arms at any time point in the study.

Paired changes in depression screen (i.e., previous negative to current positive or previous positive to current negative) revealed similar patterns across all women and those in high intensity. Those in low intensity had more gradual improvements (Figure 3.2). More women in both arms had improved depression screens (vs. previous negative to current positive) from baseline to 4 months (McNemar's $p < .001$ for all women, high intensity, and low intensity) and from 4 to 8 months for low intensity coaching ($p = 0.041$). Statistically significant improvements were not observed from 4 to 8 months for other categories ($p = .103$ for all and $p = .578$ for high) or from 8 to 12 months ($p = .124$, .157, and .491 for all, high, and low, respectively).

The overarching trend in these transitions as examined using first-order Markov transition estimates across 1,117 pairs of observations (see Table 3.2) showed a greater proportion of depression screen improvements (125, 11.2%, McNemar's $p < .001$) compared to the proportion who transitioned from a negative to a positive depression screen (72, 6.6%).

3.4.4 Transitions to Improved Depression Screen

3.4.4.1 Randomized Arms

When evaluated using generalized estimating equations with no additional covariates, the odds of women having an improved depression screen for women with a pervious negative depression were 4.69 times ($OR = 4.69$, 95% CI: 3.70 to 8.74, $n = 414$) the odds for women with a previously positive depression screen. When conditioned on

Table 3.2 First-Order Markov-Based Transition Estimates for Depression Screen Based on Patient Health Questionaire–2 (PHQ–2) Scores for Transitions Across 12 Months of Quarterly Sessions in a Community Wellness Coaching Program Among 425 Women in Racial/Ethnic Minority Communities in Utah

		Y_{ij}						
		Negative (PHQ–2 < 3)		Positive (PHQ–2 ≥ 3)				McNemar's test
		n	%	*n*	%	Total	%	*p* value
Y_{ij-1}	Negative (PHQ–2 < 3)	859	76.9	72	6.5	931	83.4	
	Positive (PHQ–2 ≥ 3)	125	11.2	61	5.5	186	16.7	
	Total	984	88.1	133	11.9	1117	100.0	.0002

Note. Previous session = *j–1*. Current session = *j*. Participant = *i*.

previous positive depression screen, the odds of achieving negative depression screen did not have statistically significant differences between randomized coaching arms based on either intention-to-treat (*OR* = 1.00, CI: 0.69 to 1.46; see Table 3.3) or per-protocol analyses (*OR* 0.95, *CI*: 0.64 to 1.40, *n* = 348). The per-protocol analysis included 172 (97.7%) women who received a "full-dose" of low-intensity coaching among the 176 who completed the 12-month session and 171 (88.6%) women who received the "full-dose" of high-intensity coaching among the 193 who completed the 12-month session. These differences in odds did not have statistically significant modification across time (i.e., quarterly session) in the intention-to-treat analysis (interaction $p = .732$).

3.4.4.2 Fruit and Vegetable Intake

In models including potential confounders, women who reported consuming ≥ 5 servings per day had 54% higher odds (*OR* = 1.54, 95% *CI* 1.05–2.27) of improving their depression screen from the previous session, versus those reporting < 5 per day (Table 3.4). When FV intake was considered as a continuous variable, women's odds of improved depression screen from the previous session were 11% higher (*OR* = 1.11, 95% 1.02–1.20) for each additional serving of FV consumed per day.

3.4.4.3 Physical Activity

Across all follow-up sessions, the odds of improved depression screen for women who reported any duration of PA per week were 3.50 times the odds for those with no PA (*OR* = 3.50, 95% CI: 1.67–7.13). In addition, women who reported an additional muscle strengthening activity per week had 11% higher odds of improved depression screen (*OR* = 1.11, 95% CI: 1.02 to 1.20).

Table 3.3 Solution Table for Relationships Between Primary Exposures and Achieving Negative Depression Screen When Controlling for the Previous Depression Screen at Quarterly Wellness Coaching Sessions Over 12 Months in the Coalition for a Healthier Community for Utah Women and Girls Study

Exposure (vs. reference)	Parameter coefficient	*SE* of coefficient	*p*
Fruit and vegetable (FV) servings per day			
FV ≥ 5 (vs. FV < 5)	0.434	0.196	**.027**
FV (continuous)	0.101	0.043	**.020**
Physical activity (PA) per week			
Any PA (vs. No PA)	1.250	0.375	**.001**
Number of muscle strengthening activities	0.120	0.057	**.036**
Interaction: FV × Age			
FV ≥ 5 (vs. FV < 5)	0.225	0.218	.302
≥ 55 years (vs. < 55 years)	-0.224	0.342	.513
FV × Age	1.021	0.513	**.047**
Interaction: PA × Age			
Any PA (vs. No PA)	0.914	0.380	.016
≥ 55 years (vs. < 55 years)	-0.367	0.914	.688
PA × Age	1.089	0.973	.263
Interaction: PA × FV			
FV ≥ 5 (vs. FV < 5)	1.146	0.922	.214
Any PA (vs. No PA)	1.197	0.439	**.006**
PA × FV	-0.782	0.958	.414

Note. $N = 413$. Each multivariable model used Generalized Estimating Equations, logit transformation, and a compound symmetry working correlation matrix for repeated measures. The three sets of exposure models (with interaction terms included PA × Age or PA × FV) controlled for the following covariates:

- PA models—racial/ethnic community, age, randomized high- versus low-intensity coaching, and quarter since baseline, education, marital status, living alone, and number preexisting conditions;
- FV models—racial/ethnic community, age, randomized high- versus low-intensity coaching, and quarter since baseline, education, marital status, living alone, and food insecurity.

Models with interaction terms included PA × Age or PA × FV. Depression screen based on Patient Health Questionnaire–2 (Dep Yes: PHQ–2 score ≥ 3); PA based on self-reported hours of usual PA per week; and FV servings based on Behavioral Risk Factor Surveillance System questions. Standard Error (SE). Max observations (i.e., follow-up sessions) per cluster (i.e., individual woman) was 3.

Table 3.4 Adjusted Odds Ratios for Women Achieving Negative Depression Screen When Controlling for the Previous Depression Screen at Quarterly Wellness Coaching Sessions Over 12 Months in the Coalition for a Healthier Community for Utah Women and Girls Study

Exposure (vs. reference)	*OR*	95% *CI*	
Fruit and vegetable (FV) servings per day			
FV ≥ 5 (vs. FV < 5)	1.544	1.052	2.266
FV (continuous)	1.106	1.016	1.204
Physical activity (PA) per week			
Any PA (vs. No PA)	3.489	1.672	7.128
Number of muscle strengthening activities	1.127	1.008	1.261
Interaction: FV × Age (*p* = **.047**)			
≥ 55 years: FV ≥ 5 (vs. FV < 5)	3.509	1.421	8.665
< 55 years: FV ≥ 5 (vs. FV < 5)	1.250	0.815	1.915
≥ 55 years & FV ≥ 5 (vs. < 55 & FV < 5)	2.797	1.024	7.650
Interaction: PA × Age (*p* = .263)			
≥ 55 years: Any PA (vs. No PA)	7.414	1.200	45.800
< 55 years: Any PA (vs. No PA)	2.495	1.185	5.252
≥ 55 years & Any PA (vs. < 55 & No PA)	5.138	1.834	14.416
Interaction: PA × FV (*p* = .414)			
Any PA & FV ≥ 5 (vs. No PA & FV < 5)	4.764	2.039	11.133
FV < 5: Any PA (vs. No PA)	3.312	1.402	7.820

Note. *N* = 413. Each multivariable model used Generalized Estimating Equations, logit transformation, and a compound symmetry working correlation matrix for repeated measures. The three sets of exposure models (with interaction terms included PA × Age or PA × FV) controlled for the following covariates:

- PA models—racial/ethnic community, age, randomized high- versus low-intensity coaching, and quarter since baseline, education, marital status, living alone, and number preexisting conditions;
- FV models—racial/ethnic community, age, randomized high- versus low-intensity coaching, and quarter since baseline, education, marital status, living alone, and food insecurity.

Models with interaction terms included PA × Age or PA × FV. Depression screen based on Patient Health Questionnaire–2 (Dep Yes: PHQ–2 score ≥ 3); PA based on self-reported hours of usual PA per week; and FV servings based on Behavioral Risk Factor Surveillance System questions. Max observations (i.e., follow-up sessions) per cluster (i.e., individual woman) was 3.

3.4.4.4 Interactions With Health Behaviors

Age modified the effect of some health behaviors on changes in depression when added to these multivariable transition models. Among women aged ≥ 55, the odds of improved depression screen for those consuming ≥ 5 FV servings per day were 3.5 times the odds (*OR* = 3.51, 95% CI: 1.42–8.67) for those consuming < 5 per day. Among women < 55 years of age, though, the difference in odds of improved depression screen was not statistically significant across these FV intake categories. The effect of FV intake on improved depression screen had a statistically significant difference across these age strata (interaction $p = .047$, see Table 3.4 and Figure 3.3).

Among women aged ≥ 55, the odds of improved depression screen for those participating in any PA each week were 7.4 times the odds (*OR* 7.41, 95% *CI*: 1.20–45.80) for those reporting no PA. This difference was smaller among women aged < 55, with the odds of improved depression for those participating in any PA each week being 2.5 times the odds (*OR* 2.50, 95% *CI*: 1.19–5.25) for those reporting no PA. These odds-ratio differences were not statistically significant (interaction $p = .263$, see Table 3.4).

When the interaction between FV intake and PA were considered, the odds of improved depression screen for women with any duration of PA combined with intake of ≥ 5 FV servings per day were 4.8 times the odds (*OR* 4.76, *CI*: 2.04–11.13; see Table 3.4) for those women reporting a combination of no physical activity and < 5 FV servings per day. Similarly, among women with FV intake < 5 servings per day, the odds of improved depression screen for women with any PA were 3.3 times (*OR* 3.31, *CI*: 1.40 to 7.82) the odds for women with no PA. However, the heterogeneity between these differences in probabilities was not statistically significant ($p = .414$). Other factors—

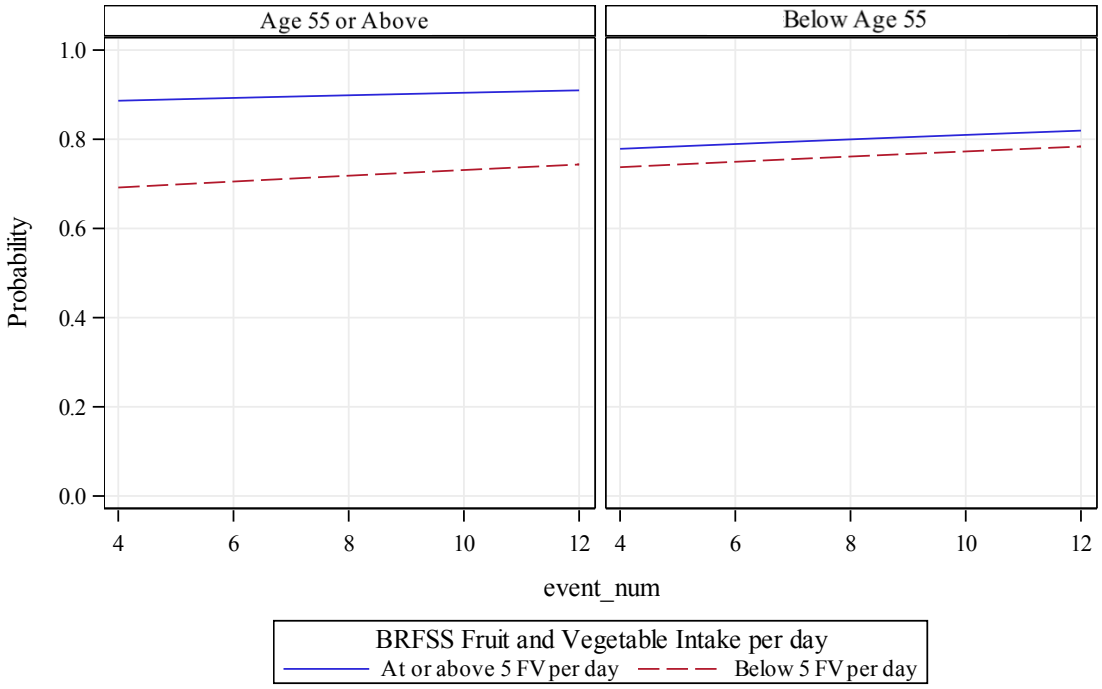

Figure 3.3 Predicted Probabilities of Achieving Negative Depression Screen per Fruit and Vegetable Intake Stratified by Age Category for Women in the Coalition for a Healthier Community for Utah Women and Girls Study. Computed with covariates at the following values: previous positive depression screen, high-intensity coaching, Hispanic community, married, less than high school graduate, and no food insecurity. Behavioral Risk Factor Surveillance System = BRFSS.

education level, obesity, and waist circumference—did not have a statistically significant interaction with the effect of PA or FV intake on transitioning to negative depression screen (not shown).

3.5 Discussion

This randomized trial of 12-month community wellness coaching allowed for detection of the following relationships between repeated measures of obesity-related health behaviors and depressive symptoms among a diverse sample of women. Women who had a positive depression screen at baseline had greater odds of remaining in the study when they were assigned to high-intensity coaching rather than low-intensity coaching. For those women who remained in the study, both increased levels of FV intake and PA behaviors were independently associated with increased odds of improved depression screen results in multivariable models. Women who had a combination of PA and high levels of FV intake had increased odds of improved depression screen compared to those with no PA combined with lower FV intake. Furthermore, FV intake may have had a stronger beneficial effect on improving depression among women age 55 or older compared to those who were under age 55, while PA appears to have similar benefits to depression regardless of age.

The association between FV intake and improved depression is in line with previous cohort studies.[30,31] Another longitudinal study that also utilized lagged variables in multivariable models found a positive relationship between increases in FV intake and both self-reported well-being and happiness.[154] Increased PA has also been associated with higher levels of happiness. Sedentary behavior may also be interlinked with social isolation, especially among the elderly.[175] A cross-sectional study among adults over age

65 in the eastern Mediterranean also found low or moderate depression among those who consumed more vegetables,[176] while sedentary behavior also increased risk for depressive symptoms. A large Australian study of adults aged 55+ had similar results, showing that fruit and vegetable consumption (based on food frequency questionnaire) were each associated with decreased odds of prevalent depressive symptoms.[177] In addition, the Women's Health Initiative[178] prospective cohort study of postmenopausal women documented the benefit of consumption of nonjuice fruit and vegetables on decreased risk for depression incidence. The mechanism of this benefit, particularly among older adults, may be the protective effect of low glycemic foods, including many vegetables and other high fiber foods,[179] in contrast to inflammation induced by high glycemic foods. The nutrients in FV may also promote a healthy nervous system and in turn benefit mental health.[180] The context of these behavior changes may have also boosted the older adults' sense of purpose thus elevating mood and addressing attributes of geriatric depression.[181] These findings emphasize the potentially broad benefits of a nutritious and active lifestyle, which can be promoted in a targeted way among high-risk groups, such as older women.

This community-engaged research benefitted from the addition of the brief PHQ–2 instrument in a relatively vulnerable population, even though it was not a main outcome of the main study. The PHQ–2 was reported to have a 76% sensitivity and 87% specificity for major depressive disorder in an internationally sampled meta-analysis and has also shown sensitivity to change in depressive symptoms over time.[161] These evaluations have been limited in Pacific Islander and refugee populations. Prior studies have reported that the PHQ–2 may have higher sensitivity and lower specificity among

African Americans, Hispanics,[159] and Kenyans.[160] Follow-up research would benefit from the addition of depression diagnostics and additional evaluation of depression referral and treatment success.

The differences in retention by baseline depression screen and randomization is noteworthy, though the declined retention among those with a positive screen assigned to low intensity has been reported elsewhere.[74,75] Low retention rates in studies of treatment of depression and other aspects of mental health have been commonly reported. For example, depression has been reported as a predictor of loss-to-follow-up in a study among low-socioeconomic and overweight African American and White women.[73] Incomplete mental health treatment and participation in mental health research has been a concern among communities of color.[74,75] Assignment to placebo or inactive control has also been associated with low satisfaction and higher rates of dropout in depression-related randomized trials.[74] Improved retention rates for those with baseline positive depression screen assigned to high-intensity coaching may be indicative of the importance of frequency of contact and peer/social support[182] in improving patient engagement among those with depression.[78]

The frequency of CWCs' use of MI (i.e., monthly vs. quarterly) and additional social support could both be key parts of the increased retention among high-intensity participants who had a positive depression screen. Various forms of peer support have been linked with increased retention among those who are hard to reach due to psychological or other socioecological factors.[182] Others have reported increased frequency of contact and improved relationships between participants and study facilitators/clinicians as important to improved retention, as in the case of treating

depression among cancer patients.[183] Patient engagement has been highlighted as a potential mediator of improvements in mental health outcomes in MI studies.[70] Since depressive symptoms can be a barrier to initiating PA,[184] MI-based interventions could be a way to increase patient engagement with this or similar treatment (e.g., through reduced ambivalence or anxiety). This may in turn enhance the effect of treatment in improving mental health outcomes.[70] Evaluation of the quality of MI delivered by CWCs may shed more light on the retention rates, especially among those with a baseline positive depression screen who were lost to follow-up in the low-intensity group.

Various forms of violence,[185] substance abuse, faith-based social support,[50] stigma,[186] cultural norms,[49] historical[187] and contemporary[188] trauma, and other factors may also be affecting the relationship between lifestyle behaviors and mental health. Coaching that can help people navigate these concerns and access culturally appropriate forms of support may have increased success.[75,76,78]

Other broader elements of this study may be fundamental to its success. The intervention was developed with equitable contributions from community leaders and public health researchers and practitioners. The aims of this study benefit from being rooted in the priorities and concerns held by CFU communities. All partners agreed on the paradigm of the Seven Domains of Health (i.e., physical, emotional, social, intellectual, financial, environmental, and spiritual).[57] This helped shape the intervention (e.g., person-centered behavior change goals, including the option of sleep behaviors and stress) and assessment (e.g., social, financial health measures were included), thus allowing for the present study and others like it that explore how the Seven Domains interact to impact health. The relationships of trust established through the CBPR

process and the holistic context appeared to enable deeper and broader understanding of sensitive topics and interconnections between the domains of health.

This study has several limitations: The research questions are secondary to the CHC-UWAG primary research questions relating to improving FV intake and PA behaviors. More frequent and evenly spaced measures of behaviors and depressive symptoms may better reflect the research aims for this study and assumptions of the GEE models. For example, time between sessions may be more or less than 4 months in some cases, which may have introduced variance into the models. Other longitudinal study designs, such as crossover or randomly staggered intervention start-times,[189] or elements, such as community-based evaluators of clinical measures who are blinded to treatment, may also allow all participants to receive treatment while further reducing bias.

In addition, these analyses did not assess causal links between these behaviors and depression since they were concurrent at each time point. Frustrations among those who were not achieving behavioral or weight loss goals, for example, may have manifested as depressed mood. Depressive mood could also increase the difficulty of making improvements in PA and nutrition through increased negative thoughts, reduced adherence to medical or behavioral regimens, and decreased utilization of social support.[35] This study may have benefited from the trusted relationships between CWCs and participants in discussing sensitive matters, such as body weight and depression, and perhaps discussing them more honestly, though it is possible that the close relationships between CWC and participant could have still included risk of social desirability bias in the participants' self-report of behaviors.[144] Future studies could confirm these findings

in these populations through the use of food frequency questionnaires, accelerometers, or other more reliable measures, along with interviewers who are blinded to the randomized intervention arm.

Despite these limitations, the analyses reported here were based on rigorous, standardized data collection and produced statistically significant results indicating that healthy lifestyle wellness coaching, while not directly focused on mental health, may impact depressive symptoms in racially/ethnically diverse communities and that FV/PA behaviors may be related to improvements in depression. In order to continue to address inequities related to both mental health and obesity among underserved communities, additional community-based interventions and policies that target health behaviors, physical health, and mental health in parallel should be implemented and evaluated, especially in older populations. Results from this study indicate that depressive symptoms decreased among Utah women participating in a community wellness coaching program. The holistic approach to health utilized in this study shows promise and should be replicated in future studies. Finally, the community-engaged approach used to identify community needs and to develop the intervention described in this study is key to addressing such disparities in any community. This approach improves the likelihood that findings will result in relevant interventions, polices, and approaches that effectively address inequities related to obesity, chronic diseases, and mental health.

CHAPTER 4

IMPACT OF HEALTH BEHAVIORS AND DEPRESSION ON CHANGES IN ADIPOSITY IN A COMMUNITY WELLNESS COACHING PROGRAM FOR DIVERSE UTAH WOMEN

4.1 Abstract

4.1.1 Introduction

The relationship between depression and obesity is complex and may vary across racial/ethnic contexts. Women in African American, American Indian/Alaskan Native, Hispanic/Latina, and Pacific Islander communities are at increased risk for either depression, obesity, or both. Improved understanding of the interconnections between mind and body could improve effectiveness of obesity prevention strategies.

4.1.2 Methods

The community wellness coaching randomized trial developed and implemented by the Coalition for a Healthier Community for Utah Women and Girls provided an opportunity to evaluate how fruit/vegetable consumption and depression interact with physical activity in their associations with clinically significant improvements in adiposity: 5% reduction in either body weight or waist circumference among at-risk women. Wellness coaches in each community were trained to measure body weight, height, and waist circumference using standardized methods, and interview women on health behaviors and depressive symptoms among 375 women with overweight/obese

body mass indexes and 363 women with a high waist circumference (WC, ≥35"). A positive depression screen (score ≥3 on Patient Health Questionnaire–2) resulted in a referral. Fruit/vegetable intake was based on Behavioral Risk Factor Surveillance System questions. Physical activity behaviors included the average duration of leisure-time activity in the past month. The relationships between these exposures and achievement of each of the adiposity changes were modeled using generalized estimating equations with compound symmetry working correlations structure.

4.1.3 Results

Women who were overweight/obese at baseline and consumed fruits/vegetables ≥5 times/day (vs. <5; *OR* = 1.73, 95% *CI* 1.08–2.78) had greater odds of losing ≥5% body weight; while women with a positive depression screen had greater odds when physical activity was ≥2.5 hours per week (*OR* = 10.05, 95% *CI* 1.13–89.77). In addition, women who had a high WC at baseline and a subsequent negative depression screen (vs. positive; $p = .043$) had higher odds of ≥5% decrease in WC.

4.1.4 Conclusion

Interventions tailored to the mental, physical, and cultural needs of women at risk for both obesity and depression could result in improved behaviors and outcomes.

4.2 Background

Evidence for what works in addressing obesity and related chronic disease prevention has included nutrition, physical activity (PA), and body weight loss,[5] but how mental health interrelates has been considered complex and in some ways unsettled.[6] Furthermore, some potential pathways between mental health and obesity may vary by

gender, socioeconomic status, and racial/ethnic contexts.[190] The integration of obesity and depression management may have potential to more effectively address both conditions, but a better understanding of the relationships between them will provide more support for this integration. In an effort to be more holistic, gender-based, and culturally tailored, the Coalition for a Healthier Community for Utah Women and Girls (CHC-UWAG) partnered with racial, ethnic, and tribal communities to design and implement a randomized trial of community wellness coaching. This study aims to describe how depression and health behaviors relate to changes in various measures of adiposity among women from who participated in the 12-month CHC-UWAG trial. Weight loss obtained through health behavior change has been shown to be a dominant predictor of decreased chronic disease incidence.[42] Changes in other measures of adiposity, though, such as reductions in visceral fat, may have additional advantages,[43,44] including declines in mortality especially among older adults.[5] Visceral fat also increases risk for insulin resistance, cardiovascular disease, cancers, and sleep apnea beyond that associated with body mass index.[191] These different measures of adiposity complement each other and have public health relevance and implications.[192] For example, the prevalence of obesity among adults has recently plateaued in the United States, but waist circumferences are continuing to expand.[193] Additional research is needed to better understand which lifestyle factors and combinations of these factors facilitate what types of changes in adiposity, especially across racial, ethnic, and tribal communities.[10]

Behavioral interventions have been considered safe compared to pharmacotherapies in addressing obesity, though behavioral specifics, the quality of reporting, results,[194] and ecological context[195] have been heterogeneous. Additional

evidence is needed to show how the combination of PA and changes in depressive symptoms impacts the likelihood of weight loss or other anthropometric changes. Some evidence has shown that PA can be an effective treatment for depression.[9] In addition, a side effect of some pharmacological treatments of depression is weight gain,[196–198] while untreated depression may also be associated with either unplanned weight gain or loss.[45] Severe depression may also reduce the positive effect of exercise on weight loss, as illustrated by the mixed success of weight loss and lifestyle interventions among those with mental illness.[199–201] This evaluation of community wellness coaching benefits from considering depression and obesity within the ecological paradigm of the Seven Domains of Health (i.e., physical, emotional, social, intellectual, financial, environmental, and spiritual).[57] A better understanding of whether PA alone, or in combination with FV or depression, is related to changes in adiposity could improve interventions and measures of success, especially among women from traditionally underserved backgrounds.

The first aim of this study was to describe how FV/PA behaviors and depressive screening are related to clinically significant obesity-related anthropometric changes. The second aim was to evaluate the interactions between PA behaviors, FV intake, and depression in their relationships with these anthropometric changes. These results could inform future interventions and policies that incorporate both health behaviors and mental health to more effectively promote obesity prevention and address health inequities.

4.3 Methods

4.3.1 Intervention

CHC-UWAG is a university, government, and community partnership that collaboratively used a community-based participatory research[12] process to conduct a needs assessment[16] among African immigrants, African Americans, American Indians/Alaskan Natives, Hispanic/Latinas, and Pacific Islanders. CHC-UWAG members used community-based participatory research processes to jointly identify obesity prevention among women as a priority, and develop a gender-specific obesity prevention program with women as community wellness coaches (CWC) in each community.[16] CWCs were trained together using a participatory curriculum that covered research ethics, person-centeredness, evidence-based obesity management, integrating MI into intake and assessment, and measuring body height/weight using calibrated scales and waist circumference (WC) using standardized procedures. CWCs demonstrated competence prior to beginning recruitment and coaching. The process and content of interviews, clinical measures, coaching, and data entry were managed via the Research Electronic Data Capture (REDCap) database.[202]

For three years, CWCs recruited adult women through community networks and events into the 12-month study. After obtaining consent and enrolling eligible participants, CWCs administered a baseline interview and coaching session in either English, Spanish, or Kirundi, which included setting personalized and measurable health behavior change goals. Participants were then randomized to high-intensity coaching with group activities and individual coaching sessions each month or low-intensity coaching with quarterly coaching and no group activities. CFU requested, during the CBPR process, that each participant have some level of intervention. Both arms also

included educational materials.

The Institutional Review Boards at the University of Utah and Phoenix Area of the Indian Health Service approved this study.

4.3.2 Primary Outcome Variables

The beginning of quarterly coaching sessions also included interviews where CWCs used standardized methods to collect clinical, behavioral, and other measures. Body mass index (BMI) was calculated based on body weight (kg) / height (cm)^2 without shoes. Overweight was defined as BMI ≥ 26 for Pacific Islanders and BMI ≥ 25 for others.[101,102] WC was measured at the narrowest point between the ribs and hips, or about 1 inch above the navel, with ≥ 35 inches (i.e., high WC) among women defined as at increased risk for cardiovascular risk (low: < 35").[203] The World Health Organization[192] and others[204] recommend waist circumference (WC) as both a reliable indicator of high-risk adiposity, especially among some racial/ethnic groups, and a practical method due to its relative simplicity in a one-on-one clinical or other private setting.[192] Although some cross-sectional studies have used different WC thresholds for racial/ethnic minority groups, the evidence has not sufficiently verified the need for unique thresholds for women in these groups,[10] such as among African Americans.[205] A contingency table was created to show the overlap between overweight/obesity and high WC. Clinically significant changes in adiposity were defined as 5% weight loss from baseline among those who were overweight or obese at baseline[42] and achieving 5% reduction in WC for those whose WC was high at baseline.[206,207] When women reported being pregnant, they were allowed to keep meeting with their CWC, but their data were excluded from the analyses of this chapter from that interview onward.

4.3.3 Primary Independent Variables

Fruit and vegetable (FV) intake was measured using Behavioral Risk Factor Surveillance System (BRFSS) FV[99] questions, which includes the number of times fruit, fruit juice, and types of vegetables were consumed per day, week, or month over the previous month. CWCs defined each time as a serving and used day-to-day objects to illustrate serving sizes (e.g., 1 serving of leafy vegetables is the size of a fist). FV servings were categorized as ≥ 5 consumed per day or < 5. Participants were asked how much time was spent being physically active or doing exercise (PA) in an average week.[100] This was categorized in half hour increments and stratified into less than sufficiently active (< 2.5 hours per week) or sufficiently active (≥ 2.5 hours per week) based on guidelines for moderate-intensity PA.[162]. A positive depression screen was based two questions regarding cognitive-affective symptoms, where a score of 3 or higher (out of 6) on the Patient Health Questionnaire–2 (PHQ–2)[98] denoted a positive screen and prompted a referral to a health care provider. The PHQ–2 is a screening tool that has been validated in international and various ethnic settings.[159,160]

4.3.4 Confounders

Potential confounders of the relationships between changes in adiposity and primary independent variables were defined a priori based on existing literature.[163,208,9,43,170,209–216] These included demographic characteristics collected at baseline interviews—race/ethnic community and age—as well as food insecurity at follow-up. Covariates for models with PA as a primary independent variable included racial/ethnic community,[163,208,209,215] age,[210,216,217] study arm, and follow-up time point. For FV models, covariates included depression screen results[218–220] and food insecurity (i.e.,

increasing risk for low FV intake and unplanned weight fluctuations),[170,213,214] in addition to PA model covariates. For depression screen models, [220,221] covariates included current PA[222] and food insecurity[214] in addition to PA model covariates. Food insecurity was defined as any days with concern about lack of food for self/family over the last 30 days.

Depression[223–225] and FV intake[226] were both hypothesized as potential moderators of the effect of PA on changes in adiposity. In these interaction models, the less desirable category (e.g., insufficient PA) was coded as the reference.

4.3.5 Data Analysis

The proportions of women who overlapped between baseline adiposity risk groups based on BMI and waist circumference were calculated. Differences in baseline demographic, health behaviors, and depression screen results were compared by adiposity risk group. These differences were assessed for statistical significance via Fisher's Exact test (when an expected cell count is <5) or Chi-square test as appropriate. The proportion of women reporting ≥ 5 FV per day, sufficient PA per week, or positive depression screen were calculated for each quarterly follow-up session among those who were overweight/obese and among those who had a high WC at baseline. The proportion of women in each baseline adiposity risk group who achieved the respective adiposity change target at each follow-up session was calculated as well.

The proportion of women who initially achieved a 5% weight loss or a 5% change in their waist circumference at any point in the study was calculated; in addition, the proportion who sustained this change at subsequent time points was calculated. For each risk group over time, the odds associated with achieving at least 5% BMI change or at least 5% waist circumference change was calculated using Generalized Estimating

Equations (GEE) with a logit transformation and compound symmetry working correlation matrix for repeated measures, and when controlling for *a priori* confounders. Odds ratios and 95% confidence intervals were calculated within and across strata for categorical exposure variables using a GLM parameterization and LSMEANS in GEE in SAS.[117] Predicted probabilities for interaction terms in these models were graphed using EFFECTPLOT in SAS.[117]

Statistical analyses were two-sided, evaluated at the $p < .05$ alpha level, and calculated using the SAS software, Version 9.4.[117]

4.4 Results

4.4.1 Sample Characteristics

Among 485 women recruited, consented, enrolled, and randomized at baseline, 392 were overweight/obese, 372 had a high WC, 17 were pregnant, 236 were randomly assigned to low-intensity coaching, and 248 were randomly assigned to high-intensity coaching (see Figure 4.1). Across the quarterly follow-up sessions, 10 women reported being pregnant in the low-intensity group and 7 reported being pregnant in the high-intensity group. Overall study retention ranged from 76% for the low-intensity group and 83% for the high-intensity group at 4-month follow-up and 75% for the low and 78% for the high at 12-month follow-up. The rates did not differ among those who were overweight/obese versus those who had high WC at baseline.

4.4.1.1 Adiposity at Baseline

Among those women who were randomized at baseline and were not pregnant (see Table 4.1), 385 women (82%) were overweight/obese and 363 (78%) had a high WC

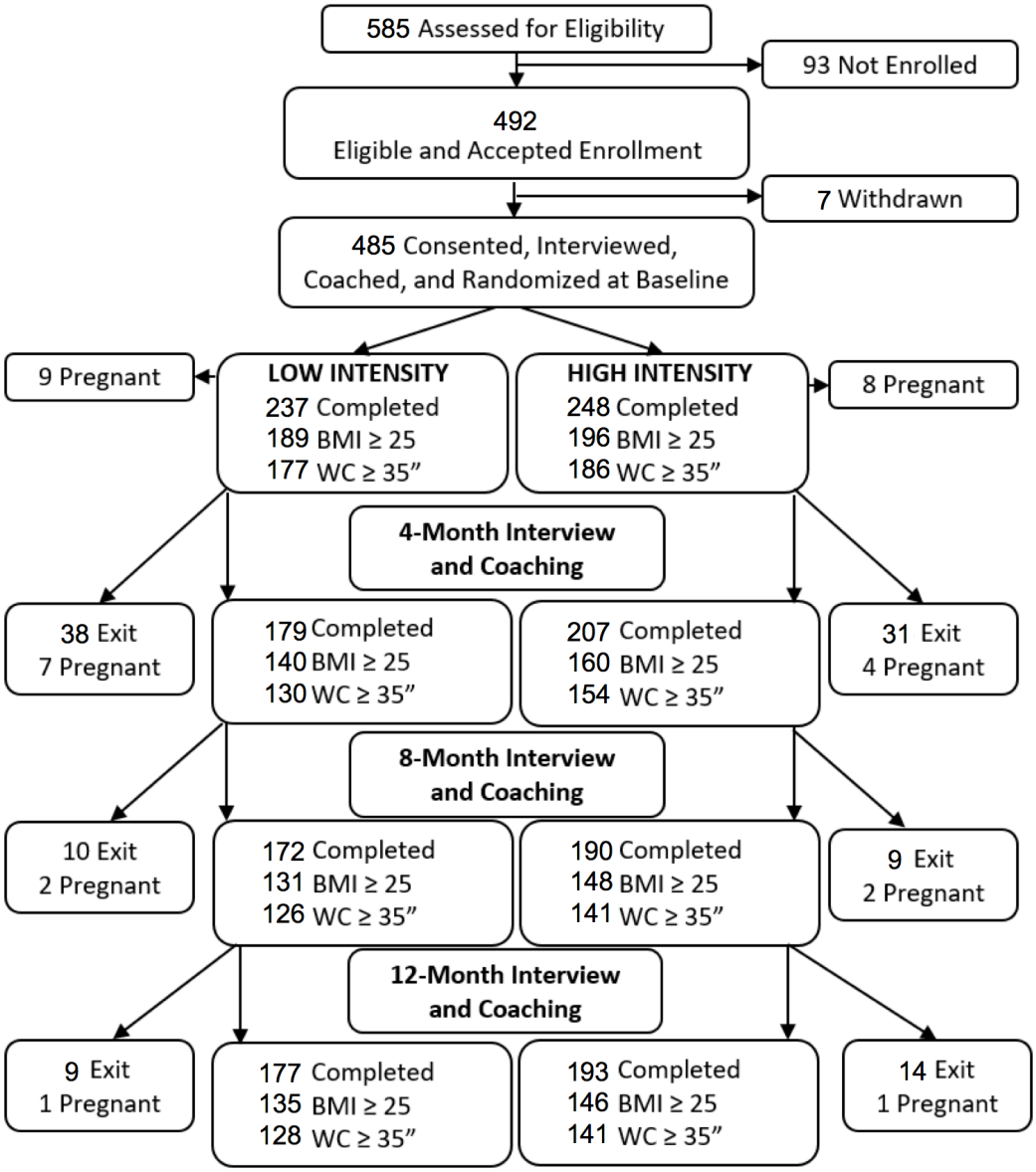

Figure 4.1 Recruitment, Consent, Randomization, Inclusion, Exclusion, and Retention for Those Who Had an Overweight/Obese Body Mass Index or a High Waist Circumference (WC) at Baseline Assessment in the Coalition for a Healthier Community for Utah Women and Girls Study. Numbers for baseline (base) overweight/obese and baseline high WC were not mutually exclusive. For Pacific Islanders, an overweight BMI is ≥ 26.

Table 4.1 Overlap Between Obesity Categories Based on Body Mass Index and Waist Circumference at Baseline Among Nonpregnant Women in the Coalition for a Healthier Community for Utah Women and Girls Study

	Body Mass Index							
	Normal or underweight < 25		Overweight 25–29.9		Obese ≥ 30		Total	
Waist circumference	*n*	%	*n*	%	*n*	%	*n*	%
< 35”	66	80	27	22	6	2	99	21
≥ 35”	16	19	95	77	252	96	363	78
Missing	1	1	1	1	4	2	6	1
Total (row %)	83	18	123	26	262	56	468	100

Note. Pacific Islanders: Overweight body mass index ≥ 26 and < 32; obese body mass index ≥ 31.

(i.e., ≥ 35 inches) at baseline. While almost all women who were obese (96%) and over three-quarters of those who were overweight (77%) had a high WC, 16 women (19%) who were normal or underweight also had a high WC and 33 (9%) women who were overweight/obese but had a normal WC.

4.4.1.2 Factors Associated With Adiposity at Baseline Assessment

Certain health behaviors and risk factors were associated at baseline with high levels of adiposity (see Table 4.2). Three characteristics were each individually associated with having high levels of BMI, as well as WC: older age ($p < .001$), racial/ethnic community ($p \leq .002$), and food insecurity ($p \leq .035$). Specifically, higher proportions of Pacific Islanders and American Indian/Alaskan Native women were obese compared to those who were normal or underweight; and lower proportions of African immigrant and Hispanic/Latina women were obese compared to those who were normal or underweight. For WC, larger proportions of Hispanic and Pacific Islander women had high WC compared to those who had lower WC, while smaller proportions of African immigrant and African American women had high WC compared to women who had lower WC in their communities. Physical inactivity was associated with high WC ($p = .028$) but not overweight/obesity. A greater proportion of women who had small WC ate ≥ 5 FV per day compared to those who had high WC, but this was not a statistically significant difference ($p = .100$).

4.4.2 Changes in Behaviors and Depression During the Study

Among the 385 women who were overweight or obese at baseline, improvements in obesity-related health behaviors (i.e., more FV intake and longer PA duration) and depression (i.e., negative depression screen) were more common between baseline and 4-

Table 4.2 Factors Associated With Measures of Adiposity at Baseline Assessment Among Women in the Coalition for a Healthier Community for Utah Women and Girls Study

	Normal or underweight *n* = 83 (18%)		Overweight *n* = 123 (26%)		Obese *n* = 262 (56%)		Total *n* = 468	Waist circumference < 35" *n* = 99 (21%)		≥ 35" 363 (79%)		Total *n* = 462
	n	%	*n*	%	*n*	%	*p*	*n*	%	*n*	%	*p*
Randomized arm							.938					.821
Low intensity	39	47	60	49	129	51		47	47	177	49	
High intensity	44	53	63	51	133	49		52	53	186	51	
Age							**< .001**					**< .001**
18–34	49	58	37	30	79	30		56	57	105	29	
35–54	29	35	57	46	131	50		34	34	181	50	
55+	5	6	29	24	52	20		9	9	77	21	
Community							**< .001**					**.002**
African Immigrant	25	30	21	17	33	13		26	26	53	15	
African American	15	18	29	23	56	21		26	26	72	20	
Hispanic/Latina	27	33	37	30	70	26		26	26	107	29	
Pacific Islander	8	10	13	11	61	23		16	16	63	17	
American Indian	8	10	23	19	42	16		5	5	68	19	
Food insecurity							**.034**					**.004**
No days	63	76	82	67	160	61		77	78	227	63	
Any days	19	23	39	31	100	38		21	21	134	36	
Missing	1	1	2	2	2	1		1	1	4	1	
Fruit and vegetable intake							.378					.100
<1 per day	4	5	10	8	30	11		5	5	38	10	
≥ 1 & < 5 per day	53	64	75	61	163	62		59	60	228	63	
≥ 5 FV per day	26	31	38	31	69	26		35	35	97	27	
Physical activity/ week							.892					**.028**
None	9	11	18	15	40	15		7	7	60	17	
> 0 & < 2.5 hours	37	45	53	43	115	44		42	42	160	44	
≥ 2.5 hours	37	45	52	42	107	41		50	51	143	40	
Depression Screen							.984					.245
Negative	65	78	96	78	203	77		81	82	277	76	
Positive	18	22	27	22	59	23		18	18	86	24	

Note. Overweight: body mass index ≥ 26 and < 32 for Pacific Islanders and ≥ 25 for others. Obese: body mass index ≥ 32 for Pacific Islanders and ≥ 30 for others. Food insecurity: Concerned about lack of food for self/family in the last 30 days. *Chi-square *p* values excluded missing observations.

month follow-up compared to 8- and 12-month follow-up. The proportions of women with ≥ 5 FV per day, being sufficiently active, and have a negative depression screen at 4-month follow-up were maintained during the next 8 months. Only 107 of these women (28%; not shown) reported consuming FV five or more times per day at baseline. This increased to 117 women (39%) among those who completed the 4-month follow-up and up to 120 (43%) at 8 months and 121 (43%) at 12 months. The improvements in the proportions reporting sufficient levels of PA were more gradual over 12 months for those overweight or obese at baseline. Starting with 159 women (41%) at baseline, 166 women (55%) reported the same level at 4 months. These improvements were then maintained at 8 months and 12 months, with 181 women (65%) and 174 (62%), at 8 and 12 months, respectively, reporting 2.5 hours or more of PA per week. Proportions of women with a positive depression screen improved in a similar manner. At baseline, 86 women (22%) who were overweight or obese had a positive depression screen. This declined to 46 women (15%) at 4 months, 37 (13%) at 8 months, and 29 (10%) at 12 months.

4.4.3 Changes in Adiposity During the Study

The proportion of women achieving clinically significant changes in adiposity at the first follow-up session was higher among the those with a high WC at baseline (18%) in comparison to those who were overweight/obese at baseline (11%). The proportion achieving at least a 5% decrease in the respective adiposity measure for the first time at the 4-month follow-up session was around twice that at the 12-month sessions for both risk groups. The proportions maintaining these adiposity targets from the previous session were such that the proportion of women who had achieved their respective target (i.e., combining those who first achieved the target with those who maintained the target)

plateaued at 8 and 12 months (see Figure 4.2).

The majority of women who missed follow-up sessions, including those who exited early, had not achieved the weight loss target. Among women who exited the study after 4 months, 3 women (20%) had not achieved the weight loss target. Among those who exited after 8 months, 6 women (29%) had not achieved the target. For women who were missing any other follow-up session, weight loss target achievement rates ranged from 15% (7 women) at 4 months, to 23% at 8 months (7 women), and 21% at 12 months (8 women). Target achievement rates were similar for those who were not missing any sessions: 14% (35 women) at 4 months, 18% at both at 8 months (46 women) and 12 months (45 women).

4.4.4 Factors Associated With Achieving Changes in Adiposity

4.4.4.1 Main Effects Models

Increased level of FV intake at follow-up was associated with greater odds of achieving ≥ 5% weight loss over 12 months among those who were overweight/obese at baseline, when controlling for potential confounders (see Tables 4.3 and 4.4). Among those who were overweight/obese at baseline, the odds of achieving ≥ 5% weight loss were 73% higher (adjusted *OR* = 1.73, 95% *CI* 1.08–2.78) over 12 months for those women who consumed FV ≥ 5 servings per day than for those who consumed FV < 5 servings per day. Similarly, women who ate one additional daily FV serving had 9% higher odds (adjusted *OR* = 1.09, 95% *CI* 1.013–1.18) of achieving ≥ 5% weight loss over 12 months. When modeling the initial achievement of a ≥ 5% decrease in WC, levels of FV intake were not associated with a statistically significant difference in odds over 12 months, but depression screen results were. The odds of first achieving a ≥ 5%

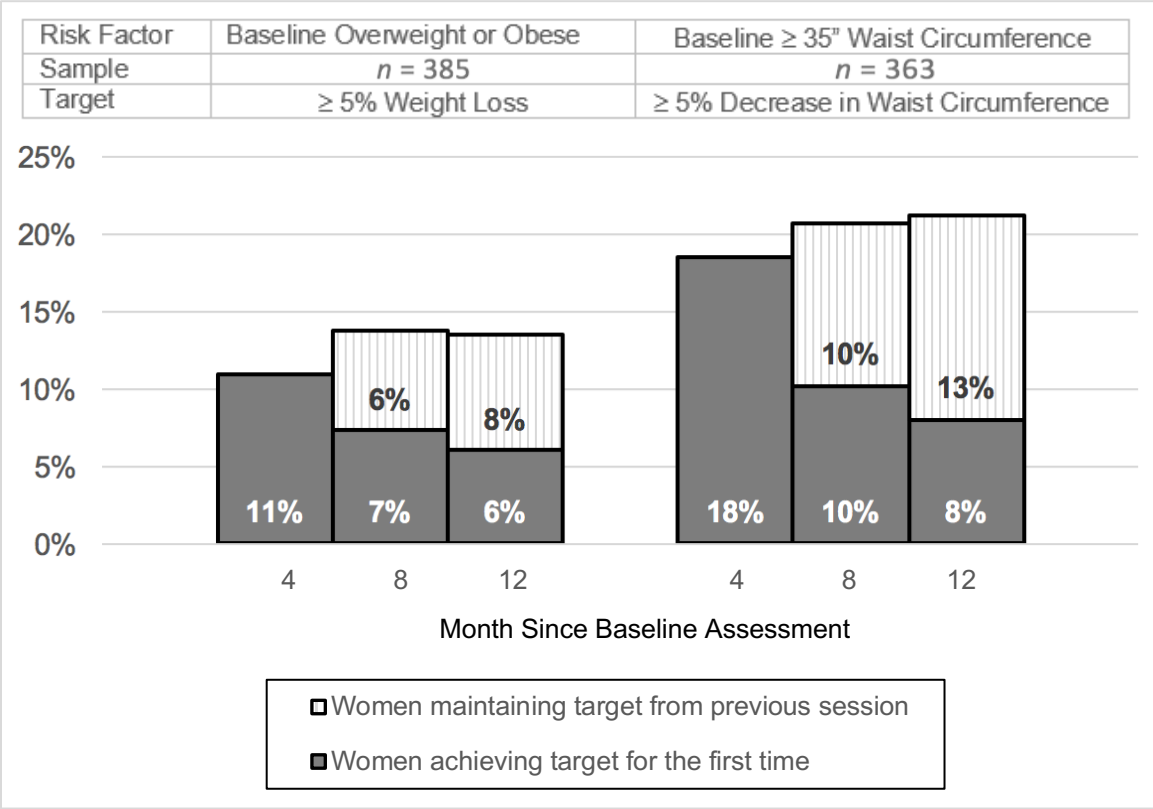

Figure 4.2 Proportion of Women at Each Follow-Up Wellness Coaching Session Who Achieved Changes for the First Time, or Subsequently Maintained Those Changes, in Terms of Body Weight or Waist Circumference (WC) Relative to the Respective Risk Category or Combined Risk Category at Baseline Assessment. Overweight: body mass index 26 for Pacific Islanders and ≥ 25 for others; Obese: body mass index ≥ 32 for Pacific Islanders and ≥ 30 for others.

Table 4.3 Solution Table for Models of the Relationships Between Exposures—Servings of Fruit and Vegetable Consumed per Day (FV), Hours of Physical Activity per Week (PA), Number of Muscle Strengthening Activities per Week, and Depression Screen (Dep)—and First Achieving Target Obesity Changes When Controlling for Potential Confounders Over 12 Months in the Coalition for a Healthier Community for Utah Women and Girls Study

Baseline risk group	BMI ≥ 25			WC ≥ 35"		
Target	5% weight loss (WL)			5% WC decrease		
Clusters	323			312		
Exposure (vs. reference)	Parameter coefficient	*SE*	*p*	Parameter coefficient	*SE*	*p*
Main effects models						
FV ≥ 5 (vs. FV < 5)	**0.549**	**0.242**	**.023**	0.283	0.206	.169
FV (continuous)	**0.087**	**0.038**	**.021**	0.037	0.036	.306
PA ≥ 2.5 (vs. PA < 2.5)	0.338	0.237	.154	0.020	0.201	.922
Muscle strengthening	**0.145**	**0.053**	**.006**	0.006	0.054	.907
Dep No (vs. Dep Yes)	0.371	0.378	.327	**0.717**	**0.355**	**.043**
Interaction - PA × Dep:						
PA ≥ 2.5 (vs. PA < 2.5)	**2.308**	**1.117**	**.039**	1.132	0.746	.129
Dep No (vs. Dep Yes)	1.915	1.058	.070	1.474	0.633	**.021**
PA × Dep	-2.132	1.147	.063	-1.252	0.765	.120
Interaction - PA × FV:						
FV ≥ 5 (vs. FV < 5)	-0.618	0.389	.112	0.415	0.308	.178
PA ≥ 2.5 (vs. PA < 2.5)	0.266	0.339	.433	0.097	0.270	.718
PA ≥ × FV < 5	0.133	0.465	.775	-0.181	0.400	.651

Note. Each multivariable model used Generalized Estimating Equations, logit transformation, and a compound symmetry working correlation matrix for repeated measures. The following three sets of exposure models controlled for the following covariates: PA models—racial/ethnic community, age, randomized high- versus low-intensity coaching, and quarter since baseline; FV models—a depression screen and food insecurity plus PA covariates; Dep models—PA and food insecurity plus PA covariates. Models with interaction terms included either PA × Dep or PA × FV: Depression screen based on Patient Health Questionnaire–2 (Dep Yes: PHQ–2 score ≥ 3); PA based on self-reported hours of usual PA per week; and FV servings based on Behavioral Risk Factor Surveillance System questions. Standard Error (SE). Max observations (i.e., quarterly follow-up sessions) per cluster (i.e., individual woman) was 3. Overweight body mass index (BMI) ≥ 26 for Pacific Islanders and BMI ≥ 25 for others.[101–103] Waist circumference (WC). Standard error (SE) of the coefficient.

Table 4.4 Adjusted Main and Interaction Odds Ratios for the Relationships Between Exposures—Hours of Physical Activity per Week (PA), Servings of Fruit and Vegetable Consumed per Day (FV), and Depression Screen (Dep)—and First Achieving Target Obesity Changes Over 12 Months in the Coalition for a Healthier Community for Utah Women and Girls Study

Baseline Risk Group	BMI ≥ 25			WC ≥ 35"		
Target	5% Weight Loss (WL)			5% WC Decrease		
Clusters	329			312		
Exposure (vs. reference)	Odds ratio	95% *CI*		Odds ratio	95% *CI*	
Main effects models						
FV ≥ 5 (vs. FV < 5)	**1.731**	**1.077**	**2.781**	1.327	0.887	1.986
FV (continuous)	**1.091**	**1.013**	**1.176**	1.038	0.967	1.113
Muscle strengthening	**1.156**	**1.043**	**1.282**	1.006	0.906	1.183
Dep No (vs. Dep Yes)	1.449	0.690	3.041	**2.048**	**1.022**	**4.105**
Interaction - PA × Dep:		*p* = .063			*p* = .120	
Dep Yes: PA ≥ 2.5 (vs. < 2.5)	**10.050**	**1.125**	**89.770**	3.101	0.723	13.285
PA < 2.5: Dep No (vs. Dep Yes)	6.789	0.854	53.960	**4.368**	**1.260**	**15.147**
PA ≥ 2.5 & Dep No (v.s PA < 2.5 & Dep Yes)	**8.088**	**1.034**	**63.245**	**3.874**	**1.123**	**13.382**
Interaction - PA × FV:		*p* = .775			*p* = .651	
PA ≥ 2.5 & FV ≥ 5 (vs. PA < 2.5 & FV < 5)	**2.420**	**1.252**	**4.678**	1.393	0.808	2.400

Note. Each multivariable model used Generalized Estimating Equations, logit transformation, and a compound symmetry working correlation matrix for repeated measures. The following three sets of exposure models controlled for the following covariates: PA models—racial/ethnic community, age, randomized high- versus low-intensity coaching, and quarter since baseline; FV models—depression screen and food insecurity plus PA covariates; Dep models—PA and food insecurity plus PA covariates. Models with interaction terms included either PA × Dep or PA × FV: Depression screen based on Patient Health Questionnaire–2 (Dep Yes: PHQ–2 score ≥ 3); PA based on self-reported hours of usual PA per week; and FV servings based on Behavioral Risk Factor Surveillance System questions. Standard Error (SE). Max observations (i.e., quarterly follow-up sessions) per cluster (i.e., individual woman) was 3. Overweight body mass index (BMI) ≥ 26 for Pacific Islanders and BMI ≥ 25 for others.[101–103] Waist circumference (WC).

decrease in WC over 12 months for those women who had a current negative depression screen was two times the odds (adjusted *OR* = 2.05, 95% *CI* 1.02–4.11) for those who had a positive depression screen, although this finding was not significant for achieving ≥ 5% weight loss among those who were overweight/obese at baseline. Increased duration of PA was not associated with a statistically significant difference in the odds of achieving ≥ 5% weight loss or reduction in WC for the respective risk group across 12 months (see Table 4.3).

4.4.4.2 Modifiers of the Effect of Health Behaviors on Adiposity Changes

While PA levels were not associated with differences in the odds of achieving ≥ 5% weight loss among all women who were overweight or obese at baseline, when the analysis was restricted to those who had a current positive depression screen across 12 months (see Tables 4.3 and 4.4), overweight/obese women who reported ≥ 2.5 hours of PA per week had odds of achieving ≥ 5% weight loss that were 10 times the odds (adjusted *OR* = 10.05, 95% *CI* 1.13–89.77) for those who reported < 2.5 hours. In a similar manner, those women with both ≥ 2.5 hours of PA per week and a current negative depression screen had odds of achieving this level of weight loss that were 8 times the odds (adjusted *OR* = 8.09, 95% *CI* 1.03–63.25) for those with both PA less than 2.5 hours per week and a current positive depression screen. Among those who had a current negative depression screen, the predicted probabilities of achieving ≥ 5% weight loss were similar for both levels of PA (see Figure 4.3). In contrast, the probabilities differed more for those with a current positive depression screen and was near zero for those less PA (see Figure 4.3). When considered as part of a GEE model, the

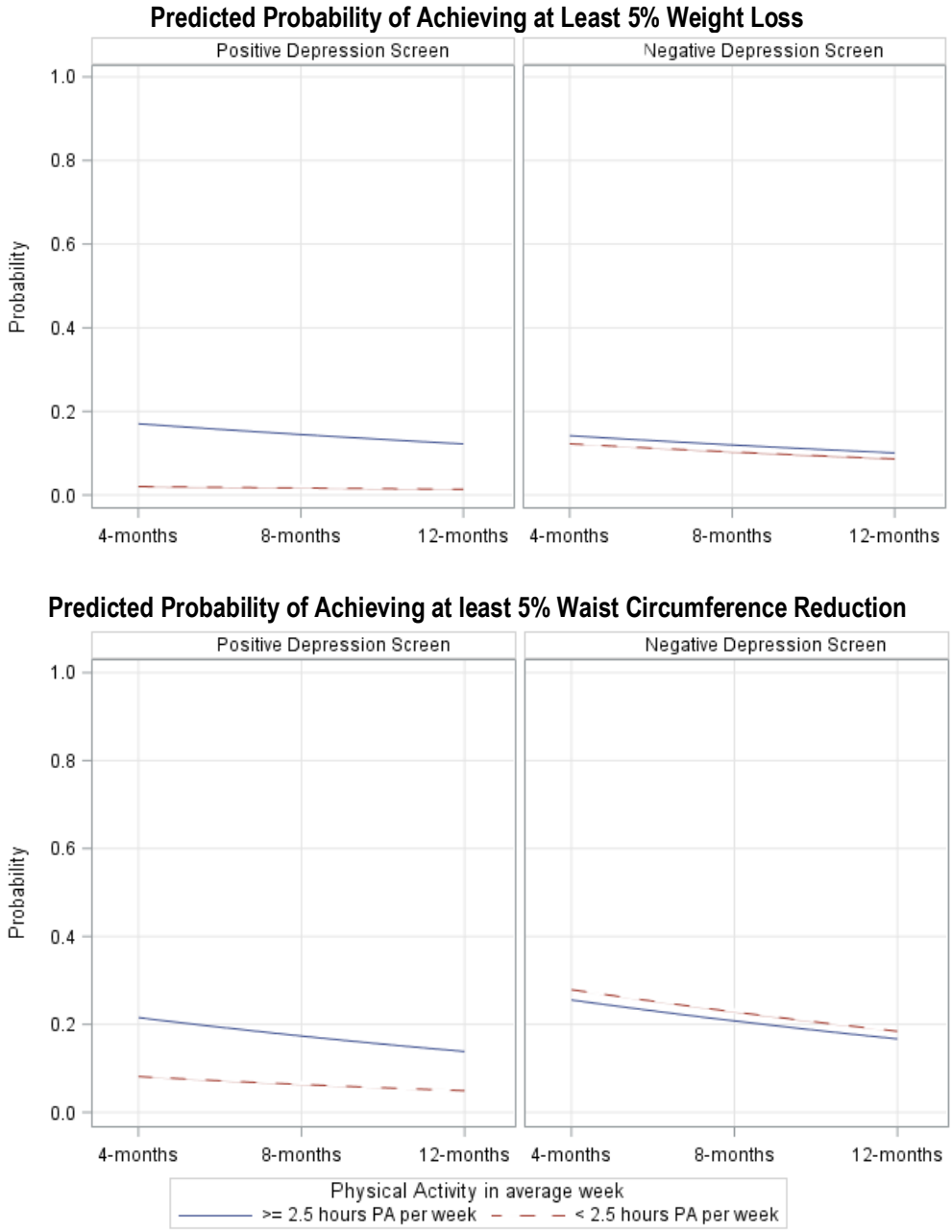

Figure 4.3 Predicted Probabilities of First Achieving Adiposity Changes Among Women Who Had Either Overweight/Obese Body Mass Index (above) or Had a Waist Circumference ≥ 35" (below) at Baseline in the Coalition for a Healthier Community for Utah Women and Girls Study. Fit computed with covariates held at high-intensity coaching, no food insecurity, age 35–44, and Hispanic community. Patient Health Questionnaire–2 score ≥ 3: positive depression screen.

heterogeneity across all levels of PA and current depression screen did not reach statistical significance ($p = .063$; see Table 4.3).

When achievement of a ≥ 5% decrease in WC was modeled among those who had a high WC at baseline, odds differed by PA level and across certain depression screen results over 12 months. For women who reported PA for < 2.5 hours per week (see Tables 4.3 and 4.4), those with a current negative depression screen had odds of achieving the WC change that were 4 times the odds (adjusted *OR* = 4.37, 95% *CI* 1.26–15.15) for those with a current positive depression screen over 12 months. Similarly, those women who had both PA for ≥ 2.5 hours per week and a current negative depression screen had odds of achieving the WC change that were 4 times the odds (adjusted *OR* = 3.87, 95% *CI* 1.12–13.38) for those who had both < 2.5 hours of PA per week and a positive depression screen over 12 months. The predicted probabilities of achieving the change in WC were similar for women with a current negative depression screen at both low and high levels of PA, along with women who were PA more often and had a positive depression screen (Figure 4.3). Women who were PA less often and had a current positive depression screen, on the other hand, had a lower probability than both PA groups with a negative depression screen. In the GEE model, though, this heterogeneity in the differences in odds of achieving the change in WC across levels of depression screen and PA was not statistically significant (interaction $p = .120$).

The effects of PA behavior and FV intake categories did not have a statistically significant interaction when modeling the achievement of ≥ 5% weight loss and controlling for possible confounders (see Table 4.3). When comparing simple effects, though, for those who were overweight or obese at baseline, women reporting both ≥ 2.5

hours of PA per week and consuming FV ≥ 5 times per day had odds of achieving ≥ 5% weight loss that were 2 times the odds (adjusted *OR* = 2.42, 95% *CI* 1.25–4.68; see Table 4.4) compared with women reporting both < 2.5 hours of PA per week and < 5 serving of FV consumed per day. This interaction between PA and FV was not statistically significant (interaction $p = .775$, see Table 4.3). When modeling the odds of achieving a 5% decrease in WC, the interaction between PA and FV was also not statistically significant ($p = .651$, see Table 4.3), nor were differences in simple effects of PA within or across FV strata (not shown).

4.5 Discussion

These results describe the potential interconnectedness of health behaviors, depression, and changes in adiposity. While increased levels of FV consumption were independently associated with increased odds of achieving ≥ 5% weight loss and negative depression screen was independently associated with increased odds of achieving a ≥ 5% decrease in WC when controlling for potential confounders, higher levels of PA were not associated with either adiposity change on its own in multivariable models. PA levels did have relationships with these changes, though, when considered within the strata of the other two exposures. Restricting analysis to those with a positive depression screen allowed for the detection of a statistically significant difference in the odds of achieving 5% weight loss across sufficient versus insufficient PA levels. When considering the achievement of a significant decrease in WC among those with insufficient PA, those with a current negative depression screen had higher odds of achieving the WC target compared to those with a positive depression screen. Furthermore, when women who had high levels of both PA and FV consumption were

compared to those who had low levels of both PA and FV, a statistically significant difference in the odds of achieving 5% weight loss over 12 months was detected. These findings have important implications for future research, interventions, and policy in the promotion of mental and physical health, while also contextualizing them and considering their limitations.

This study benefits from having participants from traditionally marginalized communities participating in a 12-month study of wellness coaching with up to four quarterly interviews and measurements. The women recruited had many risk factors at baseline, including a large proportion who were overweight/obese or depressed at baseline, but this sample may not reflect the others in their community since those who volunteered and stayed in the study may have been more prepared to improve behaviors. While many obesity prevention efforts have focused on particular cultural, racial, or ethnic groups and have called for cultural inclusiveness and adaptation of the intervention,[227–233] to date we have not found another research or intervention program similar to CHC-UWAG that has unified five distinct cultural communities, allowed for individualized cultural adaptation in each community, and utilized a gender-based approach.

The Rochester Healthy Community Partnership (RHCP) is a similar participatory research project, which included Hispanic, Somali, and Sudanese communities and academic partners in Minnesota and have reported their formative process and baseline results.[234] Both CHC-UWAG and RHCP utilized an inclusive formative process to develop study interventions and curriculum, employed community health workers who facilitated opportunities for physical activity in “safe” and at-times gender-appropriate

settings, and reported a high prevalence of obesity at baseline (82% for CHC-UWAG and 80% for RHCP).[234] While CHC-UWAG utilized randomization into a coaching program with two levels of intensity, RHCP has employed a different approach via randomly assigning participants to a (12-month) delayed-treatment control group and inclusion of a relatively long, 12-month follow-up period for those who begin the intervention at baseline.[234] Follow-up results have not yet been reported, but these have potential add to the findings of this study and provide additional insight into complex challenges and opportunities that arise with working with multiple underserved communities simultaneously.

The measures used to evaluate the primary exposures in the present study were somewhat limited by their focus on self-reported recall of behaviors. This study used BRFSS FV intake questions that are intended for use in assessing population-level prevalence and surveillance of changes on this level.[99] This was done to allow comparison with state and national data, however limited the evaluation of FV intake from considering other dietary factors, such as reductions in total caloric intake, sodium, or saturated fat intake. In addition, the measured used in this study did it evaluate dietary behaviors with more rigorous food diaries or 24-hour recall to better address recall bias. Higher levels of FV intake being associated with weight changes and not WC changes may have a few explanations. Weight loss that represents a decrease in the overall loss of adipose tissue may follow the replacement of less healthy foods with fruits and vegetables, but may also be accompanied by a loss in lean muscle mass, when it creates a negative caloric balance.[191] As an example of potentially important measures not evaluated in the present study, a diet high in both FV and dairy and low in processed

foods was associated with decreases in WC and lower increases in BMI compared to contrasting diets.[235] Others have said that changes in central adiposity, in contrast, require an increase in PA, perhaps in combination with other lifestyle changes, also in order to maintain or builds lean muscle mass.[191] Additional research in a variety of populations could help elucidate the specific nature of lifestyle factors impacting these changes and track their longitudinal benefits.

The challenges in evaluating the impact of PA in this study include the lack of either evaluating the vigor of the PA (e.g., relative to maximal oxygen uptake) or confirming the duration of the PA (e.g., with accelerometers). The inclusion of the former could have verified the accuracy of the threshold 2.5 hour per week threshold. Some in this study may have actually participated in 1.5 hours per week of vigorous PA, which would have been double counted by some measures,[162] and thus have met the 2.5 hours per week guideline. Others, conversely, may have participated in light PA relative to their sex and age for 3 hours and been counted as "sufficiently" active. Had we employed a control group, this could have allowed for a better comparison between physical inactivity and increased levels of PA in relation to adiposity changes. It should also be noted that while the proportions of women who achieved the weight loss target did not differ significantly between those who completed all sessions and those who were missing sessions or ever left the study, the majority of those who left had not achieved the goal. It is unclear if these data are missing at random.

This community-engaged research benefitted from using the brief PHQ–2 instrument to screen for depression at all study time points, despite the fact that depression was not a primary outcome of the randomized trial. The PHQ–2 had a

reported 76% sensitivity and 87% specificity for MDD in an internationally sampled meta-analysis.[161] Sensitivities have been reported to be higher and specificities reported to be lower among African Americans,[159] Hispanics,[159] and Kenyans,[160] so it is possible that the prevalence of positive depression screen was higher in the present study than the true depression prevalence based on more complete diagnostic tools. In addition, the PHQ–2 only measured cognitive-affective symptoms. Recent research has shown a stronger relationship between central adiposity and somatic-affective symptoms of depression.[37,39] For this reason, the overlap between depression, FV, PA, and WC in the present study may underestimate or misrepresent actual relationships. Future research in these populations should evaluate the somatic-affective symptoms and include more frequent and accurate measures of these and related exposures. This could shed more light on the causal pathways between these factors.

This study did not explore complex related factors such as body image[236] and acculturation.[237] Others have described how the relationships between obesity and depression may vary due to cultural norms across racial/ethnic groups and/or socioeconomic levels.[35] While those women who had a positive depression screen but also participated in more PA were more likely to achieve adiposity change targets, it is possible that unmeasured confounders, such as the severity of depression symptoms,[184] may have impeded the achievement or reduced the vigor of the PA in which these women participated, as has been described in a systematic review of longitudinal studies on depression impacting PA.[238] The direction of causation is also not clear in these results since those who had difficulty losing weight and reaching PA guidelines may have, in turn, experienced depressed mood. Other factors such as previous dieting or

weight loss attempts or success, weight cycling, physical disability, long work hours, caregiver roles, stress, or domestic violence[239] could have been influencers. Recommendations to temper the moderating effect of depressive symptoms on the initiation of PA in other studies have included more frequent contact (e.g., telephone) between sessions for those with depression or other barriers.[240] While considering these issues, other studies have also shown that women are more likely than men to gain weight when experiencing depressive symptoms.[220]

4.6 Conclusion

Physical activity may be an important component of treatment for depression, since some studies have found that it is as effective than psycho-/pharmacological treatments[222] and safer due to fewer adverse side effects, including weight gain.[194] Community-based trials, such as this one, can document the real world efficacy of these relationships. Increasing evidence also describes the relationship between metabolic syndrome and depression as bidirectional,[219] thus emphasizing the need to focus more on central adiposity. This increased focus could partially address concern that public health messaging focused on "calories in" versus "calories out"[241] and weight loss as an end goal potentially risk exacerbating body image dissatisfaction, stress, depression, and weight cycling.[242] Participants in this study may have tempered tendencies toward weight cycling by focusing on behavior goals, and specifically not including anthropometric goals. This body of research overlaps with others[243] who have summarized links between lifestyle behaviors—such as sleep, nutrition, and PA—and depression.

The described relationships between depression, PA, and adiposity changes in

this study combined with previous research that supports the relationships identified here (refs), helps support the case that a more holistic, comprehensive approach to both mental and physical health is needed to address obesity-related health disparities. Similarly, those who do not screen positive for depression and are physically active are more likely to achieve a ≥5% reduction in WC than those who are less physically active. Proactive measures that engage communities with the increased burden of disease and decreased levels of wellness should consider combining the efforts to address emotional health, health behavior change, health care, and prevention. Future research should consider this overlap between health behaviors, mental health, and adiposity changes, including long-term evaluation of outcomes following behavior change among those with depression. This could help promote progress toward the "comprehensive wellness programs" in research and policies for which the office of the surgeon general has called[244] and, thus, build bridges between the seven domains of health for more individuals, families, and communities.[57]

CHAPTER 5

CONCLUSION

5.1 Purpose

The purpose of this study was to describe the relationships among attributes of community wellness coaching and participant attributes, behaviors, and outcomes that included improved depression and adiposity changes. The first hypothesis of this dissertation was that competent motivational interviewing (MI) delivered by English-speaking CHWs in the CHC-UWAG wellness coaching randomized trial will improve participant retention, behavior change, and depressive symptoms at follow-up. Since some barriers to FV intake may increase risk for depression and differ by age,[32–34] education levels,[35,36] obesity,[11,37–39] and across racial/ethnic groups,[35,40,41] the second hypothesis in this dissertation hypothesized that personal characteristics may influence the beneficial effect of physical activity (PA) behaviors and fruit/vegetable (FV) consumption on depression for women in the five communities. The third hypothesis of this dissertation was that physical activity, fruit and vegetable consumption, and depression will impact the likelihood of significant reductions in body weight and waist circumference within the Coalition for a Healthier Community for Utah Women and Girls (CHC-UWAG) wellness coaching program.[10]

These were modified slightly from the original aims. The first aim also included a hypothesis that the competency of the CWC's in utilizing MI may vary over time (e.g.,

improve with more experience, worsen as time since training passed), but the spacing and number of CWC sessions per CWC were irregular thus making an secondary evaluation based on this hypothesis untestable. This aim did not have an explicit question about study retention. Since study retention was higher in the stratified sample than was expected and following the retention-related finding in aim 2, this detail was added to aim 1; thus enabling the discovery of a potentially important finding in this study. One modification to aim 2 was the elimination of analyses related to mental health care referral and access to care. The data on referrals was inconsistent and often missing, and thus did not appear reliable compared to the rest of the data. Future research efforts could collaborate more with mental health care providers and allow for this type of research question. Aims 2 and 3 also had subaims that intended to explore interactions between MI competency and exposures for those aims, but the sample size did not allow for stratification of this detail.

This study benefits from the community-based participatory research (CBPR) methods utilized at each phase of the main study development and implementation, along with each phase of the dissertation development. The doctoral candidate was even a member of Community Faces of Utah prior to applying to the University of Utah Division of Public Health PhD program, thus being involved with relationship building and multidirectional learning between academicians, government representatives, and community leaders at each phase of the process. The priorities of the CHC-UWAG study were defined as points of "congruence" across communities and partners.[16] This process, and the relationships which undergirded it, arguably allowed for inclusion of questions relating to sensitive topics, especially depression, which is often stigmatized.[245]

This study also has a unique strength in the diversity of its membership. No other CBPR project to the present knowledge of this author has included leaders/representatives from five distinct communities in positions as equitable fellow members alongside academic and government representatives. The closest example of such diversity and power sharing across communities and sectors is the coalition for a new study in Minnesota that includes Hispanic, Somali, and Sudanese.[234] The power sharing between coaches and participants and between community leaders and government/academia in the present study may, in small ways, counter-balance the reduction of mental well-being that is sometimes associated with reduced power, status, and resources among minority group members,[246] though this potential benefit warrants further evaluation. Further, if this were conducted in a medical context, the complexity of accurately identifying mental health issues across cultures (e.g., clinical bias in instrumenst or their administration) may result in the mundane mislabeled as a disorder.[246] Depression screening by CWCs may benefit from decreased social distance in contrast to a practitioner-participant relationship that involves cross-cultural differences. Still of concern, though, is that the symptoms used to diagnose or screen mental health concerns may vary across groups, as with increased somatization in depression for Hispanics, Asian Americans, and Native Americans when compared to white Americans. [246,(p.399)] Standardized interviews have been shown to reduce outside bias, though,[246,(p.399)] and the CWCs did receive training to follow research protocols guided by REDCap (Research Electronic Data Capture).

Finally, the present study has also benefited from knowledge sharing about policy changes within each community since the study began, such as the replacement of

sugar-sweetened beverages with bottled water across multiple community organizations. CWCs in each of these five communities have potential to promote traditional, healthy behaviors—such as methods of preparing fruits and vegetables and using dance to commemorate special occasions—as means that not only improve obesity related behaviors, but also strengthen cultural identity and social ties and promote mental wellness is their relatively collectivistic communities. Some have even reported using cross-cultural forms of dance (e.g., Zumba at Calvary Baptist Church, National Tongan American Society, and Urban Indian Center). Through these community-centered processes, they appear to be building connections, distributive justice, and trust within, across, and beyond communities, individually and collectively.

5.2 Limitations

The present study has several limitations that are noteworthy. Recruitment for the CHC-UWAG intervention had a convenience sampling process conducted by community wellness coaches (CWC) through community networks and events, thus limiting the generalizability of the results to the broader communities from which they were selected. Those participating in the study all identify with their respective racial or ethnic community, but they may be substantially different from the rest of their community (e.g., more likely to be in the action stage of change, more or less overweight or obese, more or less depressive symptoms). The present study also lacks two reference groups which may have benefited the present research questions. First is a control group that received no or standard treatment (e.g., health education materials), which is a standard part of randomized control trials, but often challenging in community-based translational studies.[247] The second reference group missing is a group coached for a

short time in rural Utah counties. They had provided data at baseline before coaching ended; and had they continued, this group of predominantly white women in rural areas would have been a helpful comparison group. Since these comparison groups are missing, it is relatively difficult to assess biases (e.g., cohort effect) in the data.

Additional or higher quality data for key measures would have also improved this research. A food frequency questionnaire tested within each community would have improved the validity of the changes in dietary consumption.[248] The Personal Health Questionnaire–9[249] or even a depression diagnostic test following a positive screen with the Personal Health Questionnaire–2. Adding each of these would also have the limitation of increasing the burden on participations and was the main reason for not including them and other measures in the study. Another limitation of this secondary data analysis is the risk of committing a Type I error as the number of analyses increase.[250] This as tempered through thorough secondary hypothesis development and research design, each of which preceded the completion of analysis protocols that did not included data exploration.

5.3 Summary Conclusions

Results from these aims have potential to guide future public health research, policy change, and interventions. Aim 1 suggest that as coaches cultivated and evoked the motivations for behavior change in the participants and exhibited accurate empathy for the participant's experience, the participants were more likely to self-explore (e.g., values and fears) and to stay in the study. Study and program retention has been challenging among people with depression. Evidence has suggested that culturally tailored interventions and case management are needed in depression management and

prevention,[78] but the key components of these interventions had yet been identified. The current study emphasizes that community health workers trained and supported in the use of motivational interviewing could be an important component of future efforts to improve study and program retention.

Results from the second aim of this study contribute other potential components of future efforts: the frequency and type of support for people with depression. Previous research has documented the tendency of people with major depression to dropout of interventions or studies,[73] especially when they are assigned to a lower or nonintervention arm of a study are more likely to dropout.[74] Furthermore, people with depression are more likely to be considered noncompliant to medical treatment.[251] Being seen by someone specialized in mental health increased retention in a study focused on communities of color,[75] though African Americans with depression still had lower rates compared to non-Hispanic whites. Culturally appropriate adaption of treatment could assist this group, such as the finding that Hispanic Americans may prefer therapy alone or combined with pharmacotherapy, versus only medication.[76] Others have documented what may be a key feature of the present study, peer support with its broad definition, may improve retention, particularly among those who are hard to reach due to psychological or other socioecological factors.[252] More frequent contact, whether in person or via telephone as was often the case for our CWCs, along with improved relationships between participants and study facilitators/clinicians may also improve engagement (e.g., when treating depression among cancer patients).[183] Thus, there is potential that the increased frequency of contact, increased peer/social support, and MI components may have each, or in combination, benefited those individuals at-risk for

depressive symptoms who stayed in the study.

Results from aims 2 and 3 contribute potentially beneficial findings on two levels: 1) defined relationships between individual behaviors and improved outcomes and 2) identified factors that may modify the effect of the behaviors on the improved outcomes. On the first level, aim 2 identified FV intake and aspects of PA as related to higher odds of improved depression screening results over the 12 months of the study. In aim 2, higher levels of daily FV intake alone was related to increased odds of achieving at least 5% weight loss over 12 months. On the second level, aim 2 defined age as a statistically significant modifier of the effect of FV on odds of improved depression screen. More specifically, the benefit of increased daily FV intake amplified for women aged 55 or over and diminished for younger women. For aim 3, the benefit of reaching PA guidelines (at least 2.5 hours per week vs. fewer than 2.5) in achieving at least 5% weight loss became clear when looking only among women with a current positive depression screen. These findings highlight the potential for improved mental and physical health outcomes through behavior change. The present study's intervention also used a person-centered goal setting and tracking process, which may have also dampened the stress commonly related to dieting, though these potential mediating factors are in need of additional research.

Through engagement with community leaders and other stakeholders as part of the final CBPR process, findings from this dissertation have potential to lead to community-driven solutions and policy change.[13–15] These could include the expanded use of CHWs and MI, such as improving study retention and mental health service utilization; developing culturally appropriate policies and programs that improve

physical activity and nutrition among populations at high risk for depression, such as those who are over age 55 and inactive; and promoting the reduction of waist circumference through behavior change in these high risk groups. The relationships of trust developed and sustained among CHC-UWAG partners as part of the CBPR process also present an opportunity for more deep and practical interpretation of the results from this dissertation. Community leaders and other stakeholders can join together to develop these policies and address systemic roots of injustices,[13–15] across multiple levels of the socioecological model[253] and in a way that promotes both physical and mental health.[1]

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