

LEVERAGING DELIVERY OF BLOOD PRESSURE CONTROL INTERVENTIONS AMONG LOW-INCOME AFRICAN AMERICAN ADULTS: OPPORTUNITIES TO INCREASE SOCIAL SUPPORT AND PRODUCE FAMILY-LEVEL BEHAVIOR CHANGE

Tracy J. Yang, MD, MPhil¹; Lisa A. Cooper, MD, MPH²;
L. Ebony Boulware, MD, MPH³; Rachel L. J. Thornton, MD, PhD⁴

Purpose: Few family-oriented cardiovascular risk reduction interventions exist that leverage the home environment to produce health behavior change among multiple family members. We identified opportunities to adapt disease self-management interventions included in a blood pressure control comparative effectiveness trial for hypertensive African American adults to address family-level factors.

Methods: We conducted and analyzed semi-structured interviews with five intervention study staff (all study interventionists and the study coordinator) between December 2016 and January 2017 and with 11 study participants between September and November 2015.¹ All study staff involved with intervention delivery and coordination were interviewed. We sampled adult participants from the parent study, and we analyzed interviews that were originally obtained as part of a previous study based on their status as a caregiver of an adolescent family member.¹

Results: Thematic analysis identified family influences on disease management and the importance of relationships between index patients and family members, between index patients and study peers, and between index patients and study staff through study participation to understand social effects on healthy behaviors. We identified four themes: 1) the role of family in health behavior change; 2) the impact of family dynamics on health behaviors; 3) building peer relationships through intervention participation; and 4) study staff role conflict.

Conclusions: These findings inform development of family-oriented interventions to improve health behaviors among

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in the United States accounting for more than one-third of deaths.² Obesity is a well-documented risk factor for CVD.³ Unlike hypertension, diabetes, and hyperlipidemia, obesity is common among children and is associated with increased lifetime risk of CVD.^{4,5}

Racial/ethnic minority and low-income populations experience disparities in obesity and CVD risk

throughout the life span.⁶⁻⁹ Health behaviors are important contributors to CVD and obesity risk. They also play an important role in familial transmission of environmental and social risk.^{10,11} Disease self-management interventions are an evidence-based strategy for improving health behaviors and outcomes among adults with CVD.^{12,13} The components of disease self-management interventions (medication adherence, health behavior change, and self-monitoring) apply to a wide range of chronic diseases, including hyperten-

African American index patients at high risk for cardiovascular disease and their family members. *Ethn Dis.* 2019;29(4):549-558; doi:10.18865/ed.29.4.549

Keywords: Cardiovascular Diseases; Family Health; Hypertension; Health Promotion; Disease Management

¹ New York-Presbyterian Morgan Stanley Children's Hospital, Columbia University Medical Center, New York, New York

² Division of General Internal Medicine, Johns Hopkins Hospital and Health System, Welch Center for Prevention, Epidemiology and Clinical Research, Johns Hopkins Center for Health Equity, Department of Health, Behavior and Society at the Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland

³ Division of General Internal Medicine, Department of Medicine, Duke University School of Medicine, Chapel Hill, North Carolina

⁴ Department of Pediatrics, Johns Hopkins Hospital and Health System, Johns Hopkins Center for Health Equity, Department of Health, Behavior and Society at the Johns Hopkins Bloomberg School of Public Health, Baltimore Maryland

Address correspondence to Tracy J. Yang, MD, MPhil; NY Presbyterian Morgan Stanley Children's Hospital; 3959 Broadway, New York, NY 10032; 212-305-2862; tjy9002@nyp.org

sion, which is the focus of this study. The goal of such interventions is to prevent complications of chronic conditions.^{14,15} Disease self-management interventions activate individuals to manage their health by increasing disease-specific knowledge, encouraging adoption of healthy lifestyle behaviors, and improving self-monitoring and adherence.^{16,17} Community health workers (CHWs) are often a core component of dis-

The goal of this study was to investigate... how family dynamics could be leveraged to achieve family-level health behavior change in addition to improving outcomes among index patients in a disease management intervention.

ease self-management. Their primary role is to support patients to improve health.¹⁸ Additionally, adult changes in lifestyle behaviors influence family member behaviors.¹⁹ For example, studies have found that behavior change interventions for overweight parents may simultaneously improve health behaviors for their children.^{20,21} However, these interventions focus on an index patient

and are not specifically geared to the family. There is limited research exploring how disease self-management programs targeting adults with chronic disease may be leveraged to improve diet and physical activity behaviors among family members. The goal of this study was to investigate the perspectives of staff involved in the Achieving blood pressure Control Together study (referred to as the ACT study or parent study) and of study participants enrolled in the ACT study (referred to as “index patients”) on how family dynamics could be leveraged to achieve family-level health behavior change in addition to improving outcomes among index patients in a disease management intervention.^{22,23} We describe study staff and index patients’ perceptions of the ACT study’s influence on family dynamics as related to index patients’ health and disease management behaviors and the health behaviors of family members. This article reports findings relevant to the study goal of exploring family dynamics and relationships and also describes additional themes that emerged through the data analysis process. This study elucidates potential intergenerational and relational implications of disease self-management interventions.

METHODS

The Parent Study: The Achieving Blood Pressure Control Together (ACT) Study

The ACT study was a blood pressure control self-management comparative effectiveness trial conducted

from September 2013 to July 2015 among African Americans with uncontrolled hypertension in Baltimore, Maryland.²²⁻²⁴ This study was a three-arm randomized comparative effectiveness trial that sought to determine the relative effectiveness of behavioral interventions to improve blood pressure control among low-income African Americans with uncontrolled hypertension receiving primary care at a community-based clinic affiliated with a large health system in Baltimore. Intervention components included use of community health workers (all arms), a brief patient and family activation intervention delivered one-on-one in the clinical setting (one arm), and a problem-solving intervention delivered in groups (one arm).²²⁻²⁴ Of the 11 index patients, 3 participated in the CHW-only intervention, 2 in the CHW intervention plus the patient and family activation intervention, and 6 in the CHW intervention plus group problem-solving intervention.

The patient and family activation intervention included in the ACT study (known as “Do My Part”) was designed to enhance active patient engagement in medical visits through a brief one-on-one training administered immediately prior to the patient’s first study clinic visit. The problem-solving intervention was an 8-week, group-based intervention facilitated by a study staff member with exercises to train patients to improve hypertension self-management by employing skills to overcome self-identified barriers to self-management.²² The ACT study design and primary outcomes articles provide further detail

regarding these interventions.^{22,24}

All participants in the parent study were followed by a community health worker (CHW). That is, at least one of the two CHWs had contact with each of the parent study participants across all three arms of the disease management comparative effectiveness trial. CHWs completed an initial home visit with each index patient focused on hypertension management including education regarding risk factors and instruction on using a home blood pressure cuff. CHWs called all index patients to follow-up with them three-days after the initial home visit and continued to follow-up with index patients by phone routinely throughout the study, as needed to meet the individual needs of index patients. CHWs connected index patients with resources such as utilities assistance. They also assisted index patients with issues related to treatment plan adherence and helped troubleshoot any issues index patients experienced with the use of the blood pressure monitor they received in connection with ACT study participation.

The parent study intervention model incorporated key aspects of Social Cognitive Behavioral Theory and the PRECEDE-PROCEED framework. This is described in detail elsewhere.²² For example, the parent study categorized determinants of patient hypertension self-management behaviors as predisposing, enabling, and reinforcing factors. Enabling factors included the provision of skill training to enhance family members' abilities to support patients' successful enactment of hypertension self-management behaviors, and reinforc-

ing factors included social support from others for continuing hypertension self-management behaviors.²²

Participants

We conducted a qualitative study completing in-depth interviews with all 5 ACT study staff (individuals who delivered or oversaw study components, referred to as "study staff") between December 2016 and January 2017. To be eligible for recruitment, all study staff were identified by the ACT study principal investigator (LEB) and were integral to study design or delivery. We recruited all study staff who participated in intervention delivery and the project director via email, mail, and phone contact. All five eligible study staff agreed to be interviewed. Thus, all interventionists and the study coordinator were interviewed as part of the current study. We conducted three interviews in-person in Baltimore, Maryland, and two interviews via telephone based on participant preference.

We also analyzed in-depth interviews with 11 ACT study index patients as a secondary data source to corroborate findings from study staff interviews. Index patient interviews were collected from September – November 2015 as part of a separate study that is detailed elsewhere.¹ Index patients were eligible if they had agreed to be re-contacted for other research and reported living in the same household with at least one adolescent aged 12-17 years who was also a family member (21 of 159 index patients enrolled in the ACT study). Ultimately, 11 index patients agreed to participate in interviews, were consented and

completed in-depth interviews. Additionally, adolescent family member interviews were conducted in the previous study, and specific influence of index patient behavior change on adolescent family members' health behaviors have been published in the literature and are not the focus of the current study.¹ Interviews with index patients were conducted in-person at the clinic site or the patients' home.

The study procedures were approved by the Johns Hopkins Medicine Institutional Review Board. Informed consent was obtained from all participants included in the study.

Interview Protocol and Procedures

We developed standard interview guides for study staff and index patients and obtained informed consent prior to each interview (Table 1). The interviews were conducted by research assistants trained in in-depth interview methodology and lasted 50 to 70 minutes. Each participant was offered a \$50 gift card as remuneration. The interviews were recorded using digital audio recording equipment, and recordings were stored on a secure server and transcribed. A study staff member reviewed transcriptions and audio recordings in tandem and made appropriate edits to transcripts to ensure accuracy.

Interviews with study staff explored their roles and interactions with index patients and family members. Interviews also explored staff members' perceptions of how intervention delivery or design may have facilitated family-level interactions, addressed family concerns, or produced health behavior change among

Table 1. Representative questions from study staff and index patient interview guides^a

Study Staff Interview Guide	
Topic	Example Question
Study roles and general experience of intervention delivery	“Walk me through what the [intervention name] involved. What was a typical delivery of the [intervention name] like?”
Relationships formed due to study participation	“What were your interactions with study participants like?”
Interactions with family members of index patients	“Did you have any involvement with the families of the index patient during the ACT study? What was that like?”
The role of family in health behavior	“Are there any challenges that you would anticipate in developing an intervention similar to the ACT study but targeting families rather than individual adults?”
Index Patient Interview Guide	
Impact of index patient study participation on family food environment	“What kinds of foods are available in your home?” Probe: “Since you participated in the study, has anything about the food available in your home changed?”
Household roles and routines/family-level impacts	“How do you think your participation in the ACT study influenced your other family members?” ^a “Did you try to help anyone in your family or anyone who lives with you make healthy changes?” ^a “Have you noticed any changes in the way members of your family get along with one another since you participated in the ACT study?”
<p>a. These questions are related to family-level intervention effects and served as initial questions to discuss <i>a priori</i> Theme 1: the role of family in health behavior change; and <i>a priori</i> Theme 2: the impact of family dynamics on health behaviors.</p>	

other family members. Interviews with index patients explored how participation in the ACT study influenced family members or if the index patient attempted to help household members make healthy changes.

Data Analysis

Using an iterative process, study team members trained in qualitative analysis methods drafted codebooks for study staff and index patient interviews. Two research assistants with graduate training in qualitative methods reviewed transcripts for familiarity and derived initial codes from a subset of study staff and index patient transcripts. Research assistants developed initial deductive codes based on *a priori* themes that were incorporated within the interview guides (Table 2). These themes were directly related to topics covered by interview questions which were

identified prior to conducting study staff and index patient interviews and were based on hypothesized family-level effects on health that were deliberately explored through the interview guide. Research assistants later developed inductive codes based on close reading of the transcripts to identify emergent content. These codes were applied to sample transcripts by two independent coders and discussed by the study team to develop the final codebook. Once agreement on the application of codes was achieved, the remaining transcripts were coded by one study staff member with qualitative analysis training and reviewed by another study team member. Any questions between coders were adjudicated by the principal investigator (RJT).

Although the primary aim of the study was to understand family-level influence on health behaviors, the

study team also coded topics that were salient in index patient and study staff interviews to allow for strong emergent themes to be captured. We compared emergent themes from analysis of study staff and index patient interviews to assess for areas of convergence and difference.²⁵ We identified potential leverage points for behavior change within the family unit, strategies for achieving family-level impacts, and perceived challenges to family-oriented adaptation of intervention components. Data entry and management were facilitated through ATLAS.ti versions 7 and 8.²⁶

RESULTS

Study staff were all female and included two CHWs, one group problem-solving interventionist, one patient and family activation clinical

Table 2. A priori themes from study staff and index patient interviews

Themes	Description	Study Staff Perspective	Index Patient Perspective
Theme 1. The role of family in health behavior change	Family members have both positive and negative roles in changing health behaviors	“I think we had a gentleman, at least one I remember who had a stroke but his wife was there and she could help him put his cuff on so, you know, we’d see if people had help there.” – CHW	“I’m doing this on my own. I try to, you know, tell my brothers the right way to eat, you know, but they don’t listen to me. . . . They be eating all that pork, bacon.” – 46yo woman, problem-solving intervention
		“So I think when it was envisioned, the Do My Part [patient and family activation intervention], the thought was that many people would come with a family member – to their visit. And [that] did not happen at all.” – Project director	“I may cook something different. Or she [family member] may cook it for me. I’ll tell her I don’t want what she cooked. She may cook just for me what I want.” - 65yo woman, patient and family activation intervention
Theme 2. The impact of family dynamics on health behaviors	Family relationships and dynamics have both positive and negative influences on health behaviors (eg providing emotional support vs creating stressful environments)	“They really just talked about kids and the future a lot . . . and that was motivation for a lot of people to get healthy, it was for their kids, or grandkids, just like anyone else.” – Patient and family activation interventionist	“I been talking to my children . . . because they are most important to me in my life, that, certain things that you all do will send my pressure up.” – 51yo woman, problem-solving intervention
		“Part of their struggle sometimes with controlling their blood pressure, had to do with family stress. . . . I remember one woman talking about her father . . . and talking about her putting her own health to the side, because she has to take care of her father.” – Project director	“And she [daughter] helps me a lot, ‘Daddy you take your medicine?’ and stuff like that. . . . And when I set her down and explain to her, I said, ‘I’m sick.’ ‘No, daddy, you’ve got to do things. . .’ – 66yo man, problem-solving intervention

interventionist, and one project director. Interviewed index patients were African American, primarily female.

Study Staff Description of Intervention Delivery

Study staff described intervention delivery as structured with specific protocols and scripts. However, study staff improvised to adapt to index patients’ needs – which often included family-related stressors. For instance, CHWs followed a script to explain accurate measurement of blood pressure. They also had unscripted conversations based on index patients’ specific circumstances including discussions of strained family relationships or parenting stress. Similarly, study staff admin-

istering problem-solving training reported having discussions related to family needs that protocols did not address, such as teen pregnancy or the violent loss of a child. Instead, such personal issues were addressed more by the relationships formed through study participation.

Study staff overall felt positively about adapting a similar disease self-management intervention toward the family, though they struggled to identify specific opportunities. They believed that prevention should begin early in life and noted that some index patients requested to include friends or family members.

We identified two *a priori* themes (themes 1-2) based on the interview guide (Table 2). Two emer-

gent themes (themes 3-4) were also identified through thematic analysis of interview responses (Table 3).

A Priori Theme 1. The Role of Family in Health Behavior Change

Study staff noted that many index patients identified family as relevant to disease management. Index patients who received the problem-solving intervention identified several barriers to disease management including familial influences: “We did have a lot of people say that their family members were the ones bringing in the donuts, and the cakes, and the cookies, and the stuff they shouldn’t have. So we did a lot of role-playing of

Table 3. Emergent themes from study staff and index patient interviews

Themes	Description	Study Staff Perspective	Index Patient Perspective
Theme 3. Building peer relationships through intervention participation	Index patients and study staff described benefits from meeting other peers who faced similar challenges to health management	“I remember one mom had a lot of kids... she is like they all want to eat something different. . . . But then it’s nothing that I am supposed to be eating And so then some of the older moms would be like no, no. This is not what you do. . . . You cook one meal, and then you say you can take this, or you can leave it. . . .” – Problem-solving interventionist	“I found that they be a woman’s tool, and you can go places and just talk about a lot of stress that’s on your mind But they also taught me other things, how to love and protect and don’t give up. You give in you never give up.” – 51yo woman, problem-solving intervention
Theme 4. Study staff role conflict	Study staff expressed felt unprepared in their professional roles to address challenges related to family relationships and dynamics	“Participants, a lot of them counted us as friends . . . friends or a relative, you know? . . . We had difficulty maybe drawing a line because as much as we did care for them – and you’re only human and you know what’s going on with this person and you want to do this but you say, ‘No, well, I can’t do that because that’s not my, there’s boundaries, we can’t do that.’” – CHW	

how they can get around that” – Problem-solving interventionist

The influence of family on disease self-management was also reflected in index patient interviews. (Table 2). Family presented both detrimental and supportive roles regarding disease management. This occurred most often through meal preparation for the index patient and via family members’ efforts to adopt behavior changes:

“My daughter tries to cook separate for me, especially with the seasoningsbut my husband he’ll eat what I eat, you know, which is always good to have somebody else to eat with you...” -72yo woman, patient and family activation intervention

A Priori Theme 2. The Impact of Family Dynamics on Health Behaviors

Study staff expressed that family dynamics impacted index patient health behaviors, but they also reported feeling inadequately equipped to

handle complex family-related challenges. While the patient and family activation intervention allowed for family member involvement, it was not generally described by study staff or index patients as producing significant changes in family engagement. Challenges to adaptation included the perception that family members often created barriers to disease management. When confronted with participant family challenges, study staff reported they did their best through listening, connecting index patients to resources, and teaching coping mechanisms. Study staff described being unable to fundamentally address these challenges within the context of the intervention:

“Well, one participant had a defiant teenage daughter and she ended up pregnant and that just added more stress to the household...it wasn’t a whole, whole lot that we could do for her other than to... talk to her about maybe talking to her physi-

cian about ... counselling.” – CHW

Index patients also described family dynamics as influencing their health and brought these issues to study staff. (Table 2). Family stressors were identified by both study staff and index patients as adversely affecting blood pressure goals. (Table 2). There were also some instances where family dynamics and interactions were described as helpful:

“And they [daughter and husband] talk to me, you take your medicine, you know, this that and the third. But we basically, you know, we concerned about each other health issues. So we stick together with the health thing.” – 50yo woman, CHW-only intervention

Study staff described family members supporting diagnosis management by helping with blood pressure cuff use and reminding index patients to take medications. They also reported family members occasionally being present in the home during interven-

tion delivery with various levels of involvement. Study staff also expressed that index patients pointed to their children as motivation for change and wanted to teach their children about healthy behaviors. (Table 2).

Emergent Theme 3. Building Peer Relationships through Intervention Participation

Both index patients and study staff discussed the supportive nature of the peer relationships that index patients formed through study participation, particularly among those enrolled in the problem-solving intervention. This group setting provided a platform to discuss family challenges. Index patients shared their family stressors and encouraged each other to adopt healthier behaviors. The problem-solving interventionist expressed that index patients with children seemed to place particular value on these interactions. Some index patients expressed that having space to distance themselves temporarily from their daily caregiver roles was a benefit of study participation. (Table 3).

Index patients formed new relationships and gained unexpected social support that was perceived as a benefit of study participation. Those in the problem-solving intervention formed shared identities due to their diagnoses and supported each other's goals:

"The group . . . we all cared about each other, you know, to the point where . . . I got phone numbers, and you know, we would call. We would talk about going exercising together . . ." –46yo woman, problem-solving intervention

The problem-solving group ap-

proach also helped parents address role stress and disease management stress. Thus, such group-based peer-to-peer activities may optimize participants' skills with managing family conflicts.

Emergent Theme 4. Study Staff Role Conflict

A theme that emerged primarily from the study staff perspective involved role conflict. Study staff discussed the sense of serving as a trusted confidant for both health and nonhealth-related issues (including family-related challenges). However, the unanticipated closeness of these relationships also created discomfort and role tension, particularly for the CHWs.

Index patients generally expressed appreciation for study staff and noted that they were more accessible than clinical staff to address their questions and concerns. Index patients could contact CHWs via cell phone and several study staff were available to patients in clinic on a drop-in basis. This allowed index patients to communicate with study staff easily.

Index patients often brought issues that exceeded the scope of study staff's expertise. Some study staff were uncomfortable due to lack of experience with intervention delivery. Others expressed feeling intimidated by visiting people's homes and being in difficult family environments: "We saw, going in the home we saw a lot of different things. People in drug-addicted neighborhoods, dealing with the stress of teenagers that were... just delinquents . . . it was somewhat challenging because, going into the homes, we didn't always know what we would expect." –CHW

Another source of discomfort came from the tension of building close relationships while maintaining a professional identity. The process of building trust created the dilemma of working in a professional capacity while listening to and caring about the personal challenges of index patients. (Table 3). Study staff discussed how index patients came to them with family-related problems, but they viewed these problems as beyond the scope of the intervention.

DISCUSSION

We found that both index patients and study staff felt there were various family influences on disease self-management related to health behaviors. Furthermore, parent study interventions provided new sources of social support (from both fellow study participants and study staff) that patients leveraged in response to family-related challenges. These findings provide evidence of the importance of family and social relationships in affecting health behaviors and elucidating opportunities to intentionally engage adults in disease self-management programs to address family-related influences.

This work also provides new insight into the potential impact that CHWs can have on families beyond their direct role in supporting patients' disease self-management behaviors. CHWs have been demonstrated as effective in supporting patients to overcome barriers to the management of chronic diseases such as cardiovascular disease and type 2 diabetes.²⁷⁻²⁹ Specifically, CHWs in

the parent study confronted complex issues that may have required additional training regarding when to refer participants to crisis intervention services or other community resources focused on family support. Study staff often reported feeling unable to handle challenging home environments and family stressors. Interventions addressing these family-oriented needs could enhance index patients' health along with producing

These findings provide evidence of the importance of family and social relationships in affecting health behaviors and elucidating opportunities to intentionally engage adults in disease self-management programs to address family-related influences.

positive family-oriented effects, thus interrupting the intergenerational transfer of cardiovascular disease risk among high-risk populations.

To produce family-level effects, primary prevention targeting health behavior change in family members must be coupled with secondary prevention in adults with CVD

via disease self-management programs. Such an intervention could be particularly relevant for improving health outcomes in high-risk populations such as African Americans who experience significant disparities in CVD outcomes.³⁰⁻³²

The group-based problem-solving setting may be particularly important given the challenges of managing a chronic illness along with childcare responsibilities. An intervention could leverage the supportive aspects of family relationships to train family members to assist their loved one with disease management. Or it might explicitly train study staff on methods to address family-related barriers, social resources specific to families, and use of motivational interviewing. The PRECEDE-PROCEDE model, which was used as a conceptual framework for the parent study, would be applicable to a family-oriented intervention informed by our study in considering potential mediators of disease management and patient, family, and even community-level factors.

This study has several limitations. We focused on a specific set of disease management interventions to identify emergent themes and applications for adaptation within a particular study setting: low-income African Americans in Baltimore. The study has a small sample size, consisting of study staff from one intervention and a subset of index patients from the same intervention. As such, these findings may not be applicable in other settings or for other interventions. Additionally, while we found that family influences can affect successful disease self-management among

index patients, we have not elucidated the ways that disease management is understood and internalized by family members. We also lack information about potential motivators for change among family members.

CONCLUSION

Our findings provide unique insights on the influence of family-related concerns on the delivery of patient-oriented behavioral interventions. Family-oriented approaches to support behavior change could address significant gaps missed by interventions targeted solely toward individuals. There are also several potential opportunities to leverage interventions to improve health-related behaviors among family members. For example, CHWs could receive training in engaging family members to educate and assist with health behavior change among other members in the home. Future studies directly addressing family challenges in the context of health behavior change may not only enhance the effectiveness of interventions on individuals but also on the family.

This study also found that social relationships with study peers and study staff emerged as salient to index patients and study staff. These findings have implications beyond the context of a clinical trial and may contribute to implementation of programs in community-based settings.

ACKNOWLEDGMENT

This study was supported by grants from the Johns Hopkins Center for Health Equity (formerly the Johns Hopkins Center to Eliminate Cardiovascular Health Disparities), which was funded by the National Heart,

Lung, and Blood Institute (Grant No. P50 HL105187) (Principal Investigator: Lisa A. Cooper). The ACT study PI (L. Ebony Boulware) was funded as part of the Johns Hopkins Center for Health Equity, which was funded by the NHLBI (Grant No. P50 HL105187). The study principal investigator (Rachel L. J. Thornton) is supported by a career development award through the NHLBI (Grant No. K23 HL121250). Tracy J. Yang was supported by funds through Rachel L. J. Thornton's K23 and the Johns Hopkins School of Medicine Predoctoral Research Program for Medical Students. No copyrighted materials were used in this study. The authors thank ACT study staff, Katherine Abowd Johnson and Sarah Flessa.

CONFLICT OF INTEREST

No conflicts of interest to report.

AUTHOR CONTRIBUTIONS

Research concept and design: Yang, Cooper, Boulware, Thornton; Acquisition of data: Yang, Cooper, Boulware, Thornton; Data analysis and interpretation: Yang, Cooper, Boulware, Thornton; Manuscript draft: Yang, Cooper, Boulware, Thornton; Acquisition of funding: Yang, Cooper, Thornton; Administrative: Yang; Supervision: Boulware, Thornton

REFERENCES

- Thornton RLJ, Yang TJ, Ephraim PL, Boulware LE, Cooper LA. Understanding family-level effects of adult chronic disease management programs: perceived influences of behavior change on adolescent family members' health behaviors among low-income African Americans with uncontrolled hypertension. *Front Pediatr*. 2019;6:386. eCollection 2018 <https://doi.org/10.3389/fped.2018.00386> PMID:30687684
- Heart Disease and Stroke At A Glance Reports. *Publications: Chronic Disease Prevention and Health Promotion*. CDC. Last accessed August 20, 2019 from <https://www.cdc.gov/chronicdisease/resources/publications/aag/heart-disease-stroke.htm>.
- Lee JM, Pilli S, Gebremariam A, et al. Getting heavier, younger: trajectories of obesity over the life course. *Int J Obes*. 2010;34(4):614-623. <https://doi.org/10.1038/ijo.2009.235> PMID:19949415
- Prendergast C, Gidding SS. Cardiovascular risk in children and adolescents with type 2 diabetes mellitus. *Curr Diab Rep*. 2014;14(2):454. <https://doi.org/10.1007/s11892-013-0454-0> PMID:24402326
- Cote AT, Harris KC, Panagiotopoulos C, Sandor GG, Devlin AM. Childhood obesity and cardiovascular dysfunction. *J Am Coll Cardiol*. 2013;62(15):1309-1319. <https://doi.org/10.1016/j.jacc.2013.07.042> PMID:23954339
- Rossen LM, Schoendorf KC. Measuring health disparities: trends in racial-ethnic and socioeconomic disparities in obesity among 2- to 18-year old youth in the United States, 2001-2010. *Ann Epidemiol*. 2012;22(10):698-704. <https://doi.org/10.1016/j.annepidem.2012.07.005> PMID:22884768
- Olds T, Maher C, Zumin S, et al. Evidence that the prevalence of childhood overweight is plateauing: data from nine countries. *Int J Pediatr Obes*. 2011;6(5-6):342-360. <https://doi.org/10.3109/17477166.2011.605895> PMID:21838570
- Robert Wood Johnson Foundation. Declining childhood obesity rates - where are we seeing the most progress? *Health Policy Snapshot: Childhood Obesity*. 2012. Last accessed August 20, 2019 from <https://www.issueelab.org/resources/15536/15536.pdf>
- Richardson LJ, Hussey JM, Strutz KL. Origins of disparities in cardiovascular disease: birth weight, body mass index, and young adult systolic blood pressure in the national longitudinal study of adolescent health. *Ann Epidemiol*. 2011;21(8):598-607. <https://doi.org/10.1016/j.annepidem.2011.02.012> PMID:21497518
- Stewart J, Manmathan G, Wilkinson P. Primary prevention of cardiovascular disease: A review of contemporary guidance and literature. *JRSM Cardiovasc Dis*. 2017;6:1-9. <https://doi.org/10.1177/2048004016687211> PMID:28286646
- Eckel RH, Jakicic JM, Ard JD, et al; American College of Cardiology/American Heart Association Task Force on Practice Guidelines. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. 2014;63(25 Pt B):2960-2984. <https://doi.org/10.1016/j.jacc.2013.11.003> PMID:24239922. Correction available at: <https://doi.org/10.1016/j.jacc.2014.03.005>
- Zhao FF, Suhonen R, Koskinen S, Leino-Kilpi H. Theory-based self-management educational interventions on patients with type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials. *J Adv Nurs*. 2017;73(4):812-833. <https://doi.org/10.1111/jan.13163> PMID:27681948
- Tshiananga JKT, Kocher S, Weber C, Erny-Albrecht K, Berndt K, Neeser K. The effect of nurse-led diabetes self-management education on glycosylated hemoglobin and cardiovascular risk factors: a meta-analysis. *Diabetes Educator*. 2012;38:108-123. <https://doi.org/10.1177/0145721711423978>
- Weingarten SR, Henning JM, Badamgarav E, et al. Interventions used in disease management programmes for patients with chronic illness-which ones work? Meta-analysis of published reports. *BMJ*. 2002;325(7370):925. <https://doi.org/10.1136/bmj.325.7370.925> PMID:12399340
- Goetzel RZ, Ozminkowski RJ, Villagra VG, Duffy J. Return on investment in disease management: a review. *Health Care Financ Rev*. 2005;26(4):1-19. PMID:17288065
- Jonkman NH, Schuurmans MJ, Jaarsma T, Shortridge-Baggett LM, Hoes AW, Trapenburg JC. Self-management interventions: proposal and validation of a new operational definition. *J Clin Epidemiol*. 2016;80:34-42. <https://doi.org/10.1016/j.jclinepi.2016.08.001> PMID:27531245
- Foster G, Taylor SJC, Eldridge S, Ramsay J, Griffiths CJ. Self-management education programmes by lay leaders for people with chronic conditions. *Cochrane Database of Systematic Reviews*. <https://doi.org/10.1002/14651858.CD005108.pub2>
- Kim K, Choi JS, Choi E, et al. Effects of community-based health worker interventions to improve chronic disease management and care among vulnerable populations: a systematic review. *Am J Public Health*. 2016;106(4):e3-e28. <https://doi.org/10.2105/AJPH.2015.302987> PMID:26890177
- Laroche HH, Heisler M, Forman J, Anderson M, Davis MM. When adults with diabetes attempt to drink less soda: resulting adult-child interactions and household changes. *J Natl Med Assoc*. 2008;100(9):1004-1011. [https://doi.org/10.1016/S0027-9684\(15\)31436-X](https://doi.org/10.1016/S0027-9684(15)31436-X) PMID:18807427
- Klohe-Lehman DM, Freeland-Graves J, Clarke KK, et al. Low-income, overweight and obese mothers as agents of change to improve food choices, fat habits, and physical activity in their 1-to-3-year-old children. *J Am Coll Nutr*. 2007;26(3):196-208. <https://doi.org/10.1080/07315724.2007.10719602> PMID:17634164
- Lubans DR, Morgan PJ, Collins CE, Okely AD, Burrows T, Callister R. Mediators of weight loss in the 'Healthy Dads, Healthy Kids' pilot study for overweight fathers. *Int J Behav Nutr Phys Act*. 2012;9(1):45. <https://doi.org/10.1186/1479-5868-9-45> PMID:22512861
- Ephraim PL, Hill-Briggs F, Roter DL, et al. Improving urban African Americans' blood pressure control through multi-level interventions in the Achieving Blood Pressure Control Together (ACT) study: a randomized clinical trial. *Contemp Clin Trials*. 2014;38(2):370-382. <https://doi.org/10.1016/j.cct.2014.06.009> PMID:24956323
- Ameling JM, Ephraim PL, Bone LR, et al; ACT Study Investigators. Adapting hyper-

- tension self-management interventions to enhance their sustained effectiveness among urban African Americans. *Fam Community Health*. 2014;37(2):119-133. <https://doi.org/10.1097/FCH.0000000000000020> PMID:24569158
24. Boulware LE, Ephraim PL, Hill-Briggs F, et al. Hypertension self-management in socially disadvantaged African Americans: the Achieving Blood Pressure Control Together (ACT) randomized comparative effectiveness trial. *J Gen Intern Med*. in press.
 25. Mays N, Pope C. Qualitative research in health care. Assessing quality in qualitative research. *BMJ*. 2000;320(7226):50-52. <https://doi.org/10.1136/bmj.320.7226.50> PMID:10617534
 26. *ATLAS.ti*. (2017). Scientific Software Development GmbH. Berlin, Germany.
 27. Brownstein JN, Chowdhury FM, Norris SL, et al. Effectiveness of community health workers in the care of people with hypertension. *Am J Prev Med*. 2007;32(5):435-447. <https://doi.org/10.1016/j.amepre.2007.01.011> PMID:17478270
 28. Fedder DO, Chang RJ, Curry S, Nichols G. The effectiveness of a community health worker outreach program on healthcare utilization of west Baltimore City Medicaid patients with diabetes, with or without hypertension. *Ethn Dis*. 2003;13(1):22-27. PMID:12723008
 29. Gibbons MC, Tyus NC. Systematic review of U.S.-based randomized controlled trials using community health workers. *Prog Community Health Partnersh*. 2007;1(4):371-381. <https://doi.org/10.1353/cpr.2007.0035> PMID:20208216
 30. Carnethon MR, Pu J, Howard G, et al; American Heart Association Council on Epidemiology and Prevention; Council on Cardiovascular Disease in the Young; Council on Cardiovascular and Stroke Nursing; Council on Clinical Cardiology; Council on Functional Genomics and Translational Biology; and Stroke Council. Cardiovascular health in African Americans: a scientific statement from the American Heart Association. *Circulation*. 2017;136(21):e393-e423. <https://doi.org/10.1161/CIR.0000000000000534> PMID:29061565
 31. Bell CN, Thorpe RJ Jr, Bowie JV, LaVeist TA. Race disparities in cardiovascular disease risk factors within socioeconomic status strata. *Ann Epidemiol*. 2018;28(3):147-152. <https://doi.org/10.1016/j.annepidem.2017.12.007> PMID:29317176
 32. Pool LR, Ning H, Lloyd-Jones DM, Allen NB. Trends in racial/ethnic disparities in cardiovascular health among US adults from 1999-2012. *J Am Heart Assoc*. 2017;6(9):6. <https://doi.org/10.1161/JAHA.117.006027> PMID:28939713