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Formative evaluation of intervention methods designed to improve behavior change strategies

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Formative evaluation of intervention methods designed to improve behavior change strategies

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CHAPTER 1. INTRODUCTION

Despite considerable public health efforts, obesity remains a major problem in the United States.[1] This complex condition is most often the result of gradual body weight gain, that is caused by an imbalance between energy expenditure (physical activity) and energy intake (dietary behavior) and poses a risk for various chronic conditions including diabetes, hypertension, high cholesterol, stroke, heart disease, and certain cancers.[2-3] Preventing and treating obesity comes with many obstacles and often methods used are unsuccessful in creating sustained weight loss. Clinical and commercial weight loss interventions can produce short-term weight loss, but one-third of people regain their lost weight in the first year and continue to regain over time.[4] Most are not able to recover from even a 1 to 2 kg gain in weight.[5] The primary method for obesity treatment remains lifestyle changes aimed at reducing caloric intake and increasing physical activity. The American College of Sports Medicine has recommended that overweight and obese individuals engage in aerobic exercise of at least 150 min/week, and that this should be increased to 200–300 min/week.[6] Furthermore, it is the position of the Academy of Nutrition and Dietetics that successful weight management to improve overall health for adults requires a lifelong commitment to healthful lifestyle behaviors emphasizing sustainable and enjoyable eating practices and daily physical activity.[7]

According to the Center for Disease Control, less than half of adults in the United States meet the 2008 Physical Activity Guidelines.[8] In addition, data suggests that at least 25% of adults in America are completely inactive.[9] Physical activity is known to provide many health benefits, including a reduced risk of coronary heart disease, stroke, type II diabetes mellitus, metabolic syndrome, and many types of cancers.[10-12] Furthermore,

physical activity has even been shown to provide protection against the health risks associated with obesity.[13] This suggests that by improving the physical activity practices of adults, the overall health of the population could be improved. It is critical that methods for sustaining a change in lifestyle behaviors are implemented when working with individuals to change eating and physical activity practices.

One popular method for improving the diet and physical activity practices of adults is to target worksites. The worksite presents extensive opportunities to reach a large captive audience for health promotion and disease prevention, given that most of the adult population is employed.[14] Lowering excessive body weight, increasing physical activity, lowering cholesterol and blood pressure have become a primary objective of worksite health promotion programs[15], as these are not only health risk factors, but also risk factors for increased health care expenditure and absenteeism among employees.[14]

The worksite can be an extremely influential setting to implement a health education program and improve health behaviors.[16-18] Building upon the natural social support network that may exist among employees in a worksite can increase each participant's chance of success at positively changing their behavior.[19-20] Furthermore, a variety of different programs can be designed to specifically meet the needs of the population and ideally develop positive health behaviors with the goal that they may carry over into the individual's personal life resulting in overall improvement of health.

Several studies have shown success in combined diet and exercise programs.[14, 21-24] However, it is important to determine which type of programs work the best to improve health and create positive health behavior changes. Programming strategies range from modest, "lunch and learn" programming[25] to more comprehensive health coaching

programs.[15] Personalized health coaching, in particular, is becoming an increasingly popular method of intervention.[17-18] Studies have demonstrated the effectiveness of lifestyle coaching at promoting positive behavior change, improving clinical outcomes and providing a positive return on investment.[26-31] While results have been promising, it is important to find more cost-effective ways to deliver worksite interventions. Recent advantages in technology offer promise, so it may be beneficial to look closer at interventions that can utilize technology to create behavior change while taking advantage of worksites as the avenue for delivery.

On-line health and lifestyle coaching, self-monitoring devices and text messaging and smart phone applications are amongst a few technological methods that can be used to improve the effectiveness of worksite wellness programs. New web-based approaches have shown considerable promise for delivering weight loss interventions over the Internet.[32,33] Successful online obesity treatment programs have targeted reduced energy intake, increased physical activity, and cognitive-behavioral strategies including personalized feedback, self-monitoring, and social support. The new generation of personalized activity monitors also offers potential for promoting self-monitoring and behavior change. Self-monitoring increases awareness of energy intake and expenditure, enhances self-efficacy, and allows for individuals to monitor progress and change over time.[34] There are a number of monitors on the market but the SenseWear® Pro Mini-Fly Armband (BodyMedia, Inc), is a particularly promising tool, as it provides individuals with an easy way to monitor and track physical activity, diet behavior and weight loss efforts. Studies have supported the utility of the armband as a self-monitoring tool.[35-36], but additional work is needed to determine the best strategies for using this technology. Another new intervention option

lies with the use of text messaging, as cell phones are now widely used by many adults. Prompts through text messages have shown promise in communicating health information and prompting behaviors as part of a worksite program.[37-39] Continued research is needed to evaluate the benefit of using technology based intervention in worksite programs geared toward health and lifestyle modifications.

The present study builds on a line of research with the SenseWear armband monitor focused on building sustainable health promotion programming in worksites. The SenseWear® Armband (SWA) was used independently, in combination with text messaging prompts or paired with on-line health coaching (ProConnect) to evaluate the relative value of incorporating these strategies into the programming. This study was conducted as a formative evaluation to specifically examine the feasibility of the approaches and to identify and test a battery of potential mediators that could be used to evaluate behavior change with this approach. A detailed literature review will provide additional information and provide a rationale for the proposed study.

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CHAPTER 2. REVIEW OF LITERATURE

Obesity continues to be a persistent problem amongst adults in the United States and worldwide. In the United State alone, 68% of adults are overweight or obese.[1] Worldwide, since 1980, obesity has nearly doubled. In 2008, more than 1.4 billion adults were overweight and of these over 200 million men and nearly 300 million women were obese.[2] Obesity presents risks for an array of chronic disease conditions including heart disease, high blood pressure, stroke, diabetes and certain types of cancer.[3] These diseases lead to a tremendous financial burden on the obese individual due to health care costs associated with managing these conditions. In 1998, an obese individual paid 37% more in health care costs than a normal weight person, whereas in 2006 this cost difference jumped to 42%.[4]

Obesity is preventable, and for those suffering from this condition it is also treatable. However, the methods for accomplishing this are complex and need to address multiple levels, from policies to individual interventions.[5] There are countless programs and facilities available to help adults achieve weight loss. Some focus specifically on physical activity (fitness centers, Curves) and others focus solely on diet (Weight Watchers, NutiSystem), but few incorporate both aspects and even less adopt a behavior change feature. Effective weight control interventions use a combination of reduced calorie intake, increased physical activity, and behavior therapy.[6] For an individual to achieve successful weight management, they must implement a life-long commitment to healthy behaviors related to eating and physical activity.[7] In order to accomplish this, it is important for an intervention to include a behavior change component. The most established strategy for

promoting behavior change in clinical research is motivational interviewing. Therefore, this is discussed in the following section.

Motivational Interviewing

One method used to promote behavior change is Motivational Interviewing (MI). This method works by activating an individual's own motivation for change and adherence to teatment.[8] This is called autonomous motivation, which more efficiently elicits and sustains change over time because the motivation to change is self-driven rather than by the instruction of others.[9] Traditional counseling methods often consist of a health care professional such as a dietitian, physician or personal trainer educating the client/patient about a topic or health concern and providing the individual with recommendations to change their behaviors and improve their health. Motivational interviewing, however, evokes a conversation with the patient and encourages the development of independent methods for a behavior change. It is a communication style that uses specific techniques and strategies such as reflective listening, shared decision-making, and eliciting change talk. Specific advice is given only if the patient/client asks or if the professional asks permission from the individual to provide information or advice. One major goal of MI is to assist individuals in working through their ambivalence or resistance about behavior change.[10] There are four major processes involved in most MI applications: engaging the patient; focusing on an issue; evoking the patient's thoughts on the matter; and planning what to do about it.[11] Each of these processes contributes to goal of working through one's ambivalence and moving toward a sustained behavior change.

More than 200 MI trials have been published and they have been summarized in

various reviews [12-19] In general, MI has proven to be more effective than standard behavioral counseling and as effective as more expensive Behavioral Cognitive Therapy techniques. Studies have even shown that it is more effective than some pharmacological therapies in specific cases.[8] Overall, early motivation in an intervention program has shown positive results regarding weight loss and weight maintenance.[20-26] The American Heart Association even recommends MI as an effective intervention method for weight loss up to 6-months.[27-28] Furthermore, the use of motivation in intervention programs has also shown to increase participation in self-monitoring aspects of interventions including on-line food, exercise and weight diaries.[29] Application of this behavior change method was first used as a brief intervention for problem drinking.[8] MI later evolved to become a useful treatment method for other health problems including chronic disease, diet, physical activity, and weight loss.

A study conducted at Arizona State University used Motivational Interviewing to determine its success in changing behaviors toward fruit and vegetable intake. Motivational interviewers were extensively trained in MI and sessions were recorded to track MI techniques used as well as the client change process including change talk. Results showed that accurate use of MI predicted firefighters' expression of intentions to make positive changes, which, in turn predicted an increase in fruit and vegetable intake.[9]

As mentioned earlier, obesity poses several risk factors for disease, including cardiovascular disease and type 2 diabetes. In order to improve risk factors, weight loss is important. Several recent studies have explored the use of motivational interviewing as a weight loss intervention. One study showed a significant increase in frequency of walking, a significant decrease in caloric, fat and carbohydrate intake and an overall reduction of

weight in participant who received motivational interviewing as part of their intervention.[30] In addition, a study looking specifically at women with type 2 diabetes showed promising results in reduction of weight and improvement of disease characteristics when MI was used in the intervention. Those in the MI intervention group lost significantly more weight than those in the control group without MI. Furthermore, weight loss in the control group remained stable for 6-months with no regain by month 12. Women in the MI intervention group also showed significantly greater improvement of A1c values than those in the control group.[31] Finally, a study conducted at the University of Brihton in the United Kingdom looked at the effects of a motivational interviewing intervention on weight loss, physical activity and cardiovascular risk factors. Participants exhibited one or more risk factors of cardiovascular disease (excess weight, hypertension, hypercholesterolemia) and received either a standard intervention of diet and physical activity education plus motivational interviewing sessions from a dietitian and physical activity professional or the standard education only. Upon completion of the 6-month intervention, results showed an overall improvement in walking and cholesterol levels for those who received motivational interviewing sessions. Furthermore, participants who were obese and/or had hypercholesterolemia showed greater improvements in Body Mass Index (BMI) and cholesterol levels when MI was included in the intervention. In addition, walking and cholesterol improvements were maintained at 12-months.[32]

While motivational interviewing was originally used to help treat substance abuse in a more traditional counseling setting, it is evident that it can be a successful intervention method for improving other health issues. It is now used in a variety of settings, including hospitals, private nutrition counseling, exercise facilities and even worksite wellness

programs. The next section will provide additional detail regarding worksite programming.

Worksite Wellness Programs

The worksite has been identified as an influential setting where health education can take place and health behaviors can improve[33, 34] With employees spending most of their time in the workplace, worksite wellness programs can be an effective method for educating and motivating individuals to make positive changes to improve their health. A 2013 survey reported that 77% of large manufacturing employers (500-4.999 employees) and 53% of smaller employers (50-499) offer worksite wellness programs focused on disease prevention and 62% and 43%, respectively offer behavior modification programs.[35] Lowering excessive body weight, increasing physical activity, lowering cholesterol and blood pressure have become a primary objective of worksite health promotion programs,[36] as these are not only health risk factors, but also risk factors for increased health care expenditure and absenteeism among employees.[37] In the worksite, obesity is largely associated with absenteeism, sick leave, disability, injuries and health claims.[38] Furthermore, research has shown that the costs of absenteeism as well as the lack of productivity related to chronic conditions of employees are often greater than the direct medical costs from these conditions.[39, 40] With more than 60% of Americans get their health care coverage through their employer,[41] worksite wellness programs not only benefit the employees, but the worksite as a whole.

A small worksite study of healthy but sedentary employees implemented an intervention to increase physical activity. The intervention implemented an exercise

prescription of 150 minutes per week as well as a behavior change program. The behavior change program included general health education seminars, one-on-one counseling and a health/wellness manuals or handouts. Results of this study showed significant improvements in waist circumference and aerobic fitness, but not in body mass or body mass index.[37] Another study implemented an intensive lifestyle intervention to improve nutrition and physical activity behaviors, as well as chronic disease risk factors. After a 6-week intervention, results of this study showed significantly lower body fat, blood pressure and cholesterol among participants. Results also showed improved cognitive understanding of nutrition and physical activity, as well as nutrition and physical activity behavior. Additionally, these behaviors continued through a 6-month follow-up.[42] These studies show that worksite interventions can improve health behaviors and improve disease risk factors of employees. However, it has proven difficult to build cost effective programming that can address the diverse range of employee health promotion needs. Personalized wellness/health coaching offers a possible solution and these approaches have become more common in worksites.

Health/Lifestyle Coaching

There are a variety of worksite wellness program designed to improve health behaviors related to overweight and obesity, including low physical activity and poor nutrition. These include seminars, lunch-and-learns, physical activity programs, and health manuals/handouts. Lifestyle coaching is a fairly new method that is becoming an increasingly popular in worksite wellness interventions.[33, 34]

Studies have demonstrated the effectiveness of lifestyle coaching at promoting positive behavior change, improving clinical outcomes and providing a positive return on

investment.[43-48] Atlantis et al conducted a simple worksite intervention study to compare physical health outcomes (waist circumference, body mass, BMI, and predicted VO_{2max}) of employees (N=73) receiving a behavioral intervention program at the worksite to provide health education seminars, one-on-one counseling and exercise prescription, and those receiving no health intervention, nutrition education or encouragement to exercise. As expected, the group receiving the intervention showed greater improvements than those without the intervention, with the greatest improvements in waist circumference, and VO2max.[37] A larger study (N=1401) delves deeper to look at a variety of different intervention methods and focuses on different methods for communication with employees. Prochaska et al looked at improving four health risk factors (stress, exercise, smoking and BMI). Groups received either a health risk assessment and intervention only (HRI), online HRI plus Transtheoretical Model-tailored communications (TTM), or online HRI plus Motivational Interviewing-based health coaching (MI). The HRI group provided participants with a health risk assessment and provided a single step they could take to begin progressing toward changing their behavior to improve the health risks. The TTM group received the same feedback as explained above, but in addition, received feedback specifically tailored to each individual. This was done online, and participants could interact with up to four tailored programs (stress, exercise, smoking, and weight management), depending on their risk. The MI group, in addition to the HRI, received MI-based health coaching. This was done face-to-face or over the telephone. The initial session was 30-45 minutes, with two follow-up sessions of 10-15 minutes each. The interesting aspect of this study is that the authors looked at the percentage of participants in each group who progressed from being at risk in one of the categories to taking effective

action. The stage of change for participants in each group was determined in the initial health risk assessment and intervention methods were geared toward helping them progress forward through the stages of change. Results of this study concluded that the addition of MI and TTM can result in greater behavior change, specifically showing a greater percent of those who were at risk in the area of stress (78.2% and 73.9%, respectively) and exercise (46% and 45.2%, respectively) had moved to the action stage, compared to the group receiving HRI alone (stress: 61.6%, exercise: 35.1%).[49]

Although lifestyle coaching, or health coaching is often done face-to-face, new methods using the Internet are becoming more popular, as illustrated in the study summarized above. There are, however, several barriers that may hinder the implementation of face-to-face programs. Often, clinicians simply do not refer patients for professional help and most personalized counseling approaches are not covered by insurance. The cost and burden associated with in-person counseling contributes to the continued challenge of implementing face-to-face programs.[50, 51] Furthermore, previous worksite wellness studies have reported low compliance and/or high dropout rates due to "lack of time."[37] Methods for better application of health interventions, such as health coaching need to be explored. With successful application of this type of intervention, perhaps issues with compliance and success can be overcome. A potentially promising solution would be to incorporate wellness coaching with other technologies.

Technology and Self-Monitoring

Remote healthcare programs using the Internet have the potential to overcome some of these barriers. They can be used in direct conjunction with other approaches, serve

as an accessory component or provide completely independent alternative for behavior change and weight control programming.[52] Along with the growing use of the Internet worldwide, these programs have the ability to provide information to many individuals at a relatively low cost and with high anonymity.[53]

Recent systematic reviews of randomized controlled trials of weight loss have concluded that weight loss interventions can be effectively delivered over the Internet.[54, 55] Successful online obesity treatment programs have targeted reduced energy intake, increased physical activity, and cognitive-behavioral strategies including personalized feedback, self-monitoring, and social support. Results for these types of programs may be enhanced by including more developed self-monitoring techniques such as physical activity monitors that can be worn by individuals to more accurately record an individual's daily activity as well as create accountability for the user.

Several recent studies have demonstrated the potential utility of a physical activity monitor called the SenseWear® Pro Mini-Fly Armband (BodyMedia, Inc) for use in behavior change programming. A study done at the University of South Carolina looked at the possible benefits of using the armband to improve weight status and waist circumference[56], as well as cardiometabolic changes including blood lipid levels, blood pressure and blood glucose.[57] This study compared those who received group weight loss education, those who wore the armband without group education, and those who received both interventions. Results showed that those with an armband had significantly larger weight and waist circumference reductions compared to those without an Armband.[56] Each group showed some weight loss and reduction in waist circumference, but those who received some method of intervention showed a greater change. Participants who received

standard care without intervention showed a reduction in weight from 102.22kg (mean standard error=2.97) to 101.32kg (3.05), and waist circumference change from 106.26cm (2.19) to 102.77cm (2.28) at nine months. Participants in the groups receiving weight loss education only, the armband only, or both the weight loss education with the armband showed greater changes in weight loss of 101.84kg (2.95) to 99.8kg, 101.15kg (2.95) to 97.60kg (2.99) and 100.32kg (2.97) to 93.73kg (2.99), respectively. Greater changes in waist circumference were also shown in groups receiving only the armband intervention [108.29cm (2.18) to 105.87cm (2.24)], with the greatest change shown in the group receiving both intervention methods together [106.04cm (2.19) to 99.27cm (2.22)]. Furthermore, the group that received both the armband and group nutrition education showed the highest reduction in glucose levels after nine months (12.59 mg/dL). This suggests that the incorporation of armband technology into weight loss interventions can be an effective strategy to lower fasting glucose.[57]

A similar study conducted at Iowa State University compared weight loss and behavior change outcomes amongst participants who received weekly health coach meetings using a behavior change curriculum (BonSanté), an armband, or both interventions.[58] At eight weeks, results showed weight loss in all three groups with the largest change in the group receiving both interventions. The guided weight loss group showed a reduction in weight of 3.69 kg (SD=3.14), the armband only group showed a 4.05 kg (2.87) loss and the combination group showed a loss in 4.88kg (3.21). The results of this study showed that the use of the armband, as a self-monitoring device, could be beneficial as an intervention tool for facilitating weight loss and behavior change. There were no significant differences among the three groups but there were trends for more favorable

outcomes for the group receiving both the armband and the health coaching. Therefore, it is possible that using the armband in combination with health coaching intervention could enhance the effectiveness.[58]

Continued research is needed to evaluate the benefit of using Internet based interventions and self-monitoring techniques for adult health promotion programming. It may show promise to utilize the popularity of the Internet and success of health/lifestyle coaching to develop an online health coach program combined with self-monitoring techniques. This tactic may prove to overcome barriers of previous interventions including cost and time commitment and improve compliance and success rates.

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CHAPTER 3. METHODS

Project Overview

The purpose of this study was to test methods and measures that may provide utility for coordinated wellness programming. The study builds on an established line of work on behavior change programming that utilizes unique capabilities of an advanced physical activity monitor called the SenseWear® Pro Mini-Fly Armband (BodyMedia, Inc). The SenseWear is a non-invasive monitoring technology that uses a pattern recognition technology to accurately assess physical activity and energy expenditure throughout the day. It provides detailed information about physical activity levels, steps walked, as well as an indicator of sleep efficiency. The data from the monitor can be uploaded into a web tool (BodyMedia FIT 3.0) to show data on behaviors over time. The software also provides a detailed dietary assessment tool to help individuals monitor food consumption and energy intake. The armband and associated software provides a way for individuals to monitor and track physical activity, diet behavior and weight loss efforts.

Methods

Design: The study was conducted in partnership with a local food company (Barilla Pasta). The protocol for this study was built upon a previous study completed during fall of 2012 with another local company (National Centers for Animal Health).[1] This study used the SenseWear armband along with health coaching and text messaging prompts to measure behavior change related to physical activity. The health coaching in the previous study was done using the associated ProConnect software that comes with the armband monitor. The programming was well received by the participants in the previous study but

some logistical challenges made it difficult to engage the participants in the health coaching. The text messaging protocol was also not customized for each participant and this may have prevented it from being as effective as possible. The present study builds on this model but used a slightly different design.

The previous study focused only on physical activity behavior where this study enabled participants to choose one of three target behaviors (physical activity, diet or weight control). The provision of choice is a novel intervention strategy but it is consistent with principles of motivational interviewing (MI). The expectation is that participants will be more focused on lifestyle change if they actively chose the behavior that they want to work on. A second difference with the most recent design is that participants had a choice for how they will be guided in the program. Participants were allowed to choose whether they would like to follow an independent path, be guided by health coaching or receive supplemental health prompts via text message. Again, according to the principles of MI, the provision of choice is thought to help participants be more committed to their behavior change programming. A final difference is that this study included an additional goal setting session to help participants establish individual goals to pursue throughout the duration of the study. Therefore, this study extends the previous project by evaluating the potential of health coaching and text messaging to supplement the self-monitoring features of the SenseWear monitor.

The primary focus of the evaluation is on identifying the strategies that participants report using as a result of the behavior change process. As described by Baranowski, a fundamental gap in current knowledge of behavior change is a lack of knowledge about the mediating variables that influence behavior change. Baranowski et al. proposed a model

(The Mediating Variable Model), which describes the role of mediating variables in the behavior change process. The authors point out four key implications of the model. *"(a) behaviors need to be selected that are maximally and causally related to the health outcomes of concern (or else the health problems will not change); (b) ecological, social and psychological mediators (in the context of known biology) need to be selected that are maximally and causally related to the behavior (otherwise change in mediators will not result in sufficiently large changes in behavior); (c) mediators need to be selected that are highly predictive of the behavior (otherwise substantial changes in the mediators may result in only small or no changes in the behavior); and (d) intervention procedures need to be identified or developed that effectively manipulate the mediators at acceptable levels (or else participants will not receive an effective intervention dose)".*[2]

This study specifically addresses this last need by testing the relative effectiveness of different mediating variable change procedures. The authors refer to this type of formative evaluation as an "Intervention Procedure Validation." Consistent with this approach, the overall goal of this evaluation was to study the behavior change strategies that participants used as a result of the programming rather than quantifying the magnitude of behavior change itself. Process data was compiled by evaluating the use of the SenseWear monitor and the responsiveness and compliance with health coaching and text message prompts. Analyses focused on evaluating the extent to which participants used different behavior strategies.

Assessments and Measures:

Behavioral strategies used by participants were assessed using a comprehensive battery of behavioral measures developed by Nothwehr.[3-5] The battery includes nine different scales, each scored on a 4-point likert scale. Two scales capture self-regulation processes (Self-monitoring of diet and self-monitoring of physical activity). Seven scales capture distinct behavioral strategies common in weight management research.[5] The specific survey items (3 to 6 per scale) were based on a previously published social cognitive framework,[6] which has been shown to have utility in weight management research.[7] The psychometrics of the scales have been well established, as well. Test retest reliability of the scales based on intraclass correlation coefficients ranged from .62 to .85.[4] Alpha reliability of the scales ranged from .69 to .93.[4] Validity was demonstrated using cross sectional associations with measures of diet and physical activity behavior in a representative sample of adults in Iowa.[5] The associations of specific physical scales were most strongly related to physical activity outcomes and diet scales were more strongly related to diet outcomes. Collectively, the scales explained 23% of variance in diet outcomes and 29% of variance in the physical activity outcomes. (See Appendix A for the final behavior survey used in this study).

An advantage of these measures is that the previous studies have demonstrated that these variables are related to the behaviors in question. Baranowski et al. referred to this phase of work as a Targeted Mediator Evaluation.[2] The previous work by Nothwehr demonstrates that these measures relate to the behaviors measured. The present study evaluated if these mediators can be changed with feasible and practical behavior change strategies.

Procedures: Approval from the Institutional Review Board was received and participants were recruited from within the company using internal flyers and an information session given by the lead graduate research assistant. Interested participants were scheduled for appointments with the research team and these were conducted onsite. Each initial appointment lasted approximately 60 minutes. During the first appointment, the participant was presented with the informed consent to participate and a copy of the same was provided to them. Details on the visits are provided below.

Visit 1 determined eligibility to participate in the study and included collection of baseline data (if eligible). Eligibility was determined using a standard clinical exercise screening tool called the **Physical Activity Readiness Questionnaire (PAR-Q).** This instrument includes 7 simple yes/no questions that help to determine if a participant can safely participate in a physical activity intervention. If the participant was eligible, they completed the following measurements.

- **Demographic and Screening Questionnaire:** This form collects basic demographic information such as gender, age and race. It also includes questions about potential medical issues that may influence eligibility in the study.
- **Anthropometric and Clinical measurements (height, weight, waist circumference, body fat and blood pressure):** The anthropometric measurements were conducted in a private room and a maximum of two researchers on the project were present when these measurements were taken. For height measurements, the participants were asked to remove their shoes and the measure was then taken using a standard stadiometer. For weight, the participant

was asked to take off all heavy clothing items including coats, sweatshirts, heavy belts etc. This measure was obtained using a standard electronic scale. For waist circumference, the participant was asked to lift up their shirt and the measurement was taken at the height of the navel with a tape measure. For overweight participants where the navel was not visible, the individual was asked to point out the navel and the researcher measured 4 inches above this point. For body fat measure, the participant was asked to grip the handles of a simple bioelectric impedance analyzer (BIA). This instrument estimates body fat based on the resistance to current flow in the body. Users of this instrument do not feel any current and the device is completely safe. For blood pressure measurement, the participant was instructed to sit quietly and comfortably for 10 minutes after which the first set of two blood pressure and pulse rate measurements were be taken. They were then asked to sit quietly and comfortably for another 10 minutes and a second set of blood pressure measurements and pulse rate were taken.

• **Survey measurements**: Each participant was instructed to complete a behaviorally-based survey to assess behavioral strategies that they have used to monitor and regulate their health behaviors.

Each participant was provided with a SenseWear armband monitor to use during the study. A researcher registered each participant for a BodyMedia FIT account and provided verbal and written instructions as to how to use the monitor and guidelines for uploading the data into the associated BodyMedia FIT software. The participant was instructed to wear the armband 24 hours per day for the subsequent week (to monitor physical activity patterns) and to enter information

regarding dietary intake using the associated diet management software. This information was critical for helping the research team understand the participants' current lifestyle habits with regard to diet and physical activity. The participant was informed that the data on the tool would be shared with them during the second visit. Participants would then be encouraged to continue using the monitor and diet monitoring tools throughout the duration of the study, but the use of these tools would depend on the goals they chose to pursue and on recommendations from the health coach.

Each participant was provided with all information needed to participate in the study during this first visit. The time commitment of the project varied between each individual based upon his or her personal interest and use of the monitor. The participants were informed that at visit 2, they would set their own goals and for the duration of the study and would be provided with the support needed to use the monitor and the software to assist in their effort to reach their goal.

Visit 2. The second visit was an individualized visit with a registered dietitian (health coach) and was designed to help the participant set goals based on the first week of data collection. Each participant completed a lifestyle screening assessment and discussed the assessment along with the data from the first week of SenseWear monitor with the dietitian. The dietitian then worked with the participant to decide upon a behavior change goal (diet, physical activity, weight management). The goals could change over time but the process of selecting a goal enabled the participant to focus on making a few key changes that were most important to the individual. Participants in the study all received the

SenseWear armband but they were given the choice to focus on different goals and to receive support through different methods (armband only, armband + health coaching or armband + text messaging). The goal of the formative evaluation was to determine what behavior change processes people use in trying to change their lifestyle.

Each participant was able to choose one of 3 options:

Option 1 (Self-Guided): In this option the participant wore the SenseWear armband (SWA) monitor and utilized the built in feedback to help monitor their progress toward their goals.

Option 2 (Health Coaching) = SWA + HC: In this option the participant used the SenseWear monitor in the same way as Option 1 but was provided access to an interface within the software that enabled the participant to share data and communicate with one of the dietitians involved in this study. Participants in this condition corresponded with the dietitian via ProConnect, which is an email system through BodyMedia FIT. Participants were instructed to interact with the dietitian at least once per week for optimal results. The dietitian used motivational interviewing techniques to engage the participant, focus on issues related to their goal, evoke the participants thoughts and feelings on certain issues and help them make a plan to reach their goal.

Option 3 (Text Messaging) = SWA + TM: In this option the participant used the SenseWear monitor in the same way as in Option 1 but was provided with access to a personalized text messaging service that would help prompt them to take and maintain action related to their individual goal. If a participant chose this option

they received two supplemental text messages per week and were required to accept any fees for these messages, as it would come to their personal cell phone. At least one of the two text messages sent each week required a response from the participant. This helped to ensure the text messages were actually being read and helped to encourage action by the participants. (See Appendix B for examples of text messages used in this study).

Thus, at the end of the second visit, each participant had chosen a specific health related goal to work toward and was provided with instructions on how to monitor their behavior over the subsequent 8 weeks. Each participant also selected which option they would like to use to assist in their health behavior change (See Table 1 for intervention groups). The participant would complete a survey of the current strategies used to monitor diet and physical activity as well as a survey that assessed the reasons for wanting to change the specific behavior chosen (diet, physical activity or weight loss).

Visit 3. The third and final appointment took place 8 weeks later (or approximately 9 weeks after the first appointment). The participant completed the same measurement protocol as the first visit (Anthropometric measurements, blood pressure, and surveys). The participants were then asked to return the armband.

(See Appendices C and D for project surveys)

Analysis

The researchers examined the impact of different behavior change strategies for facilitating self-monitoring of health behaviors. While the focus of many behavior change studies is on changing behavior, the present study focused on better understanding the behavioral change strategies that people use to monitor their lifestyles.

The Nothwehr et al.[5] survey provides a useful tool for examining behavior change. The instrument includes nine scales examining individual behavior change (diet monitoring, activity monitoring, meal planning, meal preparing, meal portion, diet social, activity social, diet cognitive, activity cognitive). To test changes, pre and post scores were recorded and change scores were computed for each scale for each participant by subtracting the pre value from the post value. Mean changes were computed for each Goal Group (diet, physical activity, weight) and for each treatment method (armband only, armband + health coaching and armband + text messaging).

Preliminary analyses of the means revealed little difference when examined across methods. In order to increase the sample size for better comparison of change, the data from the treatment methods were combined. This allowed the analysis to focus on the differences in strategies used by all participants, independent of intervention method, for each goal.

The evaluation of nine distinct scales in the Nothwehr instrument would enable distinct strategies to be examined. However, the number of comparisons and scales makes it difficult to draw clear inferences. A closer examination of the items revealed that they conceptually related to the three specific constructs or areas of behavior change (diet, activity and meal change). To determine if the individual scales can be combined into a broader construct, a confirmatory factor analyses was performed. Three separate analyses were conducted to determine if the items on the component scales loaded on a single factor (rather than 3 separate scales). Standard criteria were used to examine the factor structure

and alpha reliability of the component scales and were computed to report the overall internal consistency of the scale.

Changes in reported use of the behavior change strategies were examined using separate One-way ANOVAs. Analyses were run, first for the combined sample and then for each of the three goals to see if adoption of strategies varied by choice of goal. It is possible that overall changes in scale scores could hide important changes in the individual behavior change items. Therefore, changes were also computed for individual scales in the battery and reported as effect sizes.

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CHAPTER 4. RESULTS

Fifty-three participants from Barilla Pasta were enrolled in the study, with forty-one (10 males and 31 females) completing the 8-week intervention. The reasons for dropout included issues with the armband [(inaccurate readings, uncomfortable to wear, hassle to sync and charge) (n = 5)], time constraints (n = 4), and loss of interest (n = 3). Of the 41 that completed the study, thirty individuals worked daytime hours and eleven were overnight employees. Eighteen participants chose to complete the study using the SenseWear armband alone (Self-monitoring group), six chose to participate in the online health coaching option using ProConnect along with the armband, and seventeen chose to receive text messages along with use of the armband. Of the self-monitoring group, 8 chose a goal related to diet, 4 chose a physical activity goal and 6 chose to work on weight management. Those in the ProConnect group included 4 participants with a physical activity goal and 2 with a weight management goal. No one in this group chose a diet goal. Finally, of those in the text-messaging group, 6 chose a diet goal, 4 wanted to improve their physical activity and 7 indicated they wanted to work on weight management. The breakdown of enrollment is summarized in Figure 1.

Participants completed the intervention in a single cohort during the spring of 2013. The average age of the participants in this intervention was 41 years of age and ranged from 24 to 66 years. The mean body weight of participants at baseline was 220.59 +/- 29.2 lbs. Body mass index (BMI) at baseline was 31.75 +/- 7.84 kg/m^2, which is classified as obese according to the standard (>30kg/m^2). Mean body fat percent was 29.53 +/- .23% at baseline. According to the American College of Sports Medicine 29-35% body fat for women indicates over-fat and >25% body fat for med indicates obesity. Mean waist

circumference was 43.5 +/- 8.21 in. (See Table 2 for baseline summary). The focus of the study was not specifically on weight or health outcomes, but changes in anthropometric measures were examined over the course of the intervention to report overall changes in the sample population. Changes in anthropometric measurements were not significant: BMI [M = -.014 +/- .91 kg/m^2], body weight [M = -.66 +/- 2.27 kg,], body fat [M = .09 +/- 1.66 %], and waist circumference [M = -.27 +/- 1.62 in] (See Figure 2). The changes were also examined separately for the three goals to determine if any differences occurred. As expected, those with a goal of weight management showed greater decrease in BMI and body fat, and showed greater weight loss than those with a diet or physical activity goal, although changes were not significant (See Figure 3).

Factor Analysis

Factor analyses were conducted to determine whether the 9 individual scales of Nothwehr's behavior objectives survey could be combined into three component scales. The factor analyses supported the proposed aggregation of the individual scales into three broader categories (Diet, Activity, Meal Change). The analysis of the scales for Diet (diet monitoring, diet social and diet cognitive), was conducted by retaining 3 factors showing an Eigenvalue of greater than 1 [6.71, 1.69, 1.29]. The factor procedure showed that all questions for each scale loaded on one common factor. There were some cross-loadings with a secondary factor but the majority of the items loaded significantly on the first factor (See Table 3). Factor analysis for the Activity scales (activity monitoring, activity social, activity cognitive) retained 5 factors with an Eigenvalue of greater than 1 [7.21, 2.08, 1.92, 1.22, 1.05]. Analysis revealed all questions loaded on one common factor (See Table 4).

Finally, the Meal Change scales (meal planning, meal preparing/buying, meal portion) also revealed 5 factors with an Eigenvaule of greater than 1 [6.34, 1.76, 1.31, 1.10, 1.02]. The analysis showed that all but one question loaded on to one factor (See Table 5). Based on these analyses, it appears that the 9 individual scales can be combined into three behaviorally-specific composite scales (Diet, Activity and Meal Change).

Alpha reliability was calculated for the three composite scales to check the internal consistency. The composite scale for Diet included subscales of diet monitoring, diet social and diet cognitive and showed good internal consistency [$\alpha = .9$]. The composite Activity scale included subscales of activity monitoring, activity social and activity cognitive and had a similarly high alpha reliability [$\alpha = .89$]. Finally, the Weight Control composite scale included meal planning, meal preparing/buying, and meal portion and also showed a high alpha reliability value [$\alpha = .91$]. These results support the internal consistency of the composite scales.

Evaluation of Aggregated Behavior Change Scales

The design of the study allowed participants to select both the goal they wanted to pursue (Diet, Activity or Weigh Management) and they type of support they would receive (Armband only, Armband + Health Coaching or Armand + Text Messaging). The opportunity for choice was important in the design but led to small samples in the individual groups. Exploratory evaluation of the data revealed little difference in outcomes across the Methods, so data were combined across Methods. This made it possible to have a larger sample size for the primary evaluation of differences between the three behavior goals (Diet, Physical Activity and Weight Management) (See Figure 4 for flow chart). The

results of the factor analyses (reported above) also supported the presence of three component factors so the focus was on the 3 aggregated behavior change scales for the 3 goal groups.

Figure 5 shows overall changes in the three component scales for the combined sample (i.e. not separated by behavioral goal). There were significant changes in each of the three composite variables over time, ($p < .05$). The main hypothesis of the study was that changes in the use of behavior change strategies would vary across groups depending on the participant's goal. Therefore, additional analyses were conducted to specifically look at goals (Diet, Physical Activity, Weight Management) and determine if setting specific goals improved behavior change strategies related to that goal. For example, did a participant with a Diet goal show greater change in diet behaviors? The results when stratified across groups are shown in (See Figure 6). The magnitudes of changes varied by goal, but differences between groups were not significant (Nutrition: [$F(2, 40) = .14$, $p = .8682$], Activity: [$F(2,40) = 49$, $p = .6172$], Meal Change: [$F(2, 40) = .31$, $p = .7338$]). Although, none of these differences were statistically significant, the data show greater changes in behavior strategies related to diet in those participants with a Diet goal. Furthermore, greater changes in all three categories were seen in those participants with a Weight Management goal. This was expected, as behaviors related to diet, physical activity and meal change all play a role in managing weight. Physical activity behavior strategies were expected to have shown greater improvement in those with a Physical Activity goal, though this was not the case. It is possible, however that participants had changes in some variables within each category, but not in others, which can negate the overall changes seen with the composite

scales. Therefore, additional analyses were conducted to look at movement on the individual scales.

Evaluation of Original Behavior Change Scales

The three combined categories of the Nothwehr instrument (Diet, Activity, Meal Change) were used to determine if participants had improved changes in behavior strategies within the category specific to their health goal (Diet, Physical Activity, Weight Management). Although these changes were not significant, these results could have obscured changes in individual scales. Figure 7 reveals that there were significant changes in behavior strategies for all 9 scales on the Nothwehr instrument for the combined sample population. The effect sizes (ES) ranged from 0.22 to 0.59 showing low to moderate changes in all of the scales (See Table 6). This shows that, overall, participants did report increased use of each of the component scales in the battery. Additional analyses examines changes specific to each goal.

Diet:

Individuals pursing dietary goals were expected to have larger changes in reported use of diet strategies. Figures 8 shows the patterns of change amongst the three scales in the Diet category (Diet Monitoring, Diet Social and Diet Cognitive). Panel a illustrates that those with a Diet goal seem to have greater improvements in Diet Monitoring strategies compared to participants with other goals (ES = 0.97). However, it is evident in panel b that this is not the case in the Diet Social scale, where those with a Weight Management goal had larger observed changes (ES = 0.60) than those with a Diet goal (ES = 0.28). The observed changes in the Diet Cognitive scale illustrated in panel c (ES = 0.32) were also lower than

the changes observed by those with a Weight Management goal (ES = 0.63) and those with a Physical Activity goal (ES = 0.74).

Physical Activity:

Individuals pursuing a Physical Activity goal were expected to have larger changes in the scales related to Physical Activity (Activity Monitoring, Activity Social, Activity Cognitive) As shown in Figure 9, participants pursuing a Physical Activity goal seemed to show very similar changes in Activity Monitoring strategies to those with Diet and Weight Management goals. Those with a Physical Activity goal also showed very similar changes in the Activity Social scale (ES = 0.28) to those with a Diet goal (ES = 0.15) or a Weight goal (ES = 0.28). However, greater changes in the Activity cognitive scale were seen in those with an Activity goal (ES = 0.38) over those with a Diet goal (ES = 0.08). Values were similar for those with a Weight Management goal. Overall, individuals pursing a physical activity goal had low effect sizes for the Activity Social and Activity Cognitive scales (0.28, 0.38) but a moderate effect size for Activity Monitoring (0.50).

Weight Management:

Participants with a weight management goal were expected to show greatest improvements in the Meal Change category, however it was expected that changes would also be made in both diet and activity strategies, as these behaviors can contribute to a change in weight. Figure 10 shows the patterns of change shown in the scales related to Meal Planning, Meal Preparing/Buying and Meal Portion. Panel b and c illustrate greater changes for this goal group in strategies related to Meal Preparing/Buying (ES = 0.49) and Meal Portion (ES = 0.79) compared to those with alternate goals. However, those with a Physical Activity goal showed greatest change in the Meal Planning scale (ES = 0.41). Those

with a Weight Management goal showed greater changes in the Activity Cognitive (ES = 0.61), Diet Cognitive (ES = 0.74), and Diet Social (ES = 0.60) scales over the other goal groups.

(See Table 7 for Effect Sizes for each Goal)

When looking at the original behavior change scales, it is evident that there were changes in strategies used in some scales within each category, but not in others. This could have contributed to the absence of overall changes amongst each goal group within the 3 related composite scales. It is also possible for change to be evident in individual items (but not others) in the various scales. Therefore, additional qualitative analyses were conducted to better understand the strategies that participants reported using.

Evaluation of Individual Behavior Items

To provide a more comprehensive view of behavior change, additional analyses were conducted looking at each of the items within each scale.

Diet

Figure 11 show the patterns of change amongst the individual items within each of the three scales in the Diet category. Individuals pursing a Diet goal showed greater improvements in the Diet Monitoring scale over those who chose a physical activity or weight management goal. Changes in each item related to this scale are shown in panel a. In five of the six items in this scale, those with a Diet goal showed the largest change. Within the Diet Social scale, those with a weight management goal showed greater change overall. However, panel b shows that those with a Diet goal showed greater change in two of the three items. Within the Diet Cognitive scale, individuals who chose a Diet goal showed the

least amount of change compared to the other goal groups. Panel c shows that change within the Diet goal group was low in most items within this scale.

Physical Activity

Individuals pursuing a Physical Activity goal were expected to have larger changes in the three scales related to Physical Activity than those in the other goal groups. Looking at these scales (Activity Monitoring, Activity Social and Activity Cognitive), those with an Activity goal showed very similar changes in the Activity Monitoring and the Activity Social scales to those with other goals. Panels a and b in Figure 12 look at the changes in each of the individual items within these two scales. The figures show that individuals with a Physical Activity goal showed greater change over both Diet and Weight Management goal groups in two of the four items within the Activity Social scale. In addition, these individuals showed the greatest change in all but one item within the Activity Monitoring scale. Changes in the Activity Cognitive scale among those with a Physical Activity goal were greater than those with a Diet goal, but less than those with a Weight Management goal. Panel c shows greater change in all items within this scale over individuals with a diet goal, and greater change in three of the five items over individuals with a Weight Management goal.

Weight Management

Individuals who chose to work toward a Weight Management goal were expected to show improvements in all scales, particularly those related to Meal Change (Meal Planning, Meal Preparing/Buying and Meal Portion). In the Meal Preparing/Buying and Meal Portion scales, those with a Weight Management goal showed the greatest change. Panels b and c in Figure 13 show the change in individual items within these scales. A greater change is

illustrated in three of the six items within the Meal Preparing/Buying scale is over the other goal groups, with a visibly large change shown in item 3, specifically. Within the Meal Portion scales those with a Weight Management goal showed greater change in all five items within this scale over those with other goals. Panel a shows that individuals with a Weight Management goal showed the greatest change amongst goal groups in only one of the five items in the Meal Planning scale.

CHAPTER 5. DISCUSSION

This study was designed as a formative evaluation of behavior change strategies used in lifestyle health and wellness interventions. Experts in behavioral interventions emphasize the importance of establishing appropriate measurement tools for examining the mediation of intervention outcomes. Therefore, the focus of this study was to test the utility of an established behavioral objective instrument for use in facilitated behavior change studies. It was hypothesized that there would be larger changes in behavior change strategies for items related to a specific behavioral goal targeted by a participant (i.e. Diet, Physical Activity or Weight Management). That is, it was expected that those with a Diet goal would show improvement in diet related behavior change strategies, those with a Physical Activity goal would show improvement in behavior change strategies related to physical activity and those with a Weight Management goal would show improvement in physical activity, diet, and meal change strategies. It was further hypothesized that there would be larger changes for individuals receiving personalized health coaching as these participants would be prompted using motivational interviewing strategies to keep focused on behavior change.

The inclusion of both factors was designed to enable interactions to be examined between Goal and Method, as this would make it possible to see if the treatments had differential effects based on the behavior being targeted. However, the small sample size limited the ability to evaluate the effects due to Methods. Therefore, the focus of the analysis shifted to compare the three different Goal groups and the effect that setting a specific goal had on changes in the behavior change strategies used to reach these goals.

Changes in Behavior

The results of this study supported the use of the Nothwehr survey as an effective tool for examining strategies used for changing behavior related to diet, activity and weight management. All participants showed significant improvement in behavior change strategies identified in the survey following the intervention. The factor analysis supported the aggregation of the scales into three main categories (Diet, Activity, Meal Change), which related to the three categories of goals available for participants to select. (Diet, Physical Activity, Weight Management).

With the combined scales, results revealed significant changes, overall, in the three categories. As expected, those with a diet goal showed greater change in diet related behavior strategies than those with an activity or weight related goal. In addition, participants with a weight management goal showed the most change in two of the three Meal Change scales categories. Interestingly however, those with a physical activity goal showed greater change in diet strategies than activity strategies, although the change was similar [Diet Monitoring: ES = 0.49, Diet Social: ES = 0.35, Diet Cognitive: ES = 0.63 , Activity Monitoring: ES = 0.50, Activity Social: ES = 0.28, Activity Cognitive: ES =0.38]. This discrepancy may be due to the feature of the BodyMedia armband that allows the user to track diet intake. Although this is an optional feature, participants were asked to record their diet during the first and last week of the intervention. Some may have found the feature useful and utilized it during the entire intervention, even if their goal was specific to physical activity.

The results did not reveal significant differences in the use of specific behavior change strategies between the Goal groups, but this may be due to the limited sample size.

It is also possible that the results for the overall changes were blunted by the use of aggregate scales. To examine this, additional analyses evaluated the change in individual scales. The supplemental analyses allowed a deeper look into the individual scales to determine patterns of change related to the participants' specific goals.

Diet

It was expected that individuals pursing a Diet goal would show greater improvements in diet related behavior change strategies than those with alternate goals. However, when looking at each of the 9 scales individually, figure 8 portrays that although individuals with a Diet goal showed greater change in the Diet Monitoring scale than those with an alternate goals, they showed the least amount of change in strategies of the Diet Cognitive scale. This could be related, however, to the idea that individuals who seek to improve their eating habits may already have advanced cognitive skills related to diet. For example, two items within the Diet Cognitive scale (see Figure 11, panel c) that showed little change in those with a Diet goal are, *"How often do you think about what motivates you to eat healthy?"* and, *"How often do you think about the benefits of eating healthy."* Individuals who are contemplating or preparing for a change in their diet behaviors may already utilize these strategies often. Therefore, if most participants were in this cognitive stage when setting their goal, little change is expected following the intervention.

It is, however, critical to point out that there were no participants with a diet goal that chose to add the health coaching intervention to the use of the armband. The health coaching component included guidance from a dietitian to help the individual improve their behavior strategies in working toward their health goal. Health coaching with the use of motivational interviewing has been shown to be as effective as Behavioral Cognitive

Therapy in helping individuals change their behaviors.[1] Therefore, had the participants who were pursuing a Diet goal selected the health coaching option, greater change may have been detected in the use of cognitive strategies related to diet.

In addition, because all participants used the BodyMedia SenseWear armband monitor and its dashboard, diet tracking was an option for everyone, regardless of their health goal. For participants who tracked their intake and reviewed the nutrition results computed by the BodyMedia dashboard, it could be expected that improvements in cognitive strategies related to diet were made. This may account for the greater change detected by those with Physical Activity and Weight Management goals in some of the Diet change strategies.

Physical Activity

Figure 9 shows those individuals pursuing a Physical Activity goal showed similar changes in the 3 activity scales to those with alternate goals. It was expected that participants with a Physical Activity goal would show greater change in the Activity Monitoring scale; however, detected changes were similar amongst all goal groups. Looking deeper into the individual items within this scale, panel a in Figure 12 shows that individuals pursuing a physical activity goal showed a larger change in all items except the question, *"How often do you increase your physical activity due to expected inactivity in future days?"* In fact, no change in score was detected regarding this item, which leads to a lower change score overall for this scale. However, a larger change was detected in the question *"How often do you incorporate small bouts of physical activity daily?"* Working adults, similar to the participants in this study, may find it hard to predict when they will have time for physical activity. Therefore, they may not use the strategy to increase

physical activity due to future inactivity, however, by increasing small bouts of physical activity, the individual is using strategies to compensate for lack of time. This was an issue addressed in the health coaching sessions in this study, as well as the text message prompts sent to participants with a physical activity goal. Although change in one strategy was not detected, a larger change in the other helps to compensates for this.

It is important to keep in mind that the primary intervention method used in this study was the BodyMedia SenseWear armband. The key function of this armband is to measure physical activity. All participants, regardless of their goal and additional interventions (health coaching or text messaging) used the armband along with the dashboard to track physical activity throughout the duration of the study. Therefore, all participants could be expected to show improvements in activity behaviors.

Weight Management

Participants in this study who chose to pursue a goal related to weight management were expected to show improvements in all strategies, as they all relate to managing one's weight. For individuals who chose a goal related to weight management, aside from the Meal Planning and Activity Social scales, similar change was detected across each of the other scales. Looking at the individual items of the Meal Planning scale shown in panel a of Figure 13, participants with a Weight Management goal showed no change in the item, *"How often do you read about weight loss?"* This could account for the lower, overall change this scale. Individual who want to lose weight often already use this strategy even before preparation for weight loss. Therefore, if most individuals in this study were already using this strategy before the intervention, it is expected that little or no change would be made. Furthermore, nine of the fifteen participants with a Weight Management goal chose

to add additional support to the use of the armband (health coaching or text messaging). Specific to the Meal Planning scale, health coaching and text messaging provided these participants with information regarding methods for planning meals ahead of time and making and sticking to a grocery list. This is illustrated in the results showing increased used of these strategies following the intervention. Because weight management uses all strategies, the intervention methods of this study focused on strategies specific to the need and specific questions of each participant.

Summary

Overall, the behavior change study was implemented as planned and all participants received and used the armband monitors. The revised protocol involving two visits early in the study (weeks 1 and 2) proved to be important for establishing goals and for training participants in the use of the armband monitor. Previous studies have demonstrated the importance of goal setting for effective behavior change.[2-4] Goal setting to promote dietary change is a widely recommended strategy to enhance the behavior change process in nutrition education programs.[3] Therefore, it was also strongly emphasized in the present study. The integration of the self-monitoring device provided a way for participants to directly monitor their goals and behavior so this may have facilitated the behavior change process.

The integration of motivational interviewing within a health coaching paradigm has been reported in a number of previous studies.[5-10], but studies to date have not combined health coaching with an objective self-monitoring device. One related study reported positive intervention outcomes when the armband was used to support weight loss. This

study, performed at the University of South Carolina, compared three intervention groups to a control group, which received standard care of basic weight loss education. The intervention groups included those who received group-based behavioral weight loss education, a group that wore a physical activity armband monitor without group education, and a group that received both interventions. Results showed that those with an armband had significantly larger weight and waist circumference reductions compared to those without an Armband.[11] In addition, previous work by the team at Iowa State University have also shown that the use of the armband can have positive influence on weight loss. This study compared outcomes amongst participants who received weekly health coach meetings using a behavior change curriculum (BonSanté), an armband, or both interventions.[12] At eight weeks, results showed weight loss in all three groups with the largest change in the group receiving both interventions. The results of these studies support the idea that the use of the armband, as a self-monitoring device, could be beneficial as an intervention tool for facilitating weight loss and behavior change.

The present study sought to enhance the utility of the programming by incorporating the armband monitor into a guided motivational interviewing based health coaching program. Motivational interviewing (MI) was to be implemented with those participants that chose the health coaching option to compliment the armband. Health coaching was conducted via an online portal (ProConnect) consisting of an email system within the participants BodyMedia account to allow private communication between the user and the dietitian. However, dietitians leading this intervention found it extremely difficult to implement MI online. Motivational interviewing is a style of communication meant to evoke conversation between the client and the professional.[13] One of the four

major processes of MI is engaging the patient[14], which is very difficult to accomplish using the online method of health coaching. Without face-to-face meetings it is difficult to evoke a conversation with the participant. Dietitians were able to ask open-ended questions in their messages and evoke thought from the participants; however, the flow of conversation that makes MI successful was lost via the online portal. Furthermore, because the health coaching option required participants to log in to read a message from their health coach and type a reply, many participants found it to be a hassle and compliance with the weekly correspondence required for the study was inconsistent. The use of the online health coaching may still have value, but the results of this study show that it is not successful in incorporating contemporary MI approaches to customize and personalize the interaction effectively.

The results of this study provided valuable feedback as to how to most effectively use the armband monitor for future health coaching applications. To further test the online health coaching option, potential future studies could examine health coaching options online and in person to determine best methods for implementing motivational interviewing.

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Table 1. Intervention groups

INTERVENTION:	*SenseWear Only*	*SenseWear + Health Coaching*	*SenseWear + Text Messaging*
GOAL:			
Diet	8	0	6
Physical Activity	4	4	4
Weight Loss	6	2	7

Table 2. Descriptive Characteristics of Participants at Baseline

		Goal Groups		
Characteristic	**Population sample (n = 41)**	**Diet (n = 14)**	**Physical Activity (n = 12)**	**Weight Management (n = 15)**
Gender (n[%])				
Male	31 [75.6]	8 [57.1]	9 [75.0]	14 [93.3]
Female	10 [24.4]	6 [42.9]	3 [25.0]	1 [6.7]
Age (yrs)	40.8	41.9	42.8	38.0
Range	24-66	27-55	29-66	28-56
Work shift (n[%])				
Day	30 [73.2]	10 [71.4]	9 [75.0]	11 [73.3]
Night	11 [26.8]	4 [28.6]	3[25.0]	4 [26.7]
Height (inches)	68.00	68.92	68.95	66.32
Weight (lbs)	220.59	199.71	194.54	256.96
BMI (kg/m^2)	31.75	29.26	28.65	36.02
Body Fat %	29.53	29.15	26.41	31.83

Table 3. Factor pattern of Behavioral Change Objectives Survey, Diet category

DIET SCALE			
Variable	**Factor 1**	**Factor 2**	**Factor 3**
Tracking Types of Food	83*	-20	-3
Tracking Amount of Food	76*	-28	-12
Tacking Fat	70*	-12	-17
Tacking Calories	77*	-11	-16
Adjust Meal Intake Related to Earlier Intake	75*	2	-54
Adjust Meal Intake Related to Future Intake	77*	-15	-52
Bring Healthy Foods to Social Events	53*	58*	-1
Suggest Restaurants with Healthy Options	59*	67*	13
Serve Healthy Foods to Guests	59*	51*	-7
Praise Yourself for Eating Healthy	65*	-54*	24
Reward Yourself for Eating Healthy	58*	-27	45
Think About the Benefits of Eating Healthy	68*	32	30
Positive Self Talk Regarding Healthy Eating	71*	-5	47
Think About What Motivates You to Eat Healthy	70*	-4	26

Table 4. Factor pattern of Behavioral Change Objectives Survey, Activity category

ACTIVITY SCALE					
Variable	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**
Keep Track of PA Weekly	76*	-24	-31	7	24
Increase PA Due to Inactivity in Recent Days	72*	-41*	-25	-2	23
Increase PA Due to Expected Inactivity in Future Days	60*	-27	-44*	8	47
Incorporate Small Bouts of PA Daily	62*	-24	47*	-16	-5
Suggest Active Events with Friends and Family	52*	-42*	52*	5	-6
Set Aside Time for PA	74*	-40	13	-21	11
Ask Someone to be Active With You	51*	-50*	30	9	-34
Talk to Others About Benefits of PA	75*	-10	15	-10	15
Praise Yourself for Being Active	71*	25	-37	28	-19
Reward Yourself for Being Active	68*	13	-31	19	-41*
Think About Benefits of PA	68*	42*	-4	-49*	-3
Positive Self Talk Regarding PA	75*	17	-37	-15	-16
Think About What Motivates You to be Active	66*	32	-22	-46*	-21

Table 5. Factor pattern of Behavioral Change Objectives Survey, Meal Control category

MEAL CHANGE SCALE					
Variable	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**
Plan Meals Ahead	67*	-12	12	-59*	-14
Eat Less Due to Expected Increased Intake	58*	-14	-8	-24	-8
Make a Grocery List	50*	-21	46*	-40	14
Read about Weight Loss	43*	0	61*	27	37
Read Nutrition Labels	77*	-31	25	13	7
Choose Leaner Meats	63*	4	20	46*	-15
Cut Visible Fat From Meat	75*	-26	-7	4	-40
Remove Skin From Chicken	63*	-36	6	24	-42
Buy Low-Fat Dairy	57*	-14	-36	-2	58
Limit High-Fat Condiments	72*	-19	-29	17	34
Choose Smaller Servings of High Fat Foods	69*	-4	-54	16	-8
Stop Eating When Full	5	78*	2	8	-9
Avoid Eating When Not Hungry	56*	46*	1	-25	-4
Limit Number of Food Servings	74*	31	-19	-19	-1
Limit Size of Food Servings	82*	40	-3	2	5
Choose Alternate Activity to Avoid Snacks	56*	49	21	14	-1

Table 6. Effect sizes for combined sample of 9 original behavior change scales

Behavior Change Scales	Effect Size
Diet Monitoring	0.59
Diet Social	0.38
Diet Cognitive	0.53
Activity Monitoring	0.47
Activity Social	0.22
Activity Cognitive	0.31
Meal Planning	0.29
Meal Preparing	0.38
Meal Portion Control	0.54

Table 7. Effect sizes for 9 behavior change scales by goal

	Diet Goal	Physical Activity Goal	Weight Management Goal
Behavior Change Scales	Effect Size	Effect Size	Effect Size
Diet Monitoring	0.97	0.49	0.47
Diet Social	0.28	0.35	0.60
Diet Cognitive	0.32	0.63	0.74
Activity Monitoring	0.35	0.50	0.67
Activity Social	0.15	0.28	0.28
Activity Cognitive	0.08	0.38	0.61
Meal Planning	0.19	0.41	0.34
Meal Preparing	0.34	0.34	0.49
Meal Portion Control	0.42	0.41	0.79

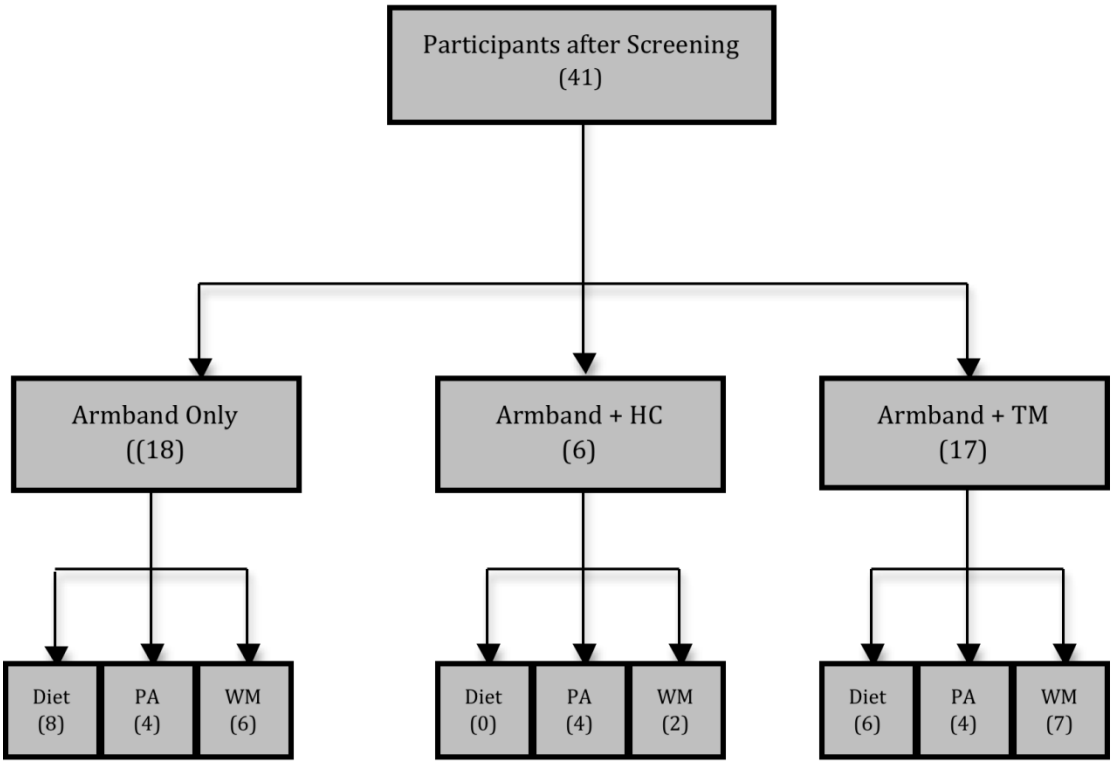


Figure 1. Participant Flow Chart

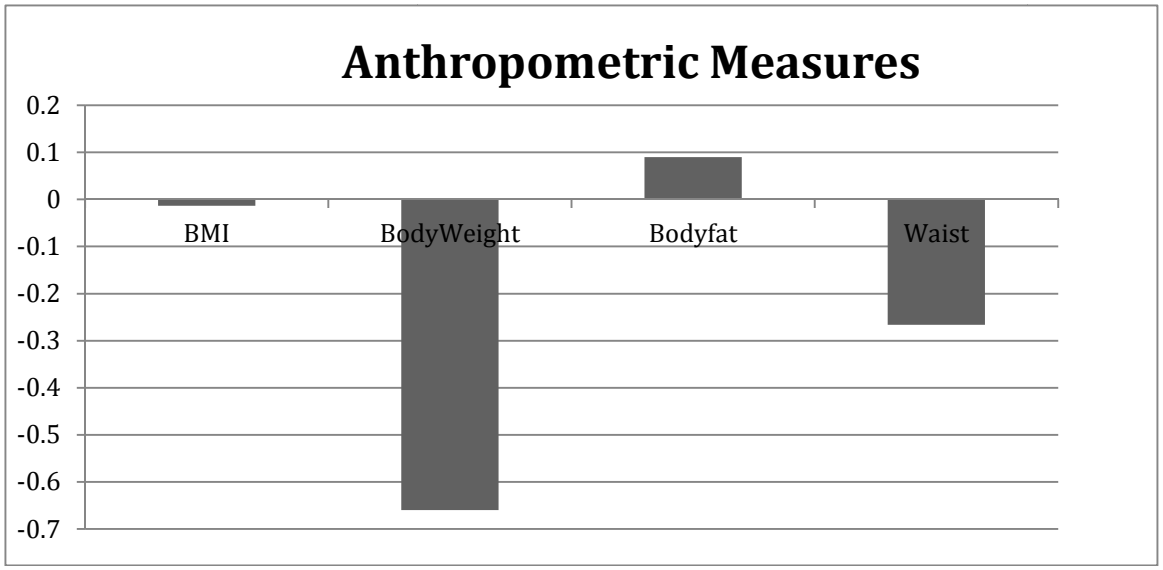


Figure 2. Mean change in anthropometrics of all participants

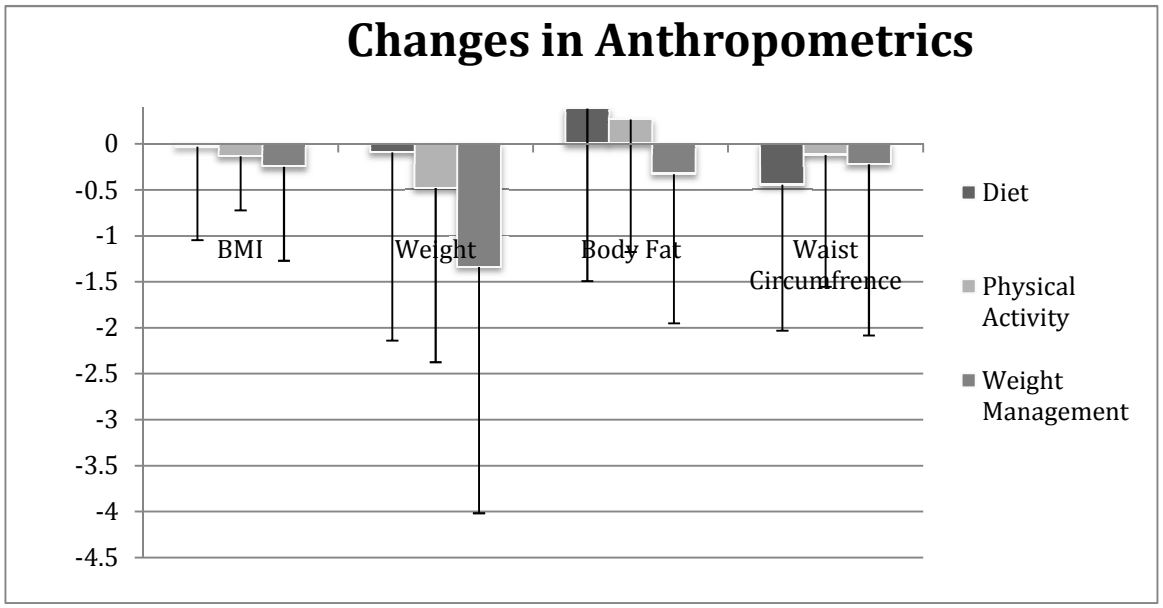


Figure 3. Mean change in anthropometric measurements between goals

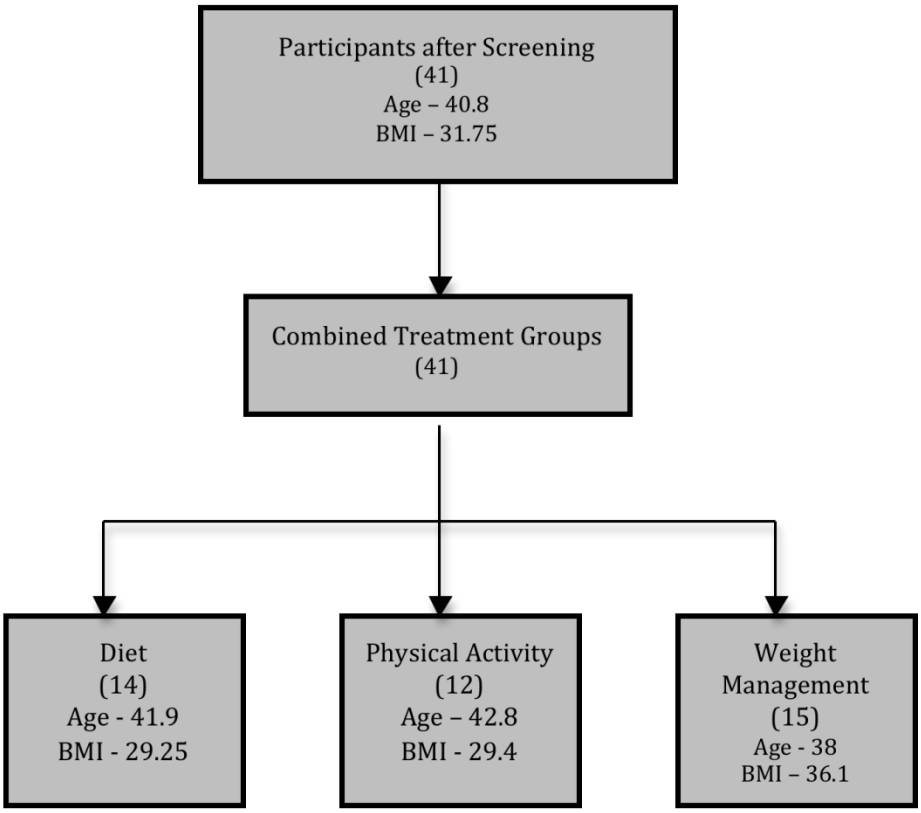


Figure 4. Participant flow chart for combined interventions.

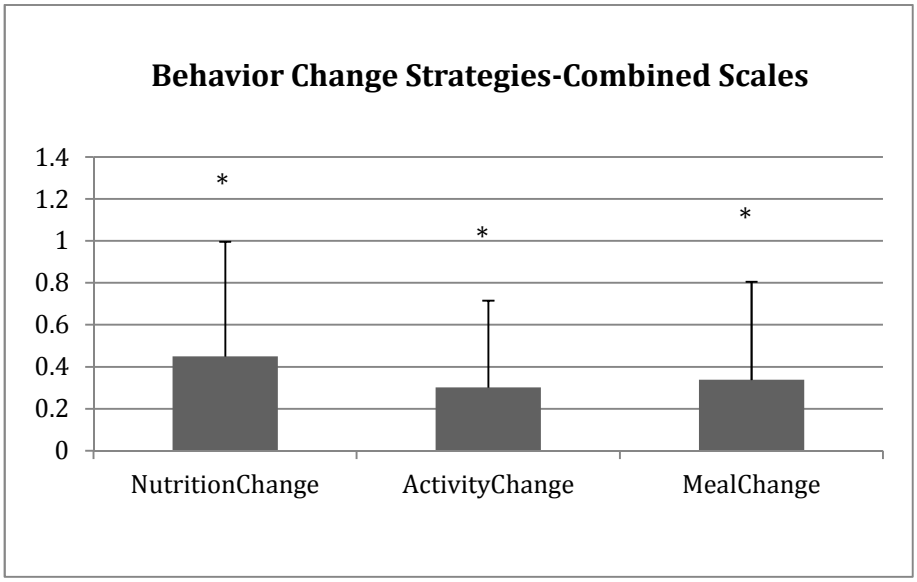


Figure 5. Mean changes in Composite Behavior Change Scales, Combined sample

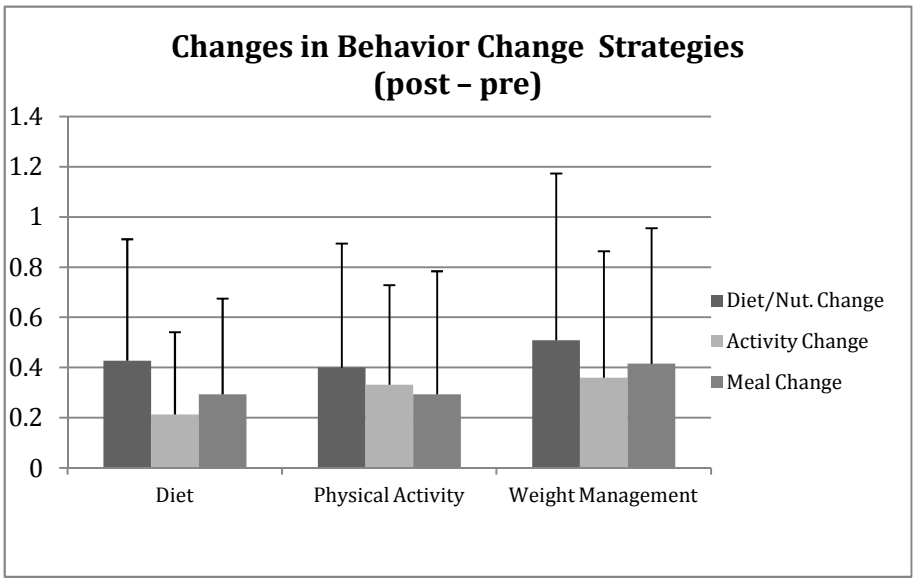


Figure 6. Mean change in Composite Behavioral Change Scales Stratified by Goal

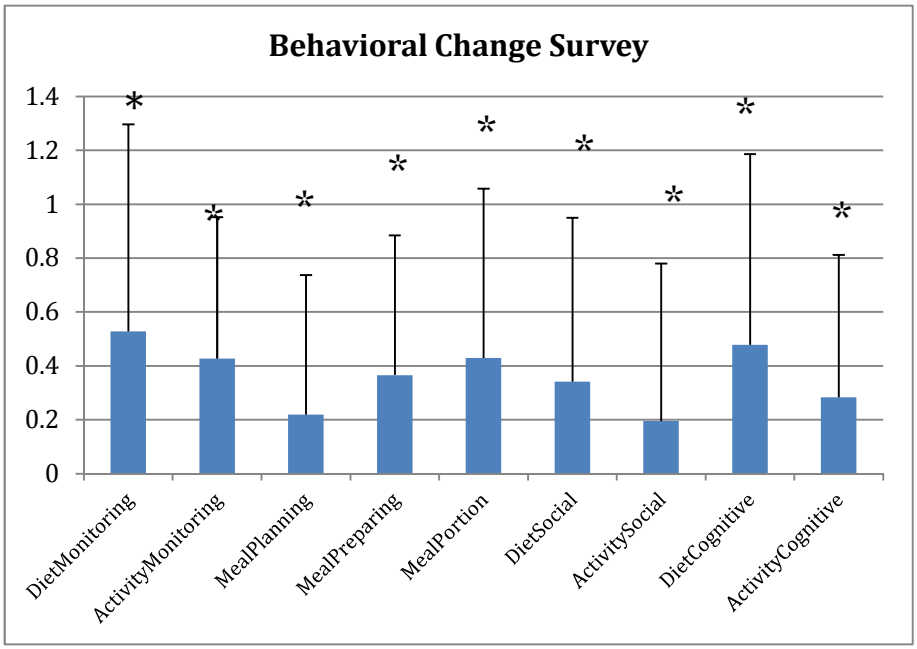
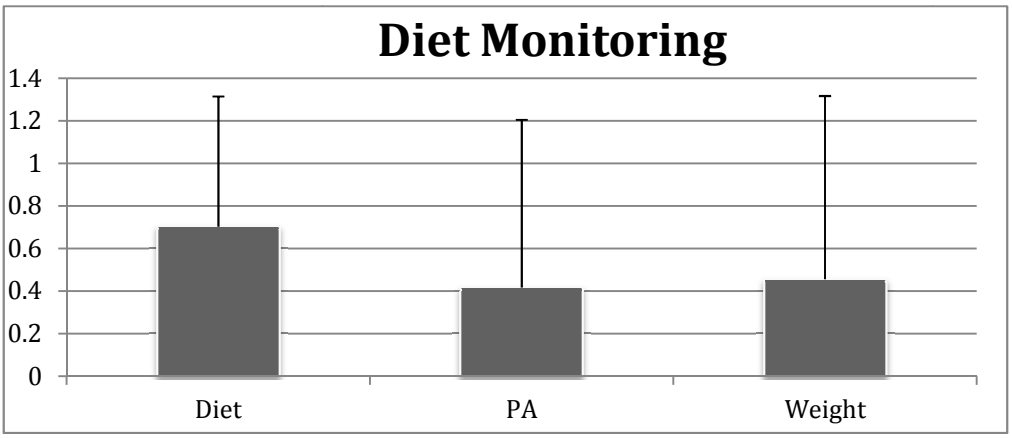
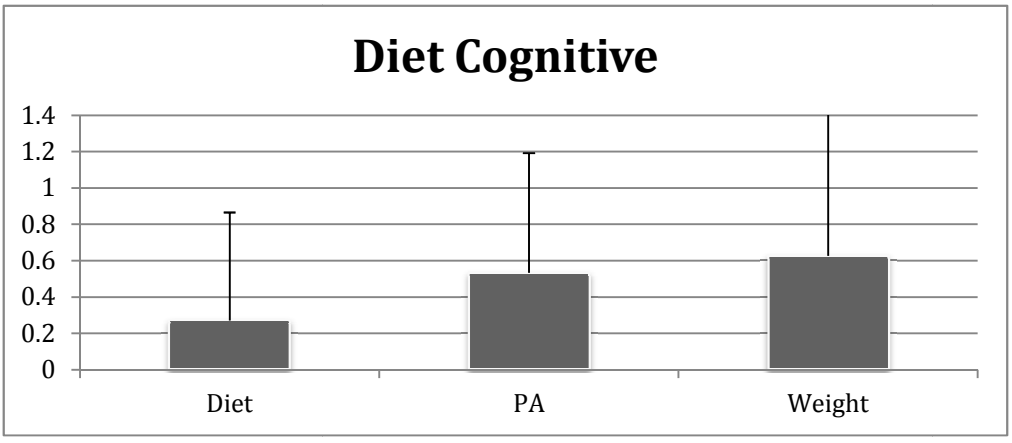


Figure 7. Mean change on Individual Behavioral Change Scales (n=41)



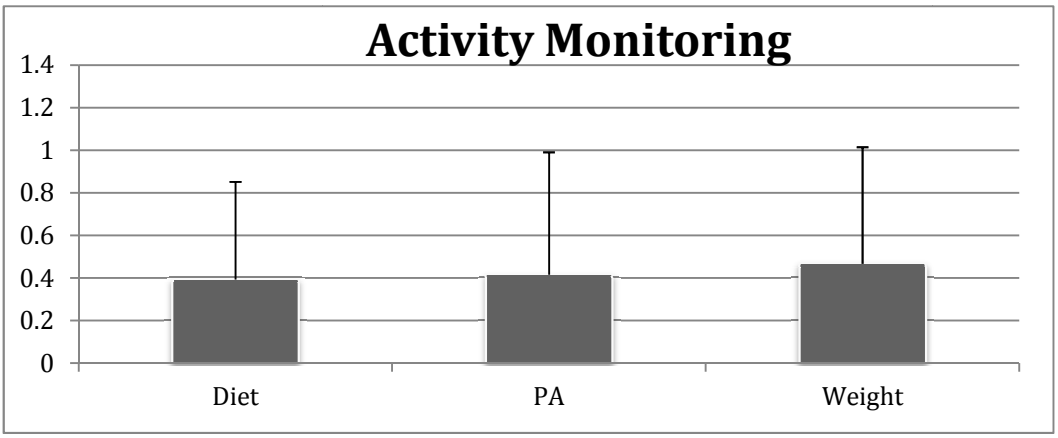
Panel a. Change in Behavior Change Strategies Stratified by Goals, Diet Monitoring scale

Panel b. Change in Behavior Change Strategies Stratified by Goals, Diet Social scale

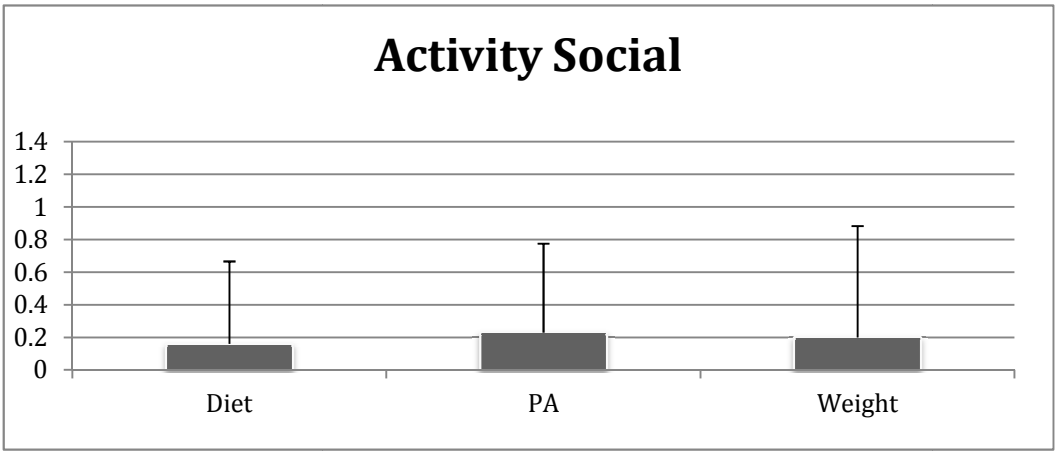


Panel c. Change in Behavior Change Strategies Stratified by Goals, Diet Cognitive scale

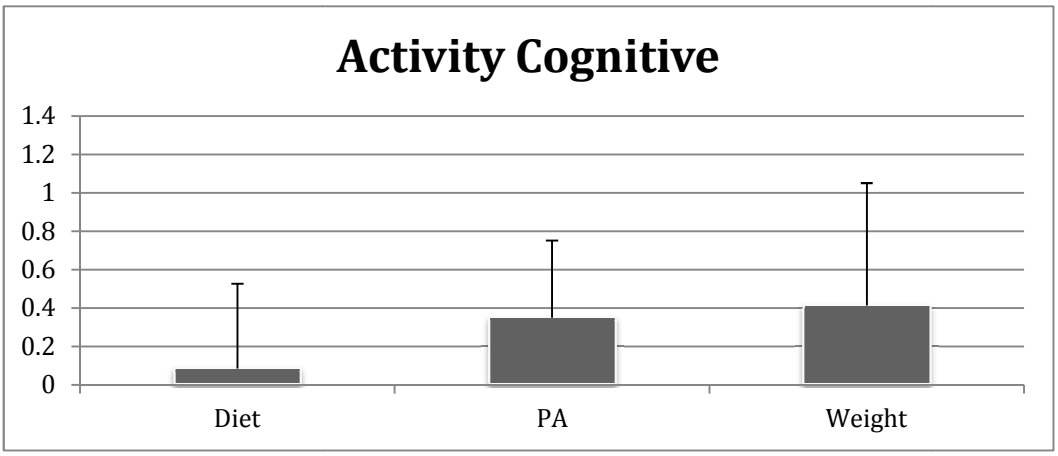
Figure 8. Change in Behavior Change Strategies Stratified by Goals, Diet Category



Panel a. Change in Behavior Change Strategies Stratified by Goals, Activity Monitoring scale

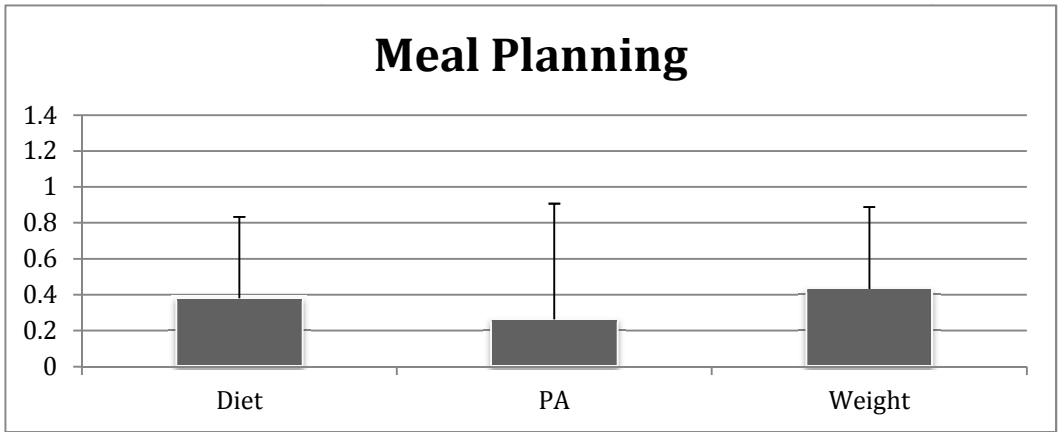


Panel b. Change in Behavior Change Strategies Stratified by Goals, Activity Social scale

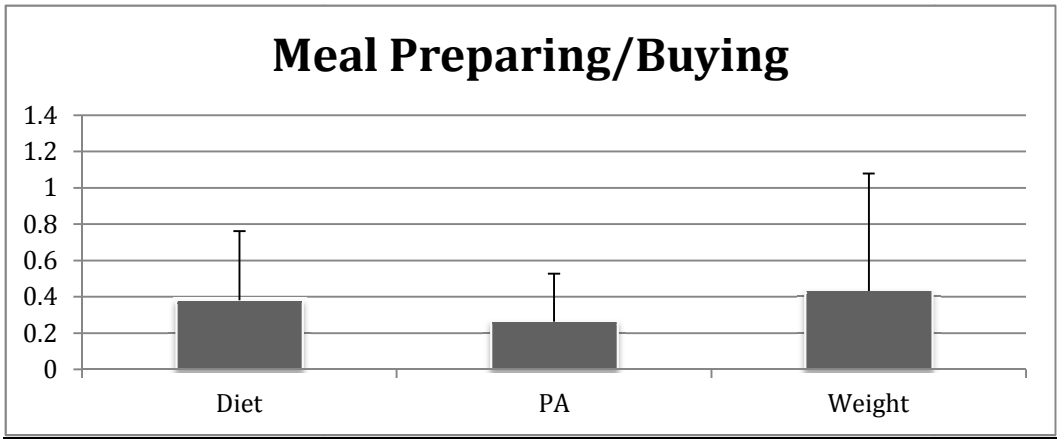


Panel c. Change in Behavior Change Strategies Stratified by Goals, Activity Cognitive scale

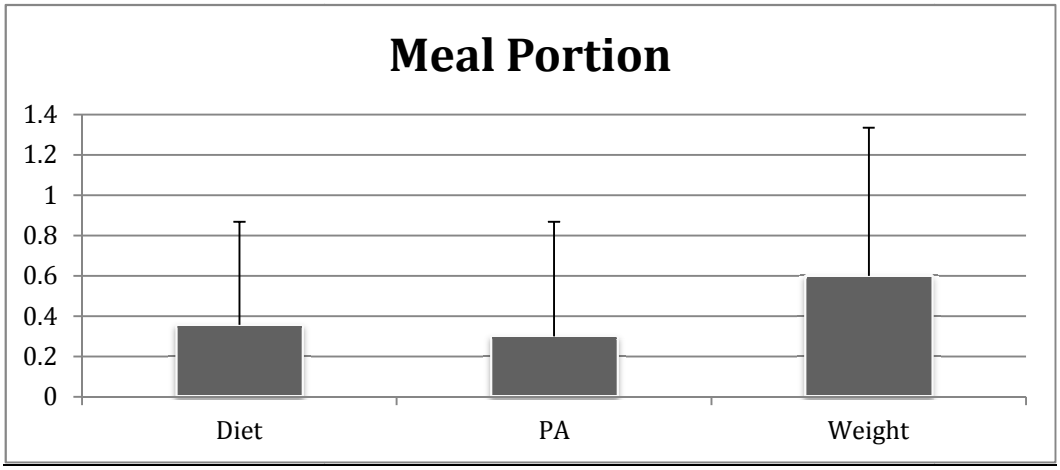
Figure 9. Change in Behavior Change Strategies Stratified by Goals, Activity category



Panel a. Change in Behavior Change Strategies Stratified by Goals, Meal Planning scale

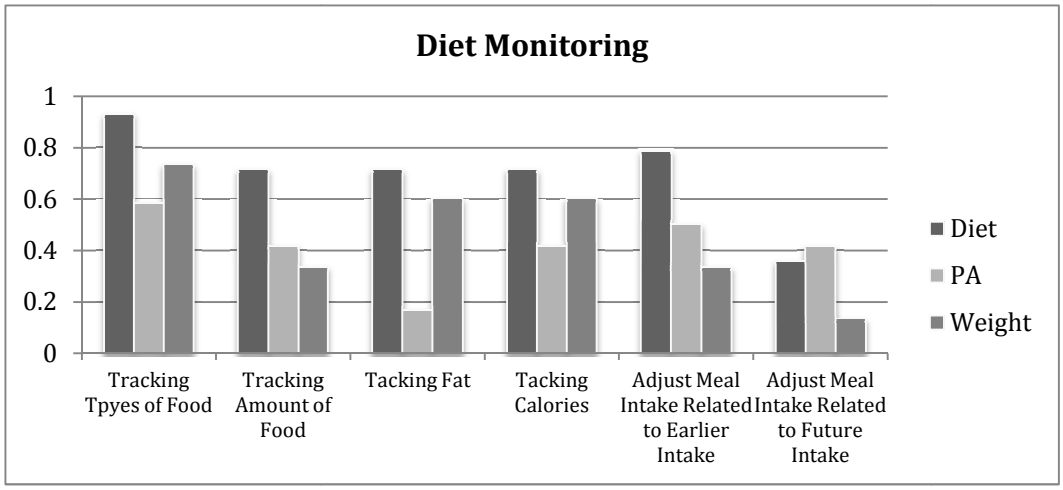


Panel b. Change in Behavior Change Strategies Stratified by Goals, Meal Preparing/Buying scale

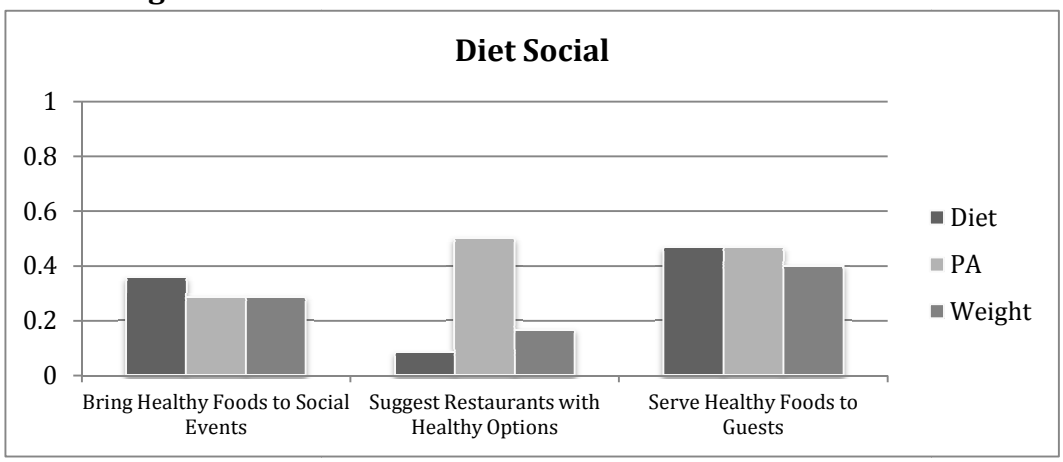


Panel c. Change in Behavior Change Strategies Stratified by Goals, Meal Portion scale

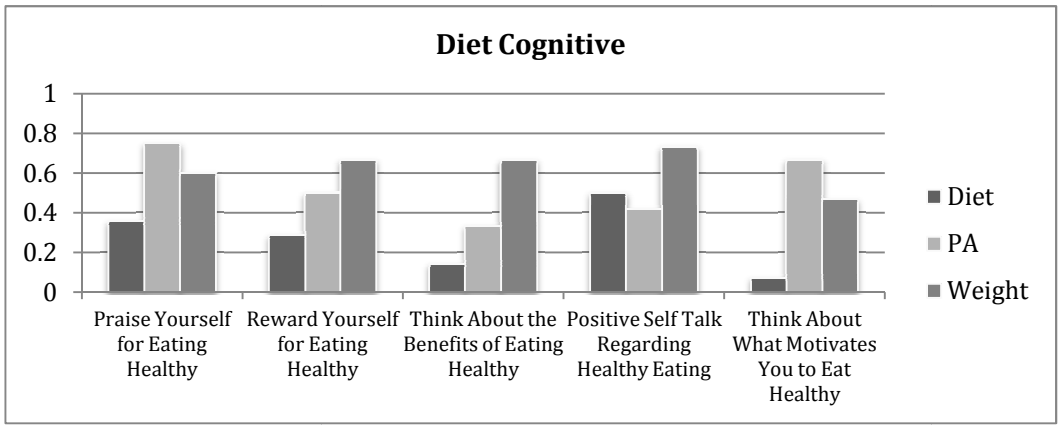
Figure 10. Change in Behavior Change Strategies Stratified by Goals, Meal Change category



Panel a. Change in Individual Behavior Change Items Stratified by Goals, Diet Monitoring scale

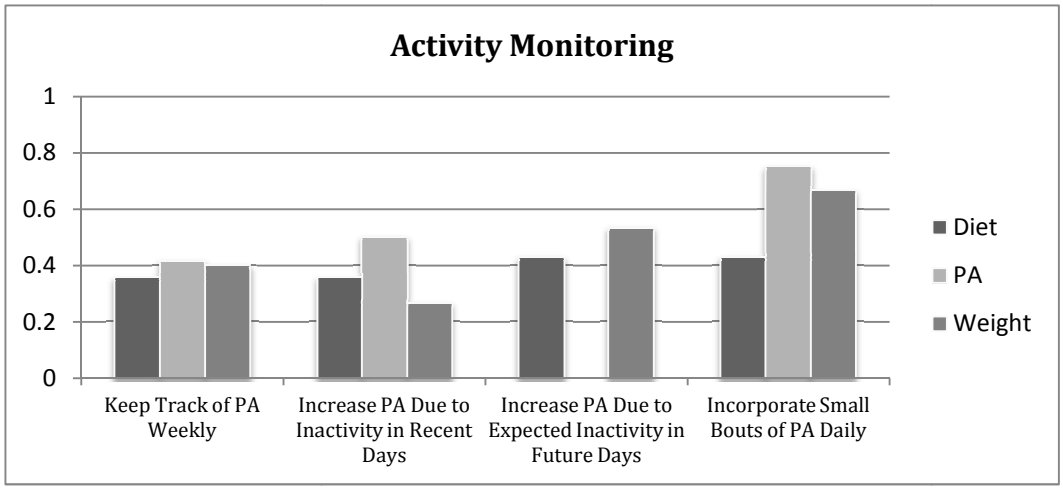


Panel b. Change in Individual Behavior Change Items Stratified by Goals, Diet Social scale

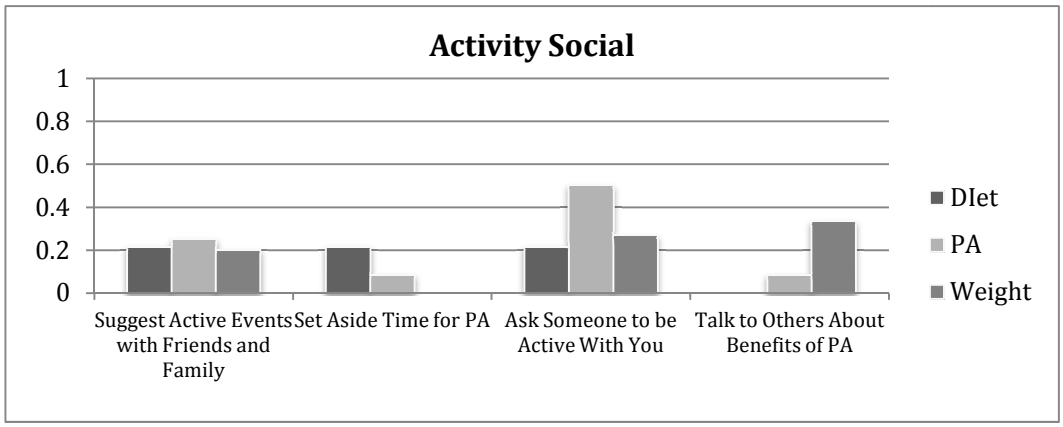


Panel c. Change in Individual Behavior Change Items Stratified by Goals, Diet Cognitive scale

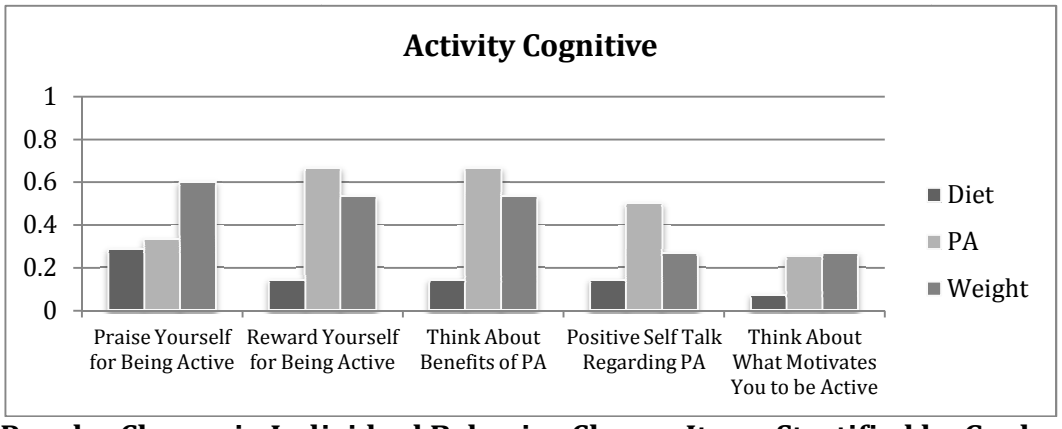
Figure 11. Change in Individual Behavior Change Items Stratified by Goals Within Diet Category



Panel a. Change in Individual Behavior Change Items Stratified by Goals, Activity Monitoring scale

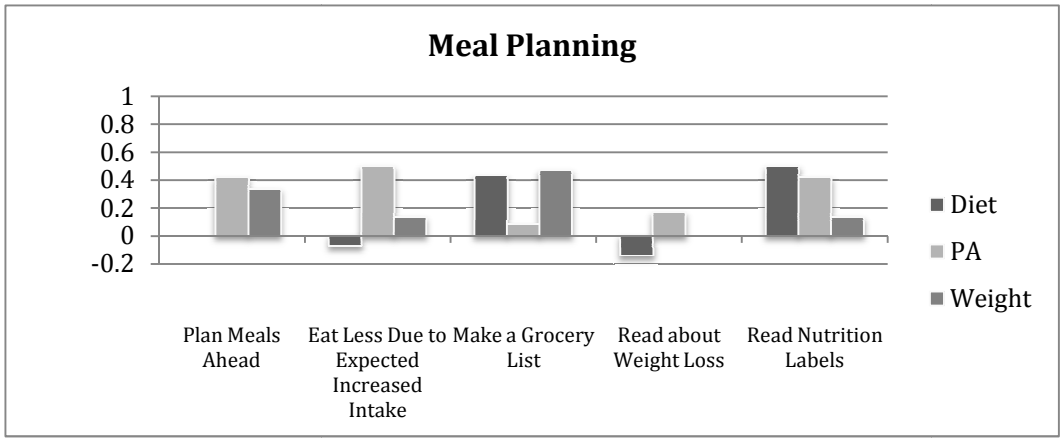


Panel b. Change in Individual Behavior Change Items Stratified by Goals, Activity Social scale

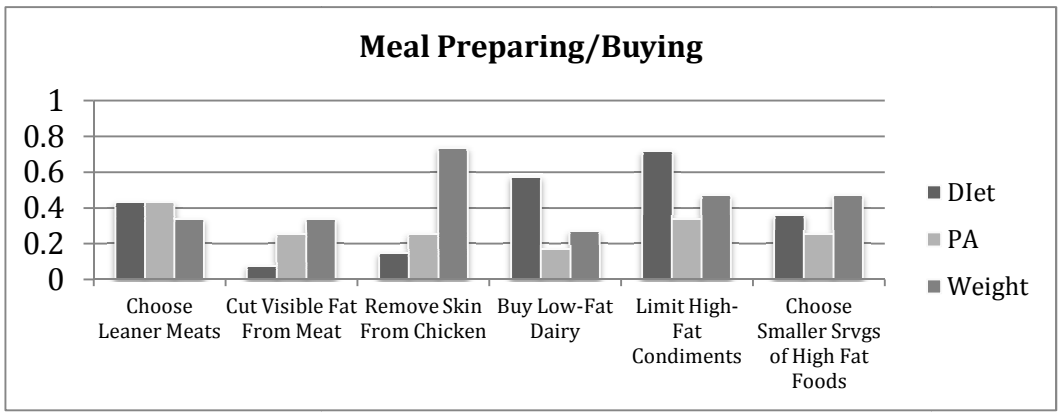


Panel c. Change in Individual Behavior Change Items Stratified by Goals, Activity Cognitive scale

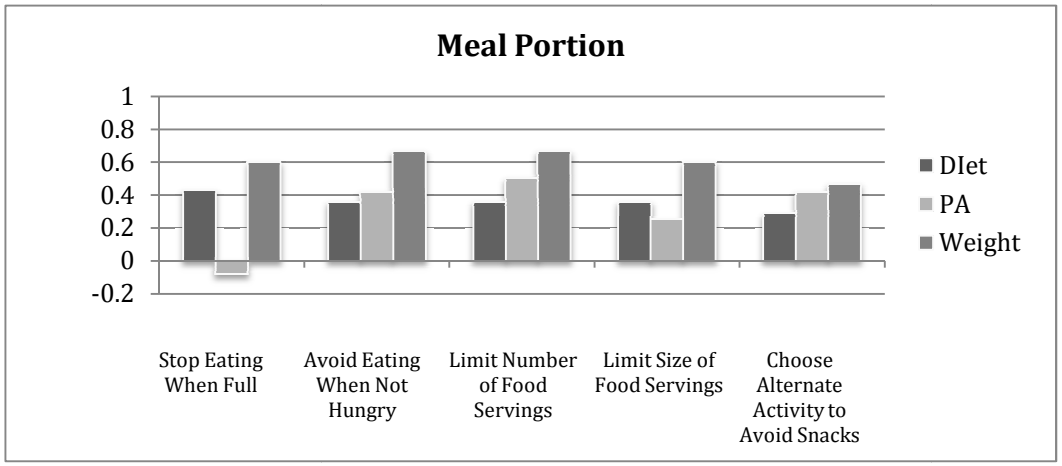
Figure 12. Change in Individual Behavior Change Items Stratified by Goals Within Activity category



Panel a. Change in Individual Behavior Change Items Stratified by Goals, Meal Planning scale



Panel b. Change in Individual Behavior Change Items Stratified by Goals, Meal Preparing/Buying scale



Panel c. Change in Individual Behavior Change Items Stratified by Goals, Meal Portion scale

Figure 13. Change in Individual Behavior Change Items Stratified by Goals Within Meal Change category

APPENDIX A.

Behavior Strategies Assessment Form

Participant ID#_____

Self-Monitoring	*Almost Never*	*Sometimes*	*Often*	*Almost Always*
***Diet:* How often do you…**				
… keep track in your head of the kinds of food you looking during the course of the day?	1	2	3	4
… keep track in your head of the amount of food you have eaten?	1	2	3	4
… keep track in your head the amount of fat you have eaten?	1	2	3	4
… try to keep track of the number of calories you have eaten?	1	2	3	4
… adjust what you ate at a meal based on what you arty ate that day?	1	2	3	4
… adjust what you ate at a meal based on what you expect to eat later in the day?	1	2	3	4
***Physical Activity:* How often do you…**	Almost Never	Sometimes	Often	Almost Always
… keep a record in your head of how physically active you have been during the week?	1	2	3	4
… increase your level of physical activity for the day because you have not been very active in recent days?	1	2	3	4
…increase your level of physical activity for the day because you expect to not be very active in the coming days?	1	2	3	4

…find ways to work in some small amounts of physical activity during the day (like taking the stairs instead of the elevator; walking instead of driving somewhere, etc.)?	1	2	3	4
***Planning:* How often do you…**	Almost Never	Sometimes	Often	Almost Always
… plan meals ahead of time?	1	2	3	4
… eat less food during the day if you were attending a social event in the evening?	1	2	3	4
… make a grocery list and stick to it at the store?	1	2	3	4
… read articles or brochures about how to lose weight?	1	2	3	4
… read labels on foods to check for nutrition information?	1	2	3	4
***Preparing/buying:* How often do you…**	Almost Never	Sometimes	Often	Almost Always
… choose leaner meats over those higher in fat?	1	2	3	4
… cut off visible fat from me?	1	2	3	4
… remove skin from chicken?	1	2	3	4
… buy low–fat versions of dairy products?	1	2	3	4
… limit high-fat extras such as butter, gravy, sauces, and salad dressings?	1	2	3	4
… choose small servings of high fat foods?	1	2	3	4
***Portion control:* How often do you….**	Almost Never	Sometimes	Often	Almost Always
Stop eating when full?	1	2	3	4

Refuse offers of food when you're not hungry?	1	2	3	4
Try to limit the number of food servings you eat?	1	2	3	4
Try to limit the size of food servings you eat?	1	2	3	4
Try to find something else to do instead of snacking?	1	2	3	4
***Social / Diet:* How often do you:**	Almost Never	Sometimes	Often	Almost Always
Try to bring healthy foods to social events with family members or friends?	1	2	3	4
When you go out to eat with family members or friends, suggest restaurants that have at least some healthy choices on the menu?	1	2	3	4
Serve healthy foods when you have family or friends over?	1	2	3	4
***Social / Activity:* How often do you….**	Almost Never	Sometimes	Often	Almost Always
Suggest doing something active when you got together with family members or friends, such as going for a walk, biking, or swimming?	1	2	3	4
Set aside a special time to do physical activity?	1	2	3	4
Ask a friend or relative to do some physical activity with you?	1	2	3	4
Talk to others about the benefits of physical activity?	1	2	3	4
***Cognitive / diet:* How often do you…**	Almost Never	Sometimes	Often	Almost Always
Praise yourself when you eat healthy foods?	1	2	3	4

Reward yourself for eating healthy foods?	1	2	3	4
Think about the benefits of healthy eating?	1	2	3	4
Say positive things to yourself about healthy eating?	1	2	3	4
Think about what motivates you to eat healthier meals?	1	2	3	4
***Cognitive/activity:* How often do you…**	Almost Never	Sometimes	Often	Almost Always
Praise yourself for doing physical activity?	1	2	3	4
Reward yourself for being physically active?	1	2	3	4
Think about the benefits of being physically active?	1	2	3	4
Say positive things to yourself about being physically active?	1	2	3	4
Think about what motivates you to be physically active?	1	2	3	4

Date:_____

Thanks for completing the Survey

APPENDIX B.

Wellness Works Text Message Bank

Diet

Half your plate should be fruits and veggies. How much of your typical plate consists of fruits and veggies?

You should eat 2-3 cups of fruits and veggies each per day. How much of each do you typically eat?

Grilling season is almost here! Throw on some veggie kabobs with peppers, mushrooms and onions. Or wrap asparagus, olive oil, salt and pepper in tin foil!

Once a week, wash and cut up veggies and put them in separate containers so they're easy, on the go snacks.

Next time at the super market, purchase a fruit you've never tried before.

For a healthy breakfast, add no sugar-added frozen fruit to non-fat plain yogurt. Sprinkle with low-fat granola. Delish!

Breakfast is the most important meal of the day! It revs up your metabolism to start burning those calories. What did you have for breakfast this morning?

While salads are low in calories and packed with nutrients, the dressing you add can ruin your waistline. Aim for just 1-2 tablespoons.

You should eat 25-30 grams of fiber each day. Try one of these high-fiber foods today: bran cereal, flax seed, edamame, lentils, and almonds.

Whole grain products make you feel fuller longer and don't spike your blood sugar. Have you ever eaten quinoa? Here is a great recipe. http://www.foodnetwork.com/recipes/quinoa-pilaf-with-pine-nuts-recipe/index.html

Most of us need to eat more Omega-3 fatty acid. Foods that are high in Omega-3's are: salmon, tuna, nuts, and flax and chia seeds.

Challenge yourself to go "meatless" for an entire day once a week. Your heart will thank you. Here is a vegetarian chili recipe that will not leave you hungry. http://greatist.com/health/quick-easy-vegetarian-chili-healthy-recipe/ Think you can do it? If not, what's stopping you?

How often do you think of the calories you're eating during a meal or snack? 1-never, 2-sometimes, 3-most often.

Weight Management

When going out to eat, share a meal with a friend or family member. If you're still hungry, have a healthy snack when you get home. You'll cut the cost and calories in half!

How often do you think of the calories you're eating during a meal or snack? 1-never, 2-sometimes, 3-most often.

Half your plate should be fruits and veggies. How much of your typical plate consists of fruits and veggies?

Once a week, wash and cut up veggies and put them in separate containers so they're easy, on the go snacks.

Breakfast is the most important meal of the day! It revs up your metabolism to start burning those calories. What did you have for breakfast this morning?

While salads are low in calories and packed with nutrients, the dressing you add can ruin your waistline. Aim for just 1-2 tablespoons.

Whole grain products make you feel fuller longer and don't spike your blood sugar. Have you ever eaten quinoa? Here is a great recipe. http://www.foodnetwork.com/recipes/quinoa-pilaf-with-pine-nuts-recipe/index.html

Fiber helps you feel fuller longer, and is great for your digestive system. You should eat 25-30 grams each day. Try one of these high-fiber foods today: bran cereal, flax seed, edamame, lentils, and almonds.

Fancy coffee drinks can pack 300-500 calories! Lighten up your favorite coffee drink with fat-free milk and sugar-free syrup. Ask for no whip cream to save even more calories.

Downsize Your Dishes. Use smaller plates and bowls to help you eat less. We tend to fill up the dish we're using and then eat it all. Our brains also think we are getting more when the same amount of food is placed in a smaller dish.

Rethink Your Drinks. High-calorie beverages like soft drinks, juice drinks, energy drinks, specialty coffees and alcohol add calories just like solid foods. Whenever possible, replace these drinks with plenty of water. If you're bored with plain water, add lemon or calorie free flavors (Crystal Light, Mio).

Don't Eat Out of a Bag or Box. When you eat out of a package, you are likely to keep eating until it's all gone – no matter how many servings the package actually contains. Pour one serving into a small bowl.

Leave Some Food on Your Plate. This is especially important if you grew up in the "clean plate club." By leaving even a few bites, you can focus more on your internal signals of satisfaction and less on eating food just because it is there.

Physical Activity

Aim for 150 minutes of moderate intensity exercise each week. This could be walking or biking for 30 minutes a day for 5 days. However you want to break it up. You'll start to feel better and have more energy! It's great for stress relief too!

Set small, achievable exercise goal every day or one for each week. "Take the stairs instead of the elevator" "Go for two 15-minute walks today". What is your exercise goal for today?

Exercise is a great way to start your morning. It boosts your energy and releases "good feeling" endorphins in your brain. Put your coffee in a to-go cup and lace up those shoes! You don't have to speed walk to reap the benefits.

Exercise can be more fun with a friend or family member. Grab a close one to combat the calories together. It's proven that having a workout partner is more effective in losing and keeping excess weight off.

Try to spice up your weekly workouts by adding strength training twice a week as well as doing cardiovascular exercise. Muscle burns more calories than fat, and looks better too!!

Exercise doesn't have to be all work and no play. What's your favorite sport to play or physical activity to do?

Gardening has a double-duty! It gives you fresh, healthy produce and is a great source of exercise! Do you have a garden at home?

Think you would like to walk or run in a 5k (3.1 miles)? There is the ISU- Donut Run 5k April 6 in Ames. https://sites.google.com/site/isutriclub/doughnut-run or Mary's Meals 5k Fun Run/Walk @ Banner Lakes Summerset State Park on April 7 in Des Moines. http://marysmeals5k.weebly.com/

Look at your armband data to see how many steps you took yesterday. Challenge yourself to beat it by an extra 1,000 steps today!

STOP WHAT YOU'RE DOING!! 25 jumping jacks, starting NOW!

STOP WHAT YOU'RE DOING!! Go for a 5 minute walk and drink a glass of water. You'll feel REVITALIZED!

STOP WHAT YOU'RE DOING!! Do 10 leg lunges for each leg. Feel the BURN!

Do you feel more energized now?

APPENDIX C.

Lifestyle and Health Behavior Assessment Questionnaire

Background and Instructions:

1. The Lifestyle and Health Behavior Assessment Questionnaire will provide information about your current lifestyle behaviors and your readiness to change your lifestyle.
2. It is important to provide honest and accurate information. Please carefully read each question and fill in the blank or place a check in the designated box.
3. The information on the Lifestyle and Health Behavior Assessment Questionnaire will be used to help determine individual interests and needs with regard to health promotion.
4. The information on the Lifestyle and Health Behavior Assessment Questionnaire will only be used by the NWRC research staff involved with the project. It will NOT be shared with any representatives of your company.

Site ID: _____

Participant ID: _____

Nutrition&Wellness RESEARCH CENTER

Perceptions of Health Status

1. Please rate your overall health status:
   - A. Poor
   - B. Fair
   - C. Good
   - D. Very good
   - E. Excellent

2. In terms of physical heath, which includes physical illness and injury, how many days during the past 30 days was your health not good? _____ days

3. In terms of mental health, which includes anxiety, stress, depression and emotional problems, how many days during the past 30 days was your health not good? _____ days

Physical Activity Habits and Behaviors

4. During the past month did you participate in any physical activities or exercises, such as running, calisthenics, golf, gardening, or walking for exercise? (Do not include exercise you get at your job.)
   - 1 = Yes
   - 2 = No

5. When you are at work, which of the following best describes what you do?
   - 1 = Mostly sitting
   - 2 = Mostly standing
   - 3 = Mostly walking
   - 4 = Mostly heavy labor or physically demanding work

The following questions ask about your participation in moderate and vigorous physical activity when you are not working. **Moderate activities** are those that cause small increases in breathing or heart rate, such as brisk walking, bicycling, vacuuming, gardening, etc. **Vigorous activities** are activities that generally last for at least 10 minutes at a time, such as running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate.

6. In a typical week, how often do you do **moderate** activities (outside of work) for at least 10 minutes at a time?

   _____ Number of days per week

   _____ Minutes per day

   ☐ I do not do moderate activity in a typical week

7. In a typical week, how often do you do **vigorous** activities (outside of work) for at least 10 minutes at a time?

   _____ Number of days per week

   _____ Minutes per day

   ☐ I do not do vigorous activity in a typical week

Lifestyle Assessment Please read the following questions and choose the best response for each question.

1. Have you been trying to lose weight? a. YES, I have been for More than 6 months. b. YES, I have been, but for LESS than 6 months. c. NO, but I intend to in the next 30 days. d. NO, but I intend to in the next 6 months. e. NO, and I do NOT intend to in the next 6 months.
2. **Do you consistently avoid eating high fat foods?** a. YES, I have been for More than 6 months. b. YES, I have been, but for LESS than 6 months. c. NO, but I intend to in the next 30 days. d. NO, but I intend to in the next 6 months. e. NO, and I do NOT intend to in the next 6 months.
3. Do you include fruit in your diet everyday? a. YES, I have been for More than 6 months. b. YES, I have been, but for LESS than 6 months. c. NO, but I intend to in the next 30 days. d. NO, but I intend to in the next 6 months. e. NO, and I do NOT intend to in the next 6 months.
4 Do you include vegetables in your diet everyday? a. YES, I have been for More than 6 months. b. YES, I have been, but for LESS than 6 months. c. NO, but I intend to in the next 30 days. d. NO, but I intend to in the next 6 months e. NO, and I do NOT intend to in the next 6 months.
5 Do you include whole grains in your diet everyday? a. YES, I have been for More than 6 months. b. YES, I have been, but for LESS than 6 months. c. NO, but I intend to in the next 30 days. d. NO, but I intend to in the next 6 months e. NO, and I do NOT intend to in the next 6 months
6 Have you attempted to reduce the amount of stress in your daily life? a. YES, I have been for More than 6 months. b. YES, I have been, but for LESS than 6 months. c. NO, but I intend to in the next 30 days. d. NO, but I intend to in the next 6 months. e. NO, and I do NOT intend to in the next 6 months.
7 Do you exercise three times a week for at least 20 minutes each time? a. YES, I have been for More than 6 months. b. YES, I have been, but for LESS than 6 months. c. NO, but I intend to in the next 30 days. d. NO, but I intend to in the next 6 months. e. NO, and I do NOT intend to in the next 6 months.

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

Name _____ Date _____

Age _____ Gender (*Circle*): **M F** Other _____

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Thanks for completing the assessment

APPENDIX D.

Participant Survey

1. Rate your overall use of and reaction to the Armband monitor

a. How much did you use it?	Nearly every day	Most days	Some days	Not at all
b. Was the monitor comfortable to wear?	Very comfortable	Somewhat comfortable	Somewhat uncomfortable	Very uncomfortable
c. Did the monitor remind you to be active?	Definitely	Maybe	Not Likely	Definitely Not
d. How satisfied were you with the monitor?	Very Satisfied	Somewhat Satisfied	Somewhat unsatisfied	Very unsatisfied

Please tell us about your perceptions with the armband?

e. What did you like about the armband?

f. What did you dislike about the armband?

2. Please tell us about your perceptions about the ProConnect software?

a. How much did you use it?	Every few days	Most every week	A few times	Not at all
b. Was the software easy to use?	Very easy	Somewhat easy	Somewhat difficult	Very difficult
c. Did the software help you to learn to monitor your behavior	Definitely	Maybe	Not Likely	Definitely Not
d. How satisfied were you with the ProConnect software?	Very Satisfied	Somewhat Satisfied	Somewhat unsatisfied	Very unsatisfied

Please provide some specific comments about the software?

e. What did you like about the software interface?

f. What did you dislike about the software interface?

Do you have any other comments about your experience with the monitor or the study?

2. Please tell us about your perceptions of the Proconnect health coaching.

a. Did you take advantage of the supplemental health coaching?	Yes	Sometimes	Rarely	Never
b. Did the health coaching help you to maintain and support your efforts?	Definitely	Maybe	Not Likely	Definitely Not
c. Would you have preferred to have in-person visits with a health coach?	Definitely	Maybe	Not Likely	Definitely Not

Please provide some specific feedback about the Health Coaching

d. What did you like about the Pro Connect coaching?

e. What did you dislike about the Pro Connect coaching?

3. Please tell us about your perceptions of the text messaging.

a. Did you take advantage of the text messaging option?	Yes	Sometimes	Rarely	Never
b. Did you read the posts provided in the text messages?	Yes	Sometimes	Rarely	Never
c. Did you respond to the prompt in the text messages?	Yes	Sometimes	Rarely	Never
d. Did the text messages prompt you take steps toward your health goal?	Definitely	Maybe	Not Likely	Definitely Not

Please provide some specific feedback about the Text messages?

e. Did the text messages affect your behavior? In what ways?

g. If it were offered, would you like to continue receiving text messages about health topics?