THE EFFECT OF WAIST CIRCUMFERENCE MEASUREMENT AND CENTRAL OBESITY TYPE 2 DIABETES DISEASE RISK EDUCATION ON COMMUNITY-BASED OLDER ADULTS' PERCEIVED SUSCEPTIBILITY, PERCEIVED BENEFITS, AND HEALTH BEHAVIORS

by

Beatrice Gaynor

A dissertation submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing Science

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DEDICATION

I dedicate this degree to my spirited children. It is my hope that this endeavor inspires them to seek every opportunity and overcome every challenge life offers them.

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ABSTRACT

Waist circumference (WC) measurement is a reliable indicator of preventable, central obesity-related, disease risk. Despite its predictive value, it is rarely measured in primary care (PC) settings. The absence of WC screening may be problematic for older adults. Older adults have higher rates of central obesity and greater risk for central obesity-related disease, such as Type 2 Diabetes (T2D), as compared to younger adults. Early detection of central obesity along with central obesity T2D disease risk education may prevent, delay, or control T2D in older adults.

It is unknown if WC measurement and central obesity T2D disease risk education affects community-based older adults' (a) acceptance of and willingness toward WC measurement, (b) perceived susceptibility to T2D and perceived benefits of WC measurement, and (c) health behaviors of physical activity and dietary behaviors. This study examined the effect of WC measurement and central obesity T2D disease risk education in comparison to the effect of the current standard practice of body mass index (BMI) calculation and obesity classification in PC. The Health Belief Model constructs of perceived susceptibility, perceived benefits, and cues to action were integral to this study design. It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on acceptance of and willingness toward WC measurement, perceived susceptibility for T2D, perceived benefit of WC measurement, physical activity, and dietary behaviors than two control cues to action (c) BMI and (d) obesity classification in community-based older adults.

This study found that 92% of the participants in this study reported never having WC measurement in the PC setting and 75% reported never having BMI calculation in the PC setting. The lack of BMI experience in both groups may have caused BMI calculation and obesity classification to function as interventional cues to action in both groups rather than control cues to action. The sample was educated and physically active. High baseline findings associated with (a) acceptance of and willingness toward WC measurement, (b) perceived susceptibility, and (c) physical activity, limited measurement of significant change at posttest. There was a significant change in perceived benefits of WC measurement and BMI calculation, as well as willingness to exercise in the experimental group compared to the control group. Changes in dietary behaviors were non-significant.

High baseline acceptance of, and willingness toward, WC measurement in the absence of WC measurement experience, supports acceptability of WC measurement among community-based older adults. Combined use of WC measurement and BMI calculation is recommended in PC settings to influence community-based older adults' perceived benefits and to motivate change in health behaviors.

Chapter 1

INTRODUCTION

The prevalence of Type 2 Diabetes (T2D), related to central obesity, is increasing in the growing older adult population (Centers for Disease Control [CDC], 1998; CDC, 2011; CDC & National Center for Health Statistics [NCHS], 2014). Obesity and T2D are major health concerns in the United States (U.S.), due to significant disease and economic burden (American Diabetes Association [ADA], 2013; CDC, 2014; Flegal, Carroll, Kit, & Ogden, 2012; Finkelstein, Trogdon, Cohen, & Dietz, 2009; Guh et al., 2009; Hammond & Levine, 2010). Central obesity is present when there is an increased amount of intra-abdominal or visceral body fat (CDC, 1998). Total obesity is present when the calculation of body weight (kg) divided by body height (m^2) yields a number equal to or greater than 30 kg/m^2. This total obesity calculation is termed body mass index (BMI) (CDC, 1998).

Older adults, aged 60 years and older, have higher rates of central obesity and greater central obesity-related disease risk, such as T2D, compared to younger adults (Flegal et al., 2012; Racette, Evans, Weiss, Hagberg, & Holloszy, 2006). Physiological changes in body composition, secondary to aging, increase the older adult's risk for central obesity (Schutzer & Graves, 2004; Winett, 2014). These physiologic changes include decreased muscle mass and increased body fat mass (Doherty, 2003; Ferrini, & Ferrini, 2013; Narici, & Maffulli, 2010; Roubenoff, 2004). This excess body fat mass is often centrally located, resulting in central obesity (Doherty, 2003; Roubenoff, 2004). Lack of physical activity and poor dietary

behaviors further exacerbate the older adult's risk for central obesity and T2D (Narici, & Maffulli, 2010; Winett et al., 2014). Identification of central obesity and education about central obesity disease risk may motivate lifestyle modifications that can prevent or delay the onset, progression, and potential complications of T2D.

1.1 Background

WC measurement is a practical, accurate measure for central obesity and a reliable indicator of T2D risk (ADA, 2004; Appel, Jones, & Kennedy-Malone, 2004; Balkau et al., 2007; Ganpule-Rao et al., 2013; International Diabetes Foundation [IDF], 2015; Jansen, Katzmarzyk, & Ross, 2004; Schulze et al., 2006; Siren, Erikkson, & Vanhanen, 2012; Usui et al., 2010). BMI, on the other hand, is a less accurate measurement of total and central obesity that lacks specificity in detecting T2D risk in the older adult population (Jansen et al. 2004; Racette et al., 2006; Schulze et al., 2006). Contrary to empirical evidence supporting WC measurement, primary care providers (PCPs) routinely assess patients' BMI and rarely assess patients' WC (Dunkley et al., 2009; Gaynor, 2015; Smith & Haslam, 2007; Sebo, Haller, Pechère-Bertschi, Bovier, & Herrmann, 2015; Ternes, 2011). Therefore, centrally obese patients with BMIs less than 30, who are at risk for T2D, may not be identified nor informed about their risk for preventive disease (Goodpaster et al., 2003). This lack of WC measurement and patient education about central obesity disease risk may inhibit older adults' perceived susceptibility to T2D, perceived benefits of WC measurement, and adoption of health promoting behaviors.

1.2 Statement of the Problem

Limited studies examined the use of and barriers to the use of WC measurement in PC (Dunkley et al., 2009; Gaynor, 2015; Smith & Haslam, 2007; Ternes, 2011). It is unknown if WC measurement and central obesity T2D disease risk education affect community-based older adults' acceptance of and willingness toward WC measurement, perceived susceptibility to T2D, perceived benefits of WC measurement, and the adoption of health promoting behaviors (i.e., physical activity and dietary behaviors).

1.3 Theoretical Framework

The Health Belief Model (HBM) is a behavioral theoretical model intended to explain and predict behaviors (Glanz, Rimer, & Visanath, 2008). This study utilized three HBM constructs: perceived susceptibility, perceived benefit, and cue to action. The model explains that a person is more motivated to improve his/her health behavior when he/she believes he/she is susceptible to disease (Rosenstock, 1966). When the individual believes he/she is susceptible and perceives particular health behaviors are beneficial, he/she is more likely to adopt these health behaviors (Rosenstock, 1966). The HBM identifies a cue to action as something that alerts an individual about health risk and triggers behavior change (Rosenstock, 1966).

Increasing central obesity rates and the burden of resultant metabolic disease warrant examining the effect of WC measurement and central obesity T2D disease risk education on community-based older adults' (a) acceptance of and willingness toward WC measurement, (b) perceived susceptibility to T2D and perceived benefits of WC measurement, and (c) the adoption of health promoting behaviors. This study, based on the HBM, examined the effect of two experimental cues to action, (a) WC

measurement and (b) central obesity T2D disease risk education, compared to two control cues to action, that mimicked the current PC practice of (c) BMI calculation and (d) obesity classification on participant perceived susceptibility for T2D, perceived benefit of WC measurement, and health behaviors.

1.4 Purpose

The purpose of this study was threefold: (a) to examine community-based older adults' experience with, acceptance of, and willingness toward WC measurement, (b) to examine the effect of WC measurement and central obesity T2D disease risk education on community-based older adults' health beliefs of perceived susceptibility to T2D and perceived benefits of WC measurement compared to the current practice of BMI measurement and obesity classification, and (c) to examine the effect of WC measurement and central obesity T2D disease risk education on community-based older adults' health behaviors (i.e., physical activity and dietary behaviors) compared to BMI measurement and obesity classification.

1.5 Research Questions

The threefold study purpose was met by aiming to answer the following three research questions:

1. What is the community-based older adults' experience with, acceptance of, and willingness toward waist circumference measurement?
    a. How often are community-based older adults having their WC measured by PCPs?
    b. Do acceptance of and willingness toward WC measurement change after participant experience with WC measurement and central obesity T2D disease risk education?

2. Do WC measurement and central obesity T2D disease risk education affect community-based older adults' health beliefs?

    a. Do WC measurement and central obesity T2D disease risk education affect community-based older adults' perceived susceptibly to T2D?

    b. Do WC measurement and central obesity T2D disease risk education affect the perceived benefit of WC measurement?

3. Do WC measurement and central obesity T2D disease risk education affect community-based older adults' health behaviors?

    a. Do WC measurement and central obesity T2D disease risk education affect community-based older adults' physical activity?

    b. Do WC measurement and central obesity T2D disease risk education affect and dietary behaviors?

1.6 Hypotheses

1. It was hypothesized that community-based older adults would report rare PCP WC measurement and frequent BMI calculation in the primary care setting.

2. It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on perceived susceptibility for T2D, perceived benefit of WC measurement, physical activity and dietary behaviors than two control cues to action (c) BMI and (d) obesity classification in community-based older adults.

1.7 Significance

Demonstrating the acceptability and effectiveness of WC measurement and central obesity-related T2D disease risk education in community-based older adults

may be key to overcoming barriers to WC measurement in PC settings. Dissemination of findings from this study are intended to facilitate adoption of WC measurement and central obesity T2D disease risk education in PC settings. The adoption of WC measurement and central obesity T2D disease risk education in PC settings may (a) promote detection of central obesity, (b) inform health beliefs about susceptibility for T2D, and benefits of WC measurement, and (c) encourage adoption of health behaviors that promote health and prevent disease in older adults.

The following two chapters include the literature review and methodology for the study

Chapter 2

LITERATURE REVIEW

A review of the relevant literature about Type 2 Diabetes (T2D), obesity, and obesity measurement is presented. The influence of aging, body composition, and health behaviors on T2D disease risk often interact. The association of aging and disease risk is threaded through this review. Literature examining primary care (PC) waist circumference (WC) utilization is examined. Next, recommended physical activity and dietary health behaviors to modify T2D risks and WC in community-based older adults is presented. Last, an overview of the health belief model (HBM) is presented to frame the examination of the effect of two cues to action (WC measurement and central obesity T2D disease risk education on (a) acceptance of and willingness toward WC measurement, (b) perceived susceptibility for T2D and perceived benefit of WC measurement, and (c) adoption of health behaviors in community-based older adults in this study.

Diabetes is a common, preventive disease that is increasing in prevalence and poses significant economic and health burdens in the United States (U.S.) (American Diabetes Association [ADA], 2013; Centers for Disease Control [CDC], 2011; CDC, 2014). The major risk factors for T2D are age, obesity, and physical inactivity (ADA, 2013; Guh et al., 2009). Inherent changes in body composition associated with aging and the increased prevalence of sedentary lifestyles among older adults compounds older adults' risk for T2D (Schutzer & Graves, 2004; Winett, 2014). The current anthropometric screening method of body mass index (BMI) is a poor indicator of

actual disease risk in the older adult population (Jansen, Katzmarzyk, & Ross, 2004; Racette et al., 2006; Schulze et al., 2006). Studies have scrutinized the specificity of anthropometric measurements in the detection of total obesity, central obesity, and disease risk (Balkau et al., 2007; Jansen et al. 2004; Racette et al., 2006; Schulze et al., 2006). Waist circumference measurement was repeatedly identified to be a better indicator of disease risk than BMI across race and gender (Balkau et al., 2007; Beydoun et al., 2010; Dunkley, et al., 2009; Gelber, et al. 2008; Jansen, Katzmarzyk, & Ross, 2004; Schulze, et al., 2006).

There is a gap in the literature examining clinical use of and effectiveness of WC measurement in PC. Studies that examine the effect of WC measurement and central obesity T2D disease risk education on community-based older adults' perceived susceptibility for T2D, perceived benefits of WC measurement, and health behaviors appear to be nonexistent.

2.1 Type 2 Diabetes

Type 2 Diabetes is a chronic metabolic disease characterized by increased plasma glucose levels (hyperglycemia) that occurs due to varying degrees of insulin resistance and impaired insulin secretion (ADA, 2004). It is estimated that 9.3% of the total U.S. population is diabetic and 37% are pre-diabetic (National Health and Nutrition Examination Survey [NHANES] 2009–2012). Of the 29.1 million people living with diabetes, 8.1 million are not diagnosed (CDC, 2014; NHANES 2009–2012). Patients with elevated fasting plasma glucose levels without physician diagnosis represent the undiagnosed population (ADA, 2013; Golden et al., 2012). Ninety to 95% of persons with diabetes have T2D (CDC, 2011). Since most patients

with diabetes have T2D, the terms diabetes and T2D will be used interchangeably throughout this chapter.

Type 2 Diabetes develops insidiously. As insulin resistance increases and insulin secretion decreases gradually, hyperglycemia occurs and early organ damage takes place. Throughout this process the commonly known diabetic symptoms of polydipsia, polyuria, and unexplained weight loss are usually not present (ADA, 2004). Patients, both diagnosed and undiagnosed with T2D, may develop macro and/or microvascular complications including cardiovascular disease (CVD), stroke, diabetic retinopathy, nephropathy, and neuropathy (CDC, 2011; CDC, 2014). Hyperglycemic damage to the peripheral nervous system leads to peripheral neuropathy that is associated with risk for foot ulcers and amputations (CDC, 2011). Damage to the autonomic system impairs gastrointestinal, genitourinary, and cardiovascular system function (ADA, 2004). These complications of T2D impact quality of life and decrease life expectancy by up to 15 years (CDC, 2008; Golden et al., 2012). Delayed diagnosis of T2D increases the risk for development of diabetic complications (ADA, 2013). Unfortunately, T2D is often not diagnosed until complications are already present (ADA, 2013).

The total national economic burden of diabetes is estimated to be $245 billion (CDC, 2014). Diabetes is the seventh leading cause of death in the U.S. (CDC, 2014). Persons with T2D are two to four times more likely to develop CVD, the leading cause of death in the U.S. (CDC, 2008; CDC, 2014).

2.1.1 Aging and Type 2 Diabetes risk

The older adult population, 65 years and older, is increasing (U.S. Census Bureau, 2014). It is estimated that over 80 million people will be older than 65 years

in 2050 (Federal Interagency Forum on Aging-Related Statistics, 2010; U.S. Census Bureau, 2014). The incidence of T2D is highest in the population over 65 years of age (ADA, 2013; CDC, 2011; NCHS, 2014). Twenty-six percent (25.9%) of the diabetic population is ≥65 years of age (CDC, 2014). Approximately 27% of adults over the age of 65 years have T2D and 50% are pre-diabetic (CDC, 2011; NCHS, 2014). Slightly more men than women have diabetes, 13.6% versus 11.2%, respectively (CDC, 2014). Because women have a greater average life expectancy, women in the U.S. have a 38% lifetime chance of developing diabetes while men have a 33% lifetime chance (Narayan, Boyle, Thompson, Sorenson, & Williamson, 2003). Health care needs and costs for this older population with diabetes are expected to increase significantly (CDC, 2003; CDC 2011; CDC 2014). The influence of aging is further threaded throughout the following subheadings.

2.1.2 Diagnosis of Type 2 Diabetes

Type 2 diabetes is most frequently diagnosed during the sixth decade of life (Golden et al., 2012). The ADA recommends testing patients, of any age, with BMI ≥25 kg/m^2 and who have one or more risk factors for developing T2D (2013). It is recommended to begin testing patients with normal BMI and no disease risk at 45 years of age, and every three years after normal testing (ADA, 2013). Tests indicated for diagnosing T2D and prediabetes are the same, per different parameters. Elevation detected by one of four plasma laboratory tests is required to diagnose T2D. The four tests and test parameters include the following: (a) HgbA1C of ≥6.5%, or (b) fasting glucose of ≥126 mg/dL, or (c) a two-hour glucose ≥200mg/dL during an oral glucose tolerance test (OGTT), or (d) a random glucose ≥200 in a patient with the commonly known diabetic symptoms (ADA, 2013). An OGTT requires the fasting patient to

consume 75 grams of glucose. Two hours after ingestion of the glucose a plasma glucose level is drawn for testing (Eborall et al., 2012). One of the following three plasma laboratory parameters is required to diagnose prediabetes: (a) HgbA1C 5.7-6.4 %, or (b) a fasting glucose 100 mg/dL to 125 mg/dL, or (c) two-hour glucose 140 mg/dL to 199 mg/dL during an OGTT (ADA, 2013). Fasting requires no caloric intake for a minimum of eight hours. The ADA (2013) recommendations presented align with recommendations of the World Health Organization (2006) and the International Diabetes Foundation (2006).

Modifiable T2D disease risk factors include physical inactivity, hypertension, abnormal lipid profile, CVD, or a history of abnormal plasma fasting glucose, glycosylated hemoglobin A1C (HgbA1C), or OGTT (ADA, 2013). Non-modifiable risks include having a first degree relative with diabetes, high risk race/ethnicity, women with a history of gestational diabetes or who have delivered a baby weighing more than nine pounds, and a history of polycystic ovarian syndrome (ADA, 2013).

Plasma laboratory values are indicated for T2D diagnosis. Screening to determine need for laboratory testing is based on patients' BMI and one or more additional risk factors for T2D (ADA, 2013). Laboratory testing is costly, inconvenient to patients, and poses a mild to moderate risk associated with fasting and venipuncture (Aujla, Stone, Taub, Davies, & Khunti, 2013; Eborall, 2012). Waist circumference measurement is not included in the ADA diagnostic protocol (2013). Although WC is more specific for T2D disease risk than BMI, particularly in the older adult population, the less disease specific BMI calculation is currently incorporated in the diabetes diagnostic protocol (ADA, 2013; Appel, et al., 2004; Djoussé et al., 2012; Grundy, 2009; Jansen, Katzmarzyk, & Ross, 2004). Inclusion of WC measurement in

the T2D diagnosis protocol may further inform the need for laboratory testing in patients with normal BMI and elevated WC. It is unknown if the absence of WC screening in the current diabetes diagnosis protocol is a contributing factor to 8.1 million undiagnosed diabetic patients in the U.S.

Additional diabetes screening protocols to reduce the number of undiagnosed T2D patients have been explored. These proposed protocols did not consider the effect of WC measurement in PC on the incidence of undiagnosed T2D patients (CDC, 1998; Chen, Yen, & Tung, 2001; Glümer, et al., 2006; Hoerger et al., 2004; Icks et al., 2004; Kahn et al., 2010). Overall, the variables of age, fasting plasma glucose, HgbA1C, OGTT, and lipid panel were examined in these studies. Two studies found increased screening in patients aged 55-75 years to be cost-effective (Hoerger et al., 2004; Icks et al., 2004). Three studies included BMI measurements when evaluating the potential effect of different diabetes screening protocols on cost and disease burden (Chen et al., 2001; Glümer, et al., 2006; Icks et al., 2004). Kahn and colleagues (2010) used a mathematical model to analyze the effect of eight screening protocols on cost and disease burden. No anthropometric measures for central obesity were considered in this hypothetical screening process (Kahn et al., 2010). Rather, fasting plasma glucose levels, blood pressure readings, and lipid panels were the proposed methods for screening (Kahn et al., 2010).

The potential effect of WC measurement on the reduction of undiagnosed T2D patients has not been explored. Literature examining the impact that incorporation of WC measurement in the diabetes diagnostic protocol might have on cost, convenience, time, patient adherence, and disease burden appears absent.

2.1.3 Body composition and Type 2 Diabetes risk

Obesity is one of the strongest risk factors for T2D (ADA, 2013; Guh et al., 2009). As the population ages and the prevalence of obesity increases, the risk for developing T2D in older adults escalates (Centers for Disease Control [CDC], 1998; CDC, 2011; CDC & National Center for Health Statistics [NCHS], 2014). Data from the NHANES 2009-2010 indicated 76.5% of men and 73.5% of women 60 years and older were overweight or obese (Flegal, Carroll, Kit, & Ogden, 2012). Body composition changes related to aging include decreased muscle mass and increased fat body mass (Doherty, 2003; Ferrini, & Ferrini, 2013; Flack et al., 2011; Narici, & Maffulli, 2010; Roubenoff, 2004; Schutzer & Graves, 2004; Winett, 2014). Both changes further increase the older adult's risk for T2D (Usui et al., 2010; Kuk, Kilpatrick, Davidson, Hudson, & Ross, 2008; Winett, 2014).

The term sarcopenia, proposed by Rosenberg in 1989, refers to the loss of muscle mass associated with aging (1997). Sarcopenia is influenced by physiological changes that occur with aging and lifestyle (Narici, & Maffulli, 2010). The physiological changes result from alterations in the nervous, endocrine, and immune systems (Doherty, 2003; Narici, & Maffulli, 2010). In a study examining the number of muscle fibers it was found that this number remains relatively constant until 60 years of age; from 60 to 80 years of age the number of muscle fibers decreases approximately 50% (Narici, & Maffulli, 2010). Studies have identified a correlation between decreased muscle mass and increased insulin resistance (Usui et al., 2010; Kuk et al., 2008). Muscle mass inhibits hyperglycemia by storing and burning glucose, thus contributing to controlled plasma glucose levels. Loss of muscle mass has been correlated with reduced basal metabolic rate, increased insulin resistance, and hyperglycemia (Flack et al., 2011).

Physiologic changes that lead to decreased muscle mass also contribute to increased body fat mass (Flack et al., 2011; Racette, et al., 2006). Myosteatosis is a condition that results from fat infiltrating muscle in persons with sarcopenia (Taaffe MA et al., 2009). Fat infiltration of skeletal muscle is believed to cause chronic muscle inflammation that limits muscle health and promotes insulin resistance (Goodpaster et al. 2003; Goodpaster et al., 2000). It is believed this inflammation causes further loss of muscle mass. The resultant cycle of muscle fiber loss, fat infiltration, inflammation, followed by more muscle loss further decreases basal metabolic rate, increases insulin resistance, and exacerbates hyperglycemia (Roubenoff, 2004).

Inflammatory markers associated with increased fat mass also contribute to T2D risk. The complete bio-chemical interaction of body fat mass leading to insulin resistance and decreased insulin secretion is not fully understood. Several inflammatory markers associated with fat mass have been linked to the development, progression, and complications of T2D. Some of these markers are C-reactive protein, tumor necrosis factor, and plasminogen activator inhibitor-1 (Nesto, Nelinson, & Pagotto, 2009).

Adiponectin is a hormone that acts as an *anti*-inflammatory agent, protective against the development of T2D and consequential micro- and macrovascular complications of T2D (Jee et al., 2013; Li, Shin, Ding, & van Dam, 2009). Increases in adiponectin have been correlated to improved insulin sensitivity and decreased hyperglycemia (Bonneau, Pedrozo, & Berg, 2014; Flack et al., 2011; Jee, et al., 2013; Li et al., 2009). Anti-inflammatory effects of adiponectin on the endothelial lining of blood vessels decrease the risks for micro- and macrovascular disease. Patients with

greater muscle mass have higher levels of adiponectin and lesser risk for T2D and CVD (Jee, et al., 2013; Li et al., 2009). Low levels of adiponectin are found in patients with greater body fat mass (Jee, et al., 2013; Li et al., 2009). Patients with greater body fat mass and lower levels of adiponectin are at greater risk for T2D and CVD (Jee, et al., 2013; Li et al., 2009).

2.2 Obesity and Anthropometric Measurements

Obese adults spend 42% more on health care than normal weight adults (Finkelstein, Trogdon, Cohen, & Dietz, 2009). The annual economic burden of obesity, including direct medical costs, productivity costs, transportation costs, and human capital costs is estimated to exceed $215 billion annually (Hammond, & Levine, 2010).

2.2.1 Total obesity

Total obesity is measured by BMI. Body mass index is calculated by dividing weight (kg) by height (m^2). Table 2.1 on the following page presents BMI obesity classification parameters. The ADA (2011) currently recommends BMI in the screening of patients to indicate need for diabetes diagnostic testing. The changes in older adults' body composition limit the usefulness of BMI (Heymsfield & Cefalu, 2013; Li & Heber, 2012). Older adults have more fat body mass than younger adults at a given BMI and the distribution of body fat may be more centralized, particularly in the intra-abdominal area resulting in greater disease risk (Heymsfield & Cefalu, 2013; Li & Heber, 2012).

Table 2.1 BMI obesity classification parameters

Obesity classification	Body Mass Index (kg/m²)
Overweight	25-29.9
Obesity I	30-34.9
Obesity II	35-39.9
Obesity III	≥ 40 kg/m²

Source: NHLBI, CDC, 1998.

Jansen, Katzmarzyk, and Ross (2005) examined the predictive value of BMI and WC for mortality in 5,200 men and women over the age of 65 years. Findings revealed increased BMI after the age of 65 did not indicate increased risk for mortality (Jansen, Katzmarzyk, & Ross, 2005). However, increased WC in this older population did indicate increased risk for mortality (Jansen et al., 2005). Kuk and Ardern (2009) found that increased BMI was associated with increased mortality under the age of 65, but did not find clear evidence indicating higher mortality with higher BMI values in adults older than 65 years. These data further highlight the lack of specificity provided by BMI as a health risk indicator in older adults. Central obesity increases older adults' risk for T2D more than total body obesity (Balkau et al., 2007; Dunkley, et al., 2009; Gelber, et al. 2008; Jansen, Katzmarzyk, & Ross, 2004; Schulze, et al., 2006). Given the increased risk of T2D in older adults, coupled by changes in body composition, use of more specific anthropometric measures is indicated.

2.2.2 Central obesity

Central obesity is present when there is an increased amount of intra-abdominal or visceral body fat. There are several methods for measuring central obesity, including imaging studies such as DEXA scans, computerized tomography (CT) scans, and magnetic resonance imaging (MRI), skin-fold thickness, and WC (Appel et al., 2004; Ganpule-Rao, 2013). Imaging studies and skin-fold thickness methods, although accurate, are less practical due to cost, time, and patient risk (Appel, et al., 2004). Waist circumference, when properly measured by a trained professional, provides a reliable indicator of disease risk (ADA, 2004; Appel, Jones, & Kennedy-Malone, 2004; Balkau et al., 2007; Dunkley, et al., 2009; Ganpule-Rao et al., 2013; Gelber, et al. 2008; Goh, et al., 2014; International Diabetes Foundation [IDF], 2015; Jansen, Katzmarzyk, & Ross, 2004; Schulze et al., 2006; Siren, Erikkson, & Vanhanen, 2012; Usui, 2010; Zhang, Rexrode, van Dam, Li, & Hu, 2008). A WC greater than 40 inches (102 cm.) in males and greater than 35 inches (88cm.) in females indicates central obesity (AHA; CDC, NHLBI, 1998). Use of more expensive methods to measure central obesity provides minimal additional predictive value over WC measurement (Beydoun et al., 2010; Ganpule-Rao, 2013). Waist circumference measurement is a low-cost, low-risk, tangible method that detects disease risk and can motivate early patient interventions that can prevent or delay disease onset and complications (ADA, 2004; Schulze, 2006; Siren et al., 2012).

Patients with central obesity are at greater risk for developing T2D and premature mortality than those with total obesity (Appel, et al., 2004; Balkau et al., 2007; Djoussé et al., 2012; Grundy, 2009; Jansen, Katzmarzyk, & Ross, 2004). Health and disease risks associated with central obesity are higher in adults over the age of 65 years (Jansen et al., 2005). Persons with a BMI < 30 kg/m² may be centrally

obese and at risk for obesity related disease (Balkau et al., 2007; Winett et al., 2014). Studies of adults over 70 years of age found additional risks of decreased mobility, decreased quality of life (QoL), and increased morbidity and mortality in the presence of central obesity (Heim et al., 2010; Heim et al, 2011; Kuk & Ardern, 2009). These additional risks were not correlated with total obesity as measured by BMI in these studies (Heim et al., 2010; Heim et al, 2011; Kuk & Ardern, 2009). Racette and colleagues (2006) found central obesity to be the single most significant risk factor for insulin resistance in adults 50-95 years of age. Similarly, Usui and colleagues (2010) found central obesity to be the most significant risk factor for insulin resistance in adults 30-72 years of age. The exclusion of WC measurement in the diabetes diagnosis protocol and current PC practice represents a gap between evidence-based knowledge and clinical practice.

2.2.3 Obesity prevalence and trends

In the U.S. seventy-seven percent (76.5%) of men and 73.5% of women 60 years and older were overweight (Flegal et al., 2012). Among the overweight population, 36.6% of men and 42.3% of women, in the same age category, were obese (Flegal et al., 2012). Although these statistics were worrisome, they did not represent the actual disease risk. As stated previously, central obesity poses a greater risk for preventive disease than total obesity (Heim et al., 2010; Heim et al, 2011; Kuk & Ardern, 2009). Central obesity is more prevalent than total body obesity in men and women over time (Ford, Li, & Tsia, 2011). Ford and colleagues (2011) compared the prevalence of total and central obesity among adult men and women ≥20 years of age in the U.S. in 1999-2000 compared to 2007-2008. Total body obesity in men increased from 26.9% to 32.0% and central obesity increased from 37.8% to 43.7% in

1999-2000 to 2007-2008. In women, total body obesity increased from 33.2% to 35.2% and central obesity increased from 55.8% to 61.8% in 1999-2000 to 2007-2008. The prevalence of both types of obesity increased, with a greater increase in central obesity among women (Ford et al., 2011). Central obesity remained more prevalent than total obesity in men and women over time (Ford et al., 2011).

It can, again, be deduced from the data that the current practice of not measuring WC in PC may result in missed identification of many adults at risk for preventive disease associated with central obesity. Findings from these studies support measurements of WC in addition to or, in place of BMI, to assess health risk in the older adult population (Racette et al., 2006).

2.2.4 Measures specific to age

Physiological changes associated with aging influence specificity of total and central obesity measurement. The current WC standards are primarily based on studies examining adults aged 20 to 65 years (Lean, Han, & Morrison, 1995). The generic population WC values are not necessarily applicable to older adults (Heim et al., 2010; Heim et al, 2011). Literature identified the need for age specific parameters for WC (Appel, et al., 2004; Djoussé et al., 2012; Grundy, 2009; Jansen, Katzmarzyk, & Ross, 2004; Heim et al., 2010; Heim et al, 2011; Siren et al., 2012). Due to normal physiologic changes associated with aging, the current WC standards may magnify actual disease risk while BMI may minimize actual disease risk in older adults. (Heim et al., 2010; Heim et al, 2011; Jansen et al. 2004; Racette et al., 2006; Schulze et al., 2006). Additional research is needed to identify age specific anthropometric measurements.

2.3 Primary Care

A review of literature reveals PCPs rarely measure patient WC. Additionally, providers' and patients' awareness of central obesity related disease risk is limited.

Patient health beliefs and behaviors are significantly influenced by information provided during PC office visits (Morey, 2015; Singh et al., 2010). Older adults seek medical care from their primary care provider (PCP) more than once per year (Morey, 2015). Studies have shown patients are more likely to make health behavior changes when their PCP informs them about the risk of disease and benefits of health behaviors (Morey, 2015-UpToDate accessed online 9/24/2015; Singh et al., 2010). The combination of WC measurement and PCP recommendation to lose weight has been associated with successful weight loss in patients (Singh et al., 2010).

Contrary to empirical evidence supporting WC measurement over BMI, PCPs do not routinely assess patients' WC (Dunkley, et al., 2009; Gaynor, 2015; Sebo, Haller, Pechère-Bertschi, Bovier, & Herrmann, 2015; Smith & Haslam, 2007; Ternes, 2011). Limited studies have examined barriers to WC utilization in PC (Aujla, Stone, Taub, Davies, & Khunti, 2013; Dunkley et al., 2009; Gaynor, 2015; Ternes 2011). Barriers to WC measurement identified by PCPs included time, workload, lack of comfort and experience obtaining WC measurement, lack of knowledge of WC parameters, perceived inaccuracy of WC measurement, and belief that measuring a patient's WC will cause the patient to feel uncomfortable (Aujla et al., 2013; Dunkley et al., 2009; Gaynor, 2015; Sebo et al., 2015; Smith & Haslam, 2007; Ternes, 2011). Patients reported less barriers to having their WC measured than PCPs reported to measuring a patient's WC (Dunkley et al., 2009). In Smith and Haslam's (2007) study patients at risk for central obesity-related disease were willing to have their waist

measured if education about WC measurement was provided at the time of measurement.

Sebo and colleagues (2015) examined the barrier of perceived inaccuracy of WC measurement using an experimental design. The researchers found weight, BMI, WC, and hip circumference measurements were all subject to measurement error (Sebo et al., 2015). Height was the only anthropometric measurement not prone to error (Sebo et al., 2015). Following measurement training, the rate of anthropometric measurement error decreased, but WC measurement accuracy improved minimally (Sebo et al., 2015). Providers' mean WC measurement error before training was 2.9%, this decreased to 2.06% after training (Sebo et al.,2015). Additional research is needed to further examine accuracy of provider and patient obtained WC measurements.

Smith and Haslam (2007) conducted a global study examining (a) patients aged 18 to 65 years, (b) at-risk patients, and (c) PCPs' knowledge and understanding of health risks associated with increased WC. In this study, 51% of the 100 participating U.S. physicians were not aware of the cardio-metabolic disease risk associated with central obesity and 62% of the U.S. PCPs reported never measuring a patient's waist circumference (Smith & Haslam, 2007). PCPs indicated they measured WC in 12% of the patient population (Smith & Haslam, 2007). Additionally, 75% of U.S. PCPs were unaware of the normal WC measurement value for male patients and *100%* of the U.S. PCPs were unaware of the normal WC measurement value for female patients (Smith & Haslam, 2007). Patients from both groups in Smith and Haslam's study (2007) were significantly less aware of disease risk associated with

central obesity than were PCPs. Participants in Dunkley and colleagues' (2009) study were also generally unaware of health risks associated with increased WC.

The lack of WC utilization, knowledge of WC parameters, and associated disease risk by PCPs and subsequent lack of patient experience with WC and central obesity T2D disease risk education reflects a research to practice gap. This gap inhibits the promotion of patient health beliefs and behaviors that could prevent or delay the onset of preventive T2D. The adoption of WC measurement and central obesity T2D disease risk education in PC settings may (a) promote detection of central obesity, (b) inform health beliefs about risk for T2D and benefits of WC measurement, and (c) encourage preventative health behaviors in older adults.

2.4 Health Behaviors and Type 2 Diabetes in Older Adults

Lifestyles that are characterized by physical inactivity and poor dietary behaviors contribute to the development of obesity, sarcopenia, myosteatosis, and T2D (American College of Sports Medicine [ACSM], 2014; ADA, 2004; Narici, & Maffulli, 2010; Taaffe MA et al., 2009). The ADA (2015) recommends lifestyle modifications that include a 7% loss of body weight by means of healthy eating and physical activity to combat the modifiable risks of obesity.

Past recommendations to decrease body weight included a low-calorie, low-fat diet and low intensity physical activity such as walking or cycling (Winett et al., 2014). These traditional recommendations have also been found to contribute to loss of muscle mass (Beavers et al., 2015; Srikanthan & Karlamangangla, 2011; Winett et al., 2014). Winett and colleagues (2014) recommended a paradigm shift that "involves moving away from a focus on overweight and obesity weight status and the usual weight loss approach, to a focus on the reduction of excess body fat while

retaining or even increasing" muscle mass (p. 118). Such a shift in body composition will improve insulin sensitivity, insulin secretion, basal metabolic rate, blood glucose levels, and decrease the prevalence of diabetes and related diabetic complications in older adults (Diabetes Prevention Program Research Group, 2009; Mavros et al., 2013).

Interventions to retain muscle mass and decrease fat body mass are important to prevent or delay the onset of T2D in older adults (Flack et al., 2011; Mavros et al., 2013; The Look AHEAD Research Group, & Wing, 2010). The Diabetes Prevention Program (2015) found a 58% reduction of T2D onset, in adults at risk, when lifestyle modifications were adopted; the greatest reduction, 71%, occurred in adults 60 years of age and older. Behaviors that decrease central obesity in older adults include resistance training, moderate to vigorous cardiovascular exercise, and diets modified to decrease intake of sugar and increase consumption of protein and nutrient rich foods (ACSM, 2014; Flack et al., 2011; Winett et al., 2014).

2.4.1 Physical activity

Exercise promotes health in older adults (ACSM, 2014; Wininger & Pargman, 2003). Older adults who participate in regular physical activity report better overall health, greater mobility, and lower health care costs than sedentary older adults. Older adults, even those who begin to exercise at the age of 85 years, gain significant health benefits and decreased mortality over older adults who remain sedentary (Stessman, Hammerman-Rozenberg, Cohen, Ein-Mor, & Jacobs, 2009).

Despite the known benefits resulting from continued exercise, the older adult population in the U.S. remains the most sedentary population; 60% do not exercise regularly (Schutzer & Graves, 2004). In 2008, 54% of adults 65 years and older did

not meet aerobic activity or muscle-strengthening guidelines (National Center for Health Statistics [NCHS], 2014). Adults ≥60 years of age with diabetes reported not being able to walk a quarter mile, climb stairs, or perform household chores 2-3 times more frequently than adults the same age without T2D (CDC, 2011). Decreased mobility in sedentary behavior further stimulates loss of muscle mass, impairs muscle protein synthesis, increases body fat mass, and exacerbates T2D risk (ACSM, 2014; Winett et al., 2014).

The National Institute on Aging (NIA) recommends older adults improve endurance, strength, balance, and flexibility. The NIA offers an abundance of free resources in print, video, and online for older adults (https://go4life.nia.nih.gov/exercises). The ADA (2013) recommends patients engage in moderate aerobic exercise a minimum of 150 minutes/week or 30 minutes/day five days each week. Patients are taught that moderate aerobic exercise causes an increase in heart rate and breathing (ACSM, 2014; ADA, 2013). During moderate exercise, they should be able to talk but not sing. Older adults should initially engage in moderate exercise for 10 minutes, three times per day with a gradual increase to a single 30-minute exercise session (ACSM, 2014; ADA, 2013).

Recommended interventions to maintain and restore muscle mass in older adults includes resistance training in conjunction with protein inclusive meals throughout the day (ACSM, 2014; Flack et al., 2011; Paddon-Jones & Rasmussen, 2009; Winett, 2014). It is critical that older adults consult their healthcare provider before adopting resistance training regimens, develop resistance routines with trained exercise professionals, be properly supervised during resistance training sessions, and not exercise at maximum resistance intensity (ACSM, 2014). Adults with T2D, and no

medical contraindications, should be encouraged to perform resistance training at least twice a week (ADA, 2013). The ACSM (2014) recommends a range from two to four resistance training sessions per week, with a minimum of 48 hours between sessions. Resistance training has been found to improve muscle mass, glucose uptake, insulin activity, and adiponectin levels while decreasing insulin resistance and inflammatory markers associated with fat mass (Flack et al., 2011).

2.4.2 Dietary behaviors

Past recommendations for limited caloric intake and moderate protein consumption, coupled with low intensity exercise promoted further loss of muscle mass (Winett et al., 2014). Studies have found the common cycle of weight loss, followed by weight gain, that occurred with past dietary recommendations further promoted muscle mass loss and gain of fat body mass (Srikanthan & Karlamangangla, 2011). Continued loss of muscle mass and gain of fat body mass, second to futile efforts to reduce total body weight, increased insulin resistance and diabetes risk (Srikanthan & Karlamangangla, 2011). Retention of muscle mass has been found to require resistance training in conjunction with a higher protein content diet than the current Recommended Dietary Allowance (RDA) (Symons, Sheffield-Moore, Wolfe, Paddon-Jones, 2009).

The RDA recommends 15% of calories should be from protein sources to initiate weight loss (Winett, et al., 2014). Yet studies have found diets with approximately 20% of calories from protein, that equated to approximately 0.75 grams of protein per kilogram of body weight daily, were inadequate to maintain muscle mass (Winett, et al., 2014). Recent studies recommend older adults consume approximately 1.2 grams of protein per kilogram of body weight daily (Winett, 2014).

Based on this recommendation an adult weighing 150 pounds should consume 82 grams of protein daily. Physically active older adults should consume 20-30 grams of protein per meal to prevent loss of muscle (Paddon-Jones & Rasmussen, 2009; Winett, 2014). This protein rich diet alone will not increase muscle mass. Dietary modifications accompanied with resistance training can maintain and regain muscle mass while reducing body fat mass (Paddon-Jones & Rasmussen, 2009). The resultant change in body composition improves basal metabolic rate, insulin sensitivity, insulin secretion, and reduces plasma glucose levels (Winett et al., 2014).

2.5 Health Belief Model

The HBM is a cognitive behavioral theory that has had a relevant impact in behavioral health sciences since its inception in the 1950s (Glanz, Rimer, & Visanath, 2008; Rosenstock, Strecher, & Becker, 1988). The model was developed by social psychologists to explain and predict population utilization of preventive health care services (Rosenstock, 1974). The HBM has since been used to plan interventions, predict behaviors, explain behavior change, and maintain health behaviors (Glanz & Bishop, 2010; Glanz et al., 2008; Jones, Smith & Llewellyn, 2014; Rosenstock, et al., 1988). It has been used in prospective and retrospective studies examining preventive health behavior, sick-role behaviors, and clinic utilization (Janz & Becker, 1984).

The HBM model has evolved over time. The initial constructs included perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action (Rosenstock, 1966). Later, the construct of self-efficacy was added (Rosenstock et al., 1988). These interrelated constructs guide clinicians and researchers in the planning, implementation, and evaluation of interventions

(Rosenstock et al., 1988). Age, gender, socioeconomic status (SES), and knowledge are modifying factors that influence individual belief constructs (Glanz, et al., 2008).

Due to the abundance of HBM studies, this literature review focused on three meta-analyses and one systematic review of HBM literature. Three meta-analyses of the HBM were conducted to assess the usefulness of the model in the explanation and prediction of behaviors (Carpenter, 2010; Harrison, Mullen & Green, 1992; Janz & Becker, 1984). Jones and colleagues (2014) conducted a systematic review of interventional studies that used the HBM to design interventions and measure adherence to health behaviors. Only one HBM study was examined in both Janz and Becker's meta-analysis and Jones and colleagues' (2014) systematic review. Three HBM studies were examined in both Janz and Becker's (1984) and Harrison and colleagues' (1992) meta-analysis. In total, 77 nonrepeating HBM studies were reviewed by Capenter (2010), Harrison and colleagues (1992), Janz and Becker (1984), and Jones and colleagues (2014). The meta-analyses and comprehensive review resulted in varying findings about the influence of HBM constructs on behaviors. For example, Janz and Becker found the constructs of perceived barriers and susceptibility had greater influence on health behaviors in studies from 1974-1984 than the constructs of perceived benefits and severity (1984). Carpenter (2010) noted perceived barriers and benefits were the strongest predictors of behavior, perceived severity weakly predicted behavior, and perceived susceptibility was not predictive of behavior. Glanz et al., (2008) explained the variability of construct measurements utilized in HBM studies contributes to the conflicting findings of these meta-analyses. Overall, the strength of the specific constructs for predicting behaviors varies throughout the literature.

Jones and colleagues' (2014) comprehensive review of interventional studies supported the choice of the HBM in this interventional study. Eighty-three percent of the 18 interventional studies included in their comprehensive review achieved significant health adherence behaviors (Jones et al., 2014). Health professional led interventions reported the greatest effects on measurable outcomes. The authors found studies that focused on primary prevention of disease had better outcomes than studies concentrating on secondary prevention (Jones et al., 2014). Studies that informed participants about health consequences, in conjunction with cues to action, had the largest effect sizes (Jones et al., 2014). Written and audio/visual interventions positively influence behavior adherence (Jones et al., 2014). Findings from this review support the theoretical foundation of this study because this study is an (a) interventional study, (b) led by a health professional, (c) focused on primary prevention, (d) utilizing written and audio/visual cues to action. Thus, the HBM is an appropriate theoretical model to guide this study.

Interactive relationships of HBM constructs have been modeled in different ways in past studies (Carpenter, 2010; Janz & Becker, 1984; Stretcher, Champion, & Rosenstock, 1977). Multiple studies examined selected constructs, rather than all model constructs (Capenter, 2010; Harrison, Mullen & Green, 1992; Janz & Becker, 1984; Jones, Smith & Llewellyn, 2014). In this study the constructs of perceived susceptibility and perceived benefits were be used to examine the effect of two experimental cues to action compared to two control cues to action.

2.5.1 Perceived susceptibility

This construct considers the individual's belief that he/she could develop or contract a disease. Individuals perceive his/her susceptibility based on the following

factors: knowledge of the disease, family history, social history, medical history, and environmental factors. Aligning perceived susceptibility with actual risk fosters health promoting behaviors. This study intended to increase participant knowledge of the T2D disease risk.

2.5.2 Perceived benefits

An individual's perception of the benefits of behavior influence his/her decision to adopt health behaviors. Benefits may be related to health outcomes or other associated outcomes. Other outcomes may be financial savings, improved family or peer relationships, or additional factors that are perceived to be beneficial. This study intended to inform participants about benefits of WC measurement and health outcomes associated with health behaviors that reduce WC.

2.5.3 Cue to action

A cue to action is something that prompts a change in health belief or behavior. A cue to action may be an internal process of a symptom, a thought, or even a memory. External cues occur outside of the person. An external cue may occur through the media, personal interaction, or medical advice during an office visit (Rosenstock, 1974). WC measurement and central obesity T2D disease risk education are two external cues to action examined in this study. Educating older adults about the health risks associated with central obesity along with measuring their waist circumference is intended to raise their perceived susceptibility for the development of T2D and impact perceived benefits about monitoring WC.

2.6 Summary

The older adult population is growing (U.S. Census Bureau, 2014). The proportion of older adults who are sedentary, with central obesity, at risk for or with T2D is increasing (ADA, 2013; CDC, 2011; NCHS, 2014; Ford, Li, & Tsai, 2011). WC measurement is recommended, over BMI, to screen patients for central obesity and promote early identification of disease risk (Appel, et al., 2004; Balkau et al., 2007; Djoussé et al., 2012; Grundy, 2009; Jansen, Katzmarzyk, & Ross, 2004). The few studies that examined the use of WC in PC found PCPs infrequently measure patient WC (Dunkley, Stone, Patel, Davies, & Khunti 2009; Gaynor, 2015; Ternes 2011; Sebo et al., 2015; Smith & Haslam, 2007). Limited studies examining WC utilization found few patients were aware of disease risk associated with central obesity (Dunkley et al., 2009; Smith & Haslam, 2007). Using the HBM, this study intends to add empirical evidence that will inform PCP's use of anthropometric measures by examining the effect of two cues to action, (a) WC measurement and (b) central obesity T2D disease risk education on community-based older adults' acceptance of and willingness toward WC measurement, health beliefs of perceived susceptibility and perceived benefit, and health behaviors.

The following chapter presents the methodology for this proposed study.

Chapter 3

METHODOLOGY

3.1 Introduction

This chapter presents a description of the research methodology used in this study. The chapter includes descriptions of the research design, setting, participants, sample size, measures, procedures, intervention, data analyses, and ethical considerations. The methodology was developed to answer the following research questions:

1) What is community-based older adults' experience with, acceptance of, and willingness toward waist circumference (WC) measurement?

    a. How often are community-based older adults having their WC measured by primary care providers (PCPs)?

    b. Do acceptance of and willingness toward WC measurement change after participant experience with WC measurement and central obesity T2D disease risk education?

2) Do WC measurement and central obesity T2D disease risk education affect community-based older adults' health beliefs?

    a. Do WC measurement and central obesity T2D disease risk education affect community-based older adults' perceived susceptibly to T2D?

    b. Do WC measurement and central obesity T2D disease risk education affect the perceived benefit of WC measurement?

3) Do WC measurement and central obesity T2D disease risk education affect community-based older adults' health behaviors?

   a. Do WC measurement and central obesity T2D disease risk education affect community-based older adults' physical activity?

   b. Do WC measurement and central obesity T2D disease risk education affect and dietary behaviors?

3.2 Research Design

The research design was a quasi-experimental study conducted in two phases. During phase one, control group baseline data were collected, followed by the control cues to action of a) body mass index (BMI) measurement, b) obesity classification, and c) health behavior handouts. Four to six weeks after baseline data collection, posttest data were collected from participants in the control group. During phase two, baseline data were collected from the experimental group participants, followed by the control cues to action (BMI measurement, obesity classification, health behavior handouts) and experimental cues to action (intervention) of WC measurement and central obesity T2D disease risk education. Lastly, posttest data were collected, four to six weeks after baseline data, from participants in the experimental group. Phased timing of the control group data collection prior to experimental group intervention was intended to limit intervention diffusion and support internal validity.

Data intended to answer research question 1a was collected from the control and experimental groups at baseline and collectively analyzed. Data intended to answer research questions 1b, 2a, 2b, and 3a and 3b were collected at baseline and posttest during phases one and two. Mean change in control and experimental group baseline and posttest data were then analyzed. The study design model (Table C.1) is presented in Appendix C.

3.3 Setting

The control and experimental groups were sampled from two geographically separate senior centers. Center comparability was determined based on the number of members, demographic characteristics of members, and available center resources. The Newark Senior Center (NSC) was designated the control group and the Modern Maturity Center (MMC) was designated the experimental group. Sampling of geographically separate senior centers was intended to limit intervention diffusion and support internal validity.

The NSC is a community-based senior center in northern Delaware designed to serve the needs of adults, 50 years of age and older, living in the Newark area. The NSC is located in an urban setting of Newark, Delaware. The NSC offers many classes, programs, and resources to enhance the holistic health of the community-based older adult. The facility houses a fitness center, indoor aquatic center, dining facility, and meeting and conference rooms. Adult education classes, in collaboration with the University of Delaware, are also offered. Members are active participants in a myriad of activities including dance classes, continuing education classes, delivery of meals to homebound elders, organization and participation in the Senior Olympics, and many more activities.

The director of the NSC shared the following demographic information. In early 2016, there were approximately 4,000 members, 17% were <65 years of age, 40% were 65 to 74 years of age, 32% were 75 to 84 years of age, and 11% were over 85 years of age. The ratio of female to male members was two to one. The NSC does not collect data about member race/ethnicity or income.

The MMC is a community-based senior center located in central Delaware. It is intended to serve the needs of adults, 50 years of age and older, in Kent County, Delaware. The MMC is located in an urban setting in Dover, Delaware. The MMC offers many classes, programs, and resources to enhance the holistic health of the community-based older adult. Many social activities that enhance physical and mental health are also available. In addition to adult education classes, in collaboration with the University of Delaware, the facility houses a fitness center, indoor aquatic center, dining facility, and meeting and conference rooms. Members are active participants in numerous activities including dance classes, continuing education classes, delivery of meals to homebound elders, organization and participation in the Senior Olympics, and more.

The director of the MMC shared the following demographic information. In early 2016, there were several thousand MMC members. The average age of members was between 70 and 75 years. The approximate ratio of female to male members was two to one. On a typical day, 300 to 400 members visit the center. The MMC does not collect data about member race/ethnicity or income. The director shared that most members live on a fixed budget.

3.4 Participants

Male and female members of both senior centers were invited to participate. Inclusion criteria were limited to senior center membership, functional independence, absence of significant pathophysiological conditions, Cushing's syndrome), the ability to score ≥31 on the Telephone Interview for Cognitive Status (TICS), and the ability to speak, read, and write using the English language (TICS is presented in Appendix A). Because the minimum age for membership at each senior center was 50 years,

participants ages 50 years and older were included in the study. Functional independence was defined as living independently, and performing basic activities of daily living (ADLs), with minimal or no caregiver support. Basic activities of daily living included eating, bathing, dressing, transferring, and toileting. Participants with significant health conditions that prohibited exercise, dietary modifications, and/or significantly altered the measurements of WC and BMI were excluded. Such pathophysiological conditions included end stage liver failure, end stage kidney disease, uncontrolled congestive heart failure, and Cushing's Syndrome. Participants with a score of ≤30 on the TICS, the cut-off for probable cognitive impairment, were excluded (Brandt, Spencer, & Folstein, 1988).

Following approval from the University of Delaware Institutional Review Board (IRB), volunteers were recruited by flyers, posters, word of mouth, and respective senior center newsletter advertisements. Participants who reported, at baseline, routine experience with WC measurement, were included in the study. Routine experience was identified by a Likert scaled response of 'sometimes' or 'all of the time' to the self-report WC experience survey item during baseline data collection.

3.5 Sample Size

Multiple Health Belief Model (HBM) studies examining the effect of cues to action, primarily the effect of educational cues to action on health beliefs and health behaviors, were reviewed. Effect size was infrequently reported in these similar studies. Similar studies, using similar variables, with power = 0.80 and $\alpha = 0.05$, frequently sampled an *n* of 40 to 120 (Heydari & Noroozi, 2015; Jadgal, Nakhaei-Moghadam, Alizadeh-Seiouki, Zareban, & Sharifi-Rad, 2015; Jeihooni, Hidarnia, Kaveh, Hajizadeh, & Askari, 2015; Pirzadeh, Hazavei, Entezari, Hasanzadeh, 2014;

Rabak-Wagener, Eickhoff-Shemek & Kelly-Vance, 1998; Tavassoli, 2015). Per Cohen (1992a) an n of 64 is required for a medium effect size and power = 0.80 and $\alpha = 0.05$. Recruitment aimed to enroll 100 volunteer participants (50 from each senior center) to allow for 46% participant attrition, with a proposed retention of 64 final participants.

3.6 Measures

Self-report survey items were developed to collect participant demographic characteristics and data about participant experience with and acceptance of WC measurement, as well as perceived susceptibility for T2D and perceived benefit of WC and BMI measurements. The Rapid Assessment of Physical Activity (RAPA) and the Rapid Eating Assessment for Patients (REAP) are two valid and reliable self-report survey scales used to measure participant health behaviors. Survey items that assessed participant willingness toward WC measurement, willingness to increase exercise, and willingness to add resistance training were developed from the validity tested Rapid Eating Assessment for Patients 'willingness to change diet' item. Survey data were intended to answer the research questions. All survey items are presented in Appendix A. Anthropometric measurements served as HBM cues to action in this study, rather than measurements to examine the effect of cues to action.

3.6.1 Survey development

First, Likert scaled survey items were developed based on study research questions, HBM constructs, and one REAP willingness assessment item. The University of Delaware IRB-recommended Flesch Reading Ease and Flesch-Kincaid Grade Level resource was used to ensure all items were written at or below a sixth

grade reading level. Second, the items were critiqued by the dissertation committee chair. Third, each item, based on the chair's recommendations, was revised. Lastly, the revised items were reviewed by the dissertation committee upon proposal evaluation. Following full committee approval, the revised items were approved by the University of Delaware IRB.

3.6.2 Demographic data

Demographic data included age in years, sex, education, and race/ethnicity. Age, sex, education, and race/ethnicity are effect modifiers that may influence health belief constructs and diabetes risk (CDC, 2014; Glanz, Rimer, & Viswanath, 2008).

3.6.3 Experience with anthropometric measurement

Two Likert scaled item assessed participant experience with WC and BMI measurement in the primary care setting. These items measured participant experience at baseline only in both the control and experimental groups. Response options included 'all the time,' 'sometimes,' or 'never.' These data were intended to answer research question 1a. The items were developed per the protocol described above.

3.6.4 Acceptance of and willingness toward waist measurement

The dependent variable (DV) of participant acceptance of waist circumference was measured at baseline and posttest with one, three point, Likert scaled item in both the control and experimental groups. Response options included 'very comfortable,' 'somewhat comfortable,' or 'not at all comfortable.' Participant willingness toward WC measurement was assessed at baseline and posttest with one using a five-point Likert scaled item. This willingness item was developed from item 31 in the REAP

survey. Item 31 in the REAP survey explores participants' willingness to make dietary changes using a one to five scale that ranges from 'not at all willing' to 'very willing'. These two survey items, intended to answer research question 1b, were developed per the protocol described above.

3.6.5 Health beliefs

The HBM constructs of perceived susceptibility (three items) and perceived benefit (six items) were measured with self-report Likert scale items at baseline and posttest in both the experimental and control groups. Response options for perceived susceptibility were 'definitely,' 'somewhat,' or 'not at all.' Response options for perceive benefits were 'definitely will,' 'not sure,' or 'will not.' Responses were scored three for 'definitely' or 'definitely will,' two for 'somewhat' or 'not sure', or one for 'not at all' or 'will not.' These survey items were developed per the protocol described above.

The six perceived health benefit items associated with WC measurement (three items) and BMI (three items) were recoded from the one to three scale (described above) to a zero to two scale. The three recoded perceived health benefits associated with WC measurement and BMI were then totaled and recorded on a scale of zero to six for each participant. Analyses of responses to these items, intended to answer research questions 2a and 2b.

3.6.6 Health behaviors

The Rapid Assessment of Physical Activity (RAPA) and the Rapid Eating Assessment for Patients (REAP) were used to assess health behaviors at baseline and

posttest in both the experimental and control groups. The RAPA and the REAP measure participants' self-reported health behaviors within the week prior to survey completion. Analyses of these data were intended to answer research questions 3a and 3b.

3.6.6.1 Physical activity

The RAPA is a nine item, yes or no format, self-report questionnaire designed to assess physical activity (Glasgow et al., 2006). The first seven RAPA items generate a total aerobic activity score from one to five. The eighth and ninth items report strength and flexibility behaviors that are scored from zero to three. Higher RAPA scores reflect greater physical activity. It has been found to be a practical, reliable, and valid measurement of physical activity in adults 50 years and older (Glasgow et al., 2006; Strath et al., 2013; Topolski et al., 2006). Pictures and definitions of light, moderate, and vigorous physical activity assist participants' self-report of activity over the prior week.

3.6.6.2 Dietary behaviors

The REAP self-report survey assessed dietary behaviors at baseline and posttest. This survey has been tested and found to be a valid and reliable tool for PCPs to guide patient interventions (Gans et al., 2003; Gans et al., 2006). Items 1 to 25 and item 31 were included in the study measurements. The first 25 items examine diet intake quality based on four possible responses: 'usually/often,' 'sometimes,' 'rarely/never,' and 'does not apply to me.' Items 26 and 27 are two physical activity items that were omitted in this study because the RAPA examined physical activity in greater detail. Items numbered 28 to 30 were omitted because these items did not align

with the study research questions. Item omissions were approved by the developer of the REAP (permission document in Appendix B). Higher scores on the REAP reflect poorer diet intake. Omission of items did not negatively affect the analysis, as total scores were not used to diagnose or categorize individuals, rather the total score reflected an individual's diet intake as a continuous variable.

3.6.7 Willingness to change behaviors

Item 31 in the REAP explores participants' willingness to make dietary changes using a one to five scale that ranges from 'not at all willing' to 'very willing'. This item measured an important covariate in the older adult population. Two additional willingness items, modeled after the REAP willingness item, measured participant willingness to change physical activity and adopt resistance training exercises. Development of these two willingness items followed the protocol described above. The three willingness Likert scaled items assessed participant willingness to change health behaviors at baseline and posttest in both groups to answer research questions 3a and 3b.

3.6.8 Anthropometric measurements

These measures were not intended to answer study research questions. Anthropometric measurements served as control and experimental cues to action in this study. Timing of anthropometric measures for the control and experimental groups is presented under the subheading 'Procedures' and in Appendix C.

3.6.8.1 Waist circumference

WC was measured with each participant standing, at the midpoint between the highest part of the iliac crest and the lowest part of the costal margin in the mid

axillary line over bare skin. Waist circumference was measured to the nearest 0.25 inch. Participants were offered a one-time-use paper shirt and private area for dressing and measurement. Each participant was given one tape measure. Using this personal tape measure, each participant was taught WC measurement landmarks, and he/she measured his/her WC.

3.6.8.2 Height

Height was measured with a stadiometer to the nearest 0.1 centimeter. Participants stood with bare feet or wearing socks.

3.6.8.3 Weight

Weight was obtained using a calibrated scale. Participants were lightly dressed without shoes. Weight was recorded to the nearest 0.1 kilogram.

3.6.8.4 Body mass index

Weight in kilograms and height in meters was used to calculate BMI. BMI was calculated by dividing weight (kg) by height (m^2). Standard obesity classifications were used to categorize participants as underweight, normal weight, overweight, obese I, obese II, or obese III. A BMI less than 18.5 kg/m^2 was underweight, 18.5 to 24.9 kg/m^2 was normal weight (NHLBI, CDC, 1998). A BMI of 25 to 29.9 kg/m^2 represented an overweight individual and $\geq$ 30 kg/m^2 indicates obesity (NHLBI, CDC, 1998). Obesity I, II, and III were respectively represented by BMIs of 30 to 34.9 kg/m^2, 35 to 39.9 kg/m^2, and 40 kg/m^2 and over (NHLBI, CDC, 1998).

3.7 Procedures

This study examined the effect of two control cues to action (phase one) compared to two experimental cues to action (phase two) on participants' (a) acceptance of and willingness toward WC measurement, (b) perceived susceptibility to T2D, perceived benefits of WC measurement, and (c) physical activity, and dietary behaviors. The control cues to action mimicked current routine PC practice. Control cues to action included (a) BMI measurement, (b) obesity classification, (c) health behavior handouts. Experimental cues to action included (a) WC measurement with WC measurement handout and (b) central obesity T2D disease risk education (10-minute video observed individually to mimic a one-on-one PC office visit).

3.7.1 Screening and consent procedures

Prospective participants were recruited onsite via posters, flyers, and word of mouth or offsite via center monthly newsletters. Prospective participants who showed an interest onsite were instructed to write their names and telephone numbers on a single piece of paper, fold it, and place it in a locked box in a designated area, near the recruitment poster, in each senior center. Participants that were interested in the study contacted the PI by email or telephone per the newsletter advertisement or onsite as above.

Everyone was contacted by telephone to administer a brief medical eligibility screening. Each prospective participant was interviewed with respect to the inclusion and exclusion criteria (described below) to determine whether he/she was eligible for the study. The number of prospective participants that were determined to be ineligible for the study was recorded. If determined to be eligible, the participant was

scheduled for a time to complete the baseline assessment on site at the respective senior center.

Scheduling of data collection sessions was coordinated with the activities coordinator of each center. Data were obtained in a confidential space within the NSC and MMC. The PI was present during all data collection sessions to promote treatment fidelity and internal validity.

During the initial visit at both senior centers, details of the consent form were reviewed with the prospective participants. The prospective participants read the consent form prior to signing. After signing, the participant was offered a copy of the consent form. Following informed signed consent, the baseline assessment took place in a confidential setting within each senior center. Each center provided a quiet meeting room with tables and chairs. A movable room divider was used to ensure privacy for dressing and obtaining anthropometric measurements.

3.7.2 Baseline and posttest assessment

All participants were asked to complete the written survey (Appendix A). Following completion of the survey, each participant's height and weight were measured, and his/her BMI was calculated. All participants were provided written documentation of their (a) BMI calculation, (b) obesity classification, and (c) two complimentary booklets and one complimentary DVD at baseline. The booklets were entitled 'Exercise & Physical Activity: Your Everyday Guide,' and 'What's on Your Plate? Smart Food Choices for Healthy Aging' and the DVD was entitled 'Go4Life DVD—Everyday Exercises.' These complimentary National Institute on Aging (NIA) publications were supported by the Robert Wood Johnson Foundation (RWJF) and funded by the National Institute of Health (NIH). Titles, links, and images for these

complimentary resources are presented in Appendix D and permission for use is presented in Appendix B.

At baseline, the experimental group (a) learned to measure their WC with one self-measurement waist circumference measurement handout, compliments of International Chair on Cardio-metabolic Risk (handouts listed in Appendix D, permissions in Appendix B) and one tape measure, and (b) viewed a 10-minute video about central obesity disease risk. The experimental group also received documentation of their WC measurement in inches and were informed if their WC was normal or high.

Participants completed the posttest survey four to six weeks after the baseline survey. Following completion of the posttest survey, the control group participants (a) learned to measure their WC with the complimentary WC measurement handout and a tape measure, and (b) viewed a 10-minute video about central obesity disease risk. The control group participants also received documentation of their WC measurement in inches and were informed if their WC was normal or high.

PCPs reported spending approximately 10 minutes educating patients during routine office visits (Gaynor 2015). Limiting the educational video to 10 minutes served to replicate the duration of an educational intervention during a PC office visit.

A four to six-week, baseline to posttest interval was chosen to allow sufficient time for the intervention to affect health beliefs and behaviors while limiting time for greater historical influence on behavior change. The four to six-week time interval was also intended to help prevent participant attrition. A review of several studies, that used HBM constructs to examine the effect of external and educational cues to action on health beliefs and behaviors, revealed a range of baseline to posttest time

intervals. The array of baseline to posttest time intervals in past studies included immediately following the intervention, two weeks, four weeks, two months, and six months after the intervention (Jadgal et al., 2015; Jeihooni et al., 2015; Khoramabadi et al., 2015; Tavassoli et al., 2015; Torbaghan, Farmanfarma, Moghaddam & Zarei, 2014; Zucker et al., 2013). The number of days between measures in Carpenter's (2010) meta-analysis of 18 HBM studies ranged from two days to 365 days. Carpenter's (2010) meta-analysis of the effectiveness of HBM variables in predicting behavior change found that increased time between construct measurement and behavior measurement resulted in decreased behavior change. Study procedures are summarized in Appendix C.

3.7.3 Intervention

The HBM constructs of perceived susceptibility, perceived benefit, and cue to action guided the selection and development of the two experimental cues to action: (a) WC measurement with WC measurement handout and (b) central obesity T2D disease risk education (10-minute video observed individually to mimic a one-on-one PC office visit).

Each participant was given a waist circumference measurement handout and a tape measure. Using this handout and personal tape measure, each participant was taught WC measurement landmarks, and he/she measured his/her WC. Participants received written documentation of their WC in inches and were informed that their WC was normal or high.

A 10-minute informational session was presented to each participant in a slideshow format that was recorded to a DVD. The learning objectives of this visual intervention were intended to answer the following three questions: a) what are central

obesity disease risks? b) what is a healthy WC for an older adult male and female? c) and what modifiable health behaviors can decrease disease risk? Information regarding health behaviors was based on recommendations from the American College of Sports Medicine, American Diabetes Association, and National Institute on Aging. The informational DVD was viewed once, individually. This single, individual viewing of a prerecorded educational video was intended to strengthen translation to practice, support treatment fidelity, and control dose effect of the intervention. Individual viewing mimicked the individual patient education provided during a PC office visit.

3.8 Data Analyses

Differences between the control and experimental group, with respect to gender, race, and level of education were assessed by comparing percent frequencies using the Harris Research Partners: Significance difference calculator. All other analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 24.0. An independent t-test was run to determine whether there was a significant age difference between groups.

Missing data, due to participant attrition and incomplete survey response, were limited. Due to the minimal extent of missing data, no imputation technique was applied. Descriptive statistics for the control and experimental group survey responses were reported for each dependent variable at baseline (Appendix E). Posttest adjusted means and standard deviations were also reported for each dependent variable (Appendix G). An independent t-test was performed comparing control and experimental baseline survey responses for each DV to identify any significant group differences.

To answer research question 1a, total sample frequency analyses were run to assess prior experience with WC measurement and to identify how often ('never,' 'sometimes,' and 'all the time') participants experienced WC measurement in PC settings.

A one-way analysis of covariance (ANCOVA) was utilized to answer research questions 1b, 2a, 2b, 3a, and 3b. Thirteen DVs were examined, with baseline responses imputed as the covariate. A total of three one-way ANCOVAs were run to assess within-group (baseline to posttest) and between-group (experimental vs. control) mean differences. The initial one-way ANCOVA was run using non-transformed data and one baseline covariate. The assumptions of a) linearity, b) homogeneity of regression slopes, c) normality, d) homoscedasticity, e) homogeneity of variance and f) absence of outliers were assessed in the non-transformed data as described below (Laerd Statistics, 2015).

Visual inspection of scatterplots was used to compare between-group survey responses for linearity. Homogeneity of regression slopes for each dependent variable was assessed using a univariate general linear model. Calculated z-scores for skewness and kurtosis, that utilized standardized residuals, were used to determine normality. Statistical significance for normality was set at 0.01, to equate to a z-score of ±2.58 (Laerd Statistics, 2015). The assumptions of homoscedasticity, homogeneity of variance and outliers were tested against the predicted values and standardized residuals (errors) produced during the one-way ANCOVA procedure in SPSS 24.0. Homoscedasticity, the error variances within each group, was checked by inspection of scatterplots of the standardized residuals against the predicted values for each dependent variable. The assumption of homogeneity of variances was tested using

Levene's test of equality of variances. For any dependent variable with a statistically significant value of $p < 0.05$, homogeneity of variance was deemed violated. Outliers were identified by standardized residuals that were greater than ±3 standard deviations.

Since one-way ANCOVA assumptions that are violated are a source of bias, the DV data were transformed (Fields, 2013). Dependent variables with moderately skewed residuals were transformed using a square root transformation (Laerd, 2015). When DV residuals were severely skewed, a log transformation was utilized (Laerd, 2015). A calculated residual skewness z-score less than -2.58 and greater than -5.0 or greater than +2.58 and less than +5.0 was identified as moderately skewed. Severely skewed data were identified by a calculated residual skewness z-score less than -5.0 or greater than +5.0. Following data transformation for each DV (square root or log transformation) a one-way ANCOVA was run using the transformed baseline and posttest DV data. This second one-way ANCOVA output was recorded and then compared to the initial one-way ANCOVA output. If F was non-significant ($p > 0.05$), then the partial eta-squared was reported for effect size. ANCOVA results that reflected a statistically significant difference between the adjusted group means ($p \leq 0.05$) were followed by a post hoc analysis using a Bonferroni adjustment. Cohen's d effect sizes and partial eta squared were reported for each of these pairwise comparisons. Adjusted means were utilized; unadjusted and adjusted means are presented in Appendix G.

Due to the presence of a zero value for the RAPA strength and flexibility scores and the need to perform the square root transformation, this DV was recoded.

Zero values were recoded to a value of one, values of one were recoded to a value of two, and so on.

Lastly, a third one-way ANCOVA was run on the WC acceptance DV and the three health behavior DVs. The willingness baseline data served as a second covariate in these four analyses. Baseline response data remained the initial covariate. Non-transformed data were used in this third analysis because prior analyses revealed no substantial difference between transformed and non-transformed data.

3.9 Participant Compensation

Per recommendations of each director from each senior center 15 $10.00 Wawa gift cards were raffled among the NSC participants and six $25.00 Walmart gift cards were raffled among the MMC participants. Three interventional DVDs were gifted to each center upon completion of data collection in each center.

Chapter 4

RESULTS

The baseline goals of this study were to examine community-based older adults' experience with, acceptance of, and willingness toward waist circumference (WC) measurement. The posttest goals of the study were to compare the effect of two control cues to action compared to two experimental cues to action on participants' a) acceptance of, and willingness toward (WC) measurement, b) health beliefs of perceived susceptibility to Type 2 Diabetes (T2D) and perceived benefits of WC measurement and body mass index (BMI) calculation and, c) health behaviors of physical activity and dietary behaviors. Between-group comparisons of demographic data and baseline survey responses are presented, followed by data analyses that address study hypotheses.

4.1 Sample

One hundred and twenty-three senior center members submitted their names to be study participants, including 57 participants during phase one (control group) recruitment, and 64 participants during the phase two (experimental group) recruitment. Twenty-four potential participants were excluded. Potential participants were excluded due to a variety of causes, in addition to not meeting physical or cognitive inclusion criteria. Potential participant exclusions are presented in Table 4.1 on the following page.

Table 4.1 *Rationale for participant exclusions*

		Control Group	Experimental Group
Physical/cognitive inclusion criteria		5	3
No-show for baseline assessment		2	3
Lack of transportation		0	2
Declined participation following PI description of study		1	5
No answer or return of call to PI		0	3
	Total	8	16

Following exclusions, 99 participants were included in the study: 49 participants in the control group and 50 participants in the experimental group. Retention from baseline to posttest was high in both groups, with 98% retained in the control group and 96% retained in the experimental group.

4.1.1 Participant demographic characteristics

The mean age of participants in the control group was 71.63 years (9.51) and 68.44 years (6.03) in the experimental group. There was a significant age difference between groups. There were significantly more male participants in the control group. There was a significantly greater percentage of non-Hispanic African-American participants in the experimental group as compared to the control group. There was a significantly greater percentage of non-Hispanic Whites in the control group compared to the experimental group. All participants in the study completed a minimum education level of a high school diploma or a graduate equivalence degree (GED). A significantly greater percentage of control group participants completed greater than four years of college as compared to experimental group participants. Tables 4.2 and

4.3 present participant demographic characteristics and denotes significant differences between groups.

Table 4.2 *Baseline comparison: Participant age*

	Control Group	Experimental Group
	M (SD)	*M (SD)*
Age (y)	71.63 (9.51)*	68.44 (6.03)

Note. y = years; * = significant difference at $p < 0.05$.

Table 4.3 *Baseline comparison: Participant gender, race, and level of education*

	Control Group	Experimental Group
	%	%
Male	42.9*	16
Race		
Non-Hispanic African American	14.3	24*
Non-Hispanic White	85.7*	68
Native American or Pacific Islander	0	2
Other	0	4
Declined response	0	2
Level of Education		
High school diploma or GED	6.1	14
Vocational, trade, or business school after high school	6.1	14
Some college or 2-year degree	24.5	34
4-year college graduate	18.4	14
More than 4-year college degree	44.9*	24

Note. GED = Graduate equivalency diploma; * = significant difference at $p < 0.05$.

4.2 Baseline Group Survey Response Comparison

Control and experimental group survey responses were compared to identify significant differences at baseline.

4.2.1 Experience with waist and body mass index measurement

Two Likert scaled items (one to three points) assessed participant experience with WC and BMI calculation in the primary care (PC) setting. Response options included 'all the time' (three points), 'sometimes' (two points), or 'never' (one point). There was no significant difference between control and experimental group mean experience with WC measurement nor experience with BMI calculation. See Table 4.4 below.

Table 4.4 *Baseline comparison: Experience with waist circumference measurement and body mass index calculation in primary care*

	Control group	Experimental group	Independent *t*-test		
	M (SD)	*M (SD)*	*t*	*df*	*p*
WC experience (scaled 1-3)	1.08 (0.28)	1.1 (0.36)	-0.28	97	0.78
BMI experience (scaled 1-3)	1.37 (0.67)	1.3 (0.61)	0.52	97	0.6

Note. WC = Waist circumference; BMI = Body mass Index.

4.2.2 Acceptance of and willingness toward waist measurement

4.2.2.1 Acceptance

One survey item assessed the dependent variable (DV) of WC measurement acceptance. This item utilized a three point Likert scale; one represented a 'not at all comfortable' response, two represented a 'somewhat comfortable' response, and three

denoted a ‘very comfortable’ response. Sixty-three percent of the total sample reported feeling ‘very comfortable’ having WC measurement and 27% reported feeling ‘somewhat comfortable’ at baseline. There was no significant difference between control group and experimental group acceptance of WC measurement.

4.2.2.2 Willingness

The DV of participant willingness to have WC measurement was assessed using one five-point Likert scaled item. A score of one represented ‘not at all willing’ and five represented ‘very willing.’ The pre-intervention willingness toward WC measurement in the entire sample was high. The mean willingness toward WC for the entire sample at baseline was high. There was no significant difference between control group and experimental group willingness to have WC measurement at baseline. Baseline group comparison of acceptance of and willingness to have WC measurement is presented in Table 4.5 on the following page.

Table 4.5 *Baseline comparison: Acceptance of and willingness toward waist circumference measurement*

	Control group		Experimental group		Independent *t*-test		
	M (SD)	Skewness Statistic	*M (SD)*	Skewness Statistic	*t*	*df*	*p*
WC acceptance (scaled 1-3)	2.55 (0.7)	-1.29^	2.5 (0.65)	-0.94	0.37	97	0.71
WC willingness (scaled 1-5)	4.67 (0.8)	-2.88^	4.82 (0.44)	-2.45^	-1.13	97	0.26

Note. WC = Waist circumference; ^ = skewness less than -1.0.

4.2.3 Health beliefs

4.2.3.1 Perceived susceptibility for Type 2 Diabetes

Three survey items, each on a three point Likert scale, measured participant perceived susceptibility to T2D. One item measured overall perceived susceptibility to T2D, the second item measured perceived susceptibility to T2D related to WC measurement, and the third item measured perceived susceptibility to T2D related to BMI. Baseline differences between the control and experimental groups' overall perceived T2D susceptibility was significant. Baseline difference between the control and experimental group susceptibility to T2D related to WC and perceived susceptibility to T2D related to BMI were non-significant. Baseline perceived susceptibility to T2D related to WC and perceived susceptibility to T2D related to BMI was high in both groups. Table 4.6, below, presents baseline group comparisons of perceived disease susceptibility.

Table 4.6 *Baseline comparison of health beliefs group survey responses: Perceived susceptibility*

	Control group		Experimental Group		Independent t-test		
	M (SD)	Skewness statistic	*M (SD)*	Skewness statistic	*t*	*df*	*p*
T2D risk	1.78 (0.8)	0.43	2.1 (0.81)	-0.19	-2.0	97	0.048*
WC T2D risk	2.41 (0.64)	-0.62	2.5 (0.58)	-0.65	-0.76	97	0.46
BMI T2D risk	2.39 (0.64)	-0.56	2.58 (0.61)	-1.17^	-1.53	97	0.13

Note. WC = Waist circumference; BMI = Body mass index; * = significant difference at $p < 0.05$; ^ = skewness less than -1.0.

4.2.3.2 Perceived health benefits

Six Likert scaled items (each on a three-point scale) measured participant perceived health benefits. Three items measured perceived health benefits related to WC measurement and three measured perceived health benefits related to BMI calculation. Perceived health benefits of each measurement (WC and BMI) were (a) decreased T2D disease risk, (b) motivation to exercise, and (c) motivation to improve dietary behaviors. Participant response 'will not' was recorded at a value of one, a 'not sure' response was recorded at a value of two, and a 'definitely will' response was recorded at a value of three. The baseline responses to these six items were compared, between the groups, to identify significant sample variance. There were no significant differences between the control and experimental group baseline perceived health benefits (See Appendix E).

The six perceived health benefit item scores, associated with WC measurement (three items) and BMI (three items), were recoded from the one to three scale

(described above) to a zero to two scale. The three recoded perceived health benefits associated with WC measurement and BMI were then totaled (respectively) and recorded on a zero to six scale. To facilitate data analysis, the scaled totals were recoded to a one to seen scale. Control and experimental totaled perceived health benefits related to WC measurement were compared (see Appendix E) and control and experimental totaled perceived health benefits related to BMI were compared. There were no significant differences between the control and experimental group baseline totaled perceived health benefits related to WC measurement and BMI). See Table 4.7 below.

Table 4.7 *Baseline comparison of health beliefs group survey responses: Totaled perceived benefits*

	Control group		Experimental group		Independent t-test		
	M (SD)	Skewness statistic	*M (SD)*	Skewness statistic	*t*	*df*	*p*
Totaled WC perceived benefit (scaled 1-7)	4.43 (1.7)	-0.93	4.86 (1.4)	-0.9	-1.38	97	0.17
Totaled BMI perceived benefit (scaled 1-7)	4.39 (1.75)	-0.92	4.9 (1.3)	-0.86	-1.65	97	0.1

Note. WC = Waist circumference; BMI = Body mass index; ^ = skewness less than -1.0.

4.2.4 Health Behaviors

4.2.4.1 Physical activity

Comparison between the control and experimental group baseline aerobic physical activity means were not significantly different. There was also no difference between group baseline strength and flexibility training. Based on the RAPA, one to five, aerobic scoring scale, 70% of the total sample scored a five. Thus, 70% of the total sample met the American College of Sports Medicine (2014) recommended guidelines for aerobic physical activity, at baseline. See Table 4.8 on the following page.

Two willingness items assessed participant willingness to increase exercise behaviors and resistance training behaviors. These two willingness items were measured using a five point Likert scale (1 = 'not at all willing,' to 5 = 'very willing'). Comparison of control and experimental group baseline willingness means to increase exercise were not significantly different. Comparison of control group and experimental group means for willingness to increase resistance training was not significantly different at baseline. Baseline willingness to increase aerobic activity was high in both groups (see Table 4.8).

Table 4.8 *Baseline comparison of health behaviors: Physical activity and willingness items*

	Control group		Experimental group		Independent *t*-test		
	M (SD)	Skewness statistic	*M (SD)*	Skewness statistic	*t*	*df*	*p*
RAPA aerobic (scaled 1-5)	4.61 (0.64)	-1.44^	4.48 (0.99)	-2.28^	0.79	97	0.43
RAPA strength flexibility (scaled 1-4)	2.8 (1.22)	-0.37	3.04 (1.23)	-0.84	-0.99	97	0.33
Willingness to increase exercise (scaled 1-5)	4.41 (0.7)	-0.78	4.34 (0.94)	-1.52^	0.41	97	0.68
Willingness to increase resistance training (scaled 1-5)	3.96 (1.06)	-0.9	4.06 (1.13)	-1.26^	-0.46	97	0.65

Note. RAPA = Rapid Assessment of Physical Activity; ^ = skewness less than -1.0.

4.2.4.2 Dietary behaviors

The Rapid Eating Assessment for Patients (REAP) total score measured baseline dietary behaviors and willingness to change dietary behaviors. The REAP total score measured dietary behaviors on a scale from 25 to 75, with greater scores representing healthier dietary behaviors. Willingness to change dietary behaviors was measured using a five point Likert scale (1 = 'not at all willing,' to 5 = 'very willing'). Missing data prevented calculation of one baseline total REAP score in the experimental group. Independent t-test findings comparing the control and experimental group baseline means total REAP scores were not significantly different.

Further, there was no significant difference between the control and experimental group baseline mean willingness responses. See Table 4.9 below.

Table 4.9 *Baseline comparison of health behaviors: Dietary behaviors and willingness to change diet*

	Control group		Experimental group		Independent *t*-test		
	M (SD)	Skewness statistic	*M (SD)*	Skewness statistic	*t*	*df*	*p*
REAP score (scaled 25-75)	57.14 (7.47)	0.18	56.92 (8.41)	-0.66	0.9	96	0.89
Willingness to change diet (scaled 1-5)	4.35 (0.78)	-0.71	4.52 (0.84)	-2.33^	-1.06	97	0.29

Note. REAP = Rapid eating assessment for patients; ^ = skewness less than -1.0.

4.3 Data Analyses

4.3.1 Research question and hypothesis 1a

> How often are community-based older adults having their WC measured by primary care providers (PCP)? It was hypothesized that community-based older adults would report rare PCP WC measurement and frequent BMI calculation in the PC setting.

Nearly 92% of participants reported their PCP 'never' measured their WC, seven percent reported their PCP measured their WC 'sometimes,' and one percent reported his/her PCP 'all the time' measured his/her WC. Seventy-six percent of participants reported their PCP 'never' measured their BMI, 15.2% reported their PCP measured their BMI 'sometimes,' and nine percent reported their PCP 'all the time' measured their BMI. Table 4.10 on the following page.

These data partially supported study hypothesis 1a. As hypothesized, community-based older adults reported no PCP WC measurement. Contrary to the hypothesis that community-based older adults would report frequent BMI measurement in the PC setting, more than three quarters of the participants reported no BMI measurement in the PC setting.

Table 4.10 *Participant experience with waist circumference measurement and body mass index calculation*

	Never %	Sometimes %	Always %
Waist circumference	91.8	7.1	1
Body mass index	75.5	15.2	9.1

4.4 Statistical Package for the Social Sciences 24.0

4.4.1 Research questions 1b through 3b

A one-way analysis of covariance (ANCOVA) was utilized to address research questions 1b through 3b. Thirteen DVs were examined. An ANCOVA was run on non-transformed data for each posttest DV after controlling for each respective baseline DV. The assumptions of (a) linearity, (b) homogeneity of regression slopes, (c) normality, (d) homoscedasticity, (e) homogeneity of variance and (f) absence of outliers were analyzed for each DV using SPSS 24.0 (Laerd Statistics, 2015). Table 4.14 summarizes met and unmet assumptions for each DV. Numerical findings associated with homogeneity of regression slopes, normality, homogeneity of variances, and outliers are presenting in Tables F.1-F.5 in Appendix F.

When ANCOVA assumptions were not met a second ANCOVA was run using transformed data. All 13 DVs did not meet one or more ANCOVA assumptions. The second analysis utilized a square root transformation or a log transformation of the baseline and posttest DV data. Square root transformation was utilized when the data were normally distributed or moderately skewed/kurtotic. Log transformation was utilized when data where severely skewed/kurtotic. Seven DVs required a square root transformation and six DVs required a log transformation (see Tables G.2 and G.3 in Appendix G). There were no substantial differences between the transformed data ANCOVA outputs and the non-transformed data outputs (see Tables G.2 and G.3 in Appendix G). Because there were no substantial differences between non-transformed and transformed ANCOVA findings, only non-transformed findings are presented for each DV below (Tables 4.10 thru 4.14 below).

4.4.2 Research question and hypothesis 1b

> Do WC measurement acceptance change after participant experience with WC measurement and central obesity T2D disease risk education? It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on community-based older adults' WC measurement acceptance than two control cues to action (c) BMI and (d) obesity classification.

An ANCOVA was run on non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention WC measurement acceptance after controlling for baseline WC measurement acceptance. Standardized residuals were not normally distributed. WC measurement acceptance for the control group reflected a skewness statistic of -1.02 (SE = 0.34) and kurtosis

statistic of 1.27 (SE = 0.67); the experimental group skewness statistic was -0.83 (SE = 0.34) and kurtosis statistic was 0.25 (SE = 0.67). There was one control group outlier in the data, as assessed by a standardized residual of -3.27. After adjustment for baseline WC measurement acceptance, there was no significant difference in post-intervention WC measurement acceptance between groups (see Table 4.10). Post hoc analysis was not indicated.

A second ANCOVA was performed utilizing non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention WC measurement acceptance after controlling for baseline WC measurement acceptance and baseline willingness to have WC measurement. After adjustment for baseline WC measurement acceptance and baseline willingness to have WC measurement, there was no statistically significant difference in post-intervention WC measurement acceptance between groups (see Table 4.11). Post hoc analysis was not indicated.

Thus, the experimental group WC measurement acceptance, after participant experience with WC measurement and central obesity T2D disease risk education, did not significantly change compared to the control group. Baseline willingness to have WC measurement was not a significant covariate in this analysis.

An ANCOVA was run on non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention participant willingness to have WC measurement after controlling for baseline willingness to have WC measurement. Five ANCOVA assumptions were not met. There was not homogeneity of regression slopes as the interaction term was statistically significant, $F(1, 92) = 9.52$, $p = 0.003$. The control group skewness statistic was -1.51 (SE = 0.34)

and kurtosis statistic was 2.42 (SE = 0.67) and the experimental group skewness statistic was -0.2 (SE = 0.34) and kurtosis statistic was 4.16 (SE = 0.67). The assumption of heteroscedasticity was met, as assessed by visual inspection of the standardized residuals plotted against the predicted values. Heterogeneity of variances was present, as assessed by Levene's test of homogeneity of variance (p = 0.02). Lastly, there was one outlier in the control group (standardized residual -3.71). After adjustment for baseline waist circumference measurement willingness, there was no statistically significant difference in post-intervention waist circumference measurement willingness between groups (see Table 4.11). Post hoc analysis was not indicated.

Table 4.11 *ANCOVA: Acceptance of and willingness toward WC measurement non-transformed data*

		Non-Transformed data findings		
Dependent variable	Baseline covariate(s)	*F*	*p*	Partial η^2
WC comfort	WC comfort	2.42	0.12	0.03
WC comfort	WC comfort and WC willingness	1.75	0.19	0.02
WC willingness	WC willingness	2.85	0.1	0.03

Note. WC = Waist circumference.

Waist circumference measurement and central obesity health risk education did not significantly affect WC measurement acceptance (comfort) in the experimental group compared to the control group. Baseline waist circumference measurement acceptance and willingness were not substantial covariates in this analysis. These findings did not support the research hypothesis.

4.4.3 Research question and hypothesis 2a

> Do WC measurement and central obesity health risk education affect perceived susceptibility to T2D? It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on perceived susceptibility for T2D than two control cues to action (c) BMI and (d) obesity classification in community-based older adults.

An ANCOVA was run to determine the effect of WC measurement and central obesity health risk education on perceived susceptibility to T2D post-intervention, after controlling for baseline perceived susceptibility to T2D. The control group skewness statistic was -0.76 (SE = 0.34) and kurtosis statistic was 4.03 (SE = 0.67) and the experimental group skewness statistic was -0.14 (SE = 0.34) and kurtosis statistic was 3.35 (SE = 0.67). There were three outliers in the data--one control group [-3.41] and two experimental group outliers [-3.75, 3.22]). After adjustment for baseline perceived susceptibility to T2D, there was no statistically significant difference in post-intervention perceived susceptibility to T2D between groups, $F (1, 93) = 2.65$, $p = 0.07$, partial $\eta^2 = 0.03$. Post hoc analysis was not indicated.

An ANCOVA was run to determine the effect of WC measurement and central obesity health risk education on perceived susceptibility to T2D related to WC post-intervention after controlling for baseline perceived susceptibility to T2D related to WC. The assumption of normality was not met. The control group skewness statistic was -1.29 (SE = 0.34) and kurtosis statistic was 1.15 (SE = 0.67) and the experimental group skewness statistic was -1.12 (SE = 0.34) and kurtosis statistic was 1.2 (SE = 0.67). After adjustment for baseline perceived T2D risk related to WC, there was no statistically significant difference in post-intervention perceived risk between groups (see Table 4.12). Post hoc analysis was not indicated.

An ANCOVA was run to determine the effect of WC measurement and central obesity health risk education on perceived susceptibility to T2D associated with BMI post-intervention after controlling for baseline perceived susceptibility to T2D associated with BMI. Standardized residuals were not normally distributed in the experimental group. The control group skewness statistic of -0.52 (SE = 0.34) and kurtosis statistic was -0.85 (SE = 0.67) and the experimental group skewness statistic was -1.02 (SE = 0.34) and kurtosis statistic was 1.47 (SE = 0.67). The assumption of homogeneity of variances was violated, as assessed by Levene's test of homogeneity of variance (p = 0.001). After adjustment for baseline perceived susceptibility to T2D associated with BMI, there was no statistically significant difference post-intervention between groups (see Table 4.12). Post hoc analysis was not indicated.

Table 4.12 *ANCOVA: Perceived susceptibility non-transformed data outputs*

		Non-Transformed data findings		
Dependent variable	Baseline covariate(s)	*F*	*p*	Partial η^2
Overall T2D risk	Overall T2D risk	2.65	0.07	0.03
WC T2D risk	WC T2D risk	0.35	0.55	0.004
BMI T2D risk	BMI T2D risk	2.83	0.1	0.03

Note. T2D = Type 2 diabetes; WC = Waist circumference; BMI = Body mass index.

The experimental group WC measurement and central obesity health risk education intervention did not significantly affect (a) total perceived susceptibility to T2D, (b) perceived susceptibility associated with WC measurement, or (c) perceived

susceptibility associated with BMI calculation in comparison to the control group. Thus, the research hypothesis was not supported.

4.4.4 Research question and hypothesis 2b

> Do WC measurement and central obesity health risk education affect the perceived benefit of WC measurement? It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on perceived benefit of WC measurement than two control cues to action (c) BMI and (d) obesity classification in community-based older adults.

An ANCOVA was run on non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention total perceived WC measurement benefit, after controlling for baseline total perceived WC measurement benefit. Four ANCOVA assumptions were not met. The data were not normally distributed for control group with a skewness statistic of -1.18 (SE = 0.34) and kurtosis statistic of 2.13 (SE = 0.67) and the experimental group with a skewness statistic of -1.73 (SE = 0.34) and kurtosis statistic of 8.26 (SE = 0.67). There was homoscedasticity, as assessed by visual inspection of the standardized residuals plotted against the predicted values for the control and the experimental groups. There was heterogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p = 0.01$). Lastly, there were three outliers, two in the control group [-3.87, -3.09] and one in the experimental group [3.66], in the data. After adjustment for baseline total perceived WC measurement benefit, there was a significant difference in post-intervention total perceived WC measurement benefit between groups (see Table 4.13). Post hoc analysis was performed with a Bonferroni adjustment. Adjusted means are presented. Perceived WC benefit was significantly greater in the experimental group (M = 4.91, SE = 1.87) compared to the control group (M = 4.17,

SE = 1.87), with a mean difference of 0.74, 95% CI [0.21, 1.26], p = .007. Cohen's d = 0.63 reflected a medium effect size. Posttest unadjusted means and adjusted means are presented in Table G.1 in Appendix G.

An ANCOVA was run on non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention total perceived benefits of BMI calculation after controlling for baseline total perceived benefits of BMI calculation. Four ANCOVA assumptions were not met. The data were not normally distributed with a control group skewness statistic of -0.95 (SE = 0.34) and kurtosis statistic of 0.90 (SE = 0.67) and the experimental group with a skewness statistic of -1.72 (SE = 0.34) and kurtosis statistic of 5.03 (SE = 0.67). Heteroscedasticity was present, as assessed by visual inspection of the standardized residuals plotted against the predicted values in both groups. Heterogeneity of variances was present, as assessed by Levene's test of homogeneity of variance (p = 0.008). Lastly, two outliers (one in the control group [-3.42] and one in the experimental group [-3.26]) were in the data. After adjustment for baseline total perceived benefits of BMI calculation, there was a significant difference in post-intervention between groups (see Table 4.13 on the following page). Post hoc analysis was performed with a Bonferroni adjustment. Adjusted means are presented. Perceived BMI benefit was significantly greater in the experimental group (M = 4.83, SE = 0.21) compared to the control group (M = 4.07, SE = 0.21), with a mean difference of 0.76, 95% CI [0.17, 1.36], p = .012. Cohen's d = 0.61, reflected a medium effect size. Posttest unadjusted means and adjusted means are presented in Table G.1 in Appendix G.

Table 4.13 *ANCOVA: Totaled perceived benefits non-transformed data outputs*

		Non-transformed data findings		
Dependent variable	Baseline covariate	*F*	*p*	Partial η^2
Totaled WC perceived benefits	Totaled WC perceived benefits	7.71	0.01*	0.08
Totaled BMI perceived benefits	Totaled BMI perceived benefits	6.61	0.01*	0.07

Note. WC = Waist circumference; BMI = Body mass index; * = Significant finding $p = < 0.05$.

The finding that WC measurement and central obesity health risk education had a significant effect on the total perceived benefit of WC measurement and total perceived benefit of BMI calculation in the experimental group compared to the control group supported the study hypothesis.

4.4.5 Research question and hypothesis 3a

> Do WC measurement and central obesity health risk education affect physical activity? It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on physical activity than two control cues to action (c) BMI and (d) obesity classification in community-based older adults.

An ANCOVA was run on non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention RAPA aerobic score after controlling for baseline RAPA aerobic score. Standardized residuals were not normally distributed for the control group with a skewness statistic of -1.34 (SE = 0.34) and kurtosis statistic of 1.66 (SE = 0.67) and the experimental group with a skewness statistic of -0.36 (SE = 0.34) and kurtosis statistic of 1.07 (SE = 0.67). There was heteroscedasticity, as assessed by visual inspection of the standardized residuals plotted against the predicted values for the control and

experimental groups. After adjustment for baseline RAPA aerobic score, there was no statistically significant difference in post-intervention RAPA aerobic score between groups (see Table 4.14). Post hoc analysis was not indicated.

A second ANCOVA was performed utilizing non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention RAPA aerobic score after controlling for baseline RAPA aerobic score and baseline willingness to increase exercise. After adjustment for baseline RAPA aerobic score and willingness to increase exercise, there was no significant difference in post-intervention findings between groups (Table 4.14). Post hoc analysis was not indicated.

An ANCOVA was run on non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention participant willingness to increase exercise after controlling for willingness to increase exercise. There was heterogeneity of regression slopes as the interaction term was statistically significant, F (1, 92) = 5.16, p = 0.03. Standardized residuals were not normally distributed for the experimental group. The control group skewness statistic was -0.91 (SE = 0.34) and kurtosis statistic of 0.09 (SE = 0.67) and the experimental group skewness statistic was -2.69 (SE = 0.34) and kurtosis statistic of 9.38 (SE = 0.67). There was heteroscedasticity, as assessed by visual inspection of the standardized residuals plotted against the predicted values. One outlier was identified in the experimental group, as assessed by a standardized residual of -4.54. After adjustment for baseline willingness to increase exercise, there was a significant difference in post-intervention willingness to increase exercise between groups (see Table 4.14). Post hoc analysis was performed with a Bonferroni adjustment. Adjusted means are

presented. Willingness to increase exercise post-intervention was statistically significantly greater in the experimental group (M = 4.62, SE = 0.12) compared to the control group (M = 4.15, SE = 0.12), a mean difference of 0.47, 95% CI [0.13, 0.81], p = .007. Cohen's d = 0.5, reflected a medium effect size. Posttest unadjusted means and adjusted means are presented in Table G.1 in Appendix G.

An ANCOVA was run on non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention RAPA total strength and flexibility training score after controlling for baseline RAPA total strength and flexibility score. The data were not normally distributed with a control group skewness statistic of -0.58 (SE = 0.34) and kurtosis statistic of 3.27 (SE = 0.67) and the experimental group with a skewness statistic of -0.56 (SE = 0.34) and kurtosis statistic of 1.41 (SE = 0.67). There was one outlier in the experimental group (-3.41). After adjustment for baseline RAPA total strength and flexibility training score, there was no statistically significant difference in post-intervention RAPA total strength and flexibility training score between groups (see Table 4.14). Post hoc analysis was not indicated.

A second ANCOVA was performed utilizing non-transformed data to determine the effect of a WC measurement and central obesity health risk education on post-intervention after controlling for baseline RAPA total strength and flexibility training score and baseline willingness to increase resistance training. After adjustment for baseline RAPA total strength and flexibility training score and baseline willingness to increase resistance training, there was no significant difference in post-intervention findings between groups (see Table 4.14). Post hoc analysis was not indicated.

An ANCOVA was run on non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention participant willingness to increase resistance training after controlling for baseline willingness to increase resistance training. The standard residual skewness z-score was significantly negatively skewed for control and experimental groups. The data were not normally distributed with a control group skewness statistic of -1.15 (SE = 0.34) and kurtosis statistic of 1.81 (SE = 0.67) and the experimental group with a skewness statistic of -1.65 (SE = 0.34) and kurtosis statistic of 3.86 (SE = 0.67). There was one outlier in the control group (-3.34) and one in the experimental group (-3.69). After adjustment for baseline willingness to increase resistance training diet, there was no significant difference in post-intervention willingness to increase resistance training between groups (see Table 4.14). No post hoc analysis was indicated.

Table 4.14 *ANCOVA: RAPA scores and willingness to increase types of exercise non-transformed data*

		Non-Transformed data findings		
Dependent variable	Baseline covariate(s)	*F*	*p*	Partial η^2
RAPA aerobic score	RAPA aerobic score	1.18	0.28	0.01
RAPA aerobic score	RAPA aerobic score and willingness to increase exercise	1.24	0.27	0.01
Willingness to increase exercise	Willingness to increase exercise	7.48	0.007*	0.07
RAPA resistance and flexibility training score	RAPA resistance and flexibility training score	0.42	0.52	0.004
RAPA resistance and flexibility training score	RAPA resistance and flexibility training score and willingness to increase resistance training	0.41	0.52	0.004
Willingness to increase resistance & flexibility training	Willingness to increase resistance & flexibility training	2.86	0.09	0.03

Note. RAPA = Rapid assessment of physical activity; * = Significant finding $p = < 0.05$.

Although willingness to increase exercise was significantly greater in the experimental group than the control group, self-reported physical activity levels were not significantly greater in the experimental group compared to the control group post-intervention. Willingness to exercise and willingness to add resistance training were not significant covariates in these analyses. Because WC measurement and central obesity health risk education intervention did not significantly affect physical activity among community-based older adults in the experimental group compared to the control group the research hypothesis was not was supported.

4.4.6 Research question and hypothesis 3b

> Do WC measurement and central obesity health risk education affect and dietary behaviors? It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on dietary behaviors than two control cues to action (c) BMI and (d) obesity classification in community-based older adults.

Missing dietary data prevented calculation of total REAP scores for 2 control group participants and 5 experimental group participants. Due to the limited nature of the missing data (seven percent), no imputation method was utilized. An ANCOVA was run on non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention total REAP score after controlling for baseline total REAP score. The data were not normally distributed. The control group skewness statistic was -0.3 (SE = 0.34), with a kurtosis statistic of 0.002 (SE = 0.67) and the experimental group skewness statistic was -0.15 (SE = 0.34) with a kurtosis statistic of 2.93 (SE = 0.67). Heteroscedasticity was present, as assessed by visual inspection of the standardized residuals plotted against the predicted values. There were two outliers in the experimental group (3.37, -3.7). After adjustment for baseline REAP total score, there was no significant difference in post-intervention REAP total score between groups (see Table 4.15). Post hoc analysis was not indicated.

A second ANCOVA was performed utilizing non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention REAP total score after controlling for baseline REAP total score and baseline willingness to change diet. After adjustment for these baseline DVs, there was no statistically significant difference in post-intervention REAP total score (see Table 4.15). Post hoc analysis was not indicated.

An ANCOVA was run on non-transformed data to determine the effect of WC measurement and central obesity health risk education on post-intervention participant willingness to change diet after controlling for baseline willingness to change diet. The control skewness statistic was -0.91 (SE = 0.34) with a kurtosis statistic of 0.35 (SE= 0.62). The experimental standardized residual skewness statistic was -0.43 (SE = 0.34) with a kurtosis statistic of -0.13 (SE= 0.62). After adjustment for baseline willingness to change diet, there was no significant difference in post-intervention willingness to change diet between groups (see Table 4.15). Post hoc analysis was not indicated.

Table 4.15 *ANCOVA: REAP score and willingness to change dietary behaviors non-transformed data outputs*

		Non-Transformed data findings		
Dependent variable	Baseline covariate(s)	*F*	*p*	Partial η^2
REAP total score	REAP total score	1.08	0.3	0.01
REAP total score	REAP total score and Willingness to change diet	1.05	0.31	0.01
Willingness to change diet	Willingness to change diet	0.86	0.36	0.01

Note. REAP = Rapid eating assessment for patients.

Waist circumference measurement and central obesity health risk education did not significantly affect dietary behaviors or willingness to change dietary behaviors in the experimental group compared to the control group. Baseline willingness to change dietary behaviors was not a substantial covariate in this analysis. These findings did not support the research hypothesis.

Table 4.16 *Summary of ANCOVA assumptions for each dependent variable*

	ANCOVA ASSUMPTIONS Non-transformed data					
	Linearity	Homogeneity of regression slope	Normality	Homoscedasticity	Homogeneity of variance	Number of outliers
WC comfort	Y	Y	N√	Y	Y	1
WC willingness	Y	N	N^	N	N	1
Perceived susceptibility						
Overall T2D risk	Y	Y	N^	Y	Y	3
WC T2D risk	Y	Y	N√	Y	Y	0
BMI T2D risk	Y	Y	N√	Y	N	0
Perceived benefits						
Totaled WC perceived benefits	Y	Y	N^	N	Y	3
Totaled BMI perceived benefits	Y	Y	N^	N	N	2
Health behaviors: physical activity						
RAPA total aerobic score	Y	Y	N√	N	Y	0
Willingness to increase exercise	Y	N	N^	N	Y	1
RAPA resistance & flexibility training total score	Y	Y	N√	Y	Y	1
Willingness to increase resistance training	Y	Y	N^	Y	Y	2
Health behaviors: diet						
REAP total score	Y	Y	N√	N	Y	2
Willingness to change diet	Y	Y	N√	Y	Y	0

Note. WC = Waist circumference; T2D = Type 2 diabetes; BMI = Body mass index; RAPA = Rapid assessment of physical activity; REAP = Rapid eating assessment for patients; Y = assumption met; N = assumption violated; √ = Moderately skewed normality z-score; ^ = Severely skewed normality z-score.

Chapter 5

DISCUSSION

5.1 Overview

Waist circumference measurement is a reliable indicator of Type 2 Diabetes (T2D) risk that is rarely utilized in primary care (PC) settings (ADA, 2004; Appel, Jones, & Kennedy-Malone, 2004; Balkau et al., 2007; Dunkley et al., 2009; Ganpule-Rao et al., 2013; Gaynor, 2015; International Diabetes Foundation [IDF], 2015; Jansen, Katzmarzyk, & Ross, 2004; Schulze et al., 2006; Siren, Erikkson, & Vanhanen, 2012; Smith & Haslam, 2007; Sebo, Haller, Pechère-Bertschi, Bovier, & Herrmann, 2015; Ternes, 2011; Usui et al., 2010). The current PC practice of body mass index (BMI) calculation to screen for T2D disease risk lacks specificity to the older adult habitus (Jansen et al., 2004; Racette, Evans, Weiss, Hagberg, & Holloszy, 2006; Schulze et al., 2006). Physiological changes, associated with aging, increase the older adult's risk for central obesity and T2D (Flack et al., 2011; Racette, et al., 2006). Research examining the effect of WC measurement on health beliefs and health behaviors in community-based older adults appears nonexistent. Findings from this study are intended to provide empirical evidence that may inform and facilitate WC measurement utilization in PC settings, particularly in the care of community-based older adults.

This study first examined community-based older adults' experience with WC measurement. Second, this study compared the effects of experimental cues to action, WC measurement and central obesity T2D disease risk education, to control cues to

action, BMI calculation and obesity classification, on community-based older adults' (a) acceptance of and willingness toward WC measurement, (b) health beliefs, and (c) health behaviors. A cue to action is a construct within the Health Belief Model (HBM) that prompts an individual to take appropriate action to prevent, delay, or control disease (Champion & Skinner, 2008; Rosenstock, 1966). Theoretically, an effective cue to action will increase health beliefs of perceived susceptibility to disease, perceived benefits of disease screenings, and/or promote adoption of positive health behaviors (Champion & Skinner, 2008; Rosenstock, 1966). When perceived susceptibility and perceived benefits are sufficiently affected by the cue to action, individuals adopt positive health behaviors. Adoption of positive health behaviors may then prevent, delay, or control disease.

Findings showed that community-based older adults lacked experience with WC measurement and BMI calculation in the PC setting. Despite this lack of experience, participants were 'very' accepting of and 'very willing' toward WC measurement at baseline. Waist circumference measurement and central obesity T2D disease risk education had a significant effect on perceived benefits but did not have a significant effect on perceived susceptibility in the experimental group compared to the control group. Health behaviors did not change significantly. Study limitations inhibited significant measurable effect of the experimental cues to action on perceived susceptibility, physical activity, and dietary behaviors.

In this chapter, findings associated with each research question and hypothesis are discussed. Study limitations, strengths, conclusions, and future recommendations are also presented.

5.2 Study Findings

5.2.1 Research question and hypothesis 1a

> How often are community-based older adults having their WC measured by primary care providers (PCP)? It was hypothesized that community-based older adults would report rare PCP WC measurement and frequent BMI calculation in the PC setting.

As hypothesized, participants reported rare PCP WC measurement. Greater than 91% of participants reported 'never' having their WC measured in the PC setting. This finding further supported the literature that reported PCPs do not routinely measure patient WC (Dunkley et al., 2009; Gaynor, 2015; Smith & Haslam, 2007; Sebo, Haller, Pechère-Bertschi, Bovier, & Herrmann, 2015; Ternes, 2011). PCPs reported that lack of time and perceived patient discomfort were barriers to WC measurement in the PC setting (Aujla, Stone, Taub, Davies, and Khunti, 2009, Dunkley et al., 2009, Gaynor, 2015, Ternes, 2011).

Contrary to the hypothesis that community-based older adults would report frequent BMI calculation in the PC setting, 76% of participants reported their PCP 'never' calculated their BMI. This finding conflicts with literature documenting PCP reported use of BMI calculation in practice and with the American Diabetes Association's (ADA, 2013) recommended use of BMI calculation to screen adults for T2D risk (Dunkley et al., 2009; Gaynor, 2015; Smith & Haslam, 2007; Sebo, Haller, Pechère-Bertschi, Bovier, & Herrmann, 2015; Ternes, 2011). Benefits of BMI calculation over WC measurement, reported by PCPs, included patient comfort with height and weight measurements and convenience of pre-programmed BMI calculators that convert patient height and weight to BMI in the patient electronic medical record (Gaynor 2015; Sebo et al., 2015). It may be speculated that PCPs

review and consider a patient's BMI calculation while reviewing the patient electronic medical record, but may not discuss the BMI calculation with each patient. This speculation may account for the discrepancy between patient and PCP reported use of BMI calculation in the PC setting. It is also possible that some PCPs may not utilize BMI calculation in the care of older adults. It is estimated that 25% of the U.S. diabetic population is undiagnosed (ADA, 2013). Primary care providers not screening patients with BMI calculation may be a contributing factor to the undiagnosed diabetic population.

Based on the literature, it was predicted that participants would report prior experience with BMI calculation in the PC setting. As 76% of participants reported 'never' experiencing BMI calculation in PC, it is possible that BMI calculation and obesity classification were interventional cues to action rather than a control cues to action in this study. The presence of an intervention in the control group may have reduced the potential for significant findings when comparing group posttest data.

5.2.2 Research question and hypothesis 1b

> Do WC measurement acceptance change after participant experience with WC measurement and central obesity T2D disease risk education? It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on community-based older adults' WC measurement acceptance than two control cues to action (c) BMI and (d) obesity classification.

It was important to examine the effect of WC measurement on participant acceptance of and willingness toward WC measurement because prior studies reported that PCPs perceived patients were unaccepting of and unwilling toward WC measurement (Dunkley et al., 2009; Gaynor, 2015; Smith & Haslam, 2007; Ternes,

2011). The ANCOVA analysis revealed WC measurement and central obesity T2D disease risk education did not significantly affect WC measurement acceptance of or willingness toward WC measurement in the experimental group compared to the control group at posttest. Consideration of baseline data is paramount when interpreting these findings. Mean baseline acceptance of and willingness toward WC measurement was high in both groups. High baseline levels of acceptance of and willingness toward WC measurement created a ceiling effect that limited possible statistically significant change in acceptance of and willingness toward WC measurement at posttest.

To my knowledge, this is the first study that examined community-based older adults' acceptance of and willingness toward WC measurement. This gap in the literature prevented comparison of study findings with prior research. The homogeneity of responses at baseline should be considered when interpreting these data. In addition to high baseline acceptance of and willingness toward WC measurement, high levels of physical activity were reported in both groups. Health behaviors were reflective of a highly health-conscious sample. Health-conscious tendencies among participants may have contributed to high levels of acceptance of and willingness toward WC measurement at baseline. A sample with normally distributed levels of physical activity at baseline may provide more representative data about community-based older adults' acceptance of and willingness toward WC measurement.

High baseline levels of acceptance of and willingness toward WC measurement did not align with prior research that highlighted PCPs' perception of WC measurement barriers. Given participants' high self-reported levels of acceptance

and willingness toward WC measurement at baseline, patient acceptance of and willingness toward WC measurement may not be considered a barrier to WC measurement in the care of physically active, community-based older adults.

5.2.3 Research question and hypothesis 2a

> Do WC measurement and central obesity T2D disease risk education affect perceived susceptibility to T2D? It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on perceived susceptibility for T2D than two control cues to action (c) BMI and (d) obesity classification in community-based older adults.

Study findings did not support this hypothesis. There was no significant change in perceived susceptibility (to T2D, to T2D associated with WC, and to T2D associated with BMI) from baseline to posttest between groups.

Per Rosenstock (1966, 1974), behavior change occurs when a cue to action sufficiently increases perceived disease susceptibility. Because research had shown that most of the general population were unaware of T2D risk associated with central obesity, WC measurement and central obesity T2D disease risk education were intended cues to action, that would pointedly increase the experimental group's overall perceived level of susceptibility to T2D and perceived susceptibility associated with WC measurement (Smith and Haslam, 2007).

Prior to exposing the experimental group to the interventional cues to action, their baseline perceived T2D susceptibility was significantly greater than the control group. This finding reduced the potential for finding significant relative change from baseline to posttest in the experimental group. It is likely that other factors contributed to the increased perceived susceptibility at baseline in the experimental group. Adults consider race/ethnicity when identifying personal risk for chronic diseases, including

diabetes (Centers for Disease Control and Prevention [CDC], 2014; Glanz, Rimer, & Viswanath, 2008; Nguyen, Oh, Moser & Patrick, 2015). Race/ethnicity are effect modifiers that may influence perceived susceptibility (Glanz, et al., 2008). The experimental group included a significantly greater percent of Non-Hispanic African Americans compared to the control group and the control group included a significantly greater percent of Non-Hispanic White participants. Per the CDC (2015), Non-Hispanic African Americans have higher rates of T2D and obesity compared to Non-Hispanic White Americans (http://www.cdc.gov/obesity/data/adult.html). Racial/ethnic differences between the experimental and control groups may have influenced the differences in perceived susceptibility to T2D at baseline.

Unlike the aforementioned finding, perceived T2D susceptibility associated with WC and BMI, at baseline, was relatively high and similar between groups. These findings did not align with research that found most patients were unaware of central obesity related disease risk (Smith & Haslam, 2007). High baseline findings also did not align with participants' reported lack of WC measurement and BMI calculation experience in the PC setting. Seventy-two percent of the experimental group and 87.8% of the control group had some (or more) college education. It is possible that this educated, health-conscious sample experienced (a) WC measurement, (b) BMI calculation, (c) learning about total obesity disease risk, and/or (d) learning about central obesity disease risks in other, non-PC, settings. Sample characteristics (education, health-consciousness) likely contributed to the high perceived T2D susceptibility associated with WC and BMI in both groups at baseline. High baseline perceptions created a ceiling effect that limited examination of the effect of WC

measurement and central obesity T2D disease risk education on perceived T2D susceptibility associated with WC from baseline to posttest.

5.2.4 Research question and hypothesis 2b

> Do WC measurement and central obesity T2D disease risk education affect the perceived benefit of WC measurement? It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on perceived benefit of WC measurement than two control cues to action (c) BMI calculation and (d) obesity classification in community-based older adults.

Both groups reported a similar lack of experience with WC measurement and BMI calculation in the PC setting. As hypothesized, WC measurement and central obesity health risk education had a significantly greater effect on total perceived benefit of WC measurement in the experimental group, compared to the control group.

It is notable that the experimental group had a significantly greater increase in perceived benefit of BMI calculation compared to the control group. This finding was not anticipated, given that both groups reported a similar lack of experience with BMI calculation in the PC setting and both groups received the same BMI calculation and obesity classification during the baseline assessment. A possible combined effect of WC measurement, central obesity T2D disease risk education, BMI calculation, and obesity classification, may have significantly increased perceived BMI benefit in the experimental group compared to the control group. Additionally, the experimental group's significantly greater perceived susceptibility to T2D at baseline may have also contributed to the significantly increased perceived benefit of both WC measurement and BMI calculation. These findings align with the HBM premise that increased perceived susceptibility enhances perceived benefits (Champion & Skinner, 2008).

Increased perceived benefits can result in positive health behavior change (Rosenstock, 1966).

In this study, the WC measurement and central obesity T2D disease risk education intervention had no measurable effect on perceived susceptibility but a significant effect on perceived benefits in the experimental group. These findings, in the absence of study limitations, would have had the potential to contrast the effects of perceived susceptibility versus perceived benefit on the adoption of positive health behaviors. Ceiling effects for baseline perceived susceptibility threatened valid contrast of the effects of perceived susceptibility compared to perceived benefits on health behaviors in this study.

In a prior study, PCPs reported feeling ineffective in the management of patient obesity (Bocquier, Verger, Basdevant, Andreotti, Baretge, et al., 2005). Yet Singh and colleagues (2010) found the combination of WC measurement and PCP recommendation to lose weight was associated with successful weight loss in patients (Singh et al., 2010). In this study, the six survey items at baseline and posttest assessed participant perceived benefit of WC measurement and BMI calculation. These items queried if participants believed (a) decreasing their WC and/or BMI would decrease their risk for diabetes, (b) knowing their WC and/or BMI would motivate them to exercise more, and (c) knowing their WC and/or BMI would motivate them to improve their diet. The experimental group's perceived benefits were significantly greater post intervention compared to the control group perceived benefits. These findings suggest that informing community-based older adults about their WC, central obesity disease risk, BMI, and obesity classification motivates them to decrease their WC and BMI with exercise and diet to decrease their disease risk. In

addition to Singh and colleagues' (2010) findings, my empirical evidence supports WC measurement, central obesity disease risk, BMI calculation, and obesity classification in the care of community-based older adults to prevent, delay, and control disease risk.

5.2.5 Research question and hypothesis 3a

> Do WC measurement and central obesity T2D disease risk education affect physical activity? It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D disease risk education would have a greater effect on physical activity than two control cues to action (c) BMI and (d) obesity classification in community-based older adults.

The cues of WC measurement and central obesity T2D disease risk education did not significantly affect physical activity among community-based older adults in the experimental group compared to the control group; however, willingness to increase exercise was significantly greater in the experimental group at posttest.

Given that the experimental group's (a) baseline perceived susceptibility to T2D was significantly greater than the control group, (b) posttest perceived benefits of WC and BMI were significantly greater than the control group, and (c) posttest willingness to increase exercise was significantly greater than the control group, it was surprising that the experimental group did not report significantly increased physical activity post-intervention. This lack of change in physical activity in the experimental group compared to the control group in this study did not support the theorized interrelationship between HBM constructs of cue to action, perceived susceptibility, perceived benefit, and adoption of health behaviors.

Prior studies have yielded varying findings about the influence of HBM constructs on health behaviors. The lack of significant change in physical activity by

the experimental group, in the presence of significant change in perceived benefits associated with WC measurement and BMI calculation, contradicts findings from a previous meta-analysis (Carper, 2010). In Carper's (2010) meta-analysis, constructs of perceived barriers and benefits were most predictive for behavior change in contrast to perceived susceptibility and perceived severity. The absence of change in perceived susceptibility and physical activity aligns with findings from an earlier meta-analysis (Janz & Becker, 1984). Janz and Becker (1984) found that the construct of perceived susceptibility influenced health behaviors more than any other HBM construct.

Another explanation for non-significant physical activity findings may be the presence of a ceiling effect in the Rapid Assessment of Physical Activity (RAPA) baseline findings. With a possible range of one to five for aerobic physical activity in the RAPA, and higher scores reflecting higher levels of activity, 70% of the total sample reported a baseline score of five. This self-reported, high baseline physical activity score did not align with data from the CDC (2014) that reported only 20% of U.S. adults meet recommended guidelines for aerobic physical activity or the National Center for Health Statistics' (NCHS, 2014) 2008 finding that 54% of adults, 65 years and older, did not meet recommended aerobic activity, or Schutzer and Graves' (2004) finding that the majority of the older adult population do not exercise regularly. It is plausible that the recruitment study title ('Healthy Body Study'), inclusion criteria, and study setting (active senior centers) attracted an uncharacteristically physically active older adult sample at baseline.

5.2.6 Research question and hypothesis 3b

> Do WC measurement and central obesity T2D disease risk education affect dietary behaviors? It was hypothesized that two experimental cues to action, (a) WC measurement and (b) central obesity T2D

disease risk education would have a greater effect on dietary behaviors than two control cues to action (c) BMI and (d) obesity classification in community-based older adults.

Despite the experimental group's (a) high baseline willingness to modify diet (similar to control group), (b) significantly greater baseline perceived susceptibility to T2D, and (c) significantly greater posttest perceived benefits of WC and BMI, WC measurement and central obesity T2D disease risk education did not significantly affect dietary behaviors in the experimental group compared to the control group. Hypothesis five was not supported.

Carper's (2010) meta-analysis noted that perceived barriers and perceived benefits predicted health behaviors. In this study, the lack of change in dietary behaviors in the presence of significant changes in perceived benefits contradicts Carper's meta-analytic findings (2010). Because this study did not explore the HBM construct of perceived barriers, this interpretation is incomplete.

Janz and Becker (1984) referred to perceived susceptibility as a catalyst for positive behavior changes. Several additional studies have linked perceived susceptibility to positive behavior changes (Gallagher et al., 2011; Jones, Weaver & Friedmann, 22007; Salz et al., 2009). The lack of change in perceived susceptibility and lack of change in dietary behaviors in this study aligned with Janz and Becker's (1984) findings regarding the influence of perceived susceptibility on behavior change. The lack of change in perceived susceptibility in this study is a possible contributing factor to the absence of positive dietary behavior change in this study.

Age, gender, socioeconomic status, and knowledge about disease are modifying factors that influence individual belief constructs (Champion & Skinner, 2008). Although this educated, health-conscious sample reported healthy baseline dietary habits, the ability to further improve dietary habits may have been limited by

socio-economic factors, socio-cultural factors, and/or dietary restrictions associated with medications or medical conditions that were not considered in this study.

5.3 Limitations

Several study limitations impacted interpretation of the study results and generalizability of the study findings. First, all data were self-reported. Second, demographic differences between the control and experimental groups threatened internal validity in this study. Third, although similarity of baseline survey responses across groups lessened this potential threat to internal validity, non-normality of baseline data for several dependent variables (DVs) increased the risk for type II error. Fourth, although the physical activity and dietary behavior measurement tools were validated in prior studies, several other survey items were not validated prior to the study. Non-validated items included survey items that measured WC acceptance, WC measurement and BMI calculation experience, and HBM constructs of perceived susceptibility and perceived benefits. The lack of survey item validity testing limited the strength and may have limited the accuracy of these results when answering research questions. Fifth, the use of a three-point Likert scale restricted participant responses to survey items that measured WC measurement and BMI calculation experience, WC acceptance, and HBM constructs of perceived susceptibility and perceived benefit. Sixth, this study examined the effect of WC measurement and central obesity T2D disease risk education on only two HBM constructs, rather than all five HBM constructs. Examination of the HBM constructs of perceived barriers, perceived susceptibility, and self-efficacy would have provided a more comprehensive investigation of health beliefs and potential interrelated effects of the HBM constructs on health behaviors. Seventh, although ANCOVA is robust against unmet

assumptions, all 13 DVs in the study did not meet one or more ANCOVA assumption(s). This limitation may have reduced the power of the statistical analysis to answer the research questions and increased the chance for type I and II errors. Eighth, the lack of prior BMI calculation experience in both groups may have created an interventional effect associated with BMI calculation and obesity classification in both groups. The presence of an intervention in both groups would decrease the measurable effects of experimental cues to action (WC measurement and central obesity T2D disease risk education) and increase the risk for a type II error. Ninth, the four- to six-week time interval from baseline to posttest assessment may have been insufficient to allow for the adoption of positive health behaviors in this population. Other diabetes prevention programs have found three and 12 month interventions had significant measurable outcomes (Hernan et al., 2014). All limitations can be addressed in future studies.

5.4 Strengths

Despite identified shortcomings of this study, several strengths were noted. Use of the HBM as the theoretical framework strengthened this study. The HBM has been used to develop interventions, explain behaviors, and predict behaviors in the prevention of disease since the 1950s (Champion & Skinner, 2008; Rosenstock, Strecher, & Becker, 1988). Jones, Smith, and Llewellyn's (2014) comprehensive review of interventional HBM studies, that impacted health behavior adherence, found the HBM to be particularly effective in interventional studies that were similar to this study. Noted similarities between this study and studies found to be effective by Jones and colleagues (2014) included the studies that (a) were led by a health professional,

(b) focused on primary prevention, and (c) utilized written and audio/visual cues to action.

The sampling method and phased data collection were study strengths. Participants were sampled from geographically separate senior centers. Data were collected in two phases. Control group data were collected during phase one in a New Castle County, Delaware senior center, prior to experimental group intervention. Experimental data collection took place in a Kent County, Delaware senior center during phase two following completion of phase one. This sampling method and data collection design limited intervention diffusion from the experimental group into the control group. These methods supported internal validity in this study.

Treatment fidelity was supported as the PI conducted all control and experimental interventions. A 10-minute, pre-recorded video, provided a controlled dose of central obesity T2D disease risk education in the experimental group. Each participant viewed the video once, in the presence of the PI. This single, individual viewing of a pre-recorded educational video supported treatment fidelity and controlled for dose effect of the intervention.

Although non-validity and reliability tested survey items examined the effect of cues to action on HBM constructs of perceived susceptibility and perceived benefit, these items were developed from existing HBM surveys. Items measuring willingness toward WC measurement, willingness to increase exercise, and willingness to add resistance training were developed from the validity tested Rapid Eating Assessment for Patients willingness to change diet item.

The statistical analyses further strengthened this study. ANCOVA is considered robust against type 1 error (Laerd Statistics, 2015). A 97% participant

retention from baseline to posttest supported the power of statistical analyses. The equal group sample size further supported the robustness of the ANCOVA in the presence of unmet assumptions, particularly homogeneity of variance (Leech, Barrett, & Morgan, 2005). Since the two groups in this study were essentially of equal size (49 in the control group and 50 in the experimental group) violation of the homogeneity of variance assumptions was not a significant threat to validity (Leech, Barrett, & Morgan, 2005).

This study provides a platform for future studies to examine cues to action in PC settings. Selection of cues to action that may significantly affect individual perceived susceptibility, perceived benefits, and health behaviors can promote adoption of health promoting behaviors that delay, prevent, or control T2D in community-based older adults.

5.5 Conclusions

The purpose of the study was to provide evidence that facilitates WC measurement utilization and central obesity T2D disease risk education in the care of community-based older adults. In doing so, I aimed to examine community-based older adult's experience with WC measurement at baseline. Post-intervention, I aimed to assess the effect of WC measurement and central obesity T2D disease risk education on community-based older adults' (a) acceptance of, and willingness toward WC measurement, (b) health beliefs, and (c) health behaviors.

Major risk factors for T2D are age, obesity, and physical inactivity (ADA, 2013; Guh et al., 2009). Delayed diagnosis of T2D increases the risk for development of diabetic complications (ADA, 2013). Complications from T2D impact quality of life and decrease life expectancy (CDC, 2008; Golden et al., 2012). Waist

circumference measurement is a practical measure for central obesity and a reliable indicator of T2D risk that is not utilized in PC settings (ADA, 2004; Appel, Jones, & Kennedy-Malone, 2004; Balkau et al., 2007; Dunkley et al., 2009; Ganpule-Rao et al., 2013; Gaynor, 2015; International Diabetes Foundation [IDF], 2015; Jansen, Katzmarzyk, & Ross, 2004; Schulze et al., 2006; Siren, Erikkson, & Vanhanen, 2012; Ternes, 2011; Usui et al., 2010). Barriers to WC measurement identified by PCPs included time, workload, lack of comfort obtaining WC measurement, and belief that measuring a patient's WC would cause the patient to feel uncomfortable (Aujla et al., 2013; Dunkley et al., 2009; Gaynor, 2015; Sebo et al., 2015; Smith & Haslam, 2007; Ternes, 2011).

Several limitations were noted in this study. The most significant limitations resulted from (a) the lack of participant BMI experience at baseline, (b) a ceiling effect of high baseline perceived susceptibility and physical activity responses, and (c) inadequate time for behavioral change from the baseline to posttest assessment. Body mass index calculation and obesity classification may have been an interventional, rather than a control, cue to action in both groups. The sample was educated, health-conscious, and physically active. These characteristics may have led to high baseline (a) acceptance of and willingness toward WC measurement, (b) health belief of perceived susceptibility, and (c) physical activity. Consideration of these baseline findings is critical when interpreting non-significant change from baseline to posttest in this study. Lastly, the four- to six-week interval between baseline and posttest may have been insufficient for the adoption of measurable behavior change.

At baseline participants reported 'never' having WC measurement in PC settings. Despite the lack of WC measurement experience, community-based older

adults reported high baseline acceptance of and willingness toward WC measurement. Although this high baseline finding limited significant change post-intervention, the baseline data refuted PCP perceived WC measurement barrier of patient nonacceptance.

Post-intervention, the health belief of perceived susceptibility and health behaviors of physical activity and dietary behaviors were not significantly affected. The HBM construct relationships between (a) cues to action and perceived susceptibility and between (b) increased perceived benefit and the adoption of positive health behaviors were not supported. These findings did not demonstrate the effectiveness of WC measurement and central obesity-related T2D disease risk education in community-based older adults. Again, consideration of high baseline findings is critical when interpreting non-significant findings in this study.

The health beliefs of (a) perceived benefits of WC measurement, (b) perceived benefits of BMI calculation, and (c) willingness to increase exercise were significantly greater post-intervention in the experimental group. The experimental group's significantly greater perceived susceptibility to T2D at baseline may have contributed to this finding. These data provide evidence that informing community-based older adults about their WC, central obesity disease risk, BMI, and obesity classification motivates beliefs about behaviors that decrease WC and BMI to decrease their disease risk. These findings demonstrated the effectiveness of WC measurement and central obesity-related T2D disease risk education in community-based older adults.

This study demonstrated acceptability of WC measurement. Empirical evidence was provided that supports WC measurement, central obesity T2D disease

risk education, BMI calculation, and obesity classification in the care of community-based older adults to prevent, delay, and control disease risk.

5.6 Future Recommendations

Future studies can help fill current gaps in the literature. More research is needed to determine how WC measurement and central obesity T2D disease risk education affect all HBM constructs and health behaviors in community-based older adults. Measurement tool recommendations include (a) use of a 5-point Likert scale rather than a three-point scale, (b) assessment of additional factors (e.g., knowledge of disease, current diagnoses, medications) that influence participant perceived susceptibility to T2D risk), and (c) development of additional perceived benefit items that include perceived benefits of health behaviors. These measurement tools will require reliability and validity testing.

Four recommendations that address the lack of significant change in health behaviors between groups in this study include (a) extension of the time interval between baseline and posttest assessments, (b) comparison of change in anthropometric measurements from baseline to posttest between groups, (c) consideration of baseline BMI calculation and WC measurement experience in non-PC settings, and (d) use of the Transtheoretical Model (TTM) to frame future studies. The stages of change constructs in the TTM identify and measure individual readiness for and progression toward behavior change (Prochaska, Redding, & Evers, 2008). The TTM constructs may better tease out the effect(s) of WC measurement and central obesity T2D disease risk education by examining individual readiness to change behaviors, regardless of actual behavior change (Prochaska, Redding, & Evers (2008).

Participants in this study did not experience WC measurement in the PC, yet they were accepting of and willing to have WC measurement. Waist circumference measurement and central obesity T2D disease risk education increased participant perceived benefit of WC measurement and willingness to exercise. Considering the physiological changes and the rapid rise of T2D among older adults, and that patient health behaviors are significantly influenced by information provided during PC office visits, inclusion of WC measurement, and central obesity T2D disease risk education during PC office visits is recommended (Morey, 2015-UpToDate accessed online 9/24/2015; Singh et al., 2010).

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Appendix A

INSTITUTIONAL REVIEW BOARD DOCUMENTS

UNIVERSITY OF DELAWARE

RESEARCH OFFICE

210 Hullihen Hall
University of Delaware
Newark, Delaware 19716-1551
Ph: 302/831-2136
Fax: 302/831-2828

DATE:	March 8, 2016
TO:	Beatrice Gaynor, MSN
FROM:	University of Delaware IRB
STUDY TITLE:	[870390-1] The effect of Waist Circumference Measurement and Central Obesity Health Risk Education on Community-based Older Adults' Perceived Susceptibility, Perceived Benefits, and Health Behaviors
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	March 8, 2016
EXPIRATION DATE:	March 7, 2017
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category # *(4,7)*

Thank you for your submission of New Project materials for this research study. The University of Delaware IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.

If you have any questions, please contact Nicole Farnese-McFarlane at (302) 831-1119 or nicolefm@udel.edu. Please include your study title and reference number in all correspondence with this office.

INFORMED CONSENT TO PARTICIPATE IN RESEARCH-CONTROL GROUP

Title of Project: The Healthy Body Study.

Principal Investigator(s): Beatrice Gaynor, MSN, FNP-BC

You are being invited to participate in a research study. This consent form tells you about the study including its purpose, what you will be asked to do if you decide to take part, and the risks and benefits of being in the study. Please read the information below and ask us any questions you may have before you decide whether or not you agree to participate.

WHAT IS THE PURPOSE OF THIS STUDY?

The study aims to examine the effect of body measurements and education on community-based older adults' health beliefs and health behaviors.

Findings from this study may support the use of measurements in primary care practice.

Findings from this study will support development of the researcher's dissertation.

As a member of the Newark Senior Center, you are being asked to participate in this study. You will be one of approximately 50 participants recruited from the Newark Senior Center to participate in this study.

WHAT WILL YOU BE ASKED TO DO?

You will be asked to meet with the researcher twice in a designated room at the Newark Senior Center. Each visit will take approximately 30 minutes. During this first visit you will complete written surveys (total of 54 items) and the researcher will measure your height and weight. Then, we will schedule a second visit to take place in 4-6 weeks. During this second visit you will complete written surveys (total of 48 items), and the researcher will measure your waist size. You will be offered the option to change into a paper shirt for this measurement or you may remain in your personal clothing. This second visit will end with you watching a 10-minute video.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

Possible risks of participating in this research study are minimal.

WHAT ARE THE POTENTIAL BENEFITS?

You might not benefit directly from taking part in this research. However, the knowledge gained from participating in this study may positively influence your health beliefs and health behaviors.

We hope you enjoy this experience.

Participant's Initials _

HOW WILL CONFIDENTIALITY BE MAINTAINED? WHO MAY KNOW THAT YOU PARTICIPATED IN THIS RESEARCH?

Consent forms will be stored is a secure location in a locked filing cabinet.

Your name, and any identifying information will be omitted in all reports, presentations, and publications.

Your name will not be included on your survey. All paper surveys will be converted to an electronic file. Electronic data will be kept private and secured in a password protected file.

Your research records may be viewed by the University of Delaware Institutional Review Board, which is a committee formally designated to approve, monitor, and review biomedical and behavioral research involving humans. The confidentiality of your records will be protected to the extent permitted by law.

WILL THERE BE ANY COSTS TO YOU FOR PARTICIPATING IN THIS RESEARCH?

There is no cost associated with participating in this research study.

WILL YOU RECEIVE ANY COMPENSATION FOR PARTICIPATION?

You will be a contestant in a raffle. The researcher will raffle 15 $10.00 Wawa gift cards at the conclusion of the study. Each participant will have one entry in the raffle.

DO YOU HAVE TO TAKE PART IN THIS STUDY?

Taking part in this research study is entirely voluntary. You do not have to participate in this research. If you choose to take part, you have the right to stop at any time. If you decide not to participate or if you decide to stop taking part in the research at a later date, there will be no penalty or loss of benefits to which you are otherwise entitled. Your decision to stop participation, or not to participate, will not influence current or future relationships with the University of Delaware.

WHO SHOULD YOU CALL IF YOU HAVE QUESTIONS OR CONCERNS?

If you have any questions about this study, please contact the Principal Investigator, Beatrice Gaynor, at [redacted] or [redacted]

If you have any questions or concerns about your rights as a research participant, you may contact the University of Delaware Institutional Review Board at hsrb-research@udel.edu or (302) 831-2137.

Participant's Initials _

Your signature on this form means that: 1) you are at least 18 years old; 2) you have read and understand the information given in this form; 3) you have asked any questions you have about the research and the questions have been answered to your satisfaction; and 4) you accept the terms in the form and volunteer to participate in the study. You will be given a copy of this form to keep.

Printed Name of Participant	Signature of Participant	Date
Person Obtaining Consent (PRINTED NAME)	Person Obtaining Consent (SIGNATURE)	Date

Participant's Initials _

UD IRB Approval from 03/08/2016 to 03/07/2017

INFORMED CONSENT TO PARTICIPATE IN RESEARCH-EXPERIMENTAL GROUP

Title of Project: The Healthy Body Study.

Principal Investigator(s): Beatrice Gaynor, MSN, FNP-BC

You are being invited to participate in a research study. This consent form tells you about the study including its purpose, what you will be asked to do if you decide to take part, and the risks and benefits of being in the study. Please read the information below and ask us any questions you may have before you decide whether or not you agree to participate.

WHAT IS THE PURPOSE OF THIS STUDY?

The study aims to examine the effect of body measurements and education on community-based older adults' health beliefs and health behaviors.

Findings from this study may support the use of measurements in primary care practice.

Findings from this study will support development of the researcher's dissertation.

As a member of the Modern Maturity Senior Center, you are being asked to participate in this study. You will be one of approximately 50 participants recruited from the Modern Maturity Senior Center to participate in this study.

WHAT WILL YOU BE ASKED TO DO?

You will be asked to meet with the study researcher twice in a designated room at the Modern Maturity Center. During this first visit you will complete written surveys (total 54 items) and the researcher will measure your height, weight, and waist size. You will be offered the option change into a paper shirt for this measurement or you may remain in your personal clothing. This first visit will end with you watching a 10-minute video. This visit will take approximately 40 minutes. Then, we will schedule a second visit to take place in 4-6 weeks. During this second visit you will complete written surveys (total 48 items). This second visit will take approximately 20 minutes.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

Possible risks of participating in this research study are minimal. You should not experience any discomfort.

WHAT ARE THE POTENTIAL BENEFITS?

You might not benefit directly from taking part in this research. However, the knowledge gained from participating in this study may positively influence your health beliefs and health behaviors.

We hope you enjoy this experience.

Participant's Initials _

HOW WILL CONFIDENTIALITY BE MAINTAINED? WHO MAY KNOW THAT YOU PARTICIPATED IN THIS RESEARCH?

Consent forms will be stored is a secure location in a locked filing cabinet.

Your name, and any identifying information will be omitted in all reports, presentations, and publications.

Your name will not be included on your survey. All paper surveys will be converted to an electronic file. Electronic data will be kept private and secured in a password protected file.

Your research records may be viewed by the University of Delaware Institutional Review Board, which is a committee formally designated to approve, monitor, and review biomedical and behavioral research involving humans. The confidentiality of your records will be protected to the extent permitted by law.

WILL THERE BE ANY COSTS TO YOU FOR PARTICIPATING IN THIS RESEARCH?

There is no cost associated with participating in this research study.

WILL YOU RECEIVE ANY COMPENSATION FOR PARTICIPATION?

You will be a contestant in a raffle. The researcher will raffle six $25.00 Walmart gift cards at the conclusion of the study. Each participant will have one entry in the raffle.

DO YOU HAVE TO TAKE PART IN THIS STUDY?

Taking part in this research study is entirely voluntary. You do not have to participate in this research. If you choose to take part, you have the right to stop at any time. If you decide not to participate or if you decide to stop taking part in the research at a later date, there will be no penalty or loss of benefits to which you are otherwise entitled. Your decision to stop participation, or not to participate, will not influence current or future relationships with the University of Delaware.

WHO SHOULD YOU CALL IF YOU HAVE QUESTIONS OR CONCERNS?

If you have any questions about this study, please contact the Principal Investigator, Beatrice Gaynor, at [redacted]

If you have any questions or concerns about your rights as a research participant, you may contact the University of Delaware Institutional Review Board at hsrb-research@udel.edu or (302) 831-2137.

Your signature on this form means that: 1) you are at least 18 years old; 2) you have read and understand the information given in this form; 3) you have asked any questions you have about the research and the questions have been answered to your satisfaction; and 4) you accept the terms in the form and volunteer to participate in the study. You will be given a copy of this form to keep.

Participant's Initials _

Printed Name of Participant	Signature of Participant	Date
Person Obtaining Consent (PRINTED NAME)	Person Obtaining Consent (SIGNATURE)	Date

Participant's Initials _

Recruitment Newsletters

Newark Senior Center

University of Delaware Research Opportunity:

Beatrice Gaynor, a Doctoral Nursing Student, invites you to participate in the *Healthy Body Study*. This two-session study will take place at the Newark Senior Center from April 4th to May 20th. The study will provide you with health information, recommendations, and a chance to win a raffle for one of 15 Wawa gift cards.

You will be asked to complete 2 surveys, watch a brief video, and have your height, weight and waist measured.

You can email Beatrice with questions at XXXX@udel.edu or sign-up to schedule a meeting at the Newark Senior Center information desk.

Modern Maturity Center

University of Delaware Research Opportunity:

Beatrice Gaynor, a Doctoral Nursing Student, invites you to participate in a Healthy Body Study. This two-session study will take place at the Modern Maturity Center from late May until early July. The study will provide you with health information, recommendations, and a chance to win a raffle for one of 6 Walmart gift cards worth $25.00 each.

You will be asked to complete 2 surveys, watch a brief video, and have your height, weight and waist measured.

You can email Beatrice with questions at XXXX@udel.edu or sign-up to schedule a meeting at the Modern Maturity Center information desk.

Recruitment Posters

Newark Senior Center

Modern Maturity Center

Telephone Screen

Medical and cognitive eligibility script and intake record form

Hello Dr/Mr/Mrs/Ms_____

Thank you for your interest in the healthy body study. I would like to review your current health and thinking to determine if you meet the criteria for this study.

	YES	NO
Are you able to see and read most written materials (newspaper, magazine)? Explanation of no response:		
Do you have any loss or seriously impaired function of any organs? Explanation of yes response:		
Do you have any conditions or disabilities that limit your physical activities? Explanation of yes response:		
Do you have any conditions that require you to limit protein in your diet? Explanation of yes response:		
Do you have any conditions that cause you to retain excess fluid in your body? Explanation of yes response:		
Have you ever been told you have Cushing's Syndrome? Explanation of yes response:		

Administer Telephone Interview for Cognitive Status (TICS).

Exclude if score ≤30. TICS score _____

If all answers above are no and TICS score is ≥ 31 then read scripts on following page.

Control group:

Thank you for your interest in this study. I will be present at the senior center these days ___between these times ___. Is there a time that is convenient for you to meet with me? During this meeting, we will review the consent form and you can decide if you want to participate in this study. After signing the consent form, I will ask you to complete written surveys, totaling 54 items, and obtain two body measurements. This will take approximately 30 minutes. Then, we will schedule a second visit to take place 4-6 weeks later. During this second visit I will ask you to, again, complete written surveys, totaling 48 items this time, and obtain one body measurement. This second visit will end with you watching a 10-minute video. This will take approximately 30 minutes.

Appointment Date:_____
Time:_____

If all answers above are no and TICS score is ≥ 31 and the potential participant will be in the

Experimental group:

Thank you for your interest in this study. I will be present at the senior center these days ___between these times ___. Is there a time that is convenient for you to meet with me? During this meeting, we will review the consent form and you will decide if you want to participate in this study. After signing the consent form, I will ask you to complete written surveys, totaling 54 items, and obtain three body measurements. This visit will end with you watching a 10-minute video. This will take approximately 40 minutes. Then, we will schedule a second visit to take place 4-6 weeks later. During this second visit I will ask you to, again, complete written surveys, totaling 48 items. This will take approximately 20 minutes.

Appointment Date:_____
Time:_____

TICS Administration Instructions

Prior to the TICS administration, examiners should ensure that they have obtained all of the necessary information (e.g., examinee's full name, complete address, etc.).

Instructions to Proctor

In a couple of minutes, I am going to be asking [*examinee's name*] a number of different questions to test [*his/her*] thinking and memory. Before we start, I need to ask you whether the address I have for your current location is correct. Please don't repeat it out loud if [*examinee's name*] is in the room with you, since I will be asking [*him/her*] the same question in a few minutes. Is your current address [*examinee's address*]? If the answer is "no," please ask the proctor either to step into another room before giving you the correct address or to have the examinee leave the room briefly before giving you the address. Then go on to say, **Please be sure that all papers, pencils, books, calendars, newspapers, and everything else that might provide distraction or visual cues are removed from [*examinee's name*] sight. Also, please be sure that the room is quiet; there should be no television, radio, or music playing.**

Some of the questions may be difficult for [*examinee's name*] to answer. [*He/She*] may ask you for help. If [*he/she*] does, just encourage [*him/her*] to do as well as [*he/she*] can. [*He/She*] should guess if necessary. Please do not give [*him/her*] any answers or hints. O.K.? If you and [*examinee's name*] are ready, please put [*him/her*] on the phone.

Instructions to Examinee

I am going to ask you some questions to test your memory. Some of these are likely to be easy for you, but some may be difficult. Please bear with me and try to answer all the questions as best you can. If you can't answer a question, don't worry. Just try your best. Are you ready? These instructions may be repeated *verbatim* or paraphrased, if necessary. For each of the actual TICS items, except Item 5 and Item 8, single repetitions are permitted.

Item	Item response	Scoring criteria	Max. score	Item score
1. **Please tell me your full name.**		1 point for correct first name (or nickname) and 1 point for correct last name	2	
2. **What is today's date?** Probe for month, date, year, day of week, and season if any not provided spontaneously (e.g., **What day of the week is it?** *or* **What season is it?**).		1 point each for precisely correct month, date, year, day of the week, and season (e.g., a hot day in early June is *not* summer)	5	
3. **Where are you right now?** Probe for house number, street, city, state, and zip code if any not provided spontaneously (e.g., **What number is that? What is your zip code?**).		1 point each for correct house number, street, city, state, and zip code (5-digit zip code is sufficient). If examinee is in a facility with no house number (e.g., hospital, nursing home), the name of the facility may be substituted for the house number.	5	
4. **Please count backward from 20 to 1.** If examinee makes an error, ask him or her to try again.		2 points if completely correct on first trial 1 point if completely correct on second trial	2	
5. **I am going to read you a list of 10 words. Please listen carefully and try to remember them. When I am done, tell me as many of the words as you can, in any order. Ready? The words are** (*pause*) **cabin, pipe, elephant, chest, silk, theater, watch, whip, pillow, giant.** (*Pause.*) **Now tell me all the words you can remember.** The words should be read at approximately one word every 2 seconds. No repetitions of the word list are permitted.		1 point for each correctly recalled word 0 points for incorrect responses, repetitions, or intrusions	10	

Item	Item response	Scoring criteria	Max. score	Item score
6. I would like you to take the number 100 and subtract 7. (Pause for a response.) **Now keep subtracting 7 from the answer until I tell you to stop.** No further prompts or instructions are given, except to **"keep going."** Stop the examinee after five serial subtractions.		1 point for each correct subtraction Do not inform examinee of incorrect responses, but allow subtractions to be made from the last response. For example, "93, 85, 78, 71, 65" would be awarded 3 points.	5	
7. What do people usually use to cut paper? (Pause for a response.) **How many things are in a dozen?** (Pause for a response.) **What do you call the prickly green plant that lives in the desert?** (Pause for a response.) **What animal does wool come from?**		1 point each for "scissors" or "shears" 1 point for "12" 1 point for "cactus" 1 point for "sheep" or "lamb"	4	
8. Please repeat this after me: "No ifs, ands, or buts." (Pause for a response.) **Now, please repeat this after me: "Methodist Episcopal."** No repetitions of the phrases are permitted.		1 point for correct repetition 1 point for correct repetition	2	
9. Who is the President of the United States right now? (Pause for a response.) **Who is the Vice-President?** Both first and last names must be correct. If only the last name is given, probe for the full name.		1 point for current president's full name 1 point for current vice-president's full name	2	
10. With your finger, tap five times on the part of the phone you speak into. If the TICS is being administered in person, the examinee should be asked to tap on the table rather than on a telephone receiver.		2 points if five taps are clearly heard 1 point if either more than or fewer than 5 taps are heard 0 points if no taps are heard.	2	
11. I am going to say a word and I want you to give me its opposite. For example, if I said "hot," you would say "cold." **What is the opposite of "west"?** (Pause for a response.) **What is the opposite of "generous"?**		1 point for "east" 1 point for "cheap," "stingy," "tight," "selfish," "greedy," "mean," "meager," or other correct antonym	2	

TICS Total score
Total possible points = 41

Participant Survey

ID: _____c/e DATE: ____/____/_____

Demographic data

Age in years: _____

Please circle one option for the following:

Gender: Male Female Other

Your highest level of education:

8th grade or less

Some high school, did not graduate

High school diploma or GED

Vocational, trade, or business school after high school

Some college or 2-year degree

4-year college graduate

More than 4-year college degree

Don't know

Your race/ethnicity:

American Indian or Alaskan Native Asian American

Non-Hispanic Black or African American Hispanic or Latino Americans

Native Hawaiian or Pacific Islander Non-Hispanic White American

Other:_____ Decline response

ID: _____c/e DATE: ____/____/_____

Below place an 'X' in the column to the right that best describes your experience.	**All the time**	**Sometimes**	**Never**
How often does your primary health care provider measure your waist size?			
How often does your primary health care provider measure your body mass index?			
Below place an 'X' in the column to the right that best describes your feeling or belief.	**Very/ Definitely**	**Somewhat**	**Not at all**
How comfortable do you feel having your waist measured?			
Do you believe you are at risk for diabetes?			
Below place an 'X' in the column to the right that best describes your belief.	**Definitely will**	**Not sure**	**Will not**
Do you believe your waist size will increase your risk for diabetes?			
Do you believe **knowing** your waist size will motivate you to exercise more?			
Do you believe **knowing** your waist size will motivate you to improve your diet?			
Do you believe **decreasing** your waist size will decrease your risk for diabetes?			

ID: _____c/e DATE: ____/____/_____

Below place an 'X' in the column to the right that best describes your belief.	**Definitely will**	**Not sure**	**Will not**
Do you believe your body mass index will increase your risk for diabetes?			
Do you believe **knowing** your body mass index will motivate you to exercise more?			
Do you believe **knowing** your body mass index will motivate you to improve your diet?			
Do you believe **decreasing** your body mass index will decrease your risk for diabetes?			

Below **Circle** the number that best describes how you feel.					
	Very willing 5	**4**	**3**	**2**	**Not at all willing 1**
How willing are you to make changes in what, how or how much you eat in order to eat healthier?	5	4	3	2	1
How willing are you to increase your physical activity?	5	4	3	2	1
How willing are you to increase resistance training activities? Examples of resistance training activities include using weights, resistance bands, or doing push-ups.	5	4	3	3	1
How willing are you to have your waist size measured?	5	4	3	2	1

How physically active are you? *(Check one answer on each line)*

RAPA 1

		Does this accurately describe you?	
1	I rarely or never do any physical activities.	Yes ☐	No ☐
2	I do some **light** or **moderate** physical activities, but not every week.	Yes ☐	No ☐
3	I do some **light** physical activity every week.	Yes ☐	No ☐
4	I do **moderate** physical activities every week, but less than 30 minutes a day or 5 days a week.	Yes ☐	No ☐
5	I do **vigorous** physical activities every week, but less than 20 minutes a day or 3 days a week.	Yes ☐	No ☐
6	I do 30 minutes or more a day of **moderate** physical activities, 5 or more days a week.	Yes ☐	No ☐
7	I do 20 minutes or more a day of **vigorous** physical activities, 3 or more days a week.	Yes ☐	No ☐

RAPA 2

3 = Both 1 & 2

1	I do activities to increase muscle **strength**, such as lifting weights or calisthenics, once a week or more.	Yes ☐	No ☐
2	I do activities to improve **flexibility**, such as stretching or yoga, once a week or more.	Yes ☐	No ☐

ID # _____

Today's Date _____

ID:_____c/e Date:_____/_____/_____

Rapid Eating Assessment for Patients (REAP)

TOPIC	In an average week, how often do you: **Please check the box that best describes your habits.**	Usually/ Often	Sometimes	Rarely/ Never	Does not apply to me
MEALS	1. Skip breakfast?	O	O	O	
	2. Eat 4 or more meals from sit-down or take out restaurants?	O	O	O	
GRAINS	3. Eat less than 3 servings of whole grain products a day? **Serving** = 1 slice of 100% whole grain bread; 1 cup whole grain cereal, high fiber cereal, oatmeal; 3-4 whole grain crackers; 1/2 cup brown rice or whole wheat pasta	O	O	O	
FRUITS AND VEGETABLES	4. Eat less than 2-3 servings of fruit a day? **Serving** = 1/2 cup or 1 med. fruit or 4 oz. 100% fruit juice	O	O	O	
	5. Eat less than 3-4 servings of vegetables/potatoes a day? **Serving** = 1/2 cup vegetables/potatoes, or 1 cup leafy raw vegetables	O	O	O	
DAIRY	6. Eat or drink less than 2-3 servings of milk, yogurt, or cheese a day? **Serving** = 1 cup milk or yogurt; 1.5 - 2 ounces cheese	O	O	O	
	7. Use 2% (reduced fat) or whole milk instead of skim (non-fat) or 1% (low-fat) milk?	O	O	O	Rarely use milk O
	8. Use regular cheese (like American, cheddar, Swiss, Monterey Jack) instead of low fat or part skim cheeses as a snack, on sandwiches, pizza, etc?	O	O	O	Rarely eat cheese O
MEATS/CHICKEN/TURKEY	9. Eat beef, pork, or dark meat chicken more than 2 times a week?	O	O	O	
	10. Eat more than 6 ounces (see sizes below) of meat, chicken, turkey or fish per day? ***Note**: 3 ounces of meat or chicken is the size of a deck of cards or ONE of the following: 1 regular hamburger, 1 chicken breast or leg (thigh & drumstick), or 1 pork chop.*	O	O	O	Rarely eat meat, chicken, turkey or fish O
	11. Choose higher fat red meats like prime rib, T-bone steak, hamburger, ribs, etc. instead of lean red meats?	O	O	O	Rarely eat meat O
	12. Eat the skin on chicken and turkey and the fat on meat.	O	O	O	Rarely eat meat, chicken, turkey or fish O
	13. Use regular processed meats (like bologna, salami, corned beef, hot dogs, sausage or bacon) instead of low fat processed meats (like roast beef, turkey, lean ham; low-fat cold cuts/hotdogs)?	O	O	O	Rarely eat processed meats O
FRIED FOODS	14. Eat fried foods such as fried chicken, fried fish or French fries?	O	O	O	

TOPIC	In an average week, how often do you:	Usually/ Often	Sometimes	Rarely/ Never	Does not apply to me
SNACKS	15. Eat regular potato chips, nacho chips, corn chips, crackers, regular popcorn, nuts instead of pretzels, low-fat chips or low-fat crackers, air-popped popcorn?	O	O	O	Rarely eat these snack foods O
FATS AND OILS	16. Use regular salad dressing & mayonnaise instead of low-fat or fat-free salad dressing and mayonnaise?	O	O	O	Rarely use dressing/mayo O
	17. Add butter, margarine or oil to bread, potatoes, rice or vegetables at the table?	O	O	O	
	18. Cook with oil, butter or margarine instead of using non-stick sprays like Pam or cooking without fat?	O	O	O	Rarely cook O
SWEETS	19. Eat regular sweets like cake, cookies, pastries, donuts, muffins, and chocolate instead of low fat or fat-free sweets?	O	O	O	Rarely eat sweets O
	20. Eat regular ice cream instead of sherbet, sorbet, low fat or fat-free ice cream, frozen yogurt, etc.?	O	O	O	Rarely eat frozen desserts O
	21. Eat sweets like cake, cookies, pastries, donuts, muffins, chocolate and candies more than 2 times per day?	O	O	O	Rarely eat sweets O
SOFT DRINKS	22. Drink 16 ounces or more of non-diet soda, fruit drink/punch a day? ***Note:*** *1 can of soda = 12 ounces*	O	O	O	
SODIUM	23. Eat high sodium processed foods like canned soup or pasta, frozen/packaged meals (TV dinners, etc.), chips?	O	O	O	
	24. Add salt to foods during cooking or at the table?	O	O	O	
ALCOHOL	25. Drink more than 1-2 alcoholic drinks a day? (One drink = 12 oz. beer, 5 oz. Wine, one shot of hard liquor or mixed drink with 1 shot)	O	O	O	

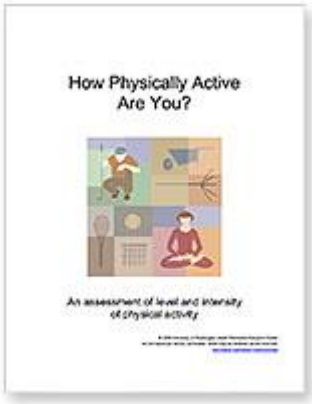
*Please review your survey to be sure you answered **all** the questions*

Thank you for completing this survey!

Appendix B

PERMISSIONS

Permission for use of Rapid Assessment of Physical Activity



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Online registration form was completed February, 2016 as required for the purpose of tracking RAPA usage at https://catalyst.uw.edu/webq/survey/hprc/55463?solstice_selected_button=btn_69408fd49a8349503716c5f72f60c099_1&sol_button_data_btn_69408fd49a8349503716c5f72f60c099_1=c3398b58607925f99837c41b2f3e52173c00497d10c6a0f4e592d473510d5a7b7de2fa1bb65ef46f53fc0badffc726f1682e6866a810baedc1bf95764ae478b8036e2df654c7665e619a31272213acfe89d8968d3f852957afb74d9ebd4aded46b073c26f46356fd9a187f8d5d27f285d2eac5c16e9cd9d2e4dae9503e6c91a5ed39e331d1bf01c477973dffb1fc662d

Permission for use of Rapid Eating Assessment for Patients

BROWN
School of Public Health

Institute for Community Health Promotion

February 28, 2016

Beatrice Gaynor, MSN, FNP-BC
Family Nurse Practitioner
Nurse Managed Health Center
University of Delaware
Doctoral Student
Virgina Lee Franklin Fellow
Jonas Nurse Leader Scholar

Dear Ms. Gaynor:

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Adjunct Professor, Department of Behavioral and Social Sciences
Brown University School of Public Health

121 South Main Street · Box G-S121 · Providence, Rhode Island 02912 Tel: (401) 863-6550 Fax: (401) 863-6551

Permission for use of National Institute on Aging Handouts

Ms. Gaynor,

Thank you for contacting the National Institute on Aging (NIA), part of the National Institutes of Health (NIH) at the U.S. Department of Health and Human Services. NIA was established to improve the health and wellbeing of older people through research. The Institute conducts and supports basic, clinical, and social and behavioral research on aging and the special problems and needs of older people.

Information available on the NIA website is in the public domain--no permission is required to use or share it. Here's where we describe this policy on our website, www.nia.nih.gov/newsroom/faq/are-nia-publications-copyright-protected. I'm delighted that you find our exercise and nutrition information helpful and want to include it as part of your dissertation project.

I'm copying Mr. Zeb Hall on your request, who will help manage your order.

Best,

Megan Homer, M.A.
Director, Go4Life® Campaign
Office of Communications and Public Liaison
National Institute on Aging
National Institutes of Health
Building 31, Room 5C37
Bethesda, MD 20892-2292
301-496-1752

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Page last updated: November 22, 2

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Permission for use of Waist Circumference Measurement Handout

International Chair on Cardiometabolic Risk

Date: 2016/02/05

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REQUESTOR CONTACT INFORMATION

Name:	Beatrice
Last Name:	Gaynor
Institute/Company:	University of Delaware
Address:	
Postal/Zip Code:	
City:	
Country:	United States
Email:	
Telephone:	

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Intended Use:	Dissertation intervention
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Please return the form to:
International Chair on Cardiometabolic Risk
Fax number: 418-656-4953
Email address: chair.cardiometabolic-risk@criucpq.ulaval.ca

Centre de recherche
Institut universitaire de cardiologie et de pneumologie de Québec
Pavillon Marguerite-d'Youville, 4th Floor
2725, chemin Sainte-Foy
Québec (Québec) G1V 4G5
CANADA

myhealthywaist.org
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Isabelle Lemieux, Ph.D.
Scientific Content Manager
International Chair on Cardiometabolic Risk
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Proof of purchase for Telephone Interview for Cognitive Status

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1 Principal Investigator/Supervisor Information

Please provide the name of the principal investigator and any other investigators involved in the study:

Supervisor's name: Regina Wright, PhD Supervisor's title: Associate Professor

School name and address: University of Delaware, Newark Delaware 19716

Expected duration of the study: March 2016- March 2017

2 Important Information About Your Research Study

Title of research: The effect of waist circumference (WC) measurement and central obesity health risk education on community-based older adults' perceived susceptibility, perceived benefits, and health behaviors.

Purpose of study: To examine community-based older adults' experience with and acceptance of WC measurement, and the effect of WC on their health beliefs and behaviors.

Brief description, including methodology (attach additional documentation if necessary):

Quasi-experimental, interventional study, using convenience sample in which pre and post survey data from the control and experimental groups will compare the effect of WC measurement to the standard of care (body mass index) on community based older adult health beliefs and health behaviors.

3 Required Signatures to Verify Supervision

I certify that the information supplied above, including information regarding my supervision of this research project, is correct.

Beatrice Gaynor

Signature of student (i.e., principal investigator)

Signature of supervisor

PAR Graduate Student Discount Order Form (continued)

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Order subtotal	$72
40% student discount.	– $28
Florida residents, add applicable sales tax. Michigan residents, add 6% sales tax.	+
Canadian residents of Nova Scotia, add 15% for GST/HST. Canadian residents of Prince Edward Island, add 14% for HST. Canadian residents of Newfoundland, New Brunswick, and Ontario, add 13% for GST/HST. All other Canadian residents, add 5% for GST.	+
Enter **Shipping & Handling** rate from box at left or below.	+ $8
Order total (USD)	$52

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*Minimum shipping & handling charge per order is $8
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Appendix C

STUDY DESIGN AND PROCEDURES

Table C.1 *Study design*

	Phase 1			Phase 2		
	Base-line	Post-test 4-6 week	Intervention	Base-line	Intervention	Post test 4-6 week
Control group	O1	O2	X			
Experimental group				O1	X	O2

Source: Shadish, W.R., Cook, T.D., & Campbell, D.T. (2002). Experimental and Quasi-Experimental Designs: for Generalized Causal Inference. Belmont, CA: Wadsworth.

Table C.2 *Summary of study procedures*

	Phase 1 control group			Phase 2 experimental group		
	Enrollment & baseline data	4-6 week post-test data	Intervention	Enrollment & baseline data	Intervention	4-6 weeks post-test data
Eligibility & informed consent	x			x		
Self-report survey	x	x		x		x
Cues to action: controlled	1) BMI and obesity category. 2) Exercise and diet handouts and DVD.				1) BMI and category. 2) Exercise and diet handouts and DVD.	
Cues to action: experimental			1) Waist measurement and handout. (2) Central obesity T2D disease risk education video.		(1) Waist measurement and handout. (2) Central obesity T2D disease risk education video.	
Anthropometric Measures						
WC			x		x	
Height	x				x	
Weight	x				x	
BMI	x				x	
BMI category	x				x	

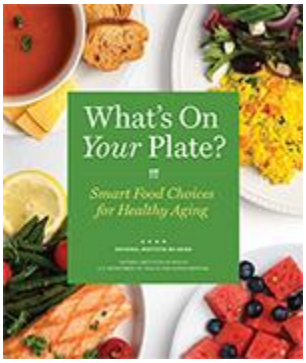
Appendix D

PARTICIPANT HANDOUTS

Go4Life DVD—Everyday Exercises from the National Institute on Aging
https://www.nia.nih.gov/health/publication/go4life-dvd

Exercise & Physical Activity: Your Everyday Guide from the National Institute on Aging
https://go4life.nia.nih.gov/exercise-guide

What's on Your Plate? Smart Food Choices for Healthy Aging
https://www.nia.nih.gov/health/publication/whats-your-plate/learn-more



Control group baseline: Control cue to action

Healthy Body Study

Your measurements today were as follows:

Height: _____ inches

Weight _____ pounds

Body Mass Index (BMI):_____kg/m²

As circled below, your BMI indicates that you are:

Underweight normal weight overweight

obese I obese II Obese III

Before changing your physical activity or eating habits consult your healthcare provider

Thank you for your participation in this study.

Below is your appointment reminder for session two:

Healthy Body Study

I look forward to seeing you for the second session

On:_____

At:_____

In room_____ at the Newark Senior Center

Control group posttest: Experiment cue to action intervention

Health Body Study

Your measurements today were as follows:

Waist size:_____inches

As circled below:

Your waist size is normal

Your waist size indicates that you are centrally obese

Before changing your physical activity or eating habits consult your healthcare provider

Thank you for your participation in this study.

Experimental group baseline: Experimental cue to action intervention

Health Body Study

Your measurements today were as follows:

Height: _____ inches
Weight _____ pounds
Body Mass Index (BMI):_____kg/m²

As circled below, your BMI indicates that you are:

Underweight normal weight overweight

obese I obese II Obese III

Your Waist size:_____inches

Your waist size is normal

Your waist size indicates that you are centrally obese

Before changing your physical activity or eating habits consult your healthcare provider

Thank you for your participation in this study.

Below is your appointment reminder for session two:

Healthy Body Study

I look forward to seeing you for the second session

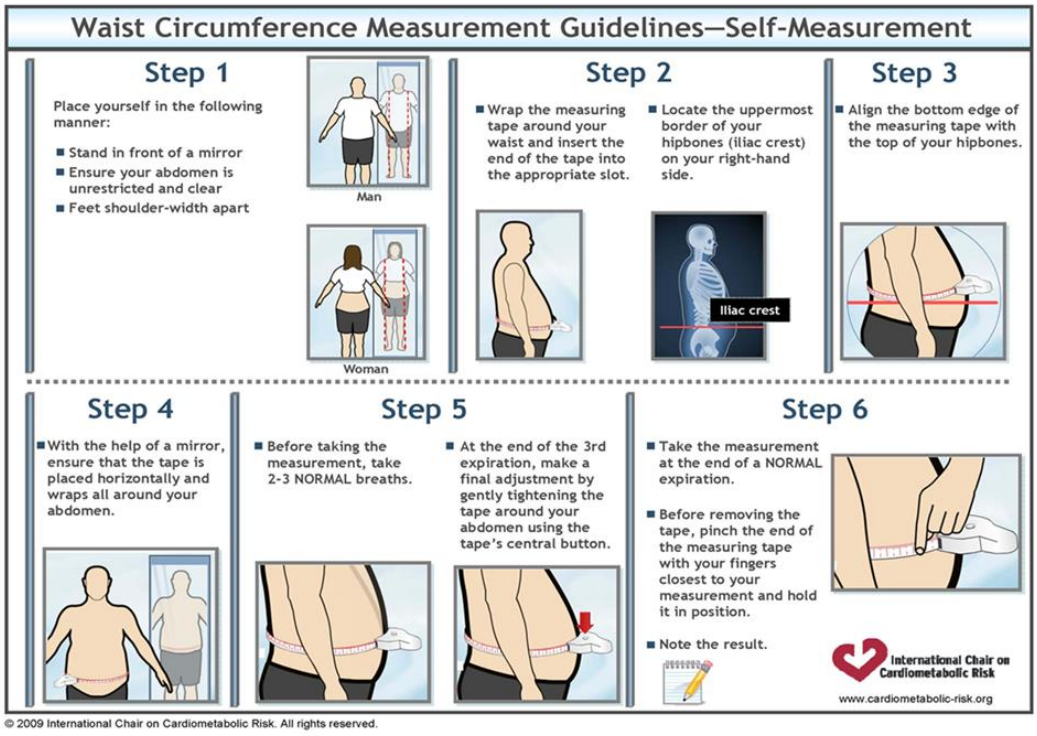
On:_____

At:_____

In room_____ at the Modern Maturity Center

Waist circumference measurement handout

Visit International Chair on Cardiometabolic Risk educational site at
www.myhealthywaist.org



Appendix E

COMPARISON OF GROUP BASELINE SURVEY RESPONSES

Table E.1 *Baseline comparison: WC measurement and BMI calculation experience in primary care*

	Control		Experimental		Independent *t*-test		
	M (SD)	Skewness Statistic	*M (SD)*	Skewness Statistic	*t*	*df*	*p*
WC experience	1.08 (0.28)	3.15	1.1 (0.36)	3.96	-0.28	97	0.78
BMI experience	1.37 (0.67)	1.61	1.3 (0.61)	1.92	0.52	97	0.6

Note. WC = Waist circumference; BMI = Body mass index.

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Table E.2 *Baseline comparison of group survey responses*

	Control		Experimental		Independent *t*-test		
	M (SD)	Skewness Statistic	*M (SD)*	Skewness Statistic	*t*	*df*	*p*
WC acceptance	2.55 (0.7)	-1.29^	2.5 (0.65)	-0.94	0.37	97	0.71
WC willingness	4.67 (0.8)	-2.88^	4.82 (0.44)	-2.45^	-1.13	97	0.26
Perceived Susceptibility							
Overall T2D risk	1.78 (0.8)	0.43	2.1 (0.81)	-0.19	-2.0	97	0.05* (0.048)
WC T2D risk	2.41 (0.64)	-0.62	2.5 (0.58)	-0.65	-0.76	97	0.46
BMI T2D risk	2.39 (0.64)	-0.56	2.58 (0.61)	-1.17^	-1.53	97	0.13

Note. WC = Waist circumference; T2D = Type 2 diabetes; BMI = Body mass index; ^ = skewness less than -1.0; * = significant difference at $p<.05$; † = missing data.

Table E.2 continued

	Control group	Experimental group	Independent *t*-test		
	M (SD)	*M (SD)*	*t*	*df*	*p*
Perceived Benefits					
Do you believe knowing your waist size will motivate you to exercise?	2.39 (0.76)	2.56 (0.67)	-1.19	97	0.24
Do you believe knowing your waist size will motivate you to improve your diet?	2.49 (0.74)	2.66 (0.63)	-1.24	97	0.22
Do you believe decreasing your waist will decrease your risk for diabetes?	2.55 (0.58)	2.64 (0.6)	-0.75	97	0.45
Do you believe knowing your BMI will motivate you to exercise more?	2.37 (0.81)	2.6 (0.53)	-1.69	97	0.09
Do you believe knowing your BMI will motivate you to improve your diet?	2.51 (0.68)	2.66 (0.56)	-1.2	97	0.23
Do you believe decreasing your BMI will decrease your risk for diabetes?	2.51 (0.62)	2.64 (0.6)	-1.06	97	0.29

Note. BMI = Body mass index; ^ = skewness less than -1.0; * = significant difference at $p<.05$; † = missing data.

Table E.2 continued

	Control group		Experimental group		Independent t-test		
	M (SD)	Skewness Statistic	*M (SD)*	Skewness Statistic	*F*	*df*	*p*
Totaled WC perceived benefits	4.43 (1.7)	-0.93	4.86 (1.4)	-0.9	-1.38	97	0.17
Totaled BMI perceived benefits	4.39 (1.75)	-0.92	4.9 (1.3)	-0.86	-1.65	97	0.1
Health behaviors: physical activity							
RAPA aerobic score	4.61 (0.64)	-1.44^	4.48 (0.99)	-2.28^	0.79	97	0.43
RAPA strength and flexibility	1.8 (1.220	-0.37	2.04 (1.23)	-0.84	-0.99	97	0.33
Willingness to increase exercise	4.41 (0.7)	-0.78	4.34 (0.94)	-1.52^	0.41	97	0.68
Willingness to increase resistance training	3.96 (1.06)	-0.9	4.06 (1.13)	-1.26^	-0.46	97	0.65
Health behaviors: diet							
REAP total score	57.12 (7.47)	0.18	56.92 (8.41)	-0.66	0.9	91†	0.37
Willingness to change diet	4.35 (0.78)	-0.71	4.52 (0.84)	-2.33^	-1.06	97	0.29

Note. WC = Waist circumference; BMI = Body mass index; RAPA = Rapid assessment physical activity; REAP = Rapid eating assessment for patients; ^ = skewness less than -1.0; * = significant difference at $p<.05$, † = missing data.

Appendix F

ANCOVA ASSUMPTION DATA

Table F.1 *Homogeneity of Regression Slopes, Non-transformed data*

	F	*p*
Waist circumference acceptance	0.003	0.96
Waist circumference willingness	9.52	0.003*
Perceived Susceptibility		
Overall T2D risk	0.32	0.58
Waist circumference T2D risk	0.75	0.69
Body mass index T2D risk	0.65	0.42
Perceived Benefits		
Totaled waist circumference perceived benefits	1.1	0.3
Totaled body mass index perceived benefits	0.03	0.86
Health behaviors: physical activity		
RAPA total aerobic score	3.56	0.06
Willingness to increase exercise	5.16	0.03*
RAPA resistance & flexibility training total score	2.36	0.13
Willingness to increase resistance training	0.000	0.99
Health behaviors: diet		
REAP Total Score	0.43	0.52
Willingness to change diet	1.8	0.18

Note. T2D = Type 2 diabetes; RAPA = Rapid assessment for physical activity; REAP = Rapid eating assessment for patients; * = Significant finding $p = < 0.05$.

Table F.2 *ANCOVA Normality Skewness Non-transformed data*

	Control group			Experimental group		
	Standardized Residual Skewness	Standard Error	z-score	Standardized Residual Skewness	Standard Error	z-score
Waist circumference acceptance	-1.02	0.34	-2.98√	-0.83	0.34	-2.43
Waist circumference willingness	-1.51	0.34	-4.41√	-0.2	0.34	-0.59
Perceived susceptibility						
Overall T2D risk	-0.76	0.34	-2.21	-0.14	0.34	-0.41
Waist circumference T2D risk	-1.29	0.34	-3.75√	-1.12	0.34	-3.25√
Body mass index T2D risk	-0.52	0.34	1.53	-1.02	0.34	-2.98√
Perceived benefits						
Totaled waist circumference perceived benefits	-1.18	0.34	-3.4√	-1.73	0.34	-5.03^
Totaled BMI perceived benefits	-0.95	0.34	-2.76√	-1.72	0.34	-5.02^
Health behaviors: physical activity						
RAPA total aerobic score	-1.34	0.34	-3.94√	-0.36	0.34	-1.05
Willingness to increase exercise	-0.91	0.34	-2.64√	-2.69	0.34	-7.85^
RAPA resistance & flexibility training total score	-0.58	0.34	-1.68	-0.56	0.34	-1.63
Willingness to increase resistance training	-1.15	0.34	-3.36√	-1.65	0.34	-4.81√
Health behaviors: diet						
REAP total score	-0.3	0.35	-0.86	-0.15	0.35	-0.43
Willingness to change diet	-0.91	0.34	-2.64√	-0.43	0.34	-1.25

Note. T2D = Type 2 diabetes; BMI = Body mass index; RAPA = Rapid assessment of physical activity; REAP = Rapid eating assessment for patients; √ = Moderately skewed standardized residual z-score = ≥2.58 and < 5.0 or ≤-2.58 and > -5.0; ^ = severely skewed standardized residual z-score = ≥5.0 or ≤-5.0.

Table F.3 *ANCOVA Normality Kurtosis Non-transformed data*

	Control group			Experimental group		
	Standardized Residual Kurtosis	Standard Error	z-score	Standardized Residual Kurtosis	Standard Error	z-score
WC acceptance	1.27	0.67	1.88	0.25	0.67	0.38
WC willingness	2.42	0.67	3.59√	4.16	0.67	6.17^
Perceived susceptibility						
Overall T2D risk	4.03	0.67	6.01^	3.35	0.67	4.97√
WC T2D risk	1.15	0.67	1.70	1.2	0.67	1.77
BMI T2D risk	-0.85	0.67	-1.26	1.47	0.67	2.18
Perceived benefits						
Totaled WC perceived benefits	2.13	0.67	3.16√	8.26	0.67	12.25^
Totaled BMI perceived benefits	0.90	0.67	1.34	5.03	0.67	7.51^
Health behaviors: physical activity						
RAPA total aerobic score	1.66	0.67	2.47	1.07	0.67	1.58
Willingness to increase exercise	0.09	0.67	0.13	9.38	0.67	13.91^
RAPA resistance & flexibility training	3.27	0.67	4.85√	1.41	0.67	2.09
Willingness: increase resistance training	1.81	0.67	2.68√	3.86	0.67	5.73^
Health behaviors: diet						
REAP total score	0.002	0.68	0.003	2.93	0.695	4.21√
Willingness to change diet	0.38	0.67	0.57	-0.13	0.67	-0.19

Note. WC = Waist circumference; T2D = Type 2 Diabetes; BMI = Body mass index; √ = Moderately skewed standardized residual z-score = ≥2.58 and < 5.0 or ≤-2.58 and > -5.0; ^ = severely skewed standardized residual z-score = ≥5.0 or ≤-5.0.

Table F.4 *Homogeneity of variances: Levene's test of equality of error variances, non-transformed data*

	F	*p*
Waist circumference acceptance	2.1	0.15
	5.66	0.02*
Perceived Susceptibility		
Overall T2D risk	0.86	0.36
Waist circumference T2D risk	0.07	0.79
Body mass index T2D risk	11.16	0.001*
Perceived Benefits		
Totaled waist circumference perceived benefits	6.29	0.01*
Totaled body mass index perceived benefits	7.34	0.008*
Health behaviors: physical activity		
RAPA total aerobic score	1.43	2.4
Willingness to increase exercise	1.48	0.23
RAPA resistance & flexibility training total score	0.000	0.99
Willingness to increase resistance training	0.33	0.57
Health behaviors: diet		
REAP Total Score	1.28	0.26
Willingness to change diet	0.79	0.38

Note: RAPA = Rapid assessment of physical activity; REAP = Rapid eating assessment for patients; * = Significant finding $p = < 0.05$.

Table F.5 *Outliers: Posttest standardized residuals, non-transformed data*

	Control group	Experimental group
Waist circumference comfort	-3.37	
Waist circumference willingness	-3.74	
Perceived Susceptibility		
Overall T2D risk	-3.41	-3.75, 3.22
Waist circumference T2D risk		
Body mass index T2D risk		
Perceived Benefits		
Totaled waist circumference perceived benefits	-3.87, -3.09	3.66
Totaled body mass index perceived benefits	-3.42	-3.26
Health behaviors: physical activity		
RAPA total aerobic score		
Willingness to increase exercise		-4.54
RAPA resistance and flexibility training total score	-3.41	
Willingness to increase resistance training	-3.34	-3.69
Health behaviors: diet		
REAP Total Score		-3.7, 3.37
Willingness to change diet		

Note. RAPA = Rapid assessment of physical activity; REAP = Rapid eating assessment for patients; Outliers were identified by standardized residuals that were more than +3 or less than -3 standard deviations.

Appendix G

ANCOVA FINDINGS

Table G.1 *Adjusted and unadjusted intervention means and variability for post-intervention dependent variables with pre-intervention dependent variable as a covariate*

	Control group		Experimental group		
	Unadjusted	Adjusted	Unadjusted	Adjusted	
	M (SD)	*M (SE)*	*M (SD)*	*M (SE)*	Cohen's *d*
WC acceptance	2.58 (0.68)	2.57 (0.08)	2.73 (0.57)	2.74 (0.08)	0.24
WC willingness	4.58 (0.85)	4.63 (0.07)	4.85 (0.41)	4.8 (0.07)	0.41
Perceived susceptibility					
Overall T2D risk	1.79 (0.77)	1.92 (0.07)	2.21(0.8)	2.09 (0.07)	0.53
WC T2D risk	2.5 (0.68)	2.52 (0.09)	2.6 (0.61)	2.59 (0.09)	0.16
BMI T2D risk	2.31 (0.8)	2.35 (0.09)	2.6 (0.54)	2.57 (0.09)	0.43
Perceived benefits					
Totaled perceived WC benefits	4.06 (1.86)	4.17* (0.19)	5.02 (1.25)	4.91* (0.19)	0.63
Totaled perceived BMI benefits	3.92 (2.01)	4.07* (0.21)	4.98 (1.39)	4.83* (0.21)	0.61

Note. WC = Waist circumference; T2D = Type 2 diabetes; BMI = Body mass index; M = Mean; SD = Standard deviation; SE = Standard error; * = utilized in Bonferroni post hoc analysis.

Table G.1 continued

	Control group		Experimental group		
	Unadjusted	Adjusted	Unadjusted	Adjusted	
	M (SD)	*M (SE)*	*M (SD)*	*M (SE)*	Cohen's *d*
Health behaviors: physical activity					
RAPA aerobic score	4.56 (0.68)	4.5 (0.09)	4.58 (0.92)	4.64 (0.09)	0.03
RAPA resistance and flexibility training	2.75 (1.36)	2.83 (0.16)	3.02 (1.6)	2.94 (0.16)	0.21
Willingness to increase exercise	4.17 (0.93)	4.15* (0.12)	4.6 (0.82)	4.62* (0.12)	0.5
Willingness to increase resistance training	3.9 (1.1)	3.9 (0.14)	4.25 (1)	4.24 (0.14)	0.37
Health behaviors: diet					
REAP total score	59.28 (7.16)	58.94 (0.7)	57.56 (8.26)	57.9 (0.71)	0.22
Willingness to change diet	4.33 (0.75)	4.36 (0.1)	4.52 (0.74)	4.49 (0.1)	0.25

Note. RAPA = Rapid assessment physical activity; REAP = Rapid eating assessment for patients; M = Mean; SD = Standard deviation; SE = Standard error; * = utilized in Bonferroni post hoc analysis.

Table G.2 *ANCOVA non-transformed and square root transformed data output*

	Non-transformed			Square root transformation		
	F	*p*	Partial η^2	*F*	*p*	Partial η^2
WC comfort	2.42	0.12	0.03	2.59	0.11	0.03
Perceived susceptibility						
WC T2D risk	0.35	0.55	0.004	0.64	0.43	0.007
BMI T2D risk	2.83	0.1	0.03	2.17	0.01	0.02
Health behaviors: physical activity						
RAPA total aerobic score	1.18	0.28	0.01	1.11	0.295	0.01
RAPA resistance & flexibility training total score	0.42	0.52	0.004	2.35	0.13	0.03
Health behaviors: diet						
REAP total score	1.08	0.3	0.01	1.06	0.31	0.01
Willingness to change diet	0.86	0.36	0.01	0.99	0.32	0.01

Note: WC = Waist circumference; BMI = Body mass index; T2D = Type 2 diabetes; RAPA = Rapid assessment physical activity; REAP = Rapid eating assessment for patients; * = Significant finding $p = < 0.05$.

Table G.3 *ANCOVA non-transformed and log transformed data output*

	Non-transformed			Log transformation		
	F	*p*	Partial η^2	*F*	*p*	Partial η^2
WC willingness	2.85	0.1	0.03	3.09	0.08	0.03
Perceived susceptibility						
Overall T2D risk	2.65	0.07	0.03	2.87	0.09	0.03
Perceived benefits						
Totaled WC perceived benefits	7.71	0.01*	0.08	7.36	0.01*	0.07
Totaled BMI perceived benefits	6.61	0.01*	0.07	7.23	0.01*	0.07
Health behaviors: physical activity						
Willingness to increase exercise	7.48	0.007*	0.07	9.82	0.002*	0.09
Willingness to increase resistance training	2.86	0.09	0.03	3.06	0.08	0.03

Note. T2D = Type 2 diabetes; WC = Waist circumference; BMI = Body mass index; * = Significant finding $p = < 0.05$.

Appendix H

TABLE OF ABBREVIATIONS

Table H.1 *Abbreviations*

Abbreviation	Complete Term
ACSM	American College of Sports Medicine
ADA	American Diabetes Association
ANCOVA	One-Way Analysis of Covariance
BMI	Body Mass Index
CVD	Cardiovascular Disease
CDC	Centers for Disease Control and Prevention
DV	Dependent variable
DVD	digital video disc
HgbA1C	glycosylated hemoglobin A1C
HBM	Health Belief Model
IDF	International Diabetes Foundation
IRB	Institutional Review Board
MMC	Modern Maturity Center
MDPP	Medicare Diabetes Prevention Plan
NCHS	National Center for Health Statistics
NHANES	National Health and Nutrition Examination Survey
NHLB	National Heart, Lung, and Blood Institute.
NIA	National Institute on Aging
NSC	Newark Senior Center
OGTT	Oral Glucose Tolerance Test
PC	Primary Care
PCP	Primary Healthcare Provider
PI	Primary Investigator
RAPA	Rapid Assessment of Physical Activity
REAP	Rapid Eating Assessment for Patients
RDA	Recommended Dietary Allowance
RWJF	Robert Wood Johnson Foundation
TTM	Transtheoretical Model
T2D	Type 2 Diabetes
U.S.	United States
WC	Waist Circumference