Online DASH Diet Education to Reduce Blood Pressure in Primary Care Patients

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Abstract

Hypertension is widespread among Americans and can lead to serious conditions such as myocardial infarction, stroke, renal failure, and potentially death if not diagnosed and treated appropriately. Non-pharmacological interventions, especially dietary modifications, are important to implement in the prevention and treatment of hypertension. The purpose of the quasi-experimental pilot project was to explore the potential effectiveness and feasibility of utilizing an online program with telephone follow-up calls to improve DASH compliance and reduce blood pressure for patients in a primary care setting. Convenience sampling among patients aged 30-80 with mild or pre-hypertension in a primary care clinic in Kansas aimed to enroll 30 participants. The intervention included participation in the DASH for Health online program along with monthly telephone follow-up calls for a duration of three months. For 11 participants, DASH compliance and blood pressure were measured at baseline and post-intervention and a validated DASH questionnaire was used to quantify DASH adherence. Results showed overall mean decreases in blood pressure and weight along with increased DASH compliance. The DASH for Health online program with monthly telephone follow-up leads to compliance with the DASH eating pattern and is an effective non-pharmacological intervention to successfully prevent and manage hypertension.

Keywords: hypertension, DASH, compliance, dietary modification, online program, blood pressure

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Known as the *silent killer,* hypertension is a major risk factor for cardiovascular disease (CVD) and a common problem in the United States (Drozda et al., 2011). Hypertension can successfully be treated with non-pharmacological interventions including lifestyle changes such as dietary modifications, stress reduction, avoidance of alcohol, and regular exercise (Mahmood et al., 2018). Adherence to the Dietary Approaches to Stop Hypertension (DASH) diet is an effective non-pharmacological intervention that has a similar blood pressure (BP) lowering effect as one hypertension medication (Mahmood et al., 2018). The project focused on utilization of an online DASH educational intervention with follow-up telephone calls to increase DASH compliance and reduce blood pressure for patients with mild or pre-hypertension in a primary care setting.

Significance

Cardiovascular disease is an expensive and sizeable problem in the United States costing an estimated $312 billion and claiming approximately 800,000 lives annually (Yang et al., 2015). In the United States, mortality due to CVD has decreased over the last 40 years but remains a significant health concern (Yang et al., 2015). Major risk factors for CVD include hypertension, high cholesterol, obesity, diabetes, smoking, sedentary lifestyle, and chronically poor dietary choices (Yang et al., 2015).

Hypertension is the leading preventable risk factor for CVD (Patel et al., 2016), and one of the most significant avoidable contributors to overall disease and death (James et al., 2014). Worldwide, hypertension affects more than one billion people and is the cause of more than 10 million preventable deaths each year (Patel et al., 2016). The global financial burden of hypertension is staggering, costing an estimated $372 billion or 10% of overall healthcare costs

in 2011 (Patel et al., 2016). In 2010, the direct and indirect costs of hypertension in the US were estimated at $93.5 billion and were expected to reach $150 billion by 2020 (Cai & McAdam-Marx, 2014).

A multi-national study showed 55.6% of participants were aware of their hypertension and 44.1% were treated, but only 17.1% had adequately controlled blood pressure (BP; Benjamin et al., 2019). Within the United States, an estimated 45.5% of adults over the age of 20 have hypertension, and 35.3% of them are unaware of their condition (Benjamin Emelia J. et al., 2019). It is projected that 77 million deaths could be avoided if even half the patients with moderate to high risk for hypertension worldwide had effective BP control (Patel et al., 2016). Hypertension can lead to serious conditions such as myocardial infarction, stroke, renal failure, and potentially death if not diagnosed and treated appropriately (James et al., 2014).

Local Issue

Locally, an estimated 28.7% of Kansans over the age of 18 reported they had been diagnosed with hypertension in 2009, which was an increase from 23.9% in 2001 (Muninger et al., 2013). The DNP project was implemented in a primary care clinic in Kansas. The local clinic utilizes a concierge medicine model where patients pay a yearly premium for personalized health services and extended access. At the clinic every visit is 30 minutes in duration, and patients can call or text the physician at any time for advice or prompt treatment. Additionally, a yearly 90-minute wellness visit is included in the standard services. These patients are generally invested in their health and are relatively compliant. Dietary advice and counseling are completed during the comprehensive patient visits but dietary support is typically lacking throughout the year.

Diversity Considerations

Within the Kansas city, the population is 80.8% Caucasian, 6.6% Hispanic or Latino, 5.9% Asian, 4.5% African American, and 2.5% American Indian or Alaskan Native (*U.S. Census Bureau QuickFacts*, n.d.). Only 7.8% of the population was foreign born (*U.S. Census Bureau QuickFacts*, n.d.). It was assumed that the patient population within the clinic possesses a similar ratio of ethnic and cultural representation as the city at large. Thus, a great majority of the clinic's patients were expected to be Caucasian and U.S. born.

Problem Statement and Intended Improvement with Purpose

An underlying cause of a large proportion of hypertension can be attributed to poor dietary practices including a high intake of sodium and insufficient intake of potassium, calcium, magnesium, protein, and a lack of vegetables, fiber, and fish fats (Whelton et al., 2018). Adherence with the DASH diet is an established non-pharmacological method to reduce BP (Appel et al., 1997) however, dietary education at regular patient visits is minimal. The project intended to improve the consistency and effectiveness of DASH diet education for patients. The purpose of the DASH education project was to determine if the DASH for Health online program with follow-up telephone calls results in an increase in DASH compliance and lower BP in patients with pre-hypertension or mild hypertension within a primary care clinic.

Facilitators and Barriers

The main facilitator for the project was the physician who was a preceptor for the student investigator. The physician recognized and valued the benefits the project would provide to patients. Other facilitators included the minimal time commitment needed from staff at the clinic, potential sustainability after the study, and the physician preceptor's prediction that many patients would be eligible and willing to participate. A barrier to the project was the cost which could hinder long term participation and sustainability as the price for a three-month subscription

to the DASH for Health program is $39. The cost to implement the program entailed paying the $39 subscription fee for each of the participants (see Appendix A for cost prediction analysis). Another barrier is the need for grant funding for the project.

Inquiry

The project proposal focused on the following inquiry: For patients 30-80 years with pre-hypertension or mild hypertension, does a web-based DASH educational program with monthly telephone follow-up calls result in an increase in DASH diet compliance, as measured by a DASH questionnaire and reduction of BP measurements after three months within a primary care clinic?

Literature Search Strategies

An extensive literature search was performed, including articles published in the English language within the last 10 years. Searched databases included PubMed, cumulative index of nursing and allied health literature (CINAHL), OVID Medline, and OVID Cochrane Database of Systematic Reviews. Keywords used, both alone and in various combinations, were DASH, dietary approaches to stop hypertension, hypertension, compliance, dietary modification, electronic message, lifestyle modification, guidelines, and social cognitive theory. Hand searching of reference lists from included articles was also performed. Additionally, an online search was completed for reliable sources for hypertension guidelines (see Appendix B for adapted PRISMA diagram). Of the 21 included articles, seven were level I evidence (two evidence based practice guidelines [EBPG] and five systematic reviews of randomized controlled trials [RCTs]), five were level II evidence (all RCTs), three were level III evidence (two quasi-experimental designs and one systematic review of a cohort study), and six were level IV evidence (four cohort studies and two cross-sectional studies) serving as the evidence

foundation for the project (see Appendix C for the rating system of hierarchy of evidence using Melnyk & Overholt, 2015, adapted).

Synthesis of Evidence

The synthesis of evidence was derived from the studies identified in the literature search (see Appendix D for table). Four topics with corresponding themes emerged from the evidence as intrinsically related to the inquiry. Analyzed topics included hypertension guidelines, DASH diet as an intervention for hypertension, specific DASH diet interventions, and DASH diet measurement methods.

Hypertension Guidelines

Hypertension parameters. In two separate EBPGs, the BP threshold for initiating pharmaceutical treatment for patients in the general population is a systolic blood pressure (SBP) greater than or equal to 140 mmHg or a diastolic blood pressure (DBP) greater than or equal to 90 mmHg (James et al., 2014; Whelton et al., 2018). In 2003, the 140/90 mmHg threshold was determined by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) as the definition of hypertension and is referenced by both James et al. (2014) and Whelton et al. (2018) as the current standing source for the designation. Additionally, Whelton et al. (2018) define elevated BP as SBP 120-129 mmHg and DBP < 80 mmHg and stage one hypertension as SBP 130-139 mmHg or DPB 80-89 mmHg. Evidence based thresholds for hypertension classifications and pharmaceutical interventions are valuable tools and routinely utilized in clinical decisions regarding preventative and treatment measures for hypertension (James et al., 2014; Whelton et al., 2018).

Hypertension treatment recommendations. The two hypertension EBPGs state that non-pharmaceutical interventions for treatment should be the primary initiative used prior to and

then concurrently throughout pharmaceutical interventions (James et al., 2014; Whelton et al., 2018). Whelton et al. (2018) list six best proven non-pharmacological interventions to reduce hypertension with three specifically related to diet (consume overall healthy diet, reduce sodium, and increase potassium) and name the DASH diet as a means to successfully accomplish all three. Both James et al. (2014) and Whelton et al. (2014) list non-pharmacological lifestyle interventions at the top of their treatment algorithms for all demographic groups.

DASH Diet as Hypertension Intervention

DASH diet is effective at lowering BP. Adherence to the DASH diet is mainly effective at reducing BP measurements. Among eight studies primarily focused on the effect of the DASH diet on BP, six of the studies found a positive correlation between the DASH diet and lower BP measurements (Appel et al., 1997; Blumenthal et al., 2010; Epstein et al., 2012; Ndanuko et al., 2016; Saneei et al., 2014; Siervo et al., 2015) and two longitudinal studies did not (Folsom et al., 2007; Jiang et al., 2015). The decreases in SBP and DBP attributable to the DASH diet varied between the studies that directly measured DASH diet correlation with BP measurements. Including the three systematic reviews and two RCTs (with the original ENCORE study and secondary analysis as one entry), the mean reductions in SBP and DBP were 6.7 mmHg and 3.85 mmHg respectively (Appel et al., 1997; Blumenthal et al., 2010; Epstein et al., 2012; Ndanuko et al., 2016; Saneei et al., 2014; Siervo et al., 2015).

Longitudinal DASH results differ. Two longitudinal studies evaluated the association of the DASH diet and hypertension and ultimately concluded that greater alignment with the DASH diet was not associated with decreased occurrence of hypertension over time (Folsom et al., 2007; Jiang et al., 2015). Folsom et al. (2007) found an inverse correlation between higher DASH concordance and incidence of hypertension when adjusted for age and energy intake.

Still, after adjusting for other risk factors, the correlation was not statistically significant. Although the final results of the two longitudinal studies were in alignment, hypertension incidence was found to decrease with higher DASH diet concordance in one study (Folsom et al., 2007), and overall BP readings increased slightly in another study (Jiang et al., 2015). Longitudinal results regarding DASH diet accordance and hypertension differ from short-term findings.

DASH Diet Interventions

Overall, there was no consensus regarding the most effective interventions to increase dietary advice adherence (Desroches et al., 2013; Kwan et al., 2013). Within the literature, four common DASH diet interventions were identified: feeding trials, counseling, telephone contact, and online programs. Telephone contact and online programs were most relevant to the project.

Telephone contact. Educational and follow-up telephone interventions were successful, particularly when used in conjunction with other intervention methods (Desroches et al., 2013; Jarl et al., 2014; Kwan et al., 2013). Two systematic reviews reported that telephone interventions can be beneficial to increase dietary adherence (Desroches et al., 2013) and enhance DASH education with a resulting decrease in BP (Kwan et al., 2013). The systematic review by Desroches et al. (2013; 38 RCTs) found that telephone follow-up interventions successfully improved three out of ten dietary improvement outcomes and multiple simultaneous interventions, which did not consistently include telephone interventions, improved 21 of 56 dietary improvement outcomes. Within a single primary care setting, a nurse practitioner (NP) implemented two 20-minute individual telephone consults as a follow-up intervention in addition to group classes and found an improvement in dietary intake (Jarl et al., 2014). Although beneficial, telephone interventions were time and resource intensive (Jarl et al., 2014) and best

utilized in conjunction with other intervention modalities.

Online programs. DASH specific online educational programs, when used as a primary intervention strategy, successfully reduced yearly healthcare costs (Sacks et al., 2009), decreased BP measurements, and resulted in an increased intake of fruits and vegetables (Dorough et al., 2014; Moore et al., 2008). Sacks et al. (2009) and Moore et al. (2008) exclusively focused on the online DASH for Health program within a corporate setting, and both studies confirmed the beneficence of the program. The systematic review by Desroches et al. (2013; 38 RCTs) concluded that interventions employing nutritional tools, including menus and portion sizes, successfully improved three of 17 dietary adherence outcomes, and feedback interventions successfully improved one of seven, therefore both favoring an intervention group. Considering that the online programs included the nutritional tool components described to be successful by Desroches et al. (2013), independently reported positive measured outcomes (Dorough et al., 2014; Moore et al., 2008; Sacks et al., 2009), and could be conducted with relatively minimal resource expenditure, online programs were found to be a practical intervention option.

DASH Diet Measurement Tools

Numerous methods have been used to measure DASH compliance with no gold standard approach identified or used in practice (Kwan et al., 2013; Schwingshackl & Hoffmann, 2015; Tangney et al., 2016). The self-report method of food intake was used in many studies (Apovian et al., 2010; Appel et al., 1997; Blumenthal et al., 2010; Dorough et al., 2014; Epstein et al., 2012; Folsom et al., 2007; Fung et al., 2008; Jarl et al., 2014; Jiang et al., 2015; Lin et al., 2013; Moore et al., 2008; Schwingshackl & Hoffmann, 2015; Tangney et al., 2016) and was the most common approach. Several different DASH scoring templates exist that could effectively quantify DASH adherence when applied to self-report data (Kwan et al., 2013; Schwingshackl &

Hoffmann, 2015; Tangney et al., 2016). Apovian et al. (2010) tested the reliability of the online DASH questionnaire created by Moore et al. (2008) that was previously used within the DASH for Health online program by validating it against the Block Food Frequency Questionnaire (FFQ) and found significant positive correlations between the two for all food groups. However, accuracy of the self-report method was constantly in question due to misreporting stemming from memory lapses, misrepresentation of portion sizes, and diet variability, among other factors (Desroches et al., 2013). Analysis of urinary excretion was the most commonly utilized objective measurement of DASH diet compliance and was more reliable than self-report measures, but was infrequently used and limitations still existed (Desroches et al., 2013; Kwan et al., 2013).

Synthesis Summary

Studies and guidelines provided direct evidence for the specific inquiry and project. The EBP guidelines defined hypertension as SBP >140 mmHg and/or DBP >90 mmHg (James et al., 2014; Whelton et al., 2018). Mild and pre-hypertension was defined by the classifications outlined by Whelton et al. (2018) for elevated BP (pre-hypertension) and stage one hypertension (mild hypertension; see Appendix E for definition of terms). Ample evidence was identified from three level I systematic reviews confirming the DASH diet as an effective non-pharmacological treatment to lower blood pressure (Ndanuko et al., 2016; Saneei et al., 2014; Siervo et al., 2015). Another level I systematic review provided adequate evidence to support the methodologies of the DASH for Health online program utilized with telephone follow-up calls (Desroches et al., 2013). The DASH for Health online program, when used in a corporate setting, successfully reduced healthcare costs (Sacks et al., 2009), BP measurements, and improved dietary intake (Moore et al., 2008). Additionally, the online DASH questionnaire,

used to measure dietary intake and DASH compliance, was previously located within the DASH for Health online program and was effective at measuring food and nutrient intake when compared to the well-established Block FFQ (Apovian et al., 2010). The DASH for Health online program, utilized with telephone follow-up calls in conjunction with the associated DASH questionnaire for measurement of compliance, was supported by the literature as an efficient and effective dietary intervention.

Theory

Social-cognitive theory (SCT) was the selected framework for application and implementation of the project. The two major concepts of SCT are self-efficacy and outcome expectations and the two secondary concepts are socio-structural factors, and goals (see Appendix F for flow diagram; Young, Plotnikoff, Collins, Callister, & Morgan, 2014). As outlined by Bandura (1977), in his original explanation of SCT, self-efficacy functions as a variable to describe and predict an individual's behavior; high self-efficacy increases a behavior and low self-efficacy decreases a behavior.

Setting small, incremental, and achievable goals, an intervention strategy that can increase self-efficacy for participants, was included in the DASH for Health program (Glanz & Bishop, 2010). During monthly follow-up phone calls, participants were asked about progress with their goal and individualized support was provided. Outcome expectations were also discussed during telephone follow-up calls and addressed with the use of the self-monitoring tool within the online program which assisted with and encouraged participant self-evaluation. A study by Dorough et al. (2014) implemented an electronically delivered intervention to increase DASH diet compliance and physical activity within the SCT framework. In the study, SCT strategies were applied to physical activity and DASH eating plan goals by focusing on

participant self-regulation of planning, goal-setting, and tracking and positive results were found (Dorough et al., 2014).

Methods

IRB Approval

The clinic is associated with a local hospital. Therefore, the project was submitted to the hospital institutional review board (IRB) for approval and was determined to not be research. The project was then submitted to the University of Missouri- Kansas City (UMKC) IRB and was approved as a quality improvement (QI) project (see Appendix G).

Ethical Considerations, Conflict of Interest, Funding

The intervention focused on improving diet for the participants wherein no inherent harm existed. Participation was voluntary and admission to the program could have been refused at any time for any reason. Participants were informed of the implications of the project prior to enrollment in the online program and had the ability to opt-out at any time. Privacy and confidentiality of the participants were upheld. All aspects of HIPAA were maintained throughout the project. The student investigator did not have any conflicts of interest associated with the project. No monetary or other incentives were given to the student investigator to influence any aspect of the project.

The predicted cost for the project was $2,430 which was comprised largely by participant subscription costs for the DASH for Health program (see Appendix A for predicted cost table). Grant money funded the majority of the project. The student investigator initially covered the cost of the project and then a grant was awarded from the University of Missouri-Kansas City Women's Council Graduate Assistance Fund to assist with project expenses.

Setting and Participants

The project was implemented at a primary care clinic in Kansas which functions within a concierge medicine model. Participants were established primary care patients at the clinic. Patients were eligible if they were between 30 and 80 years old and had pre-hypertension (SBP 120-129 mmHg and DBP < 80 mmHg) or mild hypertension (SBP 130-139 mmHg or DPB 80-89 mmHg or diagnosed hypertension and currently taking one hypertension medication; Whelton et al., 2018). Potential participants were excluded if they were pregnant, had chronic renal disease, uncontrolled diabetes, congestive heart failure, developmental delays or cognitive impairments, history of an eating disorder, or a history of a cardiovascular event within the last year. The clinic has approximately 400 patients who are members. An email was sent to all patients by the physician preceptor, through the clinic portal, with general information about the project. It was anticipated that 30 participants would complete the study (see Appendix H for logic model).

EBP Intervention

The project was completed in three stages which included sampling, intervention with data collection, and data analysis (see Appendix I). During summer of 2019, the project proposal was presented to the administrative director of the clinic and UMKC faculty and gained approval from both parties (see Appendix J). Additionally, the intervention and details of the methods were presented to staff at the clinic before the recruitment period commenced. Convenience sampling was used; the physician preceptor sent an email containing information about the study to all of his patients, which included an informational message from the student investigator and an electronic flier containing information detailing the intervention (see Appendix K and Appendix L). Printed fliers were also displayed at the clinic. All patients were afforded the opportunity to contact the student investigator via telephone or email with any questions or

concerns. Individuals who expressed an interest in participating were further screened for eligibility. Once committed to involvement in the project, participants completed the DASH questionnaire, and baseline BP and weight were measured. Baseline BP was calculated by averaging SBP and DBP measurements of two readings at least five minutes apart on the same day.

The intervention involved registering participants for a three-month subscription to the DASH for Health online program at DASHforHealth.org. The intervention period lasted from the end of September 2019 to the end of January 2020. At the initial meeting in the clinic, the student investigator took the baseline measurements of BP and weight, facilitated the completion of the DASH questionnaire, and educated participants on the intervention while answering any questions. The participants were encouraged to login to the website at least once a week and adhere to the outlined plan. Monthly follow-up phone calls were made to participants by the student investigator for encouragement and support, and participant questions or concerns were addressed. At the end of the three month intervention period, participants returned to the clinic to complete the post-intervention DASH questionnaire and BP and weight measurements were recorded. Again, the BP was calculated by averaging the SBP and DBP measurements of two readings taken at least five minutes apart on the same day (see Appendix M for project timeline).

Change Process Model

Kotter and Cohen's Model of Change was applied to the inquiry and project. The model identifies eight sequential steps used for successful organizational change (Appelbaum et al., 2012). The first steps are to instill a sense of urgency in the need to change and then form a group to guide and influence the change (Appelbaum et al., 2012). The next step is to develop a clear vision and strategy for the change and communicate them to the population at large

(Appelbaum et al., 2012). Then, empower people to become involved in the change and highlight short-term wins (Appelbaum et al., 2012). For the last step, create momentum by building on successes from the change and secure the new methods within the current culture (Appelbaum et al., 2012).

EBP Model

The Stetler Model of evidence based practice was applied to the DNP project. Stetler's model is geared toward the practitioner and outlines steps for critical thinking and decision making for the effective utilization of research (Stetler, 2001). The model uses applicability criteria to determine if data findings are desirable and feasible in alternate settings (Stetler, 2001). The criteria include substantiating evidence, the need for change in current practice, the fit of the findings in the new setting, and the feasibility of implementation (Stetler, 2001). Feasibility involves consideration of risk versus benefit, support and cooperation of stakeholders, and accessibility of required resources (Stetler, 2001).

Sustainability

The sustainability of the project was expected to be dependent on ongoing funding for the DASH for Health subscriptions and the willingness and time for staff to make monthly follow-up phone calls. Many patients follow-up in the office on a fairly regular basis but usually not as frequently as monthly. Therefore, sustainability of the intervention past the project intervention period was uncertain.

Study Design

The study design for the DNP project was quasi-experimental with a single group including pre- and post-evaluation. The participants were recruited via convenience sampling at a primary care clinic in Kansas. Measuring the two primary outcomes of DASH adherence and

BP before the intervention provided baseline data for the participants. Consequentially, the post-study measurements determined the impact of the intervention on the primary outcomes.

Validity

Internal validity was strengthened by the two face-to-face meetings, upon initiation and conclusion, and monthly follow-up telephone calls that were made to participants throughout the intervention period. Maintaining periodic communication with the participants, along with consistency in the person who provides the support, minimizes attrition (Melnyk & Fineout-Overholt, 2015). All of the measurement tools assessed variability along a continuum and were used consistently at the beginning and end of the intervention period which strengthened the internal validity. Additionally, the measurement tools were only used twice, which decreased participant time requirements and prevented nonadherence to completion of the tools. External validity was weakened because the clinic patients pay a yearly fee for concierge medicine services assumes financial security.

Outcomes

The primary measured outcomes were DASH compliance and BP after three months of the DASH for Health program with monthly telephone follow-up calls. The secondary measured outcome was weight. All the outcomes were measured at the beginning and end of the three month intervention period. Demographic information including age, gender, race and ethnicity, and highest education level were also collected at the initial face-to-face encounter.

Measurement Instruments

Participants came to the clinic for measurements twice, first within one week of the initiation of the intervention for baseline measurements, and again within one week of completion for post-intervention measurements. During these visits, BP and weight were

measured and recorded by the student investigator using the sphygmomanometer and scale owned and routinely utilized by the clinic. The DASH questionnaire was administered, by the student investigator, at both visits using a paper and pencil format to measure baseline and post-intervention DASH adherence. The BP was measured two times, at least five minutes apart, and the average of the two readings was used as the BP measurement. Procedural methods to measure BP were consistent with current guidelines as outlined by Whelton et al. (2018) to ensure accurate BP readings. Usually, the participant's weight and the first BP were measured, then the patient completed the questionnaire, and then the second BP measurement was recorded.

DASH Questionnaire. The DASH questionnaire, created by the DASH for Health team, was initially used in an online format and validated against the well-known Block Food FFQ by Apovian et al. (2010). The Block FFQ and the DASH online questionnaire (OLQ) were found to have significant positive correlations among all eleven DASH food groups (Apovian et al., 2010). Weighted kappa statistics found the level of alignment between the DASH OLQ and the Block FFQ by energy level to have a value of 0.48 (95% CI 0.38, 0.57; $P < 0.0001$) meaning moderate agreement was observed (Apovian et al., 2010). The DASH for Health team verbally granted permission via telephone for the student investigator to utilize the tool in paper and pencil format within the proposed project (DASH for Health administrator, personal communication, March 18, 2019). An administrator from the DASH for Health team emailed the PDF version of the validated tool to the student investigator.

The DASH questionnaire is based on a diet recall from the previous 24 hours only and encompasses 11 dietary categories with additional questions to determine sodium and fat intake (Apovian et al., 2010). A DASH for Health administrator estimated the questionnaire would take participants approximately four minutes to complete and would not feel burdensome

(DASH for Health administrator, personal communication, March 18, 2019). The questionnaire was initially used in HTML format on the DASH for Health website but is no longer available in the public domain; it was removed from the DASH for Health online program due to feedback from participants that it took too long to complete (DASH for Health administrator, personal communication, March 18, 2019).

Quality of Data

To ensure the confidentiality of participants, the student investigator collected all data and assigned numbers to each participant survey and other outcome measures to match baseline and post-intervention measurements; all de-identified data was then be stored in the Research Electronic Data Capture program (REDCap) through UMKC. A document with the patient's names and correlating numbers was kept at the clinic to maintain HIPAA compliance and then shredded at completion of the project. The G*Power 3 was used to identify the number of participants per power analysis. The number of participants needed for an effect size of 0.5 for the difference between two means (matched pairs) t-test was 27 and for the Wilcoxon singed-rank test was 28 (See Appendix N). The data was then compared to the benchmark study by Moore et al. (2008) where the effectiveness of the DASH for Health program was studied in a corporate setting.

Analysis Plan

Demographic data including age, gender, race and ethnicity, and highest education level was presented through descriptive and proportional statistics. The outcome measure of DASH compliance was quantified from the questionnaire; BP and weight measurements were obtained from the recorded values with a mean score determined for the pre and post BP (see Appendix O for statistical table template). The baseline and post-intervention measurements were to be

analyzed using the paired t-test or Wilcoxon Signed-rank test depending on the total number of participants. Range, median, and mode were also calculated for the outcome measures. Statistical Package for the Social Sciences (SPSS) version 26 was utilized for analysis of data (see Appendix P for variable template in SPSS).

Results

Setting and Participants

The recruitment letter (see Appendix K) was sent via email by the physician preceptor through the clinic portal to all patients on September 3, 2020. Sixteen interested patients contacted the student investigator via email and were further screened for eligibility. A total of 11 clinic patients participated in the study.

The average age of the participants was 64.9 years (*SD* = 5.34) with all being Caucasian. Seven of the participants were female (63.6%) and four were male (36.4%). Two of the participants did not earn a college degree (18.2%), and three had a Masters degree (27.3%). Four of the participants (36.3%) were not currently taking blood pressure medications. Six participants (54.5%) were taking one blood pressure medication, and one participant was taking two blood pressure medications as a combination pill.

Intervention Course, Actual

Participant recruitment occurred from September 3, 2020 through October 31, 2020. The first face-to face meeting with a participant to gain baseline measurements occurred September 25, 2020 with the last on November 1, 2020. At the initial meeting, the program was explained to participants, questions were answered, and demographic information along with baseline measurements were obtained (BP, weight, and DASH questionnaire completion). Each participant was then enrolled in a 3-month subscription to the DASH for Health online

educational program; username and login information was emailed to participants after the initial meeting.

Monthly follow-up telephone calls began on October 25, 2020 and commenced on January 7, 2020. During the second monthly telephone call, appointments were made for the post-intervention meetings where measurements were obtained a second time (BP, weight, and DASH questionnaire completion). Post-intervention meetings began on December 20, 2020 with the last on January 30, 2020. All 11 participants completed the study.

Outcomes

Due to the small sample size (N = 11), the planned t-test and Wilcoxon Signed-rank test were not utilized. Descriptive statistics were used for all data outcome reports. The primary outcomes of BP and DASH compliance and secondary outcome of weight were analyzed using descriptive statistical methods in SPSS.

Blood Pressure

Overall, the BP measurements improved after the intervention period (see Appendix Q). The mean baseline SBP (M = 137.73 mmHg, SD = 12.56) and DBP (M = 79.27 mmHg, SD = 14.04) were both lower in the post-intervention period (SBP, M = 128.91 mmHg, SD = 9.43; DBP, M = 75.27 mmHg, SD = 4.84). The mean SBP decreased by 8.82 mmHg and the mean DBP measurement decreased by 4 mmHg from baseline to post-intervention measurements.

DASH Compliance

An overall mean increase occurred in dietary servings of whole grains, low fat dairy, fruits, vegetables, and nuts and a mean decrease was observed in servings of refined grains, regular dairy, meat, and sweets, while the fat intake did not change (see Appendix Q). Mean dietary servings increased by 1.12 for whole grains, 0.4 for low fat dairy, 0.75 for fruits, 0.55 for

vegetables, 0.77 for nuts, and decreased by 0.32 for refined grains, 0.02 for regular dairy, 0.1 for meat, and 0.58 for sweets. Self-report for sodium intake had a slight increase in the post-intervention period (see Appendix Q). Other than the slight increase in sodium, dietary intake results from the self-report DASH questionnaire were more aligned with DASH compliance in the post-intervention period than at baseline.

Weight

As a whole, the group displayed weight loss over the three months (see Appendix Q). The participants' mean weight was higher at baseline (M = 85.25 kg, SD = 19.76) than in the post-intervention timeframe (M = 83.52 kg, SD = 18.24). Mean weight decreased by 1.73 kg from baseline to the post-intervention measurements.

Discussion

Successes, Most Important

The most notable successes included the overall mean decreases in BP and weight along with increased DASH compliance. The literature shows a positive correlation between the DASH diet and lower BP measurements (Appel et al., 1997; Blumenthal et al., 2010; Epstein et al., 2012; Ndanuko et al., 2016; Saneei et al., 2014; Siervo et al., 2015). Therefore, it can be inferred that participation in the DASH for Health program, with telephone follow-up, increased DASH compliance and resulted in the positive BP outcomes in the study. The secondary measure of weight also showed improvement stemming from the online educational program with associated increase in DASH compliance.

Study Strengths

The intervention setting strengthened the study due to the concierge model of the clinic and resulting demographic of the participants. The approximately 400 patient members pay

$1600 yearly for access to concierge services and have enough disposable income to afford the fee and prioritize their health, at least monetarily. Implementing the project within this setting resulted in participants who were relatively receptive to dietary education and mostly compliant with dietary change. Additionally, the physician preceptor encouraged participation for eligible individuals, reinforced dietary compliance at patient visits, and further supported the project initiative.

All the participants attended their baseline and post-intervention meetings with the student investigator and were cooperative with all outcome measurement procedures. At times, it was difficult to reach participants via telephone for the monthly follow-up calls. Although it occasionally required a few attempts by the student investigator to reach a participant by telephone, all follow-up calls were completed.

Results Compared to Evidence in the Literature

The study by Moore et al. (2008) utilized the DASH for Health online program, the same used for this project, in a corporate setting for a duration of 12-months. The program was offered as a free benefit to employees and 2834 employees and spouses enrolled (Moore et al., 2008). Participants voluntarily entered BP, weight, and food intake information on the website and the data was used by Moore et al. (2008) to determine program effectiveness. Moore et al. (2008) concluded that at the end of the 12-months, 735 (26%) of the original enrollees were still actively using the program. For overweight or obese participants, (body mass index > 25; N = 151), weight decreased by 1.9 kg (95% CI: -2.2, -6.2; $p < .001$). The effects on BP were positive with participants who showed hypertension or prehypertension at baseline (n = 62) the SBP lowered 6.8 mmHg (CI: -2.6, -11.0; $p < .001$; N = 62) and DBP lowered 2.1 mmHg ($p = .16$).

Based on self-entered food surveys, enrollees (*N* = 181) at 12 months were eating significantly more fruits, vegetables, and fewer grain products.

The benchmark study by Moore et al. (2008) differs from the current project in the large number of participants, longer length of time for intervention, corporate setting, and lack of face-to-face and telephone contact with a healthcare professional. However, both studies utilize the DASH for Health online educational program as the main intervention and found lowered BP, weight loss, and dietary improvements after the intervention period. The current project showed no attrition with the 11 participants while Moore et al. (2008) only had 26% of the participants active with the online program at the end of the 12 months. This disparity could be due to the lack of contact with healthcare professionals leading to less accountability for the Moore et al. (2008) participants or the study period difference of 12 months versus 3 months.

Limitations

Internal Validity Effects

Internal validity was strengthened by the face-to-face meetings and telephone follow-up calls; there was no attrition. The measurement tools were consistent with the use of the clinic sphygmomanometer and scale along with the validated DASH questionnaire, and measurements were only recorded pre and post intervention. However, the study sample was small (N = 11), and the results, although encouraging and clinically significant, were not statistically significant.

The self-report 24-hour dietary recall method was used, in the form of the DASH questionnaire, for all participant dietary serving data. Subjective data collection methods are inherently less reliable than objective measures, which could have resulted in inaccurate dietary data. Additionally, the dietary intervention was completed over the holiday months and the participants admitted, during follow-up telephone calls, that their compliance with the DASH

diet waned surrounding holidays.

External Validity Effects

All of the participants were Caucasian, and most (82%) earned a college degree. Additionally, the setting was in a primary care clinic with a concierge medicine model, leading to assumed financial security. The demographics of the study participants are not representative of a regular primary care clinic; therefore, the external validity is weakened. Furthermore, the demographics of the participants could have also contributed to the lack of attrition due to their relatively high prioritization of health.

Sustainability of Effects, Plans to Maintain

As with any dietary change initiative, individuals can eventually revert to previous dietary habits. Sustainability of the dietary change could be achieved with ongoing membership to the DASH for Health website and continued follow-up contact with a healthcare professional. Because the membership to the DASH for Health website requires a fee, alternative methods to maintain dietary compliance could be explored. Potentially, continuing to track dietary consumption on a free platform, along with maintaining monthly contact with a healthcare professional, could help with accountability. Also, the DASH for Health administrators offer group discounts for membership which could be further explored in sustainability efforts.

Additionally, it is expected that at some point the losses in BP and weight would plateau and these outcomes would transition into a maintenance phase and not show measured improvements. Maintenance could be tracked by regularly comparing BP, DASH compliance, and weight measurements to baseline levels. Continued achievement of improved measured outcomes would indicate intervention success.

Efforts to Minimize Study Limitations

An initial inclusion parameter for participant age was 30 to 70 years though all 400 of the clinic members were included in the first recruitment email. Two weeks into the recruitment period, due to initial low numbers, the age range was expanded to include individuals up to age 80. On September 16, 2020, a second recruitment email was sent along with notification of the expanded age range, and eligible participant numbers rose quickly. To increase accuracy of subjective data, a validated DASH questionnaire was utilized as the self-report dietary tool.

Originally, the timeline for the intervention period was planned to begin a couple months earlier that what occurred to avoid the dietary change over the holidays. However, due to delays the intervention timeline included the winter holiday months. Other than finding it difficult to reach participants over the phone near holiday times, participants stated they were relatively successful with the diet and were thankful for the extra dietary encouragement.

Interpretation

Expected and Actual Outcomes

Considering the large amount of evidence showing a correlation between DASH diet compliance and lower BP measurements (Appel et al., 1997; Blumenthal et al., 2010; Epstein et al., 2012; Ndanuko et al., 2016; Saneei et al., 2014; Siervo et al., 2015), it was expected that if participants followed the dietary recommendations from the DASH for Health program, they would have a lower post-intervention BP measurements. In the benchmark study by Moore et al. (2008), BP and weight measurements both decreased for individuals who participated in the DASH for Health program. Hence, it was predicted that the project participants would also show a decrease in these measurements. There were no unexpected results or failures in the project outcomes.

Intervention Effectiveness

The project effectively reduced BP and weight and increased DASH compliance for the project participants. From the study results, it can be inferred that the DASH for Health program, used in conjunction with regular telephone follow-up with a healthcare professional, is successful at lowering BP, improving dietary intake, and fostering weight loss. It is likely that the setting, a primary care concierge clinic, assisted with the success of the program due to the preventative health focus. The DASH for Health online program, was reported to have current utilization in primary care clinics (DASH for Health administrator, personal communication, March 18, 2019), is likely to be effective in this setting.

Intervention Revision

Although the expected outcomes were attained through the project intervention, it would be beneficial to repeat this study in the setting of a more typical primary care clinic to assess for widespread applicability. An additional consideration would be to offer the DASH for Health online program through a cardiology clinic for non-pharmacological BP management and dietary education. Also, implementing this intervention in months other than during the winter holiday period could potentially bring more success.

Expected and Actual Impact

Health System and Policy

The project aimed to enhance dietary education for patients in the primary care setting without increasing the burden on healthcare professionals. The DASH for Health online program was found to be an effective educational intervention for dietary compliance among patients in the primary care setting and required minimal time from the provider. The project was expected to impact the health system positively by decreasing BP measurements for study participants, which successfully occurred. Reducing the number of individuals with

hypertension will reduce the incidence of CVD within a population and result in lower morbidity and mortality. Utilizing the DASH for Health program in conjunction with monthly follow-up from a healthcare professional appears to have the expected positive impact on the health system.

Currently, there no set policies are present for dietary education or interventions within primary care clinics. Considering that two current EBPGs for hypertension state that non-pharmaceutical interventions for BP lowering should be the primary initiative to be used prior to and then concurrently throughout pharmaceutical interventions (James et al., 2014; Whelton et al., 2018), implementation of a dietary educational program that does not burden healthcare professionals would be an ideal advocacy initiative. The DASH for Health online program could potentially be utilized as a successful dietary intervention in a new policy proposal.

Cost

The expected cost of the study (see Appendix A) differed slightly from the actual costs. Printed brochures were not needed as an electronic flier was sent out for recruitment and further information was relayed via email or telephone at the potential participants' request, so this cost was initially overestimated. The DASH for Health membership fee was as expected but the overall cost was lower than estimated due to a low number of participants. However, time spent completing baseline and post-intervention measurements averaged at 30 minutes per visit, longer than expected, due to the need for thorough explanations on how to complete the DASH questionnaire. In the end, the total cost was only slightly different from the estimated cost due to the increased time spent with patients.

To be sustainable, the cost of the DASH for Health membership would need to be funded and without patient cost. The DASH for Health administration team does offer group discounts for clinics that utilize the intervention (DASH for Health administrator, personal communication,

March 18, 2019). Planning for further funding would include discussions with the DASH for Health administrators about payment options for groups and what is successful in other clinics. Additionally, paying a healthcare professional to complete monthly follow-up calls with the participants would also need to be considered in the budget. However, most of the phone calls were relatively short, lasting between 5 to 15 minutes and could potentially be accomplished in conjunction with follow-up for other medical conditions. At this time, funding is not in place to sustain the project at the current capacity. The project was funded by donations from the Women's Council Graduate Assistance Fund through the University of Missouri- Kansas City.

Conclusion

Practical Usefulness of Intervention

Currently, the DASH for Health online program is successfully utilized in primary care clinics throughout the United States for ongoing DASH education (DASH for Health administrator, personal communication, March 18, 2019). However, any person with internet access and a sufficient electronic device can sign up for the DASH for Health program and independently participate; affiliation with a clinic is not a requirement. The online intervention is practical as educational material is routinely administered in electronic formats. Most people access electronic devices regularly within their daily routine; therefore, the online modality should feel convenient rather than burdensome for patients.

Monthly telephone calls function to build rapport between the participants and student investigator while offering live support. Telephone meetings are more feasible than face-to face encounters due to time, travel, and location constraints. Most people have a functioning phone, whether a cell phone or home phone; hence, telephone follow-up calls are practical due to convenience and applicability.

Further Study

Implementation of the project within a traditional primary care clinic, as opposed to the concierge medicine model, would result in valuable data on the widespread applicability of the interventions. Although the studies by Moore et al. (2008) and Sacks et al. (2009) showed the DASH for Health program was effective within a corporate setting, data on the effectiveness within the primary care setting was lacking. A larger study implementing the current project's evidence-based interventions, encompassing numerous primary care clinics in differing locations, would be beneficial in establishing the benefit of the intervention in various settings.

Dissemination

The project was presented as a poster presentation at the Advanced Practice Nurses of the Ozarks annual conference in November 2019 and the Midwest Nursing Research Society annual conference (virtually) in April 2020. Additional dissemination was accomplished within local clinics through word of mouth between providers associated with the hospital at the encouragement of the student investigator. The student investigator will also discuss the project interventions with other providers to successfully promote DASH diet education. The project had an immediate positive impact on the study participants with the potential to positively impact patients in primary care clinics nationwide.

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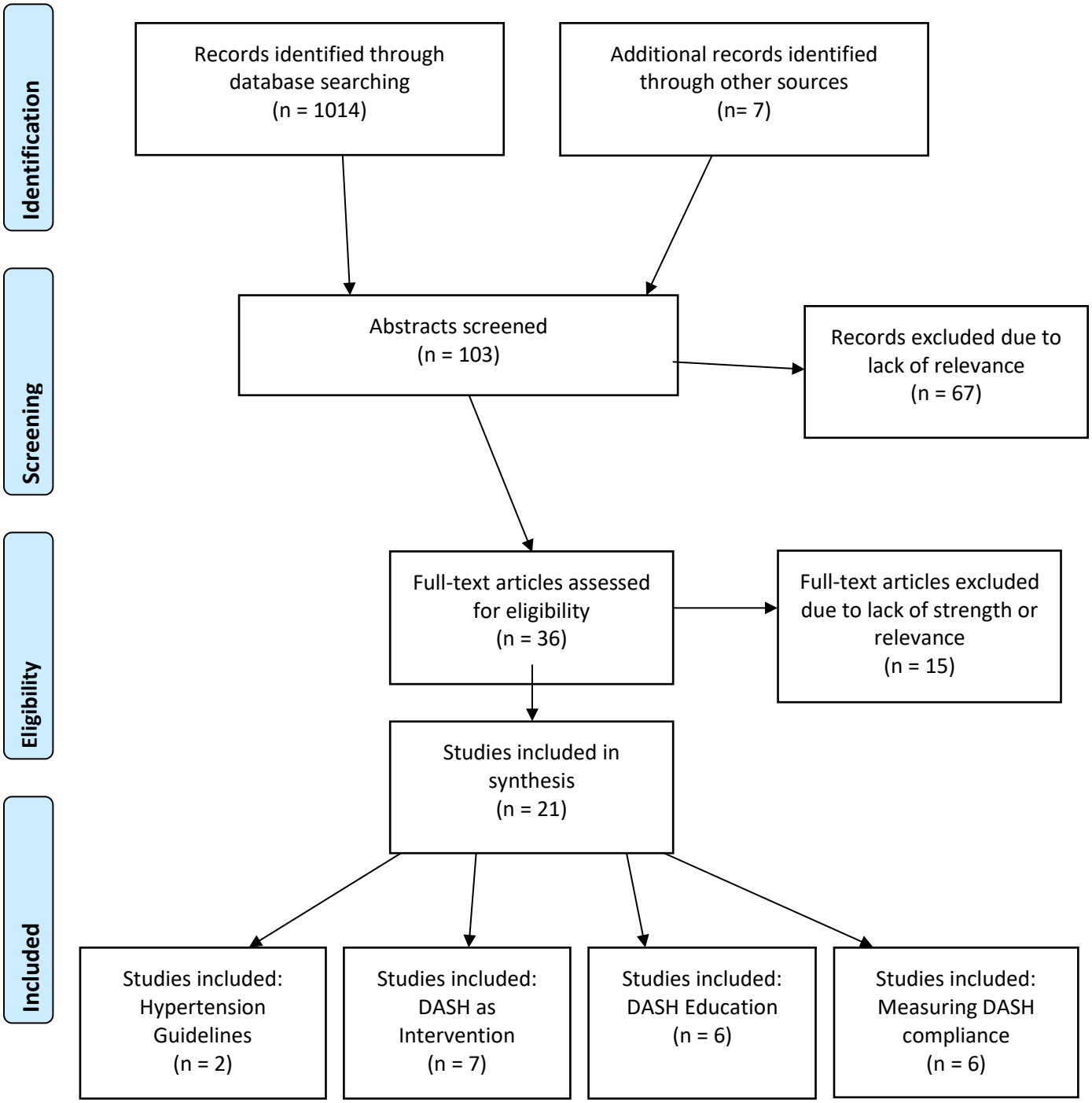
Appendix A

Budget Table

Item	**Item Description**	**Quantity**	**Unit Cost**	**Anticipated Cost**
Brochures	Informational pamphlet to handout to clinic staff and potential participants	100	$.60	$60
DASH for Health subscription	3-month subscription to DASH for Health online program	30	$39	$1,170
Phone Call Time completed by student investigator	Initial and follow-up phone calls estimated at 15 minutes for each participant occurring 4 times	30 hours	$30	$900
Measurements completed by student investigator	Baseline and post-intervention measurements taken at the clinic estimated at 10 minutes of contact time for each participant occurring 2 times.	10 hours	$30	$300
Total				$2,430

Appendix B

Adapted PRISMA Flow Diagram



Appendix C

Rating System for the Hierarchy of Evidence **For an Interventional Inquiry** (Modification by Dr. Lindholm for course N5613)	
Level I	Evidence from a systematic review or meta-analysis of all relevant RCTs. *Evidence-based clinical practice guidelines based on systematic reviews of RCTs).**
Level II	Evidence obtained from well-designed RCT. *Quantitative systematic review of well-designed controlled trial without randomization.*
Level III	Evidence obtained from well-designed controlled trial without randomization *(quasi-experimental).* *Quantitative systematic review of case-control, cohort, or correlational studies.*
Level IV	Evidence from well-designed case-control or cohort study *(or cross-sectional study)*
Level V	Evidence from systematic review of *quantitative* descriptive *(no relationships to examine)* or qualitative studies.
Level VI	Evidence from a single *quantitative* descriptive *(no relationships to examine in the study) or* qualitative study
Level VII	Evidence from the opinion of authorities and/or reports of expert committees

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Appendix D
Review of Evidence Table

First author, Year, Title, Journal	Purpose	Research Design, Evidence Level & Variables	Sample & Sampling, Setting	Measures & Reliability (if reported)	Results & Analysis Used	Limitations & Usefulness
DASH diet educational interventions						
Dorough (2014) Dash to wellness: Emphasizing self-regulation through e-health in adults with prehypertension. Health Psychology	Evaluate effectiveness and possibility of prehypertension intervention that is mostly electronic.	RCT. Level 2 evidence. Independent: Standard of care vs. wellness plus intervention. Dependent: improvement of measures.	N=27 Convenience sampling. Outpatient setting.	DASH diary and the wellness tracker, pedometer readings, weight, BP for intervention group- all self-report Reliability not reported	Electronic intervention more effective than routine care (all PHT became WNL). MANOVA To evaluate differences in lifestyle behavior	Small sample size. Individuals self-selected for participation- external validity concern. Useful bc intervention compared to standard-of-care.
Jarl (2014). Supporting cardiovascular risk reduction in overweight and obese hypertensive patients through DASH diet and lifestyle	Describe intervention to overweight and obese htn pts to encourage DASH and life changes, created and run by a PC NP.	pre- and post intervention quasi-experimental time-series design Level 3 evidence.	N= 26 Convenience sampling. One primary care office.	REAP and PIH questionnaires, body weight. Reliable as deemed by statistical measures.	Early success seen- better health for overweight/ obese pts with htn. Use of NP diet and lifestyle counseling	Small sample size. Pt's who completed study were likely more motivated than the pt.'s who dropped out.

education by primary care nurse practitioners. Journal of the American Association of Nurse Practitioners		Lifestyle factors before and after intervention.		REAP:(r = .86, p < .0001)	beneficial in PC setting. paired samples t-test	Supports that NP led education on diet within PC settings can be successful. Adaptable to PC settings with NPs.
Lin (2013) The impact of a physician and patient intervention program on dietary intake. Journal of the Academy of Nutrition and Dietetics	Assess dietary intakes for pts with htn with separate and combined physician and patient interventions.	Nested 2x2 design, RCT Level 2 evidence. Physician intervention vs patient intervention vs both interventions on dietary intakes	N= 32 physicians and 574 outpatients Quota sampling. Primary Care offices	Weight, BP, dietary intake, urinary excretion. Reliability not reported.	Both interventions improved eating patterns- pt intervention showed greater improvement. ANCOVA	inherent problem with most dietary data collection- FFQ not always accurate- may not represent actual intakes of the population. Supports team approach- PCPs can deliver brief intervention to support allied health intervention.
Desroches (2013). Interventions to enhance adherence to dietary advice for preventing and managing chronic diseases in adults. Cochrane Database of Systematic Reviews 2013.	Assess effects of interventions to improve adherence to dietary advice with purpose of managing chronic disease.	Systematic review of RCT. Level 1 evidence Outcomes of diet adherence b/t	N= 38 studies (9445 participants) Literature search. Majority (31) in outpatient	Compliance with dietary advice, attendance or participation, organizational outcomes (cost, time, resources), harms or secondary effects.	Video and nutritional tools listed as successful. Qualitative analysis.	Adherence to dietary advice defined differently, many self-report methods are not comparable. Illustrate options for health care

		intervention group control/usual care group	setting, (4) in research center.	Reliability not reported.		workers and patients that can be utilized in practice.
Sacks (2009). A web-based nutrition program reduces health care costs in employees with cardiac risk factors: before and after cost analysis. Journal of Medical Internet Research.	Assess online diet and exercise program, sponsored by employer, and effect on yearly cost of health care.	Quasi-experimental Level 3 evidence. Health care costs. Controls include yearly baseline cost, risk, socio-eco/demo variables.	N=1967 Volunteer sampling. EMC corporation employees (US based).	Yearly health care costs at baseline and after one year of DASH for health participation. Exact numbers of website visits and money spent on healthcare was obtained and reliable.	Health costs an average of $827 lower for CV risk subjects. Higher frequency of website use had lower health costs. Multiple linear regression analysis.	Participation in the program was higher for people with CV risk factors. Online program can be effective, low-cost, employee benefit that contributes to lower health care costs for people at risk for high health care costs.
Moore (2008). Weight, Blood Pressure, and Dietary Benefits After 12 Months of a Web-based Nutrition Education Program (DASH for Health): Longitudinal Observational Study. Journal of Medical Internet Research.	Creation of online nutritional education program and evaluate its effect on weight, BP, and diet after 12 months intervention period.	Longitudinal, cohort. Level 4 evidence. Participation in DASH online program and change in measures.	N=735 Volunteer sampling. US based employees of EMC corporation.	Weight, BP, and food intake differences between the baseline and after 12 months. Reliability of food questionnaire not included.	Use of nutrition edu program via the Internet, (no face contact) associated with weight loss, lower BP and dietary	All self-report, no objective data. Only included participants that were still active after 1 year. Online programs could be an effective way to improve diet in America.

					improvements after 12 months.	
Measuring DASH compliance						
Tangney (2016) Comparison of three DASH scoring paradigms and prevalent hypertension among older Hispanics. Journal of Human Hypertension	Assess adherence to DASH using three different DASH scoring paradigms. Establish which paradigm is most strongly correalted with htn in Hispanic population.	secondary analysis of a cross-sectional study Level 4 evidence. 3 different DASH score methods and BP	N=169 Reported in original study. Chicago area.	DASH scores, age, gender and acculturation Reliability not reported.	Folsom et al. DASH scores best predicted hypertension; Folsom et al. DASH score only explains 3% of variance-clinical significance is questionable. Logistic regression modeling	Small sample size. Cross-sectional design only allows for small picture of BP effect. Also, only applied to older Hispanic population. DASH scores should also be tested for other racial groups.
Schwingshackl (2015). Diet Quality as assessed by the Healthy Eating Index, the Alternate Healthy Eating Index, the Dietary Approaches to Stop Hypertension Score, and Health Outcomes. Journal of	Examine reliability of diet quality tests: Healthy Eating Index, Alternate Healthy Eating Index, and DASH score. Also assess risk of mortality	Systematic Review and Meta-Analysis of Cohort Studies Level 3 evidence. Scores of indices for all-	N= 15 cohorts (34 reports)- (15 of the reports used the DASH score as a measure) Literature Search	relative risks and/or hazard ratios with corresponding 95% CI Reliability not reported.	As assessed by all scores, high quality diets found to have reduced risk of all-cause mortality, T2DM, incidence or mortality due	Cohort studies rely on self-report methods of diet adherence. Data analysis methods could be unreliable and difficult to interpret. Shows relevance

the Academy of Nutrition and Dietetics	along with some diseases associated with diet quality.	cause mortality, CV mortality, CV incidence, ca mortality, ca incidence, t-2 DM, and neurodegen disease.	All US based cohort studies.		to CVD and overall cancer. Random effects meta-analysis methods.	of indices in clinical and public health settings.
Kwan (2013) Compliance with the Dietary Approaches to Stop Hypertension (DASH) Diet: A Systematic Review. PLOS ONE.	Reviews recent evidence on DASH assessment methods, DASH compliance and patient compliance when interventions are utilized.	Systematic review of RCTs. Level 1. DASH intervention and DASH compliance	N=9 Literature search. No setting listed.	Primary measures: Assessment methods, DASH compliance. Reliability not reported.	No consensus found on the most effective measure of DASH compliance. Descriptive analysis	Few eligible studies and a lot of inconsistencies between them Many methods to measure DASH compliance were looked at.

Apopvian (2010) Validation of a web-based dietary questionnaire designed for the DASH (dietary approaches to stop hypertension) diet: the DASH online questionnaire. Public Health Nutrition.	Assess validity of online DASH questionnaire by comparing to Block Food Frequency Questionnaire.	Cross-sectional study Level 4 evidence. DASH OLQ included 11 food groups, the Block includes 110 questions.	N=191 Convenience sampling. Boston University Medical Center	DASH OLQ and the Block FFQ Reliability not reported.	The DASH OLQ represents intake well when compared to the Block FFQ. Servings from both converted to grams and compared; four adjustment levels.	Many of the participants were highly educated. The online program that encompasses the DASH OLQ could be offered to the population at large.
Fung (2008). Adherence to a DASH-style diet and risk of coronary heart disease and stroke in women. Archives of Internal Medicine.	Determine association between DASH-score and risk for CHD and stroke in women.	Cohort study. Level 4 evidence. Unique FFQ with DASH score and incidence of CHD and stroke.	N= 88,517 female nurses. Volunteer sampling 11 US states.	Amount of nonfatal MI, CHD death, and stroke. Reliability not reported.	Concordance with DASH with lower risk of CHD and stroke for middle-aged women. Cox proportional hazard modeling	The FFQ did not account for sodium intake and also did not measure the amount of servings per group. Association bt DASH score and CVD is helpful information.

Folsom (2007) Degree of concordance with DASH diet guidelines and incidence of hypertension and fatal cardiovascular disease. American Journal of Hypertension.	To determine if DASH compliance is associated with lower rates of htn and CV mortality in non-htn participants.	Longitudinal, observational, cohort study Level 4 evidence. DASH compliance and htn (self-reported) and CV mortality.	N= 20,993 (women) Voluntary sampling. Iowa	DASH index (DASH number) Reliability not reported.	Incidence of htn inversely assoc with level of DASH compliance. Inverse associations b/t DASH compliance and mortality from CHD, stroke, and all CVD. Cox proportional hazards regression and Chai squared statistic.	DASH guidelines are difficult to operationalize. Self-report method of htn. Adjusting for other RF, it is not certain that any endpoint was associated with DASH adherence. Hence, long-term clinical trial would be ideal.
DASH diet as therapy						
Ndanuko (2016). Dietary Patterns and Blood Pressure in Adults: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Advances in Nutrition.	Determine effect of different dietary patterns on BP in adults.	Systematic review and meta-analysis. Level 1 evidence. Entire dietary pattern intervention on BP.	17 RCTs N=5014 participants Lit search. US (7), Italy (2), other single study countries.	SBP and DPB are primary measures. Reliability not reported.	Results show healthy dietary patterns lowered SBP and DBP by 4.26 mm Hg and 2.38 mm Hg, respectively. Meta-analysis	Intervention methodology differed, some trials provided foods, others did not. Diets were not homogenous. Healthy lifestyle with healthy diet can lower BP.

Jiang (2015) Concordance with DASH diet and blood pressure change: results from the Framingham Offspring Study (1991–2008). Journal of Hypertension.	Evaluate association of DASH adherence with BP trajectories and incidence of Htn: Participants from Framingham Offspring cohort.	Cohort study. Level 4 evidence. DASH score and BP.	N= 2187 Volunteer sampling. Originated in Framingham, MA.	Dietary assessment (FFQ), then entered into Folsom model for DASH score, BP. Reliability of FFQ was referenced.	Results showed NO evidence that adherence with DASH correlates with positive longitudinal change in BP. Cox proportional-hazards regression	Diet adherence was somewhat low, self-report method used, most participants white and had low BP to start, volunteer sampling. Useful to know longitudinal correlation of DASH score and BP with no intervention.
Saneei (2014) Influence of Dietary Approaches to Stop Hypertension (DASH) diet on blood pressure: a systematic review and meta-analysis on randomized controlled trials. Nutrition, metabolism, and cardiovascular diseases.	Systematic review and meta-analysis, assess effect DASH diet has on BP in RCTs among adults.	Systematic review and meta-analysis. Level 1 evidence. effect of DASH diet on BP	17 RCTs. N= 2561 participants Literature search. Setting not stated.	Average change of systolic and diastolic BP (including SDs) in DASH and control diets. Reliability not reported.	DASH diet significantly reduced SBP by 6.74 mmHg and DBP by 3.54 mmHg. Subgroup analysis and meta-regression.	Eating plan not homogenous among studies. Several studies had unadjusted means. Important for public health- can be adopted by all demo groups. Cost-effective way to prevent htn and complications.

Siervo (2014) Effects of the Dietary Approach to Stop Hypertension (DASH) diet on cardiovascular risk factors: a systematic review and meta-analysis. British Journal of Nutrition.	Analyze effects of DASH diet on CVD risk factors.	Systematic review and meta-analysis (20 RCT). Level 1 evidence. SBP, DBP, glucose, HDL, LDL, total cholesterol, TAG	N= 1917 Literature search. Majority of articles from US (9), Australia (4) and Iran (3).	Absolute difference between DASH and control groups. DASH group: baseline and post-intervention mean, SD, and sample size for each variable analyzed. Reliability not reported.	Confirmed DASH diet is successful for BP prevention and management. Significant beneficial effects on other CV risk factors. Meta-regression analysis.	Data from RCT may not be intended for the same purpose as the meta-analysis. Found, a 13% reduction in 10-year Framingham risk score for CV events could result.
Epstein (2012). Determinants and consequences of adherence to the Dietary Approaches to Stop Hypertension diet in African-American and white adults with high blood pressure: Results from the ENCORE trial. Journal of the Academy of Nutrition and Dietetics.	Assess what factors predict dietary adherence. Determine extent of dietary adherence necessary for clinically significant BP reduction.	RCT Level 2 evidence. DASH intervention alone, DASH + weight management, control group-effect on BP and DASH adherence b/t two intervention groups.	N=144 Volunteer sampling. Tertiary care medical center.	Main measures-a composite index of adherence to the DASH diet and clinic BP. Reliability of FFQ was referenced.	Greater adherence to DASH diet associated with larger BP reductions independent of weight loss. Every 2-point increase in DASH adherence with 3.4-mm Hg reduction in SBP. General linear models, linear	Participants highly motivated (very low dropout rate) so sample might not accurately represent typical patients. Knowing DASH adherence reduces BP and the socio-economic differences between adherence may

					regression, and analysis of covariance.	help translate to clinical practice
Blumenthal (2010). Effects of the DASH diet alone and in combination with exercise and weight loss on blood pressure and cardiovascular biomarkers in men and women with high blood pressure: the ENCORE study. Archives of Internal Medicine	Determine if DASH diet alone or with a weight program with usual diet is effective to lower BP for patients with pre-htn or stage 1 htn.	RCT Level 2 evidence. Usual diet controls, DASH diet alone, and DASH diet plus weight management-effect on BP in clinic and ambulatory BP.	N=144 Volunteer sampling. Tertiary care medical center.	Main= BP Secondary= pulse wave velocity, dilation of brachial artery, baroreflex sensitivity, and left vent mass. Reliability reported.	BP reduced 16.1/9.9 mm Hg (DASH plus weight program); 11.2/7.5 mm (DASH alone); and 3.4/3.8 mm (usual diet) (P.001). General linear model function.	Small sample, highly motivated participants, labor intensive, may be difficult to use in practice. The DASH diet, especially with exercise and weight loss, benefits pts with high BP, by lowering BP and also modification of biomarkers of disease risk.
Appel (1997). A clinical trial of the effects of dietary patterns on blood pressure. New England Journal of Medicine.	Tested effects of dietary patterns on BP with a randomized feeding study. Trialed diet patterns, not specific nutrients.	RCT Level 2 evidence. Standard diet vs diet high in fruits and veggies vs DASH diet and effect on BP.	N= 459 Diversity sampling Three centers	Self-report of discretionary items, between diet difference of BP, 24 hr urine excretion. Reliability not reported.	DASH lowered SBP 5.5 mmHg and DBP 3.0 mm Hg more than control. Two-way analysis of variance.	Did not assess adherence for people choosing own food or long-term effect of the diets on BP and CV events. Broadly adaptable to the US.

Hypertension Guidelines						
Whelton (2018). 2017 Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Journal of the American College of Cardiology	To provide recommendations for patients diagnosed with or at risk for CVD. Also provides guidelines for medical practice.	EBPG Level 1 evidence Many- focused on guidance for prevention, detection, evaluation, and management of high BP.	N= 29 Focused on RCT but also included registries, non-random comparative and descriptive studies, case series, cohort, SR, and expert opinion. Various (clinic, outpatient, home, etc.)	Measurements differ for each of the 4 main research questions. COR and LOE reported for each recommendation.	Lifelong BP below 120/80 considerably lowers CVD and CKD incidence. Mostly qualitative, described as "modular knowledge chunk format"	Some of the included studies are "related statements" which include expert opinion. Utilized for guidance in the prevention, detection, evaluation, and management of high BP.

James (2014). 2014 evidence-based guideline for the management of high blood pressure in adults: Report from the panel members appointed to the eighth joint national committee. JAMA	EBP guideline for adults with htn to endorse treatment paramaters, goals, and medications for management.	EBPG from RCT Level 1 evidence. Most variables relate to BP and change in BP with pharmaceutical interventions.	N=64 Literature search of RCTs. Out of office setting (home, community, workplace) and outpatient office.	Change in BP, health outcomes, adherence to medications. Reliability not reported.	For general population <60 yrs old, treat htn if SBP >140 and/or DPB >90 to threshold lower than limits. Healthy diet is emphasized, it can reduce need for treatment and meds. Qualitative synthesis.	Only included RCTs, limited to the focus of the 3 study questions. Widely used in clinical practice to guide decisions on htn treatment.

Appendix E

Definition of Terms

DASH diet: Dietary Approaches to Stop Hypertension diet; high in fruits, vegetables, whole grains with reduced meats, sugar, and fats. The diet advocates for low-fat dairy products and lean proteins (such as fish and plant-based proteins) rather than high fat foods (Appel et al., 1997).

Hypertension: Measured SBP greater than or equal to 140 mmHg and/or a DBP greater than or equal to 90 mmHg (James et al., 2014; Whelton et al., 2018).

Mild hypertension: Referred to as stage-one hypertension by Whelton et al. (2018); measured SBP 130-139 or DPB 80-89. Also encompasses patients with diagnosed hypertension currently taking one hypertension medication.

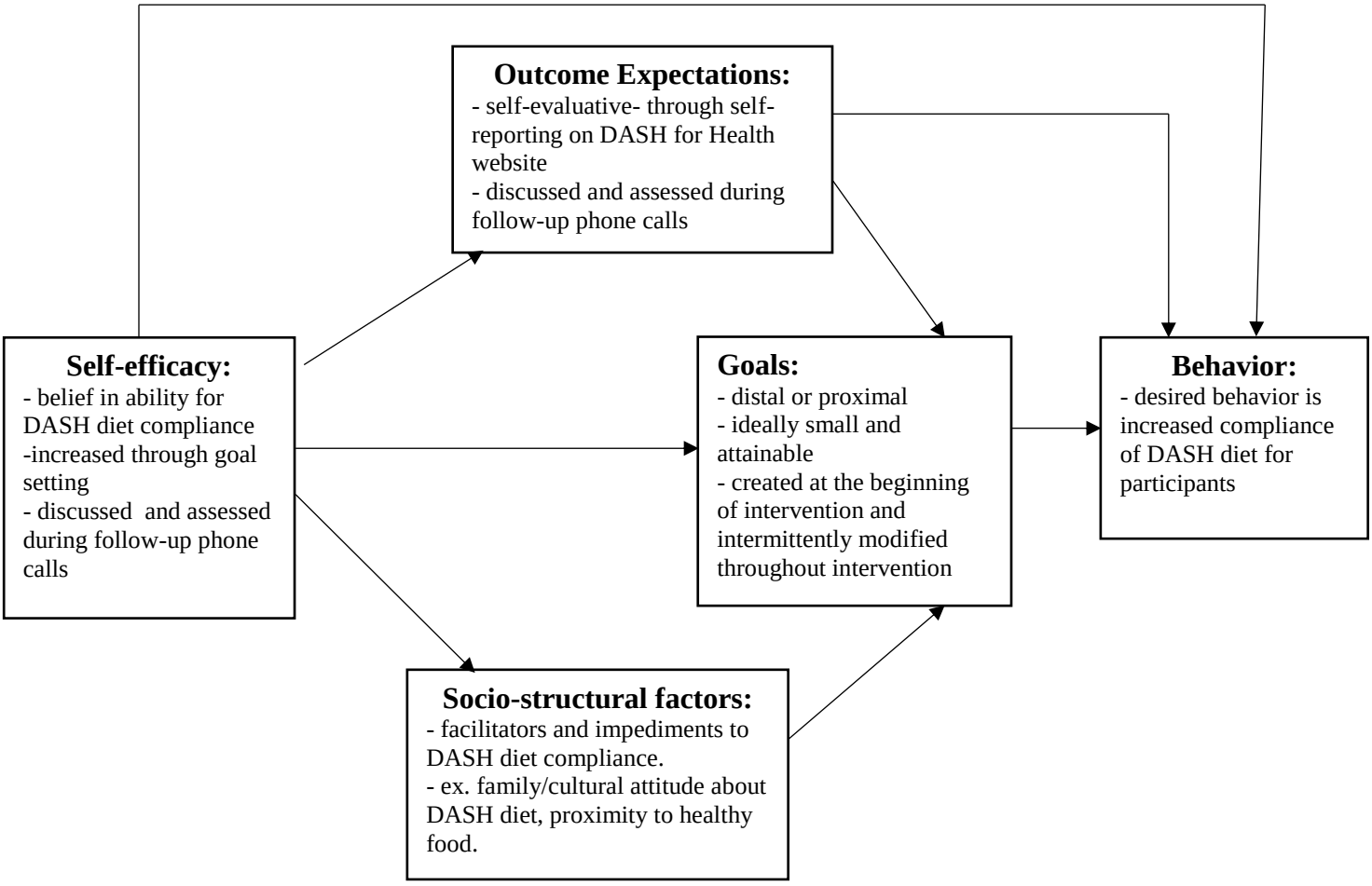
Pre-hypertension: Referred to as elevated blood pressure by Whelton et al. (2018); measured SBP 120-129 with DBP < 80.

Sphygmomanometer: An instrument used to measure blood pressure. Usually consists of an inflatable rubber cuff which enables the determination of systolic and diastolic blood pressure by increasing and gradually releasing the pressure in the cuff when applied to the arm (*Sphygmomanometer | Definition of Sphygmomanometer in US English by Oxford Dictionaries*, n.d.).

Student investigator: The specific student who is the primary researcher in the study and overseeing all aspects of the implementation of the project.

Appendix F

Social Cognitive Theory Flow Diagram



Appendix G

IRB and QI Determination

UMKC Institutional Review Board
University of Missouri-Kansas City

5319 Rockhill Road
Kansas City, MO 64110
816-235-5927
umkcirb@umkc.edu

Dear Lyla Jo Lindholm,

A member of the UMKC Research Compliance Office screened your QI Questionnaire to project #2015745-QI entitled "" and made the following determination:

QI Determination: **The project has been determined to be a quality improvement activity not requiring IRB review.**

If you have any questions regarding this determination, please feel free to contact our office at 816-235-5927, umkcirb@umkc.edu, or by replying to this notification.

Note Regarding Publications: It is appropriate to disseminate and replicate QI/program evaluation successes, including sharing the information external to an organization. This may include presentations and publications. The mere intent to publish the findings does not require IRB review as long as the publication does not refer to the activity as research.

Thank you,
UMKC Institutional Review Board

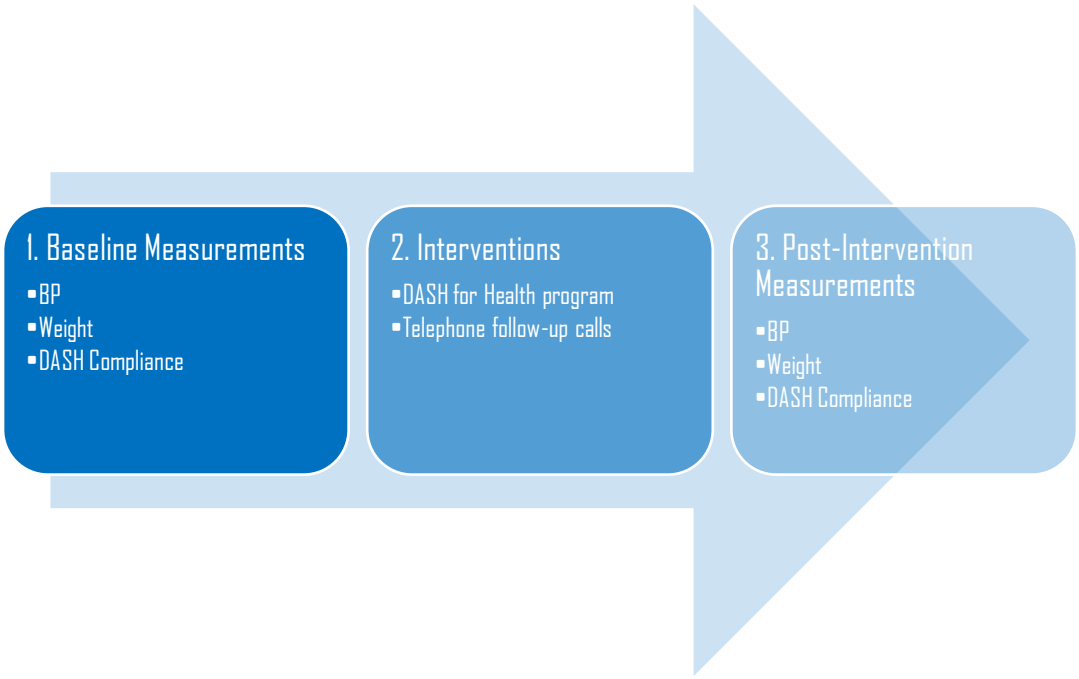
Appendix H
Logic Model

❖ **Inquiry, PICOTS: For patients aged 30-80 years with pre-hypertension or mild hypertension, does a web-based DASH educational program with monthly telephone follow-up calls, compared to no intervention, result in an increase in DASH diet compliance, as measured by an online DASH questionnaire and reduction of BP measurements, after three months within a primary care clinic?**

Inputs	**Intervention(s)** *Activities*	**Outputs** *Participation*	**Outcomes -- Impact** *Short*	*Medium*	*Long*
Evidence, sub-topics 1.Hypertension guidelines 2. DASH diet effectiveness 3. DASH interventions 4. Measuring DASH compliance **Major Facilitators or Contributors** 1. Minimal time commitment from staff. 2. Sustainable after DNP project completion. 3. Physician preceptor support **Major Barriers or Challenges** 1. Cost of enrollment in online program. 2. Lack of support from DASH for Health administrators. 3. Grant needed for funding.	**EBP intervention which is supported by the evidence in the Input column (brief phrase)** DASH for Health online program and telephone follow-up calls **Major steps of the intervention (brief phrases)** 1. Sampling completed via email 2. Enroll participants in online program 3. Pre-intervention DASH questionnaire, BP, and weight measures 4. Three months of participation in online program 5. Monthly phone call follow-up 6.Post-intervention DASH questionnaire, BP and weight measures	**The participants (subjects)** Patients from the primary care clinic **Site** Midwest Clinic **Time Frame** Three months **Consent or assent Needed** Enrollment in program will confirm consent. **Other person(s) collecting data** No, student investigator will collect all data. **Others directly involved in consent or data collection** No	**(Completed during DNP Project)** **Outcome(s) to be measured** Primary: DASH compliance and BP Secondary: weight **Measurement tool(s)** 1. DASH questionnaire 2. BP measured with sphygmomanometer 3. Weight measured with scale. **Statistical analysis to be used** 1. Paired t-test 2. Wilcoxon text	**(after student DNP)** **Outcomes to be measured** 1. DASH adherence after 6 months 2. BP measurement after 6 months	**(after student DNP)** **Outcomes that are potentials** 1. DASH adherence after 1 year 2. BP measurement after 1 year

Appendix I

Intervention Flow Diagram



Intervention Procedure

1. Baseline Measurements
    a. BP- measured twice at least five minutes apart.
    b. Weight measured on clinic scale.
    c. DASH compliance measured by DASH questionnaire.
2. Interventions
    a. DASH for Health- Three month subscription to online program.
    b. Telephone follow-up calls performed at initial enrollment in program and then monthly.
3. Post-Intervention Measurements
    a. BP- measured twice at least five minutes apart.
    b. Weight measured on clinic scale.
    c. DASH compliance measured by DASH questionnaire.

Appendix J

Approval Letter

UMKC School of Nursing and Health Studies

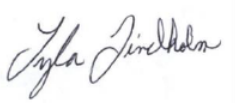
July 17, 2019

DNP Project Proposal Approval
UMKC DNP Student

This letter serves to provide documentation regarding Angela Cloud's Doctor of Nursing Practice (DNP) project proposal. Ms. Cloud obtained approval for her proposal, *Online DASH Diet Education to Reduce Blood Pressure in Primary Care Patients,* from the School of Nursing and Health Studies DNP faculty on July 17, 2019.

If we can provide further information, please feel free to contact us.

Sincerely,



Cheri Barber, DNP, RN, PPCNP-BC, FAANP
Clinical Assistant Professor
DNP Program Director
UMKC School of Nursing and Health Studies
barberch@umkc.edu

Lyla Lindholm, DNP, ACNS-BC
UMKC MSN-DNP Program Coordinator
Clinical Assistant Professor
DNP Faculty

Appendix K

Recruitment Letter

Dear Patient,

My name is Angela Cloud and I am a current graduate student at the University of Missouri-Kansas City and plan to graduate with my Doctorate of Nursing Practice with a Family Nurse Practitioner degree in May 2020. I am currently seeking clinic patients of to participate in a quality improvement study for my doctorate project. Potential participants must be between the ages of 30 to 70 and have pre-hypertension or diagnosed hypertension and taking one hypertension medication. The purpose of the study is to examine the relationship between an online DASH diet educational program and blood pressure.

Eligibility criteria for this study includes:

- Age 30-70
- Initial blood pressure reading greater than 120/80 OR currently taking one blood pressure medication
- Weekly access to an electronic device with internet connectivity
- Telephone access

Participation in this study involves:

- Visits to the clinic at the beginning and end of the study to complete a dietary questionnaire and have blood pressure and weight measured
- An included three-month subscription to the DASH for Health online program
- Monthly follow-up telephone calls

For more information about this study, please contact the principal investigator, Angela Cloud, by phone at 913.901.7789 or email at amsqm9@mail.umkc.edu.

Thank you,

Angela Cloud
Principal Investigator

Study Title: Online DASH Diet Education to Reduce Blood Pressure in Primary Care Patients

Appendix L

Recruitment Flier

DASH Diet Education



Participant Information

The DASH diet is a healthy way of eating that is effective at reducing blood pressure. DASH is high in fruits, vegetables, and whole grains with reduced meats, sugar, and fats. All participates will receive a free 3-month subscription to the DASHforHealth.com online program. You will come in to the MDVIP clinic twice, before and after participation in the online program, to complete a dietary questionnaire and have your blood pressure and weight measured. The length of the program is 3-months, beginning at the end of summer and going through the fall. You are encouraged to login to the DASH for Health website at least once a week during the program. Additionally, you will receive monthly telephone follow-up calls.

45.5%

Percent of US adults over 20 years old with hypertension.

800k

Lives claimed by cardiovascular disease in the US annually.

Hypertension is a main contributor to cardiovascular disease.

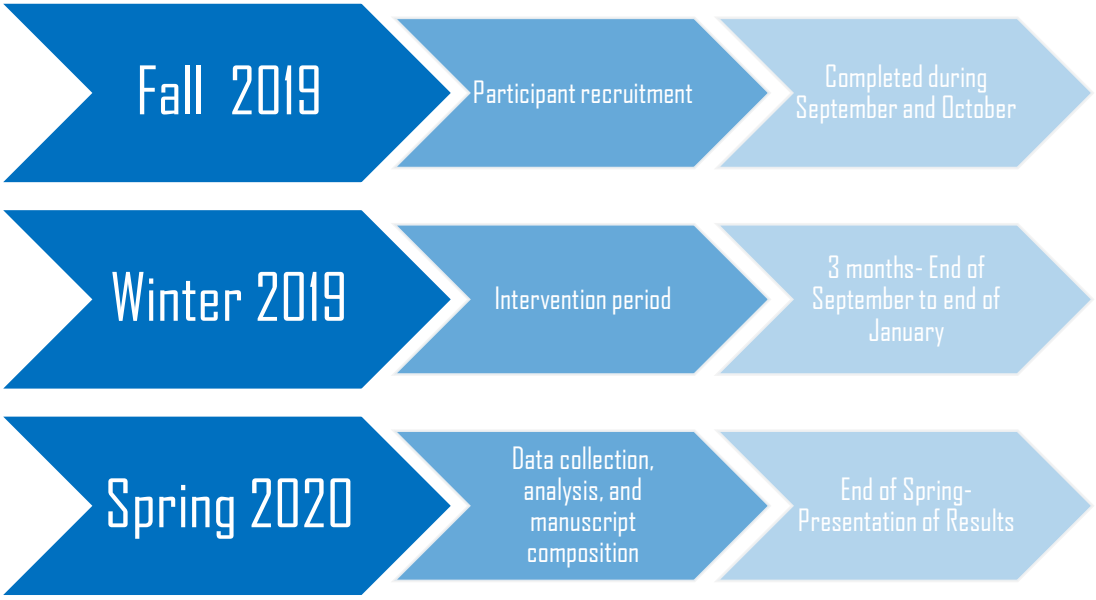
$150 billion

Projected total cost of hypertension in the US in 2020.

Angela Cloud | 913.901.7789| amsqm9@mail.umkc.edu

Appendix M

Project Timeline Flow Chart



Appendix N

A Priori Power Analysis

Appendix O

Statistical Analysis Table Template

Socio-demographic information.

Variable	**Percentage**	***p*-Value**
Gender Male Female		
Age 30-39 40-49 50-60 >60		
Race Caucasian Hispanic Black-American other		
Highest level of education Illiterate Grade School High School Associates Bachelor's Masters or Doctorate		

Comparison of measured variables: SBP, DBP, and weight.

Variable	**Pre-intervention (Mean, SD)**	**Post-intervention (Mean, SD)**	***p*-value**
Systolic Blood Pressure			
Diastolic Blood Pressure			
Weight			

Comparison of pre- and post-intervention dietary components from DASH questionnaire.

Variable	**Pre-intervention**	**Post-intervention**	***p*-value**
Whole Grain			
Refined Grain			
Meat			

Regular Dairy			
Low-fat Dairy			
Fruit			
Vegetables			
Nuts/Seeds			
Sweets			
Fats			
Sodium			

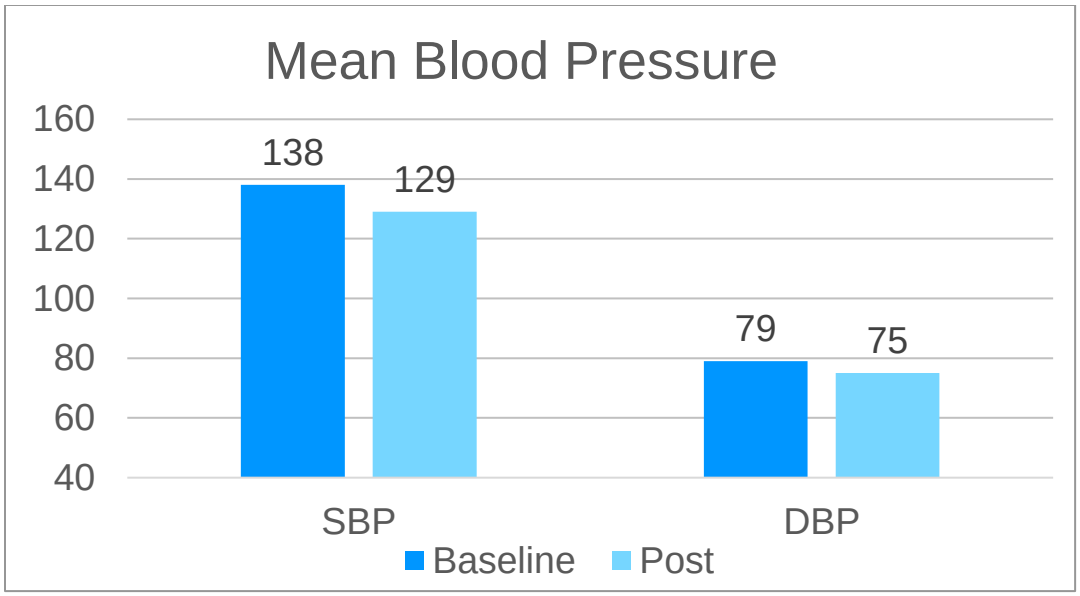
Appendix P

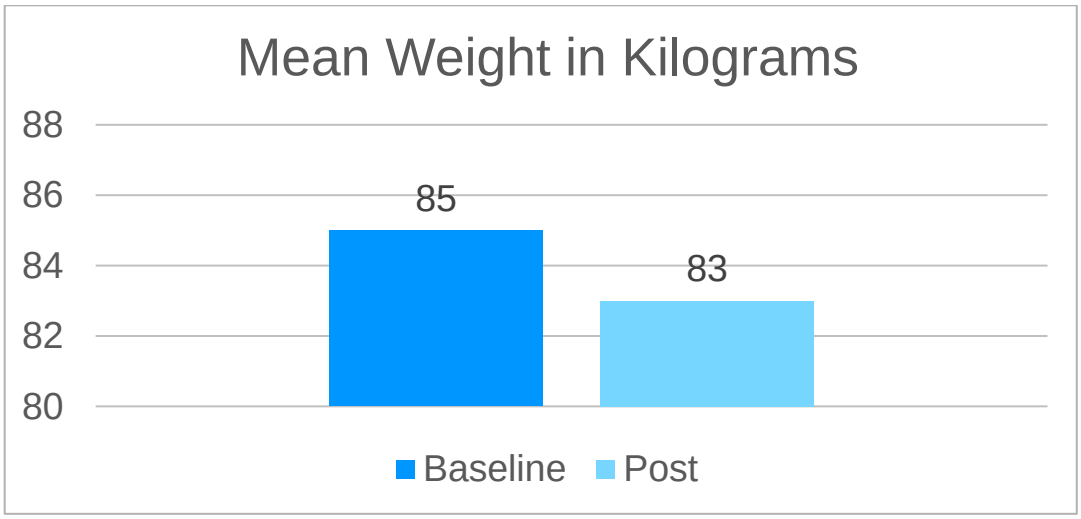
Data Collection Template from SPSS

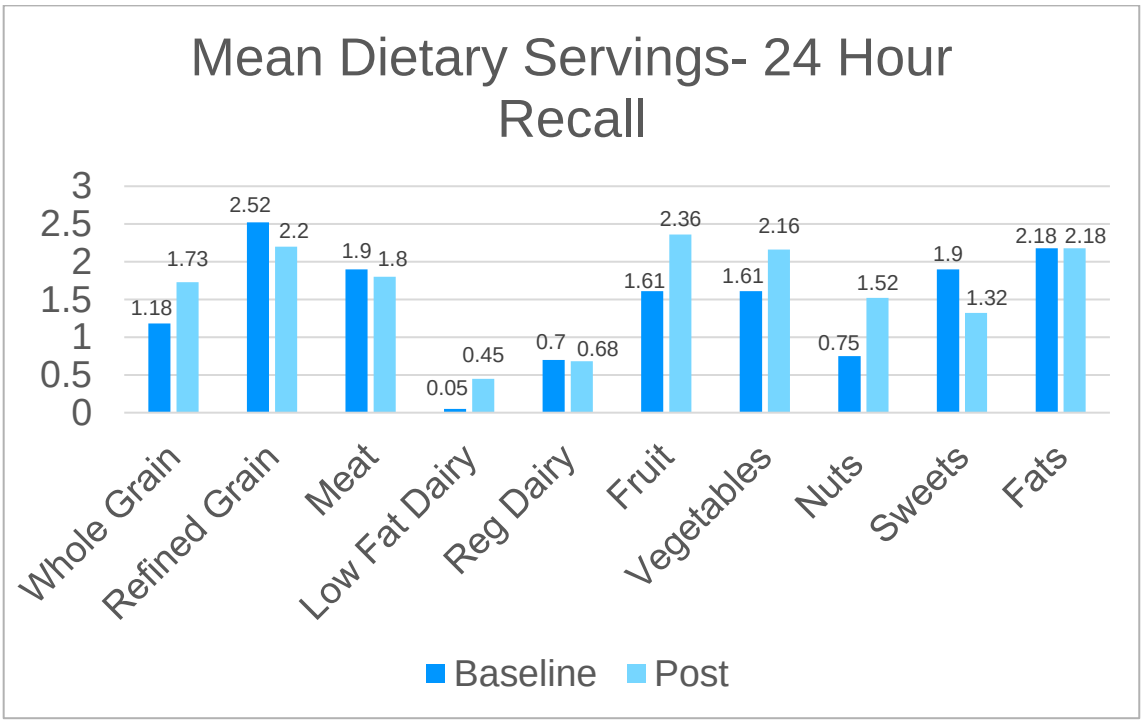
	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	systolic1	Numeric	8	2	Pre-intervention systolic blood pressure	None	None	14	Right	Scale	Input
2	diastolic1	Numeric	8	2	Pre-intervention diastolic blood pressure	None	None	8	Right	Scale	Input
3	weight1	Numeric	8	2	Pre-intervention weight	None	None	8	Right	Scale	Input
4	DASH_compliance1	Numeric	8	2	Pre-intervention DASH compliance	None	None	8	Right	Scale	Input
5	systolic2	Numeric	8	2	Post-intervention systolic blood pressure	None	None	8	Right	Scale	Input
6	diastolic2	Numeric	8	2	Post0intervention diastolic blood pressure	None	None	8	Right	Scale	Input
7	weight2	Numeric	8	2	Post-intervention weight	None	None	8	Right	Scale	Input
8	Whole_grain1	Numeric	8	2	Pre-intervention whole grain intake	None	None	8	Right	Scale	Input
9	Refined_grain1	Numeric	8	2	Pre-intervention refined grain intake	None	None	8	Right	Scale	Input
10	Meat1	Numeric	8	2	Pre-intervention meat intake	None	None	8	Right	Scale	Input
11	Regular_dairy1	Numeric	8	2	Pre-intervention regular dairy intake	None	None	8	Right	Scale	Input
12	Low_fat_dairy1	Numeric	8	2	Pre-intervention low-fat diary intake	None	None	8	Right	Scale	Input
13	Fruit1	Numeric	8	2	Pre-intervention fruit intake	None	None	8	Right	Scale	Input
14	Vegetables1	Numeric	8	2	Pre-intervention vegetable intake	None	None	8	Right	Scale	Input
15	Nuts_seeds1	Numeric	8	2	Pre-intervention nut and seed intake	None	None	8	Right	Scale	Input
16	Sweets1	Numeric	8	2	Pre-intervention sweets intake	None	None	8	Right	Scale	Input
17	Fats1	Numeric	8	2	Pre-intervention fat intake	None	None	8	Right	Scale	Input
18	Whole_grain2	Numeric	8	2	Post-intervention whole grain intake	None	None	8	Right	Scale	Input
19	Refined_grain2	Numeric	8	2	Post-intervention refined grain intake	None	None	8	Right	Scale	Input
20	Meat2	Numeric	8	2	Post-intervention meat intake	None	None	8	Right	Scale	Input
21	Regular_dairy2	Numeric	8	2	Post-intervention regular dairy intake	None	None	8	Right	Scale	Input
22	Low_fat_dairy2	Numeric	8	2	Post-intervention low-fat dairy intake	None	None	8	Right	Scale	Input
23	Fruit2	Numeric	8	2	Post-intervention fruit intake	None	None	8	Right	Scale	Input
24	Vegetables2	Numeric	8	2	Post-intervention vegetable intake	None	None	8	Right	Scale	Input
25	Nuts_seeds2	Numeric	8	2	Post-intervention nut and seed intake	None	None	8	Right	Scale	Input
26	Sweets2	Numeric	8	2	Post-intervention sweets intake	None	None	8	Right	Scale	Input
27	Fats2	Numeric	8	2	Post-intervention fat intake	None	None	8	Right	Scale	Input
28	Gender	String	8	0	Participant's gender	None	None	8	Left	Nominal	Input
29	Age	Numeric	8	2	Participant's age	None	None	8	Right	Scale	Input
30	Race	String	8	0	Participant's race	None	None	8	Left	Nominal	Input
31	Education_level	String	8	0	Participant's highest completed education	None	None	8	Left	Nominal	Input
32	Sodium1	String	8	0	Pre-intervention sodium intake	None	None	8	Left	Ordinal	Input
33	Sodium2	String	8	0	Post-intervention sodium intake	None	None	8	Left	Ordinal	Input

Appendix Q

Data Tables







Sodium Intake Self-Report	Baseline # of participants	Post-Intervention # of participants
No salt added while cooking or at the table	5	2
Either salt added while cooking or at the table	2	5
Added salt both while cooking and at the table	4	4