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# Community health workers and childhood obesity: combatting health disparities

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Thesis

**COMMUNITY HEALTH WORKERS AND CHILDHOOD OBESITY:  
COMBATting HEALTH DISPARITIES**

by

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B.S., Michigan State University, 2017

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**COMMUNITY HEALTH WORKERS AND CHILDHOOD OBESITY:**

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**ABSTRACT**

Obesity is caused by a variety of contributing factors including genetics, behavior, and environment, which contribute to weight gain in children and adults. The obesity epidemic is growing rapidly, predisposing both children and adults to preventable chronic diseases such as heart disease and type 2 diabetes. Obese children often become obese adults, further contributing to the obesity epidemic and its economic consequences including higher healthcare costs and lost productivity. The obesity epidemic also exposes significant health disparities; non-Hispanic Blacks and Hispanics represent a disproportionate number of obese adults and children in the United

Community Health Workers (CHWs) are uniquely positioned to support current efforts in the prevention and treatment of childhood obesity. Studies have found CHWs to be effective at increasing healthy behaviors and reducing disparities in cancer screenings for adult minority groups. CHWs can be trained to provide a variety of health services, reducing the burden of healthcare professionals, and reducing cost of care. CHWs provide peer to peer, culturally sensitive health information in an individual's preferred language.

The proposed study is a three-year randomized controlled clinical trial with 262 participants divided equally into two groups, intervention, and control. Non-Hispanic

Black and Hispanic children ages 1-5 years old will be recruited from their pediatrician's offices in the Boston Metropolitan Statistical Area (MSA). Participants will be identified and enrolled by research assistants based on language of care and BMI (body mass index) as recorded in the electronic medical record (EMR). Both groups will receive standard of care treatment throughout the study. The intervention group will additionally receive monthly in-home CHW visits for the first one and a half years. CHWs will take quarterly BMIs and provide education materials on healthy eating and physical activity. The primary outcome is BMI and the secondary outcomes will include healthy behaviors such as average weekly servings of fresh fruits and vegetables. At the end of the study period, all guardians will be given a survey to assess their opinions on the standard of care treatment and CHW interventions.

CHWs are an untapped resource in the fight against childhood obesity, reducing health disparities, and the obesity epidemic. However, more research is needed in this area and the proposed study is a step toward proving their efficacy and efficiency. In the United States, the implementation of CHWs over time could make a huge impact on public health by reducing preventable chronic diseases.

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## LIST OF ABBREVIATIONS

BMC	Boston Medical Center
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CHA	Cambridge Health Alliance
CHW	Community Health Worker
COVID-19	Coronavirus Disease 2019
EMR	Electronic Medical Record
FQHC	Federally Qualified Community Health Center
FTO	Fat Mass- and Obesity-Associated Gene
GERD	Gastroesophageal Reflux Disease
HVP	Home Visitation Program
INSIG2	Insulin-Induced Gene 2
LEP	Leptin
LEPR	Leptin Receptor
MGH	Massachusetts General Hospital
MI	Motivational Interviewing
MSA	Metropolitan Statistical Area
NCHS	National Center for Health Statistics
RA	Research Assistant
SES	Socioeconomic Status
US	United States

## INTRODUCTION

### Background

To effectively battle the childhood obesity epidemic, it is important to understand how overweight and obesity are defined. The most common measure of weight status is body mass index (BMI), which is calculated using height and weight and when calculated for children and adolescents also includes gender and age to produce a percentile.<sup>3</sup> Other factors such as muscle mass and body type are also considered when assessing the health significance of weight.<sup>4</sup> Pediatric overweight is defined as a BMI  $\geq$  85<sup>th</sup> percentile and  $<$  95<sup>th</sup> percentile, while pediatric obesity is defined as a BMI  $\geq$  95<sup>th</sup> percentile.<sup>3</sup> BMI contributes to the picture of a child's health, however, it is not the only factor.<sup>3</sup>

Obesity is a serious health issue which puts people of all ages at risk of severe health consequences. Childhood obesity is the number one pediatric chronic disease and is even more common in minorities with the exception of non-Hispanic Asian children.<sup>5,6</sup> The causes of obesity are varied, intertwined, and complicated. Genetics, behavior, and environment can all influence weight gain and eventually lead to obesity in both children and adults.<sup>7</sup>

Childhood obesity is of special concern because overweight and obese children generally continue on to be overweight and obese as adults.<sup>8</sup> This increases the risk for premature onset of chronic disease such as diabetes and cardiovascular disease.<sup>8,9</sup> While these diseases are often thought to affect adults only, obesity can facilitate the early and even childhood onset of largely preventable, life-threatening conditions. Obesity also has economic consequences, including health costs and lost productivity. In the United States

by the year 2030, additional cases of obesity and related diseases are estimated to add as much as \$66 billion in total healthcare costs.<sup>10</sup>

### **Statement of the Problem**

The causes of obesity are varied and include behavioral, environmental, and genetic factors.<sup>7,11</sup> Treatments of obesity include strategies for weight maintenance, weight loss, medications to aid weight loss, and weight loss surgery in extreme cases.<sup>4</sup> Obese children tend to stay obese into adulthood which contributes to the rapidly increasing number of obese adults.<sup>8</sup> Most recently, CDC National Center for Health Statistics (NCHS) data reports the 2017-2018 prevalence of adult obesity in the United at 42.4% with the prevalence of severe obesity at 9.2%.<sup>12</sup> This is a dramatic increase since 1999-2000, at which time the prevalence was 30.5% for adult obesity and 4.7% for severe adult obesity.<sup>12</sup>

There were significant disparities in adult obesity rates by race in the United States; the highest prevalence of obesity was in non-Hispanic Black women at 56.9%.<sup>13</sup> In contrast, the prevalence of obesity was found to be 42.2% for non-Hispanic whites, 49.6% for non-Hispanic Blacks, and 44.8% for Hispanics.<sup>13</sup>

Statistics for childhood obesity also expose concerning disparities. The most recent CDC NCHS data reported a prevalence of childhood obesity of 18.5% in the US from 2015-2016.<sup>14</sup> Hispanic boys had the overall highest prevalence of childhood obesity at 28.0%.<sup>14</sup> For boys and girls together the reported prevalence for non-Hispanic white children was 14.1%, non-Hispanic Blacks was 22.0%, and Hispanics was 25.8%.<sup>14</sup> There was also a difference in the rates of childhood obesity between genders. There were more

obese boys in all ethnicities except for non-Hispanic Blacks where 19.0% of boys were obese compared with 23.1% of girls.<sup>14</sup> This contrast reveals an area of great concern and also sheds light on an area with much room for improvement.

Rates of childhood obesity continue to rise despite current standards of prevention and treatment; the number of obese children has tripled since 1980.<sup>6</sup> Current childhood obesity prevention and treatment focuses on reducing and modifying risk factors for overweight and obesity by promoting healthy behaviors at home, in medical settings, and even in schools.<sup>15</sup> There are also evident and extreme disparities in the childhood obesity epidemic. Moving forward, it is important to explore potentially more effective ways and overlooked resources to combat the obesity epidemic.

### **Hypothesis**

The use of trained Community Health Workers will lead to a lasting decrease in the BMI of minority overweight and obese children, as well as an increase in their overall healthy behaviors.

### **Objectives and specific aims**

The childhood obesity epidemic is growing and causing more children to suffer from chronic diseases earlier in life. Non-Hispanic Black and Hispanic children are more likely to develop obesity than their non-Hispanic white or non-Hispanic Asian counterparts. Community Health Workers are members of the communities they serve and, thus, are uniquely positioned to combat the childhood obesity epidemic and reduce the existing disparities.<sup>16</sup> The literature review below will discuss how CHWs are being used already. In the proposed study, CHWs will counsel minority families of young obese children at

office visits with their pediatricians. Using a randomized controlled trial this study will seek to establish Community Health Workers as an effective resource for providing culturally sensitive childhood services to reduce obesity. Further, this study will identify potential next steps to further integrate the use of CHWs in this new role. Specifically, this study aims to:

- Over a period of 3 years, measure and compare the BMI percentiles of overweight and obese non-Hispanic Black and Hispanic children ages 1-5 years old who receive services for 18 months to reduce the prevalence of obesity from a CHW to those who receive only the standard of care treatment at pediatric visits.
- The intervention group will receive one and a half years of home CHW intervention and then one and a half years of additional monitoring and data collection during which time participants will continue to receive the standard care. During this additional period patients will be monitored via electronic health records.
- During the study period investigators will collect data quarterly on BMIs of the intervention group as the primary outcome, as well as the following secondary outcomes: average weekly minutes spent doing active play and playing outdoors, average weekly servings of fresh fruits and vegetables, average weekly servings of sugary drinks and junk foods.

## REVIEW OF THE LITERATURE

### Overview

The World Health Organization (WHO) estimates that overweight and obesity cause upwards of 2.6 million deaths annually.<sup>17</sup> Including mortality, obesity has many detrimental consequences on health, economics, and society. Obesity can lead to the development of dire health consequences including: heart disease, stroke, type 2 diabetes, some cancers, osteoarthritis, and premature death.<sup>12,17</sup> Childhood obesity can lead to premature onset of many of these preventable and chronic disease.<sup>8</sup> Further, childhood obesity has been linked to issues such as anxiety and depression, low self-esteem, and bullying.<sup>7</sup> Obesity has the potential to affect health in unpredictable ways, such as with the novel virus COVID-19. Obesity and overweight have been linked with more severe illness and worse outcomes from COVID-19.<sup>18-20</sup>

Childhood obesity increases the risk of developing certain health conditions in childhood such as: high blood pressure, high cholesterol, impaired glucose tolerance, insulin resistance and type 2 diabetes, breathing difficulties including asthma and sleep apnea, joint and musculoskeletal issues, fatty liver disease, gallstones, and GERD.<sup>7</sup> Childhood obesity also facilitates the development of mental health issues like anxiety and depression which can lead to low self-esteem and result in poor academic performance and social issues. Further, obese and overweight children bear the stigma of being overweight which can lead to bullying.<sup>7,21</sup> Adult obesity has health implications including an increased risk of hypertension, stroke, type 2 diabetes, certain types of



cancer, mental illnesses such as depression and anxiety, body pain, and a reduced quality of life.<sup>22</sup>

Along with numerous health consequences, adult obesity represents a huge economic burden which should not be overlooked. This includes both direct and indirect costs.<sup>22,23</sup> Direct costs of obesity are due to services such as laboratory testing, procedures, and hospital visits. Indirect costs are due to resources used or lost as a result of obesity, which could have otherwise been allocated elsewhere.<sup>23</sup> Indirect costs include lost work productivity and employer costs including increased insurance premium, lower wages, and early death.<sup>22</sup> One estimate from 2008 totaled US medical costs due to obesity at \$147 million per year.<sup>12,24</sup> Coupled with the prevalence statistics for childhood and adult obesity, the health consequences and economic cost of obesity paint a concerning picture for the future.

On a larger scale, one paper published in 2012 used an instrumental variables approach to suggest that previous studies have vastly underestimated the costs of obesity; by their most recent estimate, 20.6% of medical expenditures in the United States are a result of obesity.<sup>25</sup> Another study published in the Lancet in 2012 found that the loss of productivity due to obesity in the United States in 2008 was equivalent to 1.7-3 million productive person years, amounting to economic costs between \$390-580 billion.<sup>10</sup> Unfortunately more recent estimates of the costs of obesity in the United States were not readily available. The issues created by obesity and overweight are concerning for not just for the individual but also for the nation.

There are many risk factors that impact whether a child may become overweight in their lifetime. Babies who gain weight quickly, have a high birth weight, and are born to mothers with gestational diabetes are at an increased risk of becoming overweight in childhood.<sup>9</sup> Additionally, family history of conditions, such as obesity, type 2 diabetes, hypertension, and hyperlipidemia predisposes a child to developing obesity.<sup>9</sup> Other risk factors include an unhealthy diet, lack of exercise, genetics, psychological factors, and socioeconomic factors.<sup>26</sup> A combination of many risk factors ultimately increases the likelihood for developing childhood overweight and obesity.

The human body needs a balance of healthy behaviors such as physical activity and healthy foods to maintain a healthy body weight.<sup>22</sup> Therefore, behaviors play a significant role in weight gain and obesity development. Many unhealthy choices are known obesity risk factors, including choosing high-calorie and low-nutrient foods, poor sleep hygiene, medication use, lack of physical activity, and a sedentary lifestyle.<sup>7</sup> Additionally, consuming large portions, eating junk foods (foods high in calories but low in nutrients), lots of time spent on screen devices (computers, television, videogames, etc.), and less time spent being physically active are also behaviors known to facilitate weight gain.<sup>9</sup>

Family history also influences the development of overweight and obesity. Family history is a combination of shared genetics and similar environments.<sup>22</sup> While certain families may encourage physical activity and healthy eating, others may be less active and may tend to eat less healthfully.<sup>22</sup> Along with their genetics, families pass learned

behaviors down from generation to generation.<sup>22</sup> A child's home life has a huge impact on the choices the child makes.

An "obesogenic" environment is one in which there is easy access to high-calorie foods, but not to physical activity.<sup>11</sup> Depending on a child's environment, the availability of nutritious foods and the time and space available for exercise, it may be more or less difficult for the child to make healthy choices.<sup>7</sup> The places children spend their time, such as childcare, school, and home, have an undeniable impact on the food and activity choices available to them.<sup>7</sup> Factors in the community such as the availability of support systems, grocery stores, and space for exercise, affect what choices a child has available to them.<sup>7,9</sup>

Additionally, obesity rates are tied to socioeconomic status (SES).<sup>5</sup> The Centers for Disease Control (CDC) found that children from households with a higher education level of most ethnicities, were less likely to be obese.<sup>5</sup> The CDC further stated that children from low-income families are more affected by obesity than those from high-income families.<sup>27</sup> As previously noted, different communities have access to different and sometimes limited resources.<sup>9</sup> Lack of access to grocery stores may force families to purchase food from convenience stores, increasing consumption of pre-made, packaged, and processed foods.<sup>26</sup> Also, low income communities may not be close to safe outdoor spaces for physical activity<sup>9</sup>.

Previous medical conditions of the child and medications they may already be prescribed can also impact weight gain and obesity.<sup>22</sup> For example, Prader-Willi and hypothyroidism can cause childhood obesity.<sup>9</sup> Additionally, medications such as steroids

and certain antidepressants are known to cause weight gain.<sup>9</sup> Some children may use eating as a way to cope with psychological issues including stress; this can be a learned behavior from parents who may themselves use eating as a coping mechanism.<sup>9</sup>

Genetics can be a risk factor for or a direct cause of childhood obesity. While it is not a guarantee that a child will be obese, children with an obese parent are more likely to be obese themselves.<sup>9</sup> Further, genes direct the body on how to respond to its environment and some genes can lead to increased hunger and food intake.<sup>22</sup> Multifactorial obesity is due to the interactions between various behavioral, environmental, and genetic factors, and likely comprises most cases of obesity.<sup>22</sup>

Infrequently, obesity in families is due to the inheritance pattern of a single gene, most often MC4R that encodes the melanocortin 4 receptor.<sup>11</sup> Changes affecting function in the MC4R gene – causing increased hunger and hyperphagia – are only found in only  $\leq 5\%$  of obese people, regardless of ethnicity.<sup>11</sup> At this time, variants in nine genes have been linked to monogenic obesity and over 50 genes have been linked to obesity in general, including variants of the following genes: leptin (LEP), leptin receptor (LEPR), insulin-induced gene 2 (INSIG2), and fat mass- and obesity-associated gene (FTO).<sup>11</sup> A monogenic cause of obesity is rare and singular genes usually have only a small effect on an individual's weight.<sup>11</sup> However, if an individual has many of these genes, their risk of developing obesity increases.<sup>11</sup>

The prevention of childhood obesity is not drastically different from that of adult obesity; it involves maintaining a balance between calorie intake through food and drinks and calories expended through physical activity and a child's growth.<sup>15</sup> Throughout

childhood, a healthy and balanced diet, along with regular physical activity should be encouraged. Some ways that parents and providers can encourage and teach healthy habits in children include providing healthy foods like vegetables, fruits, whole-grains, low-fat dairy, and lean proteins, as well as encouraging exercise and limiting the amount of time a child is sedentary.<sup>15</sup> Parents should consider children's portion sizes, and encourage their children to have water in place of sugary drinks.<sup>15</sup> This can prove difficult as fresh healthy foods are more expensive and not available in all communities.

Treatment of childhood obesity, compared to prevention, is more complex and varies depending on many factors including the child's age, weight status, and other health conditions.<sup>4</sup> Unlike adults, emphasis for overweight children should usually not be placed on weight loss, rather the goal should be to stabilize the child's weight to avoid continued weight gain while encouraging normal growth.<sup>4,15</sup> On the other hand, obese children may benefit more from gradual weight loss achieved by modifying their eating habits.<sup>4</sup> In obese children the goal should be gradual weight loss up to but no more than one pound per month in children ages 6-11 and up to but no more than 2 pounds per week in obese or severely obese children and adolescents.<sup>4</sup> To achieve either weight maintenance in the case of overweight, or gradual weight loss in the case of obesity, children should eat a healthy diet and get adequate physical activity, similar to the measures involved in obesity prevention.<sup>4</sup> To help increase physical activity, screen time should be limited to 2 hours per day and parents should encourage active play.<sup>4</sup> Further, parents should expect to be involved and committed to helping their child make these changes.<sup>4</sup>

In some cases of severe longstanding obesity children and adolescents are prescribed a medication or surgery to aid weight-loss. Both options have significant risks, should be carefully considered, and will not be right for every child. Taking a weight loss medication in childhood may have unknown long-term consequences their long-term efficacy is unknown.<sup>4</sup> Medications including metformin, sibutramine, orlistat, and fluoxetine have been studied and were shown to be mildly effective in aiding weight loss for children and adolescents.<sup>28</sup> However, the issues above should still be considered. Weight-loss surgery is an even more extreme option and should only be pursued if the risks of the child's obesity outweigh the risks of the surgery.<sup>4</sup> In cases of severely obese children who have not found success with first line treatments of lifestyle changes or with medications a weight loss surgery may be recommended.<sup>4</sup> Like medication, surgery does not guarantee that a child won't develop obesity again later on in life.<sup>4</sup>

Often, studies that develop and test weight-loss programs yield only small reductions in weight and/or would be difficult to maintain long-term on a large scale due to heavy resource requirements including extensive involvement from many professionals (pediatricians, nurses, and registered dieticians). For example, one study published in 2018 developed a program of lifestyle interventions which did result in significant weight loss in obese children and adolescents.<sup>29</sup> However, the eight week long program involved an extensive team of interventionalists as well as sessions on healthy diet and exercise recommendations, a carefully monitored diet, one or six individual sessions with a dietician, a possible additional group session with a dietician, and six individual sessions with researchers.<sup>29</sup> While this study had good results, it would not

work well in the long-term, on a large scale involving many children, or in underserved populations without easy access to these healthcare professionals. Given the moderate success of childhood weight-loss programs and huge potential consequences of other treatment options such as medications and surgery, the focus for combatting the childhood obesity epidemic in the long term needs to be on prevention.

CDC data from 2015-2016 showed that the overall prevalence of childhood obesity in the United States was 18.5% (around 13.7 million children and adolescents nationwide).<sup>5,14</sup> However, this number was much higher for many minorities; in Hispanic children the prevalence was 25.8% and among non-Hispanic Black children it was 22.0%.<sup>5</sup> The prevalence for non-Hispanic whites was much lower at 14.1% and the lowest was for non-Hispanic Asians at 11.0%.<sup>5</sup> These statistics mirror those for adults with non-Hispanic white and non-Hispanic Asian adults having the lowest prevalence and non-Hispanic Black and Hispanic adults having the highest prevalence of obesity.<sup>14</sup> These numbers represent a huge and unacceptable disparity in the rates of both adult and childhood obesity in the United States. Further, because it is known that obese children often become obese adults, addressing the disparities in childhood obesity rates is key to combating the overall obesity epidemic in the United States.

A recent study published in 2018 analyzed how the prevalence of known obesity risk factors in early life varies between races and ethnicities and how these factors contribute to disparities.<sup>30</sup> They found that African American children had the most risk factors, while Asian children had the fewest.<sup>30</sup> This study also found that infant weight gain and socioeconomic status accounted for most of the disparities found between white

children and those of other races and ethnicities.<sup>30</sup> Interestingly, this particular study also found that other risk factors such as fruit and vegetable intake and screen time had less impact on the disparities found.<sup>30</sup> When compared with the CDC data on childhood obesity prevalence, this study found that risk factors for childhood obesity align with prevalence. This suggests that combatting the risk factors for childhood obesity in minorities is a viable means of intervention and can help to reduce existing health disparities.

Along with doctors, nurses, nutritionists, and other healthcare professionals, there is another largely untapped group with the potential to help fight childhood obesity, especially in minorities. Community Health Workers (CHWs) also called Promotoras de Salud, Community Health Representatives, and Lay Health Educators, are members of the communities they work in.<sup>16,31</sup> They share a culture and language with those they serve which uniquely enables them to promote health in their communities as a trusted resource and as health and social educators.<sup>16,31</sup> CHWs have worked in the US since the 1960s, but their role is still adapting and they are being implemented on a wider scale as they are proven effective in more areas.<sup>31</sup> CHWs are both paid professionals and volunteers who help to increase access to health care and reduce health disparities through their services including patient education, community outreach, and connecting patients to resources.<sup>31</sup>

Community Health Workers have the skills to work at the forefront of the childhood obesity epidemic and are uniquely positioned to help address disparities in the rates of childhood obesity in the United States. CHWs are well trusted members of the



communities they serve and often share a common ethnicity, culture, and language with those they serve.<sup>16,32</sup> They link the community to healthcare and social services and help improve both access to care as well as quality of care in the community.<sup>16,32</sup> CHWs are trained to provide both education and resources on needs in the community, and also can perform some direct care such as taking blood pressure readings.<sup>32</sup> Some known beneficial outcomes from the use of CHWs include: improved access to health care services and screening, improved adherence to health recommendations, and a reduced need for emergency services.<sup>32</sup> Further evidence of such will be discussed below.

CHWs are already being utilized in the United States most often with a focus on heart health. The NIH National Heart, Lung, and Blood Institute (NHLBI), as well as the CDC, have materials available online to help in the training of CHWs to combat heart disease.<sup>33,34</sup> The Community Health Worker Health Disparities Initiative, a program of the NHLBI, educates and trains CHWs to inform the public on their risks for heart disease and smoking prevention, monitor progress toward health goals, and teach topics like healthy cooking and physical activity.<sup>32</sup> A 2009 study by the NHLBI showed the positive effect of CHWs on heart healthy behaviors and after six months found statistically significant improvement in LDL cholesterol, hemoglobin A1c, and diastolic blood pressures.<sup>35</sup> The childhood obesity epidemic is another front where the service of CHWs may have value. The adaptability in the education and training of CHWs means that they can be educated on things such as risk factors for and prevention of childhood obesity and calculating BMI. Further, CHWs can help model and lead families to make

behavior changes that will reduce obesity risk factors for their children, while maintaining cultural sensitivity.

Community Health Workers can be trained to teach and encourage lifestyle changes and to take BMI measurements to provide direct childhood obesity education and prevention resources to children and families. With the use of CHWs, disparities in childhood obesity and the childhood obesity epidemic can be reduced. Health professionals such as nurses and nutritionists are equally capable of providing any of the services provided by a CHW and have had moderate success. However, these professionals are more highly paid due to the amount of education and training they have received, whereas CHWs may be volunteers with training limited to more specific topics. For this reason, the use of CHWs could be more cost effective and would enable other professionals like nurses and nutritionists to fill roles that require their added skill set.

### **Existing research**

The use of Community Health Workers to combat the childhood obesity epidemic in the United States has not been widely implemented nor studied in detail. However, the essential components of using CHWs in childhood obesity prevention and treatment have been studied or are already in practice. Interventions that focus on community- and family-based approaches and those that integrate an individual's culture have been studied. These studies indicated the importance and influence of these aspects in childhood weight loss programs.<sup>36,37,38</sup> Although there are limited studies on the use and efficacy of CHWs in childhood obesity in the United States, the implementation of CHWs in other areas has been proven to be useful.<sup>35,39,40</sup> Therefore, it is feasible that

bringing these elements together through the work of CHWs would be an effective method of childhood obesity prevention and treatment in the United States.

The 2018 Early Childhood Obesity Prevention Program, a randomized, controlled trial for underserved mother/newborn dyads, focused on individualized home interventions to address childhood weight status.<sup>36</sup> The study involved community-based events and home visits, both of which focused on strategies for behavioral changes. The study enrolled 47 dyads, assessed at both 6 and 12 months. Infants of mothers who completed the program had a lower BMI at 6 and 12 months, despite a higher BMI at birth. Ultimately, this showed that the use of this community-based program, involving home visits and family-based interventions, was able to positively impact weight. A strength of this study was its use of an existing home visitation program, the Nurturing Families Network (NFN), which had not previously been used to address obesity. One self-reported and notable weakness of this study was that the follow-up period ended at 12 months. As mentioned in the study, behavioral changes and BMI changes at 12 months may not be sustainable into early childhood. The study recommends a longer intervention period and possibly interventions continuing into childhood and adulthood.<sup>36</sup>

A 2013 study by the Communities for Healthy Living (CHL) program was designed with input from parents to educate and empower Head Start families on childhood obesity.<sup>37</sup> The study involved 423 children between the ages of 2 to 5 years old. The parents of these 423 children received a survey regarding various aspects of childhood obesity and common misconceptions on the topic. The CHL intervention included a 6-week program aimed at parents and led by “peers”, letters to parents with

their children's height and weight, family nutrition counseling, and a "health communication campaign".<sup>37</sup> The results of this study found that parents had fewer misconceptions regarding childhood obesity after the campaign and shows the importance of involving parents and community members in the design and implementation of childhood obesity programs. It further shows the effectiveness of peer involvement. CHWs may be more likely to be viewed as peers by parents due to their community ties as well as their cultural and linguistic commonalities. While this study does not show efficacy in reducing childhood obesity as this was not the goal, it does show the effectiveness of peer involvement in childhood obesity awareness.<sup>37</sup>

A 2019 study focused on culturally appropriate tools and motivational interviewing (MI) to address childhood overweight and obesity in an underserved population.<sup>38</sup> This study enrolled 137 overweight and obese children between the ages of 24 and 66 months from their pediatric clinics. Study interventions took place in clinics and were carried out by doctors and nurses. Post-intervention families were more likely to return for clinic follow-up visits. This study is important because it demonstrates how culturally appropriate tools led to increased engagement in the treatment of childhood obesity.<sup>38</sup> One gap in this study is that it did not assess BMI as an outcome, therefore it is unknown whether this increased engagement resulted in an effect on weight status.

A 2017 concept paper explored home visitation programs as a promising option for early childhood obesity prevention, specifically in low-income underserved communities.<sup>41</sup> The proposed model for prevention runs from infancy through early childhood and includes weekly in-home services delivered by an existing home visitation

program (HVP). They establish a lack of access to “culturally competent services” as a major barrier for these children and home visits to increase access. Further, the paper sets out what they describe as a sustainable and cost-effective program which incorporates maternal, infant, and child education on nutrition and physical activity.<sup>41</sup> Home visitors in existing HVP programs are often Registered Nurses or License Vocational Nurses who speak the same language and share a similar culture with the families they service.<sup>41</sup> Nurses have more extensive training than CHWs, however, the services they provide are more extensive as well. While HVP nurses may provide services such as immunizations and other more direct health care, CHWs would be able to be trained to take child weights and teach healthy lifestyle skills in an in-home setting.

A randomized controlled trial published in 2019, examined the efficacy of the “Tu Salud ¡Si Cuenta!” (Your Health Matters!) at Home Intervention, a CHW home visit intervention program using Motivational Interviewing.<sup>39</sup> The study enrolled only adult Mexican Americans on the Texas-Mexico border.<sup>39</sup> The intervention group received 6 monthly CHW visits where they were provided with education and support to make lifestyle changes with a main outcome goal of meeting physical activity guidelines. In contrast, the standard care group received a program welcome letter and various media and materials aimed at the larger community. The CHW intervention group had success in the short-term; at the 6-month follow-up they were more likely to meet their physical activity goals than the standard care group. Importantly, obese participants in the intervention group were also more likely to meet physical activity recommendations at the 6-month follow-up. However, at 12 months this change was not significant. This

suggests that the effect of the CHW on the participants was lost between when the 6 month intervention period ended and the 12 month follow-up.<sup>39</sup> This study shows that CHWs can help adults make a change in their physical activity levels, a similar program may show similar results for children. It is also possible that a longer study and intervention period would produce a more sustainable change in physical activity levels.<sup>39</sup> While this study was aimed at adults and focused on change in physical activity levels, there are principles of this study which can be utilized for childhood obesity prevention. First, they showed the efficacy of CHWs in increasing physical activity, which is a piece of obesity prevention. Therefore, it is possible that with materials aimed toward families and children, principles of this study are transferable to a younger demographic.

A 2018 article evaluated the Healthy Fit program and its use of CHWs to address health disparities in the Hispanic population.<sup>40</sup> This study focused on combatting health disparities related to cancer and cardiovascular disease in a largely uninsured population. CHWs completed health screening and provided education along with referrals and vouchers for various preventative measures such as breast cancer screening and influenza vaccinations.<sup>40</sup> Community health workers followed-up via phone calls at 1, 3, and 6 months after the screenings and recorded follow through on referrals given at the time of the screenings. Among other results, the self-reported follow-up on interventions for which participants received a voucher was 54% for breast cancer screening. While this study is not focused on childhood obesity, it does help to prove the efficacy of CHWs in other areas and demonstrates their efficacy in reducing health disparities.

The La Vida Buena (The Good Life) Evaluation is an in progress study published in 2019, which designed an intervention to use CHWs in a family-based childhood obesity program on the US-Mexico border.<sup>42</sup> This study does not yet have any published preliminary results, however, the design of this study is an important view of the future of this topic. La Vida Buena program targets Latino children between 5 and 8 years old and their families that are patients at a Federally Qualified Community Health Center (FQHC) with a primary outcome of BMI change at the 6-month follow-up. The study's secondary outcomes will include a change in family-focused healthy lifestyle practices, fruit and vegetable consumption, weekly physical activity, and consumption of sugary beverages.<sup>42</sup> There is an intervention group which receives an 8-week intervention and a comparison group which receives one educational session.<sup>42</sup> The eight sessions in the intervention arm correspond to eight curriculum objectives including topics such as health consequences of being overweight, fruits and vegetables, serving size, label reading, physical exercise, and healthy cooking. The major goals are to use CHWs to disseminate a culturally and linguistically appropriate program which encourages a healthy lifestyle and in turn favorably affects childhood overweight and obesity in the Latino community.<sup>42</sup>

## **METHODS**

### **Study design**

The proposed study will be a randomized controlled clinical trial to reduce obesity that takes place over 3 years. Two groups of non-Hispanic Black and Hispanic obese and overweight children ages 1-5 years old at study enrollment will be recruited from their pediatrician's offices in the Boston Metropolitan Statistical Area (MSA). Participants will be randomly assigned to either the control or intervention group. Both groups will receive standard of care treatment throughout the study. The intervention group will additionally receive one and a half years of monthly CHW interventions in their preferred language of care; during the remaining one and a half years the intervention group will receive standard of care treatment only. For the intervention group, throughout the first half of the study period CHWs will collect data quarterly on BMI as the primary outcome, as well as the following secondary outcomes: average weekly minutes spent exercising and outdoors, average weekly servings of fresh fruits and vegetables, average weekly servings of sugary drinks and junk foods. Data on these secondary outcomes will be collected in weekly phone interviews completed by CHWs. Finally, there will be a survey at the end of the study to assess the guardian's opinions on the standard of care and CHW interventions.

### **Study population and sampling**

The study population will include non-Hispanic Black and Hispanic obese and overweight children ages 1-5 years old who will be recruited from their pediatrician's offices in the Boston MSA which includes the following counties: Norfolk, Plymouth,



Suffolk, Essex, Middlesex, Rockingham, and Strafford. Recruitment sites will include pediatric offices affiliated with the following hospitals: Boston Children's Hospital, Boston Medical Center (BMC), Massachusetts General Hospital (MGH), and Cambridge Health Alliance (CHA). Research assistants (RAs) will first identify potential participants based on language of care and BMI at the most recent pediatrics visit as recorded in the EMR.

Inclusion criteria are as follows. The participants and their parents must: be English, Spanish, Portuguese, or Haitian-Creole speaking; include Hispanic and Non-Hispanic Black children ages 1-5 years at recruitment; include children who are overweight, obese, severely obese as defined by BMI calculated using the child's age, weight, and height; include children with a steady caregiver who has primary custody of the child; and include children regardless of parent's BMI or number of siblings.

Exclusion criteria as follows: speak languages other than English, Spanish, Portuguese, or Haitian-Creole; children with diagnosed endocrine disorders or genetic conditions which may cause the child to be overweight despite nutrition and activity level; children with disabilities which would impede physical activity or their ability to cooperate in study interventions; participant's whose families are planning to leave the Boston MSA or change pediatrics providers during the study period of 3 years; and children who do not have a permanent legal guardian or are currently in foster care. Other exclusions may be decided on a case-by-case basis.

The most recent US Census Bureau report for the Boston MSA is from July 1, 2019 (Table 1).<sup>1,2</sup> Assuming 3/5<sup>ths</sup> of persons 0-5 years are 0-2 years, the study

population is approximately 32,699 persons. Using a confidence level of 95%, margin of error of 5%, population proportion of 22% (based on the obesity rates for non-Hispanic Blacks and Hispanics being 22.0% and 25.8% respectively<sup>13</sup>), population size of 32,699 persons, the estimated sample size should be 262 persons. One half of participants will be randomly assigned to the control group and one half to the intervention group for a total of 131 participants in each group. The study will use block randomization with random block sizes to help reduce selection bias and to ensure a more equal number of participants in each group.<sup>43</sup>

**Table 1. Boston MSA Demographics adapted from the US Census Bureau <sup>1,2</sup>**

County	Population estimate July 1, 2019	Persons under 5 years, percent	Persons under 5 years	Black or African American alone and Hispanic or Latino, percent	Persons Black or African American alone or Hispanic or Latino under 5 years	Persons Black or African American alone or Hispanic or Latino under 5 years, estimate*
Rockingham	309769	4.60%	14,249.374	4.40%	626.972456	376.183474
Middlesex	1,611,699	5.20%	83,808.348	14.20%	11,900.7854	7,140.47125
Essex	789,034	5.60%	44,185.904	29.30%	12,946.4699	7,767.88192
Suffolk	803,907	5.10%	40,999.257	47.60%	19,515.6463	11,709.3878
Plymouth	521,202	5.30%	27,623.706	15.90%	4,392.16925	2,635.30155
Norfolk	706,775	5.30%	37,459.075	13.00%	4,869.67975	2,921.80785
Strafford	130,633	4.50%	5,878.485	4.20%	246.89637	148.137822
Totals	48,73,019		254,204.149		54,498.6195	32,699.1717

\*Assumes 3/5<sup>ths</sup> of persons 0-5 years are 2-5 years.

### **Intervention**

The control group will receive standard of care treatment through their pediatrician for the entire 3-year study period. Via the EMR, research staff will obtain a baseline BMI at study enrollment, a BMI at the halfway point of the study, and a BMI at the end of the

study. The intervention group will receive standard of care treatment through their pediatrician as well as monthly interventions from a trained CHW in their preferred language of care. Research staff will also attempt to match participants and CHWs by ethnicity as available. The intervention group will have a baseline BMI obtained by a CHW at their first visit. CHWs will provide a 1-hour home visit every month for the first one and a half years. At home visits the CHW will provide educational materials on healthy eating and physical activity for the child and family. The CHW will also counsel on specific dietary changes that can be made and are inclusive of traditional cultural foods. At every third home visit the CHW will calculate the child's BMI. Weekly, CHWs will administer a phone survey to the parents regarding average weekly minutes spent exercising and outdoors, average weekly servings of fresh fruits and vegetables, and the average weekly servings of sugary drinks and junk foods. Participants will have a final BMI at the end of the study period taken by an RA.

### **Study variables and measures**

The primary outcome variable will be BMI and will be measured using measuring tapes to determine height and portable electronic scales to determine weight. For the intervention group this data will be obtained by CHWs in the participant's homes at home visits. For the control group data will be obtained through the EMR at the pediatrician's office at baseline, the halfway point, and at the end of 3 years. BMI data will then be plugged into the CDC BMI Calculator for Child and Teen. This tool calculates both the BMI and the BMI percentile which will determine whether the child is considered overweight.

Secondary outcomes will focus on improving healthy behaviors including average weekly minutes spent exercising and outdoors, average weekly servings of fresh fruits and vegetables, average weekly servings of sugary drinks and junk foods. For the intervention group this data will be collected from the primary caregiver using a phone survey administered by the CHW weekly. For the control group the survey will be given in conjunction with BMI checks at baseline, the halfway point, and at the end of the study period for each participant.

Finally, at the end of the study period there will be a reflection survey administered by an RA to the guardian of participants in both the control and intervention groups. The goal of this survey will be to illicit what progress or not the guardian feels has been made as well as whether they felt the CHW interventions were helpful.

### **Recruitment**

Recruitment sites will include Boston area pediatric offices affiliated with the following hospitals: Boston Children's Hospital, Boston Medical Center (BMC), Massachusetts General Hospital (MGH), and Cambridge Health Alliance (CHA). There will be one RA assigned to each hospital system who will travel to individual clinical sites and will identify potential participants based on language of care and a BMI from their last pediatric visit. They will reach out to the pediatrician for permission prior to the appointment and then meet potential participants at their next pediatric visit.

RAs will approach the patient's guardian after the patient has been roomed either before or after they have been seen by the healthcare provider. RAs will use an interpreter when necessary. The assigned RA will offer participation, explain the study, and decide

whether the potential participant meets criteria to be in the study. If appropriate the RA will obtain consent from the child's legal guardian. If necessary, the RA will set up additional time to meet with the family by phone, video call, or in person to further discuss the study, answer questions, and consent the participant.

### **Data collection**

BMI measurements will be taken by CHWs and RAs as described above. Survey data will also be obtained by CHWs and RAs as described above. BMIs and lifestyle data will then be transferred to one of two spread sheets corresponding to the control or intervention group. Quantitative data from questionnaires such as average servings of fruits and vegetables consumed in one week will also be transferred to one of two corresponding spread sheets. Qualitative and opinion data such as thoughts about the helpfulness of CHWs will be transferred to a Word document corresponding to the control or intervention group.

### **Data analysis**

Quantitative analysis will be done using R statistical software. Research staff will conduct a T test for difference of means in BMI in each the control and intervention group at baseline, halfway, and end of study. Additionally, research staff will conduct a T test for difference of means across the groups. All quantitative analysis will be done by the statistician. Qualitative analysis from surveys will be described by emerging theme analysis as performed by the RAs and co-investigator. Data analysis will control for confounding variables including number of siblings, obese parents, age of child, and gender of child.

### **Timeline and resources**

The projected timeline for the study is five years divided as follows: one and a half years to write the study protocol, obtain IRB approval, train CHWs, and recruit participants; three years of interventions and data collection; and a final six months to be spent on any remaining data analysis, writing, and editing the transcript, and submission to journals.

Necessary personnel for implementation of the project include: one primary investigator, one co-investigator, one statistician, one study coordinator, four RAs to be divided evenly among the four main recruitment sites, and ten CHWs with two CHWs being fluent in each of the four study participant languages apart from Spanish and English for which there will be three CHWs each. In addition, all CHWs must be fluent in English.

The investigators, RAs, and CHWs will have shared office space available to them. Additional resources will include six portable electronic scales and six tape measures, one set for each RA and each CHW. Educational materials to be provided by the CHWs will need to be printed in each of the four participant languages. The study will use Microsoft Excel, Microsoft Word, and R Statistical Software to record and analyze the data obtained throughout the study period.

### **Institutional Review Board**

Study investigators will submit a request for IRB approval with a full-board review. The intended study participants are a protected population and, thus, it is most appropriate for the study to undergo a full-board review. All participants will receive standard of care treatment throughout the study period. Further, the assent of all participants will be

obtained in addition to the consent of all legal guardians. Neither the treatment nor control group are at any risk posed by the study as assessed by the investigators. No participant will be offered any incentive to participate beyond the possible gains posed by participating in the study.

## CONCLUSION

### Discussion

There are limitations to the proposed study including the inability to match all participants with a CHW from their precise community. While all participants will be matched for language and a best attempt will be made to match communities as closely as possible, this will not be possible in all cases. It would take an immense number of CHWs and huge amount of funding to truly match all participants and CHWs by community. Another potential limitation is loss to follow-up, since no incentives will be given beyond those possibly obtained by the study interventions themselves.

Strengths of the study include parent participation and home visits by CHWs. By providing the services at home, this may mitigate some of the loss to follow-up since participants will not have to travel to stay in the study and research staff will make every effort to work with the family's schedule. This also may have benefits beyond the study participant. Because interventions will be in the home, other family members may also gain valuable health information from the CHW. This may additionally lead to weight loss or an increase in the healthy behaviors of older family members, which would be another avenue of research.

The location of this study is limited to the Boston Metropolitan Statistical Area and will only sample participants from four hospital systems in the area, all of which are teaching hospitals. Therefore, it may be difficult to generalize the findings to other demographics such as patients of private practices, white or Asian children, or those in



communities outside the city of Boston or the state of Massachusetts, especially rural communities.

### **Summary**

The childhood obesity epidemic in the United States is growing rapidly and contributing to the rising rates of adult obesity with obesity leading to early onset of preventable chronic diseases and huge economic costs to the nation.<sup>8-10,12,13</sup> Rates of both childhood and adult obesity are rising and expose extreme racial disparities, namely that the portion of obese non-Hispanic Blacks and Hispanics is disproportionate compared with other groups.<sup>12,13</sup> With their unique connection to the communities they serve, CHWs are perfectly positioned to help in the childhood obesity epidemic. CHWs have been proven to be effective in areas such as increasing healthy behaviors in adults, reducing parent's misconceptions about childhood obesity, and reducing health disparities in cancer screening for Hispanics.<sup>37,39,40</sup> Therefore, it is possible that CHWs may be able to reduce the disparities in childhood obesity rates and help to combat the obesity epidemic.

The proposed study is designed to investigate how CHWs can directly impact childhood obesity rates in an underserved minority population. This has not been sufficiently explored and this study would help to fill a gap in current knowledge. If the results of this study prove the efficacy of CHWs on this front, then this study could serve as a jumping off point for further research into how the role of CHWs can be expanded to combat other diseases.

**Public health significance**

Obesity has a clear impact on public health because it increases the risk of developing many chronic diseases and disproportionately affects minorities.<sup>12,13</sup> By slowing the obesity epidemic, we can improve the health of the general population and reduce health disparities. We know that obese children often become obese adults, therefore, it is important to focus on childhood obesity as a means of slowing the rapidly rising rate of obese adults in the nation.<sup>8</sup> CHWs could be a cost effective and important piece in the fight against the obesity epidemic but first there needs to be more research in this area.

### LIST OF JOURNAL ABBREVIATIONS

Acad Med J Assoc Am Med Coll	Academic Medicine: Journal of the Association of American Medical Colleges
Am J Prev Med	American Journal of Preventive Medicine
Clin Pediatr	Clinical Pediatrics
Cochrane Database Syst Rev	The Cochrane Database of Systemic Reviews
Diabetes Metab Syndr	Diabetes and Metabolic Syndrome
Health Aff	Health Affairs
J Fam Med Prim Care	Journal of Family Medicine and Primary Care
J Health Care Poor Underserved	Journal of Health Care for the Poor and Underserved
J Health Econ	Journal of Health Economics
J Med Virol	Journal of Medical Virology
Mayo Clin Proc	Mayo Clinic Proceedings
Obes Rev Off J Int Assoc Study Obes	Obesity Reviews: An Official Journal of the International Association for the Study of Obesity
Pediatr Obes	Pediatric Obesity
Prev Chonic Dis	Preventing Chronic Disease

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**CURRICULUM VITAE**







