# Background

Due to the growing burden of chronic cardiovascular conditions and increasing prevalence in specifically rural populations, it is important to design and implement community programs that address risk factors of more serious chronic complications to change these trends.1–3 One condition in particular, high blood pressure or hypertension (HTN), is a growing issue in the United States, as data from the center for disease control (CDC) indicates that not only has the prevalence been increasing consistently each year, but reports prevalence in adults to range from 40.5-60.5% and prevalence in rural adults to be as high as 47%.4 Furthermore, in common cardiovascular conditions that result in adverse health outcomes such as stroke, heart failure (HF), and coronary heart disease (CHD), HTN has been shown to increase risk by up to 3.8x, 4.0x, and 2.2x respectively.5 HTN has also been shown to commonly occur in conjunction with other comorbidities which often significantly increases the risk of these health outcomes by up to 4 times.6,7 It has consistently been shown that reductions in blood pressure (BP) by 4-11 mmHg for systolic BP (SBP) and 2-5 mmHg for diastolic BP (DBP) can reduce the risk of cardiovascular events such as stroke, HF, CHD, and even all-cause mortality by 11-43%, a significant change in outcome.8

Walking and physical activity (PA) have consistently been shown to significantly reduce BP, despite much variation in the duration of implementation of walking programs.9–13 Interventions range from 4-36 weeks of twice-weekly meetings to fully independent pedometer-based walking programs.9–12 All report significant reductions in BP ranging from reduction in SBP of 3.10 -13.75 mmHg, and reductions in DBP of 1.60 mmHg.9–12 A meta-analysis by Borjesson et al. found that walking 3-7 times per week produced significant reductions in SBP and DBP of 6-15 mmHg and 3-4 mmHg respectively.9 These changes in BP were not only statistically significant, studies show that a reduction of SBP by 10-12 mmHg and DBP by 5-6 mmHg has been related to a 34-38% reduction in risk of stroke and 16% reduction in risk of CHD.14,15

In addition to walking, the other component of the program, educational intervention, has been well-validated through a variety of different methods and durations in the rural population.13,16,17 Interventions have range from 12 – 32 weeks of 45-120 minute interventions occurring as little as every two weeks or as frequently as 3 times per week.13,16,17 The variation continues as each of these PA and educational programs utilized a different model of behavior change. One program using the social cognitive theory (SCT) found that after 16 weeks, there was a significant and large effect size for the reduction in DBP.16 Another study using the transtheoretical model (TTM) found that after 6 weeks of educational training and daily BP logs, participants gained significant knowledge relating to HTN, heart disease, and stroke as well as a significant decrease in SBP and DBP of 4 and 3 mmHg respectively.17 Lastly, an intervention based on the social-ecological model (SEM) found that after 8 weeks, participants exercised significantly more and for each increase of 1,000 steps compared to baseline, participants had a significantly lower odds of HTN (OR = 0.9).13

The SEM is useful in this population of rural adults as it addresses behavior change on an individual, interpersonal, community, and population-level.18,19 Studies have shown that intervention to just one of these levels is not enough to produce significant outcomes when it comes to cardiovascular risk factors.20 On an individual level, rural-dwelling adults commonly have lower levels of health-related knowledge or education, limited financial resources, and lack of motivation or self-efficacy when it comes to making health-behavior changes.16,17,21 Success with program activity adherence as well as education has been shown to significantly impact these factors in relation to PA, self-efficacy, and health-related knowledge.16,17 Furthermore, the addition of an interpersonal component, the use of group-based activity, can help increase adherence and longevity of change by increase in support by family, friends, and other significant relationships.22 Lastly, intervention on the community level to increase accessibility of the landscape, workplace, or norms of the community, common barriers to behavior change, is crucial for sustained change to an area.18,20,23

There are positive results for implementation of the SEM as it relates to cardiovascular risk factors, specifically reduction in BP, in rural Americans, as a recent program implemented in Minnesota found a significant increase in percentage of population at target BP (6.2% in intervention, 2.0% in control) as well as a small but significant decrease in SBP and DBP of 0.7 and 1.7 mmHg respectively, while the control group had increases in SBP and DBP of 1.4 and 0.1 mmHg respectively.24,25 Overall, established programs implementing the SEM to target individual and community change around activity and cardiovascular risk factors such as high BP were successful, indicating strong evidence for the use of this behavior change model for the program.20,24,25

The 6-minute walk test (6MWT) is a validated measure of walking endurance that has been validated for many different populations and conditions, and for which there are validated prediction equations that can be used to identify patient-specific age-predicted norms.26–28 Although literature on the 6MWT is limited in patients with HTN, one study found significantly lower 6MWT distances in patients with HTN compared to healthy controls indicating sensitivity to the patient population.29 Furthermore, a distance of less than 338 meters has been shown to increase risk of all-cause mortality over 8 years by 1.7 to 2.1 times.30 Lastly, in a study of inactivity in adults, the 6MWT was found to be the best measure (second only to number of steps taken per day) at predicting inactivity in otherwise healthy adults.31 Overall this measure is valid, has validated predicted norms, is simple to perform, and able to predict significant risks and outcomes in the population of interest.26–28,30,31

A second measure of significance is the General Practice Physical Activity Questionnaire (GPPAQ), a quick objective measure of PA validated for use in adult populations that can be used to track physical activity behavior change.32 Although the measure is far from a perfect predictor of activity levels, 3 recent systematic reviews showed the GPPAQ to have better correlation with activity trackers, reliability, validity, sensitivity, and specificity than other commonly used measures of PA.33–35 The measure rates PA in one of four categories ranging from “inactive” to “active” taking into account activity at work and outside of the workplace.32 Workplace and leisure activity levels have been shown to be significantly related to all-cause mortality, with each of the 4 categories of the GPPAQ, inactive, moderately inactive, moderately active, and active, correlating to a significant reduction in risk when compared to the “inactive” group.36 Those who scored “moderately active” or “active” had a 32% reduced risk of all-cause mortality compared to those who were “inactive” and even those who were “moderately inactive” had a 17% reduction in risk.36 Therefore, this is the best valid, quick, objective measure that is currently available for assessing PA.32–36

To track the understanding and retention of health-related knowledge, a survey created by the National Heart, Lung, and Blood Institute’s (NHLBI) Community Health Worker Health Disparities Initiative called “My Health Knowledge” will be administered both before and after the program. This is a free, 21-question survey that assesses health-related knowledge regarding risk factors, disease, symptoms, risk reduction, and cardiovascular health. The survey is commonly scored based on percent of correct responses for a score ranging from 0% correct to 100% correct indicating highest levels of health-knowledge.17,37,38 Although there are not currently studies validating the tool, it has been specifically developed to address cardiovascular health knowledge in rural populations and is used both for NHLBI programs and in a few studies of behavior change in this particular population and is therefore a useful assessment tool for this program.17,38–40 Studies report improvement in knowledge by 4-26% to be significant and correlated with changes in health behavior and BP.17,37,38

Lastly, although not technically an outcome measure, vitals measurements of BP, smoking status and amount, participant height and weight (for BMI calculation), as well as record of PA are important to track both for patient quality of life and success of the progam.5,6,14,15,41–43 As stated above, changes in BP can indicate significant reductions in risk of adverse health outcomes, making it a meaningful piece of information to track for evaluation of program effectiveness.5,6,14,15 Additionally, to track actual behavior change, a daily log of PA enables comparisons to national guidelines and is the most feasible.43,44 However, use of technology such as pedometers or use of apps, depending on accessibility, has been shown to be more reliable and less prone to bias, making fitness trackers the ideal solution if financially feasible.11,43–45

# Program Goals

A Change of Heart is a program designed to address and cardiovascular risk factors in rural adults through the use of specifically trained community health ambassadors (CHA) as they lead group-based walking and educational sessions. These sessions, outlined in the sample schedule below, aim to increase participant health-related knowledge, overall physical activity, and awareness of their blood pressure.

1. By week 16, participants will improve their 6MWT by 30 meters or to 100% of distance determined by prediction equations in order to demonstrate improved aerobic capacity and endurance through attainment of minimally clinically important difference or their “normal” distance.46,47
2. Men: 6MWD = (7.57 x heightcm) - (5.02 x age) - (1.76 x weightkg) - 309 m
3. Women: 6MWD = (2.11 x heightcm) - (2.29 x weightkg) - (5.78 x age) + 667 m
4. By week 16, participants will demonstrate improved overall maintenance of blood pressure through ≧ 90% compliance with weekly BP logs and reduced SBP by 4-11 mmHg and DBP by 2-5 mmHg as these have been shown to significantly reduce risks of disease and mortality by as much as 43%.8,17
   1. Example BP Log can be found in Appendix A
5. By week 16, participants will indicate increase in weekly physical activity through improving GPPAQ index score to either “active” or “moderately active” as these are not only more aligned with the national activity recommendations, but are shown to reduce risk of all-cause mortality by up to 32%.32,36
   1. GPPAQ can be found in Appendix B
6. By week 16, participants will demonstrate improvement in prevention and heart health-related knowledge by improvement of at least 4 points on NHLBI “My Health Knowledge” Survey compared to their pre-intervention scores.17,39
   1. My Health Knowledge Survey can be found in Appendix C

# Methods

1. **Leadership and Instruction**

The use of Community Health Ambassadors (CHAs) is multifold. First of all, this technique has been used commonly and successfully in programs targeting behavior change in rural populations.17,48,49 These CHA will be recruited from significant local social or cultural groups as this has been shown to increase participation and interest in the program.17 For example, this could be a local religious leader, school principal, or a long-time local business owner and resident of the area. Furthermore, use of local, social influencers, people who already have strong social networks in a community, will utilize multiple levels of the SEM to the program’s advantage as these familiar faces rely on the strong intrapersonal relationships already established in the community and the current social and cultural institutions.18,19 The use of these leaders and established groups will therefore engrain the program into the established community more seamlessly than if started by outsiders to the community.18,19 Secondly, the use of CHAs to supplement the involvement of healthcare providers reduces costs, is more sustainable, and increases feasibility of growing the program.49,50 These individuals will be chosen prior to the initiation of the program, and will be provided with all materials and trained by healthcare professionals to ensure sufficient understanding of program goals, materials, and information.17,40,49 These individuals will then be responsible for leading the weekly education sessions (with provided materials) and accompanying participants on walks to continue facilitation of conversation about weekly topics as well as increase comradery of group members. Their role is crucial as not only are they the vessel of all program information, but they will also role model that health-related knowledge as an attainable goal for all community members regardless of educational or financial barriers.18

All CHAs will be trained by and supported by a few local healthcare providers who will direct the program as a whole, so that there is involvement of local providers and increase referrals to the program from a medical standpoint.49,51 The goal is to use CHA to improve social integration and connection while a backbone of a few, crucial healthcare providers help to direct the program on a broad scale. Use of local providers can help to increase familiarity and patient confidence and comfort when talking with healthcare professionals.18,51

1. **Enrollment**

Information about the program, schedule, locations, and who to contact will be posted on fliers in healthcare offices, local community centers, and social organizations such as churches. The CHAs will be responsible for advertising and mentioning the program in their social networks, as word of mouth recommendations can be powerful in rural areas. Participants will be able to enroll by either calling a local program director or CHA, whose information will be on the flyer.

In each community, ideally a Physical Therapist and a physician will volunteer to team up to organize, plan, and train the CHAs that will lead the group. The healthcare providers will attend all days where baseline assessments or outcome measures are performed, and may initially attend meetings and walks to support the program, but are not required to do so. Each group of participants will be led by two CHAs and contain 20 participants at a maximum. However, the program is not limited to 20 participants, as an added benefit of the use of CHAs is that multiple groups can be operating at the same time with different CHAs all managed by the same PT and physician pair.

1. **Walking Intervention**

As described above, risk factors such as high blood pressure are modifiable through lifestyle interventions such as increased physical activity, and therefore the program is based around a walking program to increase physical activity. A group-based setting is encouraged by most behavior change models as it encourages relationships and increases motivation and adherence.19,20,24,25 As described above, the frequency and duration of other successful and evidence-based programs is highly variable, and therefore, A Change of Heart will employ a unique structure that will taper intervention frequency in three distinct stages. First, from weeks 1 to 8, participants will meet twice weekly to participate in 60 minutes of group-based walking, then from weeks 9 to 12, the group walks will drop to 60 minutes once weekly as participants increase personal responsibility for activity integration outside of the program. Lastly, from weeks 13 to 16, participants will not meet for walking groups organized by the program, but will instead be fully responsible for walking activity until the final group meeting, debrief, and end of program. This model will provide enough structure to establish personal self-efficacy, as well as community and relationships before transitioning participants to more independent portions of the program. Assessment of participant activity and BP will occur pre-intervention, at week 8, week 12, and week 16 to track progress throughout the different stages of the program and give participants targeted feedback about how to personally integrate the walking exercise into their schedule. Other studies have shown that being active with others in the program as well as friends and relatives are the most helpful components when it comes to exercise behavior change.52 Therefore, A Change of Heart will create a space for these relationships and communities to grow before releasing participants to continue health behaviors on their own without support or guidance of the program. Additionally, some programs have had a difficult time with adherence when programs are too long or intensive, and therefore the planned structure allows for participants to receive guidance or support they may need from the program, but with a decreasing burden on their personal time.17,40 The main goal is to establish personal and community investments in behavior change, and then gradually increase the participants’ responsibility while they are still being monitored and supported by the program.

1. **Educational Intervention**

Lastly, the educational component will be addressed through 12 short, 30 minute presentations on relevant topics (full list in schedule below) that are led by the CHAs. Each of these will be given at the start of the first group meeting of the week, and then a list of discussion questions will be given to participants so that the group continues to discuss the educational topic and application strategies as they complete the walking portion of the meeting. Educational topics will range from cardiovascular risk factors, basic information and risk factors of common concurrent chronic conditions such as obesity, diabetes, high cholesterol, and lifestyle changes and recommendations about diet, physical activity, stress management, weight loss, and smoking cessation. The goal of this intervention is to boost participants’ knowledge and confidence in their ability to understand and manage different components of their health. The CHAs will be provided short presentations with talking points and brief handouts for the participants on each topic. Presentations can be done by PowerPoint if space allows, but ideally the presentation will be more of a group discussion guided by the CHAs. The talking points and discussion questions will be used to transition discussion from facts about disease or lifestyle changes and towards practical application. For example, educational sessions on diet may end with talking points about where to find healthier foods at nearby grocery stores and with a sharing of healthy recipes among group members.18 Relating health education back to community resources is important as it strengthens the relationships supporting healthy lifestyle choices and encourages participants to think about changes on a community level.19 For example, are there space and resources to turn an open plot of land into a walking trail if one does not exist in the area? In addition to the discussion, the handouts will provide crucial information in a way that is continually accessible to the participants that they can continue to reference after the program.

1. **Location**

It will be up to the CHAs and program directors to choose a specific location for the meetings as each community will have different buildings and resources available, but a few examples would be a local park with a covered area where the education lesson could be taught before walking around the park, a local school that offers use of a classroom or gym-space for education before walking around the school or track, or a local healthcare office, library, or church, that could be used for education before walking around in a neighborhood. This flexibility allows for tailoring to the potentially limited environment, seasonal differences in weather, and a personal assessment of environmental barriers and best options.18,19,53 As space allows, the program will invite participants to bring a family member or friend to education sessions and walking who will be their “accountability partner” as support from strong intrapersonal relationships can be pivotal in behavior change.19 The goal with this is to create additional support networks that support the participants outside of program participant groups.

1. **Sample Schedule** (weekly educational topics in italics)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Monday** | **Wednesday** | **Friday or Saturday** |
| Pre-Intervention | Recruiting  (CHA training completed, no program activities) | | BASELINE ASSESSMENT DAY (PT and MD attend) |
| Week 1 | *Cardiovascular Disease Overview*  60 min walk | 60 min walk | Participants encouraged to walk independently |
| Week 2 | *Heart Disease Risk Factors*  60 min walk | 60 min walk | Participants encouraged to walk independently |
| Week 3 | *Controlling Blood Pressure*  60 min walk | 60 min walk | Participants encouraged to walk independently |
| Week 4 | *Diabetes*  60 min walk | 60 min walk | Participants encouraged to walk independently |
| Week 5 | *Blood Cholesterol*  60 min walk | 60 min walk | Participants encouraged to walk independently |
| Week 6 | *Controlling Weight*  60 min walk | 60 min walk | Participants encouraged to walk independently |
| Week 7 | *Physical Activity Guidelines*  60 min walk | 60 min walk | Participants encouraged to walk independently |
| Week 8 | *Strength Training*  60 min walk | 60 min walk | ASSESSMENT DAY  (PT and MD attend) |
| Week 9 | *Preparing Healthy Meals*  60 min walk | Participants encouraged to walk independently | |
| Week 10 | *Budget Friendly Healthy Eating*  60 min walk | Participants encouraged to walk independently | |
| Week 11 | *Smoking and Substance Abuse*  60 min walk | Participants encouraged to walk independently | |
| Week 12 | *Review and Goal Setting*  60 min walk | Participants encouraged to walk independently | ASSESSMENT DAY  (PT and MD attend) |
| Week 13-15 | Participants encouraged to walk independently | | |
| Week 16 | Participants encouraged to walk independently | | FINAL ASSESSMENT DAY (PT and MD attend) |

# Program Evaluation

# Participant Outcomes

This program will utilize not only the outcome measures described above, but participants will also be provided with weekly logs, example in Appendix A, to document BP readings and physical activity. In the pre-intervention baseline testing, patients will complete the 6MWT, GPPAQ, and My Health Knowledge Survey. Baseline measures will also include resting BP, and general demographic information such as height, weight, and smoking status.

Patients will be encouraged weekly to fill out activity logs and BP logs, but will not be tested again on outcomes until week 8. All baseline measures (6MWT, GPPAQ, and My Health Knowledge Survey) will be completed by staff at the end of week 8 (end of twice-weekly group-based walking), week 12 (end of group-based walking), and the end of week 16 (end of program) as this will be useful in evaluation of program effectiveness. A resting BP will be recorded with an automated cuff at the end of each weekly educational session as well as at the evaluation days at weeks 8, 12, and 16. This will not only standardize recordings as participants will have sat for 30 minutes prior to recording, but will also provide meaningful information about rate, timing, and size of changes in BP that occur through the intervention.

Program goals will be evaluated at the completion of the program, with outcome assessments taken at week 16. Additionally, the effectiveness of the program will be evaluated through a comparison of participant scores on outcome measures and BP recordings taken throughout the program. Statistical analysis of changes in group mean from baseline to completion, baseline to week 8 and week 12, week 8 to 12, and week 12 to completion will be assessed to monitor progress and effectiveness of tapered intervention structure on behavior change. For example, if significant improvements in activity and BP are seen at week 12 but diminish by week 16, that could indicate that participants were not prepared enough to begin the independent portion of the program.

Due to weekly logs of BP readings as a crucial part of the program, any participants who do not currently have access to an automated BP cuff will be provided with one at the baseline measurement day. This will hopefully boost enrollment and adherence, as any participant who completes the program with > 85% adherence will be allowed to keep their BP cuff, all others will be asked to return the device at the end of the 16 weeks.

1. **Evaluation Plan**

In addition to the statistical outcome evaluation, it is important to evaluate the quality and broader effectiveness of a program. A thorough evaluation will be done at the completion of the first cohort that follows the CDC recommendations for community program evaluations.54 A group of stakeholders will be identified, most likely including a sample of participants, the CHAs and program directors, friends and family members of participants, community members who did not enroll, an additional healthcare professional who was not associated with the program and who may treat patients with HTN or cardiovascular conditions commonly, a local government official such as the director of parks and recreation who may know more about the local environmental barriers, and a representative from the space chosen to hold the educational component of the program (the school, church, restaurant, or park). Each of these individuals is involved in some aspect of the program and will receive a brief overview of the program, the results, and expected long-term outcome, most likely in the form of a logic model, and then asked to complete a survey about the impacts and effectiveness of the program as it has the potential to affect each of these individuals.54 Additionally, their unique experiences or expertise may inform changes to the structure, frequency, or educational topics discussed in the program.

Specifically in the evaluation, it will be important to not only get information about success of participants enrolled, but evaluate the integration of the program and receptivity of the community to the program. Survey results from family members of participants, community members who did not enroll, any drop-outs from the program, and local healthcare providers will be especially informative in this step. These surveys will include reasons for drop-out or not enrolling, largest two barriers to participation, what type of incentive would be necessary for participation, and if the use of technology (smartphone apps, fitness trackers) would have improved compliance or participation. It is important that the program is tailored to suit the rural location to increase future cohorts and impact in the community.

If the program is not meeting the established goals for the enrolled participants, this evaluation with healthcare providers and participants can be crucial in determining better structure or educational topics. For example, participants may need a more-specific training recommendation from the beginning, or my need more of the educational time to be spent doing a question and answer format, or covering different topics. The information provided from participants will give additional insight to strengths and barriers that may not have been addressed in the original plan, such as language barriers or location/distance. It is possible that the use of technology such as pedometers, a smartphone app, or fitness tracking device would improve adherence and encourage activity more than handwritten logs, so this would be an important factor to evaluate based on participant reactions and opinions as well as financial feasibility.

# Conclusion

A Change of Heart aims to enter into small, rural communities to produce exactly what the name implies, heart healthy behavior changes that dramatically alter risk of cardiovascular disease. The health impacts of reductions in BP are many and well-known. Through this preventative program, adults with HTN who are currently at significantly increased risk for many cardiovascular outcomes can reduce their risk, thereby improving quality of life as well as possibly reducing long-term healthcare costs. Furthermore, the health literacy and knowledge gains can be passed down to children, resulting in healthier communities over time and patients who are more confident and better able to advocate for their health needs. The unique, community member-led and tapered structure of this program will gradually increase participant responsibility resulting in higher compliance and behavior change over time. This allows participants to use what they have been learning, make it applicable for their life, and take control of their health. The SEM has been engrained in all aspects of design and evaluation of the program, to better address specific barriers, cultural impacts, and the importance of relationships throughout the program. Overall, this program is flexible to meet the specific community and environmental barriers that may be present in different rural areas, but aims to consistently use established social networks to initiate physical activity and health-related confidence in adults with hypertension.

# Bibliography

1. Callaghan T, Ferdinand AO, Akinlotan MA, Towne SD, Bolin J. The changing landscape of diabetes mortality in the United States across region and rurality, 1999-2016. *J. Rural Health* 2019. doi:10.1111/jrh.12354.

2. Kulshreshtha A, Goyal A, Dabhadkar K, Veledar E, Vaccarino V. Urban-rural differences in coronary heart disease mortality in the United States: 1999-2009. *Public Health Rep* 2014;129(1):19-29. doi:10.1177/003335491412900105.

3. CDC: More obesity in U.S. rural counties than in urban counties. *Centers for Disease Control and Prevention* 2018. Available at: https://www.cdc.gov/media/releases/2018/s0614-obesity-rates.html. Accessed October 26, 2019.

4. Explore High Blood Pressure in the United States | 2018 Annual Report | AHR. Available at: https://www.americashealthrankings.org/explore/annual/measure/Hypertension/state/ALL. Accessed November 15, 2019.

5. Kannel WB. Blood pressure as a cardiovascular risk factor: prevention and treatment. *JAMA* 1996;275(20):1571-1576.

6. Kannel W. Risk stratification in hypertension: new insights from the Framingham study\*1. *Am J Hypertens* 2000;13(1):S3-S10. doi:10.1016/S0895-7061(99)00252-6.

7. Sunkara N, H Ahsan C. Hypertension in diabetes and the risk of cardiovascular disease. *Cardiovasc. Endocrinol.* 2017;6(1):33-38. doi:10.1097/XCE.0000000000000114.

8. Thomopoulos C, Parati G, Zanchetti A. Effects of blood pressure lowering on outcome incidence in hypertension. 1. Overview, meta-analyses, and meta-regression analyses of randomized trials. *J Hypertens* 2014;32(12):2285-2295. doi:10.1097/HJH.0000000000000378.

9. Börjesson M, Onerup A, Lundqvist S, Dahlöf B. Physical activity and exercise lower blood pressure in individuals with hypertension: narrative review of 27 RCTs. *Br J Sports Med* 2016;50(6):356-361. doi:10.1136/bjsports-2015-095786.

10. Igarashi Y, Akazawa N, Maeda S. The required step count for a reduction in blood pressure: a systematic review and meta-analysis. *J Hum Hypertens* 2018;32(12):814-824. doi:10.1038/s41371-018-0100-z.

11. Yuenyongchaiwat K, Pipatsitipong D, Sangprasert P. Increasing walking steps daily can reduce blood pressure and diabetes in overweight participants. *Diabetol. Int.* 2018;9(1):75-79. doi:10.1007/s13340-017-0333-z.

12. Arija V, Villalobos F, Pedret R, et al. Physical activity, cardiovascular health, quality of life and blood pressure control in hypertensive subjects: randomized clinical trial. *Health Qual Life Outcomes* 2018;16(1):184. doi:10.1186/s12955-018-1008-6.

13. Schulz AJ, Israel BA, Mentz GB, et al. Effectiveness of a walking group intervention to promote physical activity and cardiovascular health in predominantly non-Hispanic black and Hispanic urban neighborhoods: findings from the walk your heart to health intervention. *Health Educ Behav* 2015;42(3):380-392. doi:10.1177/1090198114560015.

14. Blood Pressure Lowering Treatment Trialists’ Collaboration, Turnbull F, Neal B, et al. Effects of different regimens to lower blood pressure on major cardiovascular events in older and younger adults: meta-analysis of randomised trials. *BMJ* 2008;336(7653):1121-1123. doi:10.1136/bmj.39548.738368.BE.

15. MacMahon S, Peto R, Cutler J, et al. Blood pressure, stroke, and coronary heart disease. Part 1, Prolonged differences in blood pressure: prospective observational studies corrected for the regression dilution bias. *The Lancet* 1990;335(8692):765-774. doi:10.1016/0140-6736(90)90878-9.

16. Shamizadeh T, Jahangiry L, Sarbakhsh P, Ponnet K. Social cognitive theory-based intervention to promote physical activity among prediabetic rural people: a cluster randomized controlled trial. *Trials* 2019;20(1):98. doi:10.1186/s13063-019-3220-z.

17. Williams LB, Franklin B, Evans MB, Jackson C, Hill A, Minor M. Turn the beat around: a stroke prevention program for african-american churches. *Public Health Nurs* 2016;33(1):11-20. doi:10.1111/phn.12234.

18. Braveman P, Egerter S, Williams DR. The social determinants of health: coming of age. *Annu Rev Public Health* 2011;32:381-398. doi:10.1146/annurev-publhealth-031210-101218.

19. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Education & Behavior* 1988;15(4):351-377. doi:10.1177/109019818801500401.

20. Fahs PS, Pribulick M, Williams IC, James GD, Rovnyak V, Seibold-Simpson SM. Promoting heart health in rural women. *J. Rural Health* 2013;29(3):248-257. doi:10.1111/j.1748-0361.2012.00442.x.

21. Poverty Rate Lower in Rural America Than Urban Centers. Available at: https://www.census.gov/library/stories/2017/11/income-poverty-rural-america.html. Accessed November 18, 2019.

22. Kassavou A, Turner A, French DP. Do interventions to promote walking in groups increase physical activity? A meta-analysis. *Int J Behav Nutr Phys Act* 2013;10:18. doi:10.1186/1479-5868-10-18.

23. Pullyblank K, Strogatz D, Folta SC, et al. Effects of the strong hearts, healthy communities intervention on functional fitness of rural women. *J. Rural Health* 2019. doi:10.1111/jrh.12361.

24. Sidebottom AC, Sillah A, Miedema MD, et al. Changes in cardiovascular risk factors after 5 years of implementation of a population-based program to reduce cardiovascular disease: The Heart of New Ulm Project. *Am Heart J* 2016;175:66-76. doi:10.1016/j.ahj.2016.02.006.

25. Sidebottom AC, Sillah A, Vock DM, et al. Assessing the impact of the heart of New Ulm Project on cardiovascular disease risk factors: A population-based program to reduce cardiovascular disease. *Prev Med* 2018;112:216-221. doi:10.1016/j.ypmed.2018.04.016.

26. The 6 Minute Walk Test - The Cardiology Advisor. Available at: https://www.thecardiologyadvisor.com/home/decision-support-in-medicine/cardiology/the-6-minute-walk-test/. Accessed November 18, 2019.

27. Duncan MJ, Mota J, Carvalho J, Nevill AM. An evaluation of prediction equations for the 6 minute walk test in healthy european adults aged 50-85 years. *PLoS ONE* 2015;10(9):e0139629. doi:10.1371/journal.pone.0139629.

28. 6 Minute Walk Test | RehabMeasures Database. Available at: https://www.sralab.org/rehabilitation-measures/6-minute-walk-test. Accessed November 13, 2019.

29. Ramos RA, Guimarães FS, Cordovil I, de Sa Ferreira A. The six-minute walk distance is a marker of hemodynamic-related functional capacity in hypertension: a case-control study. *Hypertens Res* 2014;37(8):746-752. doi:10.1038/hr.2014.59.

30. Yazdanyar A, Aziz MM, Enright PL, et al. Association between 6-minute walk test and all-cause mortality, coronary heart disease-specific mortality, and incident coronary heart disease. *J Aging Health* 2014;26(4):583-599. doi:10.1177/0898264314525665.

31. Sperandio EF, Arantes RL, da Silva RP, et al. Screening for physical inactivity among adults: the value of distance walked in the six-minute walk test. A cross-sectional diagnostic study. *Sao Paulo Med J* 2016;134(1):56-62. doi:10.1590/1516-3180.2015.00871609.

32. The General Practice Physical Activity Questionnaire (GPPAQ) - Irritable Bowel Syndrome in Adults - NCBI Bookshelf. Available at: https://www.ncbi.nlm.nih.gov/books/NBK51962/#appendixes.app10.s14. Accessed November 18, 2019.

33. Smith TO, McKenna MC, Salter C, et al. A systematic review of the physical activity assessment tools used in primary care. *Fam Pract* 2017;34(4):384-391. doi:10.1093/fampra/cmx011.

34. Dutton SN, Bauman A, Dennis SM, Zwar N, Harris MF. Resourcing an evolution of roles in general-practice: a study to determine the validity and reliability of tools to assist nurses and patients to assess physical activity. *Aust J Prim Health* 2016. doi:10.1071/PY15027.

35. Golightly YM, Allen KD, Ambrose KR, et al. Physical activity as a vital sign: A systematic review. *Prev Chronic Dis* 2017;14:E123. doi:10.5888/pcd14.170030.

36. Khaw K-T, Jakes R, Bingham S, et al. Work and leisure time physical activity assessed using a simple, pragmatic, validated questionnaire and incident cardiovascular disease and all-cause mortality in men and women: The European Prospective Investigation into Cancer in Norfolk prospective population study. *Int J Epidemiol* 2006;35(4):1034-1043. doi:10.1093/ije/dyl079.

37. Abbott LS, Slate EH. Improving cardiovascular disease knowledge among rural participants: the results of a cluster randomized trial. *Healthcare (Basel)* 2018;6(3). doi:10.3390/healthcare6030071.

38. Hurtado M, Spinner JR, Yang M, et al. Knowledge and behavioral effects in cardiovascular health: community health worker health disparities initiative, 2007-2010. *Prev Chronic Dis* 2014;11:E22. doi:10.5888/pcd11.130250.

39. Community Health Worker Health Disparity Initiative. My Health Knowledge Survey. 2012. Available at: https://www.nhlbi.nih.gov/health/educational/healthdisp/pdf/resources/CHWI\_MyHealthHabits\_Pre\_FI.pdf. Accessed December 4, 2019.

40. Abbott LS, Slate EH, Lemacks JL. Influencing cardiovascular health habits in the rural, deep south: results of a cluster randomized trial. *Health Educ Res* 2019;34(2):200-208. doi:10.1093/her/cyy052.

41. Virdis A, Giannarelli C, Neves MF, Taddei S, Ghiadoni L. Cigarette smoking and hypertension. *Curr Pharm Des* 2010;16(23):2518-2525. doi:10.2174/138161210792062920.

42. Carroll AJ, Huffman MD, Zhao L, et al. Associations between depressive symptoms, cigarette smoking, and cardiovascular health: Longitudinal results from CARDIA. *J Affect Disord* 2020;260:583-591. doi:10.1016/j.jad.2019.09.049.

43. Sylvia LG, Bernstein EE, Hubbard JL, Keating L, Anderson EJ. Practical guide to measuring physical activity. *J Acad Nutr Diet* 2014;114(2):199-208. doi:10.1016/j.jand.2013.09.018.

44. Physical Activity and Outcome Measures - Physiopedia. Available at: https://www.physio-pedia.com/Physical\_Activity\_and\_Outcome\_Measures. Accessed November 19, 2019.

45. Bravata DM, Smith-Spangler C, Sundaram V, et al. Using pedometers to increase physical activity and improve health: a systematic review. *JAMA* 2007;298(19):2296-2304. doi:10.1001/jama.298.19.2296.

46. Bohannon RW, Crouch R. Minimal clinically important difference for change in 6-minute walk test distance of adults with pathology: a systematic review. *J Eval Clin Pract* 2017;23(2):377-381. doi:10.1111/jep.12629.

47. Enright PL, Sherrill DL. Reference equations for the six-minute walk in healthy adults. *Am J Respir Crit Care Med* 1998;158(5 Pt 1):1384-1387. doi:10.1164/ajrccm.158.5.9710086.

48. Ali MK, Echouffo-Tcheugui J, Williamson DF. How effective were lifestyle interventions in real-world settings that were modeled on the Diabetes Prevention Program? *Health Aff (Millwood)* 2012;31(1):67-75. doi:10.1377/hlthaff.2011.1009.

49. McKnight T, Demuth JR, Wilson N, Leider JP, Knudson A. Assessing effectiveness and cost-benefit of the trinity hospital twin city Fit For Life Program for weight loss and diabetes prevention in a rural midwestern town. *Prev Chronic Dis* 2018;15:E98. doi:10.5888/pcd15.170479.

50. Winstein CJ, Stein J, Arena R, et al. Guidelines for adult stroke rehabilitation and recovery: A guideline for healthcare professionals from the american heart association/american stroke association. *Stroke* 2016;47(6):e98-e169. doi:10.1161/STR.0000000000000098.

51. Freeman AM, Curran-Everett D, Sabgir D. How starting a patient education/fitness program can improve health. “Walk with a Doc” program shows you how to model healthy behaviors and strengthen the patient-physician bond. *Med Econ* 2014;91(1):42-4, 47.

52. Kurti AN, Logan H, Manini T, Dallery J. Physical activity behavior, barriers to activity, and opinions about a smartphone-based physical activity intervention among rural residents. *Telemed J E Health* 2015;21(1):16-23. doi:10.1089/tmj.2014.0034.

53. Kreuter MW, Lukwago SN, Bucholtz DC, Clark EM, Sanders-Thompson V. Achieving Cultural Appropriateness in Health Promotion Programs: Targeted and Tailored Approaches. *Health Education & Behavior* 2003;30(2):133-146. doi:10.1177/1090198102251021.

54. U.S. Department of Health and Human Services Centers for Disease Control and Prevention. *Introduction to Program Evaluation for Public Health Programs: A Self-Study Guide.* Office of the Director, Office of Strategy and Innovation.; 2011. Available at: https://www.cdc.gov/eval/guide/CDCEvalManual.pdf. Accessed October 30, 2019.

# APPENDIX

1. **Daily BP and Activity Log**

**Example**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Mon** | **Tues** | **Wed** | **Thurs** | **Fri** | **Sat** | **Sun** | **Week Average** |
| **Week 1** | Systolic | 138 | 140 | 137 | 138 | 137 | 138 | 137 | 137.8 |
| Diastolic | 83 | 81 | 82 | 82 | 83 | 82 | 82 | 82 |
| Activity | Walk 60 min | none | Walk 60 min | none | Walk 30 min | Walk 15 min | none | Total: 2.75 hr |

**Participant Log**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Mon** | **Tues** | **Wed** | **Thurs** | **Fri** | **Sat** | **Sun** | **Week Average** |
| **Week 1** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 2** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 3** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 4** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 5** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 6** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 7** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 8** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 9** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 10** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 11** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 12** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 13** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 14** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 15** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |
| **Week 16** | Systolic |  |  |  |  |  |  |  |  |
| Diastolic |  |  |  |  |  |  |  |  |
| Activity |  |  |  |  |  |  |  |  |

1. **General Practice Physical Activity Questionnaire (GPPAQ)**32

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1. **My Health Knowledge Survey**39

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