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**BLOOD PRESSURE AND QUALITY OF LIFE IN YOUTH ENROLLED IN A
CULINARY SKILLS, FAMILY MEALTIME AND PHYSICAL ACTIVITY
PROGRAM: PILOT STUDY ICOOK 4-H**

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**Thesis submitted to the
Davis College of Agriculture, Natural Resources and Design at
West Virginia University
in partial fulfillment of the requirements
for the degree of**

**Master of Science
in
Nutrition and Food Science**

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**Morgantown, West Virginia
2014**

Keywords: Blood Pressure, Quality of Life, Youth, BMI, Childhood Obesity

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ABSTRACT

Blood Pressure and Quality of Life in Youth Enrolled in a Culinary Skills, Family Mealtime and Physical Activity Program: iCook 4-H Pilot Study

Objective:

The pilot study objective is to determine if blood pressure (BP) and perception of quality of life (QoL) in 9-10 y/o youth changes after a 12 week 6-session program focusing on culinary skills, family mealtime and physical activity.

Methods:

Pre-post treatment only assessments were collected at 0 and 4 months for child/adult dyads (n=49 dyads). Five states (ME, NE, SD, TN, WV) recruited and delivered 6 sessions every two weeks that focused on increasing cooking skills, family mealtime, and physical activity. During BP assessments, each child had an initial rest of 5 min with 2 min rest between measurements using a digital Omron BP machine with averages recorded. The Peds-QL tool assessed perceived QoL in youth related to their functioning physically, emotionally, and socially.

Results:

At baseline, 93% (n=45) of participants had normal BP and 6% (n=3) were pre-hypertensive. At 4-month post assessment (n=43), 91% (n=39) had normal BP and 7% (n=4) were pre-hypertensive. Significant differences were seen in QoL between pre and post-measurements (mean difference = -0.284; $p < 0.01$), indicating the perception of QoL increased. No correlations were seen between QoL and BP at pre- or post-test.

Conclusions and Implications:

While BP varied little from pre to post, QoL increased over the 4 month pilot study. However, based on findings, there was no correlation between BP and QoL, and the increase in QoL was not

reflected in BP. Increased QoL could have a positive effect on systemic responses such as BP, but since most youth had normal BP, little effect would be expected.

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LIST OF ABBREVIATIONS

Blood Pressure -BP

Systolic Blood Pressure- SBP

Diastolic Blood Pressure- DBP

High density lipoprotein- HDL

Low density lipoprotein- LDL

Body Mass Index- BMI

Health Related Quality of Life- HRQoL

Quality of Life- QoL

Pediatric Quality of Life- Peds-QL

Quality of Urban Life- QUL

Community-based participatory research- CBPR

Social Ecological Theory- SET

Social Cognitive Theory- SCT

Inter Rater Reliability- IRR

Family Base Behavioral Therapy- FBBT

Center for Disease Control- CDC

Cardiovascular Disease- CVD

Waist circumference- WC

Mental Component Summary- MCS

Physical Component Summary- PCS

CHAPTER I

INTRODUCTION

With increasing rates of obesity especially in young citizens of the United States (US), it is important that Americans focus on promoting healthier lifestyles. In the US, heart disease is the leading cause of death.¹ The US Government has increased funding to programs to help with the obesity initiative in adolescence like the *Let's Move* campaign that was launched by first lady Michelle Obama on February 9, 2010. Obesity has become an increasingly large problem in youth and is leading to more co-morbidities that increase risk for developing heart disease in adulthood.² The number of children ages 6-11 years identified as obese in the United States increased from 7% in 1980 to nearly 18% in 2012.. Similarly, the percentage of adolescents aged 12–19 years who were obese increased from 5% to nearly 21% over the same period³ Obese youth are more likely to have risk factors for cardiovascular disease, such as high cholesterol or high blood pressure. In a population-based sample of 5 to 17-year-olds, 70% of obese youth had at least one risk factor for cardiovascular disease.² Social and psychological problems are often seen in obese youth as well.³

With iCook4-H, physical activity is one of the main focuses in the curriculum. The American Heart Association recommends 2 hours of screen time per day for adolescents.⁴² The average amount that 8-18-year old adolescents spend is 7.5 hours a day using entertainment media, including, TV, computers, video games, cell phones and movies.⁴³ Due to the increase in screen time, we inversely see a decrease in physical activity which is related to an increase in obesity in our youth. Gordon-Larson et al. stated that adolescents are not getting the recommended moderate to vigorous activity 5 times per week and this is carrying over into adulthood which coincides with the increased obesity rates.⁴¹ Excess weight at young ages has been linked to higher and earlier death rates in adulthood.⁴²

Family meal time is another focus in the curriculum developed for iCook4-H. Families sitting down at the dinner table and enjoying each other's company has decreased significantly compared to past generations. Eto K. et al. looked at a total of 236 participants and family meal frequency showed that 73% reported a positive intention to eat meals as a family. They also found that 84% enjoyed eating meals with their family, 71% thought eating family meals was important, and 68% looked forward to family meals. The actual family meal frequency showed that 73% of adolescents reported to only eating breakfast with their family 2 days or fewer per week and 17% reported having family breakfast 5 days or more. Enjoyment of family meals in youth remains high, but as they get older the perception of barriers to eating meals together increases. This leads to the proposition that encouraging family meal time and showing the benefits it can have could have a positive impact on health. It also would be beneficial to trouble shoot and work through ways to overcome barriers to eating meals together.⁴⁴ Since family meals are positively associated with making more healthful decisions, this is a valuable component in developing educational curriculum focusing on making nutritious decisions.

Culinary skills are the third and last main component in the iCook4-H curriculum. Research suggests the decline in cooking ability is related to the lack of healthy home cooked meals⁴⁵ The food budget spent on away-from-home meals has also been gradually increasing since the mid 1970's. Today Americans spend 49% of their budget on food with 32% of their calories on away-from-home foods.⁴⁶ This demonstrates the need to focus on adolescents and their parents cooking skills, in hope of increasing knowledge and ability to create healthier meals at home.

Figure 1.0 Goals of iCook4-H

Community-based Participatory Research

Community-based participatory research (CBPR) is an approach to research meant to enrich the value of a study for both researchers and the community being studied.¹⁶ “According to the Kellogg Foundation’s Community Scholars Program, CBPR is a collaborative approach to research that equitably involves all partners in the research process and recognizes the unique strengths that each brings.”¹⁷ ¹⁸ CBPR begins with a research topic of importance to the community with the objective of combining knowledge and action to improve the community.¹⁷ In CBPR, community members are equal partners with academic researchers in defining the problem, collecting information, interpreting data, and developing solutions that are applicable to the situations. Community members are recognized as experts in their own right and their knowledge is equally valued as is academic expertise.¹⁹ The CBPR team forms a relationship where they are continually learning from each other and seeing issues and solutions from different perspectives. Social ecological theory (SET) is often important with curriculum development as well as determining which measurement tools to be used. SET looks at the interactions within social factors, organizational and community factors, interpersonal influences as well as individual factors and the contexts of people-environment relations that make up well-being.⁴⁷ Below is a picture depicting the social ecological model.

Figure 2.0 Social Ecological Model

CBPR allows different perspectives to help determine what could be potentially increasing obesity as well as many other health disparities. Drawing from SET the Social Cognitive Theory (SCT) is also critical to iCook4-H development. The SCT looks at self-efficacy, reinforcement, self-control, observational learning, and reciprocal determinism. SCT considers many levels of the social ecological model in addressing behavior change of individuals.⁴⁸ These theories prove to be important in curriculum development.

Figure 3.0 Social Cognitive Model

The ultimate goal of iCook4-H was to help the children learn by doing as well as get positive reinforcement and this is where the dyad model comes into play largely. By combining CBPR and keeping the SCT in mind, it has potential to be more successful and promote community empowerment. It allows the population being studied to see potential benefits from the research as opposed to feeling exploited.¹⁸ The best source of information about the community is the community.

Blood Pressure

“The definition of hypertension in children and adolescents is based on the normative distribution of BP in healthy children. Blood pressure tables were developed on the Center for Disease Control (CDC) growth charts.”⁴ The child’s measured SBP and DBP are compared with the numbers provided in the table (boys or girls) according to the child’s age and height percentile. The child is normotensive if the BP is below the 90th percentile. If the BP is equal to or above the 90th percentile, the BP measurement should be repeated at that visit to verify an elevated BP. BP measurements between the 90th and 95th percentiles indicate pre-hypertension and warrant reassessment and consideration of other risk factors.⁴

This is the current procedure for diagnosing hypertension in adolescents. In 2004 the standards for diagnosing pre-hypertension, stage 1 and stage 2 hypertension were updated. Children over the age of 3 years should have their BP measured at least once during every health care visit. Children under age 3 should have their BP measured in special circumstances.⁴ Elevated blood pressure should be seen on several different occasions before hypertension is diagnosed in a child.

In addition to the rise in pediatric and adolescent obesity, hypertension has also undergone an epidemiological shift.⁵ Hypertension in children used to be seen mainly in children with renal disease, but this health disparity is now often seen in an apparently healthy adolescent that suffer from obesity.⁵ Hypertension in youth can result in immediate health consequences and is shown to persist into adulthood resulting in a significant risk factor for cardiovascular disease (CVD).^{6 7} The current information indicates that early detection could have a positive impact on reducing health risks and improving cardiovascular health.⁶ Pediatricians and other health care providers need to stress the importance in blood pressure monitoring in the pediatric and adolescent

population. Children with blood pressure levels above the 90th percentile have 2.4 times higher risk of becoming hypertensive adults.⁸

Hypertension is often asymptomatic so routine measurement is key to an early diagnosis. The Fourth Report on Childhood Blood Pressure from the National Heart Lung and Blood Institute recommends that BP be measured routinely for all health care encounters in children aged 3 years and older. Without appropriate measurement and interpretation, increased BP cannot be recognized and necessary treatment strategies cannot be implemented.⁹ Accurate Blood pressure measurement can be difficult if cuff size is not appropriate. The cuff should encircle at least 80% of the upper arm but ideally 100%. The best method in assessing BP is checking it 2-3 times with an automated device to eliminate human error.¹⁰ Once the blood pressure is measured it is important to interpret what it means accurately.⁹

The prevalence of hypertension and pre-hypertension among adolescents was determined by Karen L. McNiece et al. from 2003 to 2004. They conducted a cross-sectional assessment of blood pressure on 6790 adolescents (11-17 years) in Houston schools. “All students with a mean blood pressure in the hypertensive range had repeated measurements on up to two subsequent occasions if persistent to confirm the presence of hypertension as recommended.”¹¹ Prehypertension, stage 1 hypertension, and stage 2 hypertension all showed a statistically significant trend for increasing prevalence with increasing BMI percentile. The concerning issue is that more than 15% of this population fell into that at-risk category based on blood pressure values in this range or higher on at least one occasion.¹¹ This study suggests that almost 20% of the adolescent population is already at risk for future cardiovascular disease and displays the importance of shaping an adequate and successful prevention program. Three Months seems to be adequate time to see an improvement in BP.⁹

Quality of Life

The CDC has defined health related quality of life (HRQoL) as “an individual’s or group’s perceived physical and mental health over time.” There are multiple forms of these surveys for different ages and populations that can come in short form surveys as well as more in depth depending on the type of information interested in collecting. The PedsQL (Pediatric Quality of Life Inventory) is a modular instrument for measuring health-related quality of life (HRQoL) in children and adolescents ages 2 to 18. This scale allows researchers to get a look at the subjects own perception of quality of life and its possible impact when looking at different dimensions including; physical functioning, emotional functioning, social functioning, and school functioning. There are surveys designed for pediatric self-reported as well as parent proxy reported surveys when trying to assess pediatrics perception of QoL. When the pediatric population is able, it is important for them to take assessments because minimal agreement has been shown in some circumstances between self-reported and parent proxy reported surveys.¹² These surveys are found to become more important to determining certain influences on QoL and its impact.¹³ This will help clinicians better help the patient by understanding what is affecting them emotionally in addition to physically.

With the increase in pediatric obesity it is important that we monitor QoL in this population. It has been shown that higher BMI in the overweight category is associated with lower Peds-QoL scores in the social and physical functioning categories. Children in the obesity category had decreased scores in the same with an addition to emotional functioning.¹⁴ When measuring quality of life there is only one expert and that is the participant taking the QoL survey.¹⁵

Study Objectives

The pilot study objective is to determine if a change was seen in BP, BMI and perspective of quality of life in youth at pre and post assessment after a 3 month culinary skills, family mealtime and physical activity focus intervention on 9-10 year olds. The second objective is to determine if there are correlations between BP and QoL after the three month intervention.

Chapter II

LITERATURE REVIEW

Blood Pressure and its Effects on Quality of Life in Children and Adolescents

The rise in obesity in pediatrics and adolescents leads health professionals to have many concerns to what their future health status might hold. With obesity, come many other possible health conditions, including: hypertension, type 2 diabetes mellitus, dyslipidemia, as well as social and psychological problems. The main focus is to see if children and adolescents with pre-hypertension or hypertension will have a lower quality of life (QoL) compared to normotensive. A systematic search of the literature returned few results that looked specifically at blood pressure (BP), and its impact on QoL in children and adolescents so the search was broadened, looking at all age groups. A study done in Germany found individuals with hypertension had significantly higher QoL in family life, self-esteem and physical well-being compared with normotensive adolescents. This contradicts what is seen in adults in other studies where results showed that the Health Related Quality of Life (HRQoL) was worse in hypertensive patients than in normotensive. Labeling someone as prehypertensive had no negative effects on BP and Quality of Life (QoL) so should be used as a preventative tool. Lastly a BP was determined for optimal HRQoL and they found that for adults age 18-65 was 125/75mm hg and for 65 and older is was 125/80 mm hg. Although this was determined, ultimately, each person needs to be treated on an individual basis to help reach optimal HRQoL.

Obesity is also a well-known risk factor in children and adolescents for hypertension. A study done in West Virginia, known as the *Cardiac Project* looked at whether obesity screening was an adequate measurement as a means of detecting higher risk for cardiovascular disease (CVD) in children and adolescents. They found that the odds of having high total cholesterol, low high

density lipoprotein (HDL), and hypertension among obese children were 2 to 5 times those of non-overweight children. Approximately 45% of the children in this study were overweight or obese. When obesity was used as a criterion, approximately 50-65% of children were found to have probable dyslipidemia and hypertension.²⁰ Multiple risk factors need to be assessed when trying to determine if a child or adolescent has hypertension or is at risk for developing hypertension. Some of the known risk factors are ethnic and racial differences, weight and BMI status, hypertension, type 2 diabetes mellitus, and dyslipidemia.¹ The goal of this review will be to focus on childhood and adolescent blood pressure data, and whether the impact on quality of life of these children and adolescents can be strongly determined.

A cross-sectional study conducted in Brazil tried to determine the best risk factors to look for when trying to monitor for pediatric hypertension. This study looked at one private school and one public school, which could be an indicator of socio economic status. This study used the Quality of Urban Life (QUL); this is based on family income, health conditions, social assistance, education, and housing conditions. Of 307 white children, 21.5% were overweight or obese compared to 14.5% non-white children being overweight or obese. The systolic blood pressure (SBP) was significantly higher in school-aged white children ($p < 0.001$), in children with a high QUL and in children with a high body mass index (BMI). The diastolic pressure was significantly higher in white children and in children with a high QUL. This shows that the QUL could be used as a possible risk factor for increased blood pressure in children.⁷

In contrast to the last study, many studies have been conducted on high risk populations for CVD, such as African American children and Mexican children.^{21 22} CVD is one of the main causes of reduced quality of life among African Americans with hypertension being one of the risk factors.²³ In a study with Mexican children of low socioeconomic status, 22.8% had mixed

hypertension which is a high systolic and diastolic number. 3.6% had systolic hypertension and 14.2% diastolic hypertension. The prevalence of hypertension in the sample of Mexican children is high, with waist circumference (WC) being the main factor associated with systolic pressure and higher total fat intake being related to diastolic hypertension.²¹ The statistical analysis conducted on a cohort of African American children with a high BMI showed that measuring WC is a strong predictor of cardiovascular disease (CVD). The overall conclusion from this study is that WC is either as good as or better than BMI in predicting CVD risk using these markers.²² In contrast, a meta-analysis completed by Friedemanm et al. found that having a BMI outside of normal range significantly worsens risk parameters for CVD in relatively healthy school aged children.²⁴ Overall WC, BMI, and QUL have all been shown to be beneficial markers in predicting CVD risk.

Kalarchian et al. researched a program that's main focus was to treat severe pediatric obesity. The children were between the ages of 8 and 12 and the average BMI percentile for age and gender was 99.18. The families were randomly assigned to the intervention which used family based treatment or the usual care. The intervention had 20 group meetings in the first 6 months. The results showed a significant decrease in blood pressure in the intervention group but not in the usual care group. There was also an average decrease of 8.2% overweight in the intervention.²⁵

Quality of Life in Children and Adolescence

The question is does the prevalence of hypertension among the pediatric population have an impact on their perception of quality of life? Few studies have looked at this, but there are some that look at Peds-QL with weight maintenance or weight loss in adolescents and its impact on the quality of life. Another important factor to keep in mind is increased health disparities in different ethnic populations. A study looking at racial and ethnic health disparities among fifth-graders found significantly lower differences in health status and QoL comparing white non-Latinos to

black and Latino children. They found that the black and Latino children reported significantly lower with fair to poor health, psychological quality of life in past 30 days, and physical quality of life in past 30 days ($p < 0.001$).²⁶

Angela Berendes et al. conducted research on adolescents, ages 11-17 with hypertensive blood pressure to determine if it is linked a lower quality of life and higher distress. After taking the BP, HRQoL, and a Measure of Distress questionnaire on 7688 adolescents in Germany, the results are quite shocking. Individuals with hypertension had significantly higher QoL in “family Life” ($P = .011$), “self-esteem” ($p = .028$), and “physical well-being” ($p = .001$) compared with normotensive adolescents. The parents confirmed the same thing as the adolescents. This is the opposite of what has been suggested. The measure of distress scores from parents and children revealed that the hypertensive children were less active than normotensive ($p < 0.005$)

The authors provided possible explanations as to why these scores were the opposite of what one would expect. Some adolescents may be more focused on reaching goals that get them recognized so are more successful in their school careers than others which may increase their level of stress and result elevated BP but lead to better self-esteem and QoL. Trying to be unaware of one's emotions may lead to better self-ratings of distress and QoL, and repressed emotions might at the same time lead to elevations in BP. Either way, none of these explanations have been proven hence more research in this area is needed.²⁷ Table 1 compares all of the studies discussed that look specifically at blood pressure and its impact on quality of life. The German study had a large number of participants, but the results were different than the other studies. The German study also had a large age range, which could contribute to variability.

Table 1.0 Comparison of BP and its Effect on HRQoL

Comparison of BP and its Effect on HRQoL				
Study	Age Examined in Years	Number of Individuals	Improvement in BP or already Normotensive	Improvement in HRQoL
Helen Croker et al.	8-12 years of age	72	Yes	Yes
Angela Bernendes et al.	Ages 11-17	7688	No	No
Jen-Chen Tsai et al.	20-60 years of age	102	Yes	Yes
Josiane Lima de Gusmao et al.	$54 \geq 8$ years	77	Yes	Yes
Didem Arslantas, et al.	≥ 50 years of age	1193	Yes	Yes

Kalarchian et al. looked at the feasibility as well as the preliminary outcomes of a program focusing on childhood obesity with one of its main outcome focuses on health related quality of life (HRQoL). This study had 155 children and their parent/guardian. The parent and child would attend the sessions together over the six months with 24 sessions total and six of them were face to face. The focus of the treatment was the child with emphasis on the parent to help support the child in the weight management. The overall sample experienced a significant percentage reduction in weight ($p=0.001$) after 6 months with 8% fewer children above the 99th percentile at 24 weeks and 10% fewer children were in obese category at 24 wks. With the pre-test child-report of HRQoL it was worse in healthy children and adolescents across multiple domains. At 6 months the children experienced significant improvements in HRQoL. These improvements in HRQoL were greater in the younger group with $p<0.001$ compared to $p=0.03$, but were significant in both age groups. The children reported the biggest improvement in emotional functioning whereas the parents believed the biggest improvement in their child's HRQoL was in physical health. These

findings show clinically significant outcomes, including improvements in weight status as well as HRQoL after these 24 sessions.²⁸

Another study that was done in the United Kingdom (UK) used family base behavioral therapy (FBBT) with a socially diverse population. The children were randomized into the FBBT group or the control group. A pre and post assessments at 12 months was taken and it looked at anthropometric measures as well as psychosocial measures. There were significant BMI changes and a significant reduction in systolic BP. There were improvements in QoL and eating attitudes but they were not found to be significant. The FBBT group showed a significant reduction in systolic BP and improvements in QoL and eating attitudes with no significant change in the control group. No significant differences were found when the two groups were compared with independent t-tests or Mann-Whitney test (continuous variables) or chi-squared test (categorical variables).²⁹ This shows that FBBT could be used when trying to improve QoL and BP.

Blood Pressure, Quality of Life, and Adults >18 years

The lack of information pertaining to children's blood pressure and the impact on quality of life needs to be looked into further. There are very few studies that specifically look at the two. With the increased risk of developing hypertension when overweight or obese the impact on quality of life is still unknown.³⁰ Given that there is little information pertaining to children, there is some research that looks into BP and its potential impact on QoL with adults. Jen-Chen Tsai et al. discovered a correlation in ages 20-60 that HRQoL is lower in hypertensive patients than normotensive and the reason behind this is still unknown but the question has been posed if it was because they were aware they had hypertension.^{31 32} This is the opposite of what was shown in adolescents in the German study which showed that QoL was not affected by BP.²⁷

A study conducted in a semi-rural area of western Turkey tried to determine the effects on the HRQoL that hypertension among individuals aged 50 years and over can have. This was a population based cross sectional study on 1193 individuals. The HRQoL and BP were determined as well as a questionnaire determining health history, socio economic status and, demographics were taken with face to face interview. The BMI was also calculated. What they found was the HRQoL was worse in hypertensive patients than in normotensive in this study ($p \leq 0.001$). Again, in a different population and age range the opposite of what was found in the German adolescent study was discovered.²⁷

A study that looked specifically at QoL in hypertensive patients found very similar results to what Jen-Chen Tsai et al. found. This research design looked at people with hypertension that had complications opposed to those that had no complications. The hypertensive patients without complications had to have SBP greater than or equal to 140mmhg, and a DBP less than 110mmhg, either undergoing treatment or not getting treatment, and no target-organ damage. The hypertensive patients with complications had to have a DBP greater than or equal to 110 mm hg, also undergoing treatment or not, and had clinically marked target-organ damage. In the beginning of the study there was no significant difference between the two groups. They did find however, that normotensive patients had a significantly higher HRQoL in the functional capacity, bodily pain, and vitality domains and a change in one dimension for QoL can impact another dimension.⁷ The studies conducted on adults have been conclusive in determining that as BP worsens so does QoL.

To determine if labeling someone with prehypertension could have an impact on their QoL, Tanya M Spruill et al. tried to establish if it is beneficial to their health and to their QoL. The label prehypertension was developed to try and help patients become more aware of their increased risk

for hypertension. The question was discussed earlier if telling someone they are hypertensive automatically affects that person's perception of their quality of life.³¹ This study tries to determine if it that holds some truth. There were two randomized groups, one of the groups was informed of their risk, but was not specifically told that they have prehypertension. The other group was told that they were at risk and is prehypertensive. Both groups were given the HRQoL questionnaires at baseline and 3 months. The results from this study showed that prehypertension labeling did not negatively affect patients. It did not negatively affect blood pressure or their QoL.³²

The final question assessed was to determine if there is a specific BP value for optimal quality of life? A study by Monika Zygmuntowicz et al. tried to find that out. This study looked at 11,498 white patients ages 18-65 and older than 65 years old. The 18-65 were called the "younger" group and the greater than 65 was the "older". They all had to of been treated continuously for hypertension for at least 12 months. These participants HRQoL was assessed using the 12-Item Short Form Health Survey. They found that for SBP to be associated with an optimal physical component summary (PCS) in both the young and old group it needed to be 125 mm hg. For the mental component summary (MCS), it was 8 mm hg higher in the older group. The DBP associated with optimal PCS and MCS scores was 80 mm hg in the older group and 75 mm hg in the younger group. Ultimately, BP values associated with optimal HRQoL increase with the number of drugs which reflects the severity of the disease so each person needs to be treated on an individual basis to help reach optimal HRQoL.³³

Overall, research in pediatric population has been inconclusive but in the adult population it is shown that as BP worsens so does QoL. Due to the increase in adolescent and pediatric obesity, there is also an increase in multiple health complications. Pediatric hypertension is one of the possible complications that can have detrimental effects. Hypertension in children and adolescents

persist into adulthood and is a significant risk factor for CVD, which is the number one killer in the United States. With very little data to look at in the adolescent population and the conflicting data between adolescents and adults, more research is greatly needed. Research done on the adult population has found that normotensive patients had a significantly higher HRQoL in the functional capacity, bodily pain, and vitality domains where as in a study on adolescent's individuals with hypertension had significantly higher QoL compared to the normotensive adolescents.²⁷ Studies have also found that prehypertension labeling did not negatively affect patients with their BP or their QoL, suggesting that earlier detection can still be used to help enforce a positive impact on an individual's health.³² In conclusion, the lack of research on children and adolescence blood pressure and its impact on QoL is an area that needs more research. When looking at this data it is important to remember that children and adolescents are different from adults and the more research we do on this population, the closer we can become in tackling a possible epidemic in the near future.

Chapter III

Journal Article Submission

Abstract

As childhood obesity rates climb, health professionals' concern for the well-being of children and adolescents increases. Obesity creates many other possible health conditions, including: hypertension, type 2 diabetes mellitus, dyslipidemia, as well as social and psychological problems. Children and adolescents with prehypertension or hypertension may have a lower quality of life (QoL) compared to normotensive individuals. An investigation of the current literature returned few results specifically targeting blood pressure (BP) and its impact on QoL in children and adolescents. Due to the limited outcome, the search was then broadened to all age groups. A study done in Germany, found individuals with hypertension had significantly higher QoL in family life, self-esteem and physical well-being compared with normotensive adolescents. This contradicts what was seen in adults in other studies, where results showed that the Health Related Quality of Life (HRQoL) was worse in hypertensive patients than in normotensive. Labeling individuals as prehypertensive was found to have no negative affects on BP and Quality of Life (QoL) which could be used as a preventative tool. Lastly, a BP was determined for optimal HRQoL in adults age 18-65 was 125/75mm hg and for 65 and older is was 125/80 mm hg. Although this was determined, ultimately, each person needs to be treated on an individual basis to help reach optimal HRQoL.

Keywords: Blood Pressure, Quality of Life, Youth, Children

Due to the rates of obesity increasing, it is important that Americans focus on promoting healthier lifestyles. The US Government has increased funding to programs to help with this initiative in adolescence; for example “Let’s Move” campaign that was launched by first lady Michelle Obama. In the United States, heart disease is the leading cause of death. (CDC/National Center for Health Statistics, October 19, 2012) Obesity has become an increasingly large problem in children and adolescents; it is potentially leading to more co-morbidities. Among children 2-5 years old, obesity prevalence increased from 5% to 12.4%; among children 6-11 years old, it increased from 6.5% to 17%; and among adolescents 12-19 years old, it increased from 5% to 17.6%. (CDC grand rounds: Childhood obesity in the united states.2011) Some possible co-morbidities related to obesity include: hypertension, type 2 diabetes mellitus, dyslipidemia, as well as social and psychological problems. (Obesity evaluation and treatment: Expert committee recommendations1998)

In addition to the rise in pediatric and adolescent obesity, hypertension has also undergone an epidemiological shift. (Sorof & Daniels, 2002) Hypertension in children used to be seen mainly in children with renal disease, but this health disparity is now often seen in an apparently healthy adolescent that suffers from obesity. (Sorof & Daniels, 2002) Hypertension in pediatric patients can result in immediate health consequences and is shown to persist into adulthood, resulting in a significant risk factor for CVD. (Cromwell, Munn, & Zolkowski-Wynne, 2005) (Garcia et al., 2004) The current information indicates that early detection could have a positive impact on reducing health risks and improving cardiovascular health. (Cromwell et al., 2005) Pediatricians and other health care providers need to stress the importance in blood pressure monitoring in the pediatric and adolescent population. Children with blood pressure levels above the 90th percentile have 2.4 times higher risk of becoming hypertensive adults. (Mahoney, Clarke, Burns, & Lauer,

1991) The best method in assessing BP is checking it 2-3 times with an automated device. (Chen, Wang, Appel, & Mi, 2008)

Obesity is a well-known risk factor in children and adolescents for hypertension. A study done in West Virginia, known as the “Cardiac Project,” determined that obesity screening is an adequate measurement tool for detecting higher risk for cardiovascular disease (CVD) in children and adolescents. The Cardiac Project found that the odds of having high total cholesterol, low high density lipoprotein (HDL), and hypertension among obese children are two to five times those of non-overweight children. Approximately 45% of the children in this study were overweight or obese. When obesity was used as a criterion, approximately 50-65% of children were found to have probable dyslipidemia and hypertension. (Demerath et al., 2003) Multiple risk factors need to be assessed when trying to determine if a child or adolescent has hypertension or is at risk for developing hypertension. Some of the known risk factors are ethnic and racial differences, weight and BMI status, hypertension, type 2 diabetes mellitus, and dyslipidemia. (CDC/National Center for Health Statistics, October 19, 2012) The goal of this review is to focus on childhood and adolescent blood pressure data, and whether the impact on quality of life of these children and adolescents can be strongly determined.

A cross-sectional study done in Brazil tried to determine the best risk factors to look at when trying to monitor for pediatric hypertension. This study looked at one private school and one public school; this could be an indicator of socio economic status. This study used the Quality of Urban Life (QUL) which is based on family income, health conditions, social assistance, education, and housing conditions. It was determined, that of the 307 white children, 21.5% were overweight or obese compared to 14.5% non-white children being overweight or obese. The systolic blood pressure (SBP) was significantly higher in school-aged white children ($p < 0.001$), in

children with a high QUL and in children with a high body mass index (BMI). The diastolic pressure was also significantly higher in white children and in children with a high QUL. This study shows that the QUL could be used as a possible risk factor for increased blood pressure in children. (Garcia et al., 2004)

In contrast to the last study, many studies have been conducted on high risk populations for CVD, such as African American children and Mexican children. . (Colin-Ramirez et al., 2009) (Raman, Sharma, Fitch, & Fleming, 2010) CVD is one of the main causes of reduced quality of life among African Americans with hypertension being one of the risk factors. (Gittner, Hassanein, & Murphy, 2007) In a study with Mexican children of low socioeconomic status, 22.8% had mixed hypertension which is a high systolic and diastolic number. 3.6% had systolic hypertension and 14.2% diastolic hypertension. The prevalence of hypertension in the sample of Mexican children was high. Waist circumference (WC) was determined as the main factor associated with systolic pressure and higher total fat intake being related to diastolic hypertension. . (Colin-Ramirez et al., 2009) The statistical analysis from a cohort of African American children with a high BMI showed that measuring WC was a strong predictor of cardiovascular disease (CVD). The overall conclusion of this study was that WC is either as good as or better than BMI in predicting CVD risk... (Raman et al., 2010) In contrast, a meta-analysis done by Friedemanm et al. found that having a BMI outside of normal range, significantly worsens risk parameters for CVD in relatively healthy school aged children. (Claire Friedemann et al., 2012)

Kalarchian et al. did a study on a program that's main focus was to treat severe pediatric obesity. The children were between the ages of 8 and 12; the average BMI percentile for age and gender was 99.18. The families were randomly assigned to the intervention, which used family based treatment or the usual care. The intervention had 20 group meetings in the first 6 months. The

results showed a significant decrease in blood pressure in the intervention group, but not in the usual care group. There was also an average decrease of 8.2% overweight in the intervention.

(Kalarchian et al., 2009)

The PedsQL (Pediatric Quality of Life Inventory) is a modular instrument for measuring health-related quality of life (HRQoL) in children and adolescents ages 2 to 18. This scale allows researchers to get a look at the subjects own perception of quality of life. The question is, “does the prevalence of hypertension among the pediatric population have an impact on their perception of quality of life?” Few studies have looked at this, but there are some that look at PedsQL with weight maintenance or weight loss in adolescents and its impact on the quality of life. Another important factor to examine was the increased health disparities in different ethnic populations. A study looking at racial and ethnic health disparities among fifth-graders found significantly lower differences in health status and QoL comparing white non-Latinos to black and Latino children. They found that the black and Latino children reported significantly lower with fair to poor health, psychological quality of life in past 30 days, and physical quality of life in past 30 days ($p < 0.001$). (Schuster et al., 2012)

Angela Berendes et al. examined adolescents, ages 11-17 with hypertensive blood pressure to determine if it is linked a lower quality of life and higher distress. After taking the BP, HRQoL, and a Measure of Distress questionnaire on 7688 adolescents in Germany, the results are quite shocking. Individuals with hypertension had significantly higher QoL in “family Life” ($P = .011$), “self-esteem” ($p = .028$), and “physical well-being” ($p = .001$) compared with normotensive adolescents. The parents confirmed the same thing as the adolescents; this is the opposite of what has been suggested. The measure of distress scores from parents and children, revealed that the hypertensive children were less active than normotensive ($p < 0.005$)

The authors provided some possible explanations as to why these scores were the opposite of what one would expect. Some adolescents may be more focused on reaching goals that get them recognized; therefore, they are more successful in their school careers than others, which may increase their level of stress and result elevated BP, but lead to better self-esteem and QoL. Trying to be unaware of one's emotions may lead to better self-ratings of distress and QoL, and repressed emotions might at the same time lead to elevations in BP. Either way, none of these explanations have been proven, so there is more research needed in this area. (Berendes, Meyer, Hulpke-Wette, & Herrmann-Lingen, 2013) Table 1 shows all of the studies discussed that look specifically at blood pressure and its impact on quality of life. The German study had a large number of participants, but the results were different than the other studies.

“Insert Table 1 Here”

Kalarchian et al. looked at the feasibility as well as the preliminary outcomes of a program focusing on childhood obesity with one of its main outcome focuses on health related quality of life (HRQoL). This study had 155 children and their parent/guardian. The parent and child would attend the sessions together over the six months with 24 sessions; a total and six of sessions were face to face. The focus of the treatment was the child, with emphasis on the parent to help support the child in the weight management. The overall sample experienced a significant percentage reduction in weight ($p=0.001$) after 6 months with 8% fewer children above the 99th percentile at 24 weeks and 10% fewer children were in obese category at 24 wks. With the pre-test child-report of HRQoL it was worse in healthy children and adolescents across multiple domains. At 6 months, the children experienced significant improvements in HRQoL. These improvements in HRQoL were greater in the younger group with $p<0.001$ compared to $p=0.03$, but were significant in both age groups. The children reported the biggest improvement in emotional functioning, whereas the

parents believed the biggest improvement in their child's HRQoL was in physical health. These findings show clinically significant outcomes, including improvements in weight status as well as HRQoL. (Foster et al., 2012)

Another study that was done in the United Kingdom (UK) used family base behavioral therapy (FBBT) with a socially diverse population. The children were randomized into the FBBT group or the control group. A pre and post assessments at 12 months was taken and it examined anthropometric measures as well as psychosocial measures. There were significant BMI changes and a significant reduction in systolic BP. There were improvements in QoL and eating attitudes, but they were not found to be significant. The FBBT group showed a significant reduction in systolic BP and improvements in QoL and eating attitudes with no significant change in the control group. No significant differences were found when the two groups were compared with independent t-tests or Mann-Whitney test (continuous variables) or chi-squared test (categorical variables). (Croker et al., 2012)

The lack of information pertaining to children's blood pressure and the impact on quality of life needs to be examined further. There are very few studies that specifically look at the two. With the increased risk of developing hypertension when overweight or obese, the impact on quality of life is still unknown. (Ogden et al., 1997) Since there is little information pertaining to children, much of the research examined adults. Jen-Chen Tsai et al. found a correlation in ages 20-60, that HRQoL is lower in hypertensive patients than normotensive. The reason behind this is still unknown. The question has been posed if it was because they were aware they had hypertension. (Tsai et al., 2004) (Spruill et al., 2013) This is the opposite of what was shown in adolescents in the German study. (Berendes et al., 2013)

A study conducted in a semi-rural area of western Turkey tried to determine the effects on the that hypertension among individuals aged 50 years and over can have. This was a population based cross sectional study on 1193 individuals. The HRQoL, BP were determined as well as a questionnaire determining health history, socio economic status and, demographics with face to face interview were taken. The BMI was also calculated. What they found was the HRQoL was worse in hypertensive patients than in normotensive in this study ($p \leq 0.001$). Again, in a different population and age range the opposite of what was found in the German adolescent study was discovered. (Berendes et al., 2013)

A study that looked specifically at QoL in hypertensive patients found very similar results to what Jen-Chen Tsai et al. found. This research design looked at people with hypertension that had complications and that had no complications. The hypertensive patients without hypertension had to have SBP greater than or equal to 140mmhg, and a DBP less than 110mmhg, either undergoing treatment or not getting treatment, and no target-organ damage. The hypertensive patients with complications had to have a DBP greater than or equal to 110 mm hg, also undergoing treatment or not, and had clinically marked target-organ damage. In the beginning of the study there was no significant difference between the two groups. They did find however, that normotensive patients had a significantly higher HRQoL in the functional capacity, bodily pain, and vitality domains and a change in one dimension for QoL can impact another dimension. (Garcia et al., 2004)

To determine if labeling someone with prehypertension could have an impact on their QoL, Tanya M Spruill et al. tried to determine if it is beneficial to their health and to their QoL.

Prehypertension was developed to try and help patients become more aware of their increased risk for hypertension. The question was discussed earlier if telling someone they are hypertensive automatically affects that person's perception of their quality of life. (Tsai et al., 2004) This study

tries to determine if it that holds some truth. There were two randomized groups; one of the groups were informed of their risk, but was not specifically told that they have prehypertension. The other group was told that they were at risk and is prehypertensive. Both groups were given the HRQoL questionnaires at baseline and 3 months. The results from this study showed that prehypertension labeling did not negatively affect patients. It did not negatively affect blood pressure or their QoL. (Spruill et al., 2013)

The final question assessed was to determine if there is a specific BP value for optimal quality of life. A study by Monika Zygmuntowicz et al. examined 11,498 white patients ages 18-65 and older than 65 years old. The 18-65 were called the “younger” group and the greater than 65 was the “older”. They all had to of been treated continuously for hypertension for at least 12 months. These participants HRQoL was assessed using the 12-Item Short Form Health Survey. They found that for SBP to be associated with an optimal physical component summary (PCS) in both the young and old group it needed to be 125 mm hg. For the mental component summary (MCS), it was 8 mm hg higher in the older group. The DBP associated with optimal PCS and MCS scores was 80 mm hg in the older group and 75 mm hg in the younger group. Ultimately, BP values associated with optimal HRQoL increase with the number of drugs. This reflects the severity of the disease, which proves that each person needs to be treated on an individual basis to help reach optimal HRQoL. (Zygmuntowicz, Owczarek, Elibol, Olszanecka-Glinianowicz, & Chudek, 2013)

Due to the increase in adolescent and pediatric obesity, there is also an increase in multiple health complications. Pediatric hypertension is one of the possible complications that can have detrimental effects. Hypertension in children and adolescents persist into adulthood and is a significant risk factor for CVD, which is the number one killer in the United States. The lack of research on children and adolescence blood pressure and its impact on QoL is a huge area that

needs more research. With very little data to examine in the adolescent population and the conflicting data between adolescents and adults, more research is greatly needed. Research done on the adult population has found that normotensive patients had a significantly higher HRQoL in the functional capacity, bodily pain, and vitality domains where as in a study on adolescent individuals with hypertension had significantly higher QoL compared to the normotensive adolescents. (Garcia et al., 2004)(Berendes et al., 2013) Studies have also found that prehypertension labeling did not negatively affect patients with their BP or their QoL, suggesting that earlier detection can still be used to help enforce a positive impact on an individual's health. (Spruill et al., 2013) When looking at this data it is important to remember that children and adolescents are different from adults and the more research we do on this population, the closer we can become in tackling a possible epidemic in the near future.

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Table 1. Comparison of BP and its Effect on HRQoL				
Study	Age Examined in Years	Number of Individuals	Improvement in BP or already Normotensive	Improvement in HRQoL
Helen Croker et al.	8-12 years of age	72	Yes	Yes
Angela Bernendes et al.	Ages 11-17	7688	No	No
Jen-Chen Tsai et al.	20-60 years of age	102	Yes	Yes
Josiane Lima de Gusmao et al.	54 ≥ 8years	77	Yes	Yes
Didem Arslantas, et al.	≥ 50 years of age	1193	Yes	Yes

Chapter IV

METHODOLOGY

This study is a pilot study for a childhood obesity prevention five year study using a CBPR approach with integration from Extension, research and education. Due to the purpose of the pilot study, which was to test the measurements, curriculum and feasibility of this study across five states, assessments at 0(T0) and 4(T1) months for child/adult dyads (49= dyads) were collected. The dyad is made up of a child and an adult that is the child's main preparer of food in the home. The design is a one-group, pre-, post- assessment study across Maine, Nebraska, South Dakota, Tennessee and West Virginia. Research teams, including Extension Agents, Students and Researchers, in all five states were trained by webinars and then conducting IRR with <0.5 probability. West Virginia was responsible for BP training. In each state, dyad pairs were recruited to participate in a 12 week, 6-session educational program designed to improve culinary skills, family mealtime and physical activity to include play time interaction from the development of a web-site and by giving a video camera to document this interaction. Youth were also able to create and share, on a secure study website, short teaching videos they developed to demonstrate their involvement in cooking, mealtime and activity at home or in their own community.

The pilot study inclusion criteria is that the participant could not have a life threatening illness, and seemingly healthy. Sabine et al looked at pediatric and youth in a multi-faceted education program to determine if it had a positive impact on hypertension. The inclusion for this study was the participant had to have uncontrolled office blood pressure measurements. (>160/95 or >140/90 mmHg) They did see a significant reduction in blood pressure but the fact that they had to have uncontrollable hypertension to begin with is like so many other studies. ³⁴ This sets iCook 4H out from many other studies because it is looking at otherwise healthy participants and trying to work

on behavior change with SCT in education to impact BP, BMI, and QoL. Results also indicated that participants BMI did not change significantly and with growing children, this is positive. The intervention contained 6 sessions every other week for a total of 12 weeks. Each session had a focus on a particular culinary skill, using a specific recipe and nutrient focus, and family engagement tasks such as setting the table or creating a menu and understanding physical activity and the importance of doing all these items together when possible. Table 2 represents the 6 sessions and there specific weekly focus. Fidelity was performed within multiple sessions to ensure timing was adequate and similar across the boards as well as assessments for the parent and child dyads given at the end of each session to help determine content.

Table 2. iCook4H Curriculum Session Overview for the Pilot Study

Session	Culinary Skills	PA Skills	Nutrient Focus	Family Engagement
1	Cool Cooks Tools	Goal Setting for eating and PA	Fruits and Vegetables: More Matters	Dinner Time Talk Strategies
2	Food Safety Basics	Stretching	The Whole Story on Whole Grains	Division of Responsibilities
3	The Art of Meal Planning	Healthy Downtime	Nutritious Beverages	Family-focused mealtime with controlled use of "screen time"
4	Grocery Shopping	Know Your Heart Rate	Focus on Healthy Fats	Improve family communication through daily food preparation
5	Eating Together	Active Play	Dairy Does It	Identifying games for the whole family
6	Spices and Seasoning	Building Strong Muscles	Power Protein	I love it, I like it, No thank you, Differences in taste

Recruitment involved selecting a convenience sample of family dyads of 9-10 year old youth and the primary adult meal preparer. In addition, to be eligible they need to be free from life-threatening illness or other conditions and/or activity-related medical restrictions that would prevent participation in a face-to-face nutrition and fitness program, and have regular access to computer with Internet connection. Potential participants were reached by sending fliers home with children before school ended for the summer. Informational emails were sent out to 4-H club

members as well as Home Schooled listings. Churches and 4-H camps were the last efforts for recruitment before the intervention began.

Participant incentives were a video camera for the child and \$100 total, distributed as \$10 gift cards for both child and adult at pre and post assessments (\$40), and \$60 in gift cards for the adults, distributed in \$10 increments at each of the six educational sessions. Participants must have attended the sessions to receive incentives. The researcher received training in human subjects research and all methods were approved by the Human Subjects Institutional Review Board for each participating state. IRR was established on a representative sample of 8-11 year olds until a $p\text{-value} > 0.8$ was established.

At each assessment period T0 and T1, the child completed two online surveys that included; Peds-QL, a 23-item questionnaire used to assess quality of life in the children.³⁵ (See Appendix C) This survey is validated for use in children between the ages of 5 and 17 years. Other survey items included Eating Habits, a 10-item subscale from Project EAT to assess eating habits, Family meal-time where children describe their family meal times using a 10-item questionnaire, Cooking Skills Measurement, a 6-item instrument designed to elicit a child's comfort level with specific cooking skills, and the Block Food and Activity Screener for Ages 2-17 that helps measure foods eaten last week. The survey also requested demographic information including state, age, school grade, gender, and race. Surveys were administered through Qualtrics, a survey tool used for creating and conducting surveys and through the nutrition block website.³⁶

Physical assessments were collected (see Appendix D) to include waist circumference which was measured with a gulick tape measure at the iliac crest to the nearest 0.1 centimeter. Height was measured with shoes off on a portable stadiometer to the nearest 0.1 centimeter. Weight was measured with a digital scale to the nearest 0.2 kilogram and physical activity was measured with a

gt3x accelerometer that was asked to be worn for seven days. Body mass index was calculated using height and weight.

The child's blood pressure was taken with the Omron HEM 907 XL Intellisense Prof. Digital BP monitor with an initial rest time of 5 minutes and 2 minutes of rest in between measurements.³⁷ An average of 3 measurements was then recorded. Using the National Heart, Lung, and Blood Institutes "Pocket Guide to Blood Pressure Measurement in Children" the BP classification was then recorded (see Appendix D). Procedures for taking blood pressure are those outlined from the CARDIAC Project Surveillance Intervention Research.²⁰

Data was analyzed using SAS 9.3³⁸ and REDCap³⁹. Frequencies were determined with demographics and measures (see Appendix C). Match paired t tests were done with SBP, DBP, BMI, and Peds-QL to determine if there were significant changes between pre and post assessment. The Pearson's correlation coefficient was used to determine if there were any correlations between BP and Peds-QL, and BMI and BP. A positive correlation was defined as 0.3 equal or greater and a negative correlation at -0.3 equal or less. Statistical significance was assigned at <0.05 level of probability.

CHAPTER V RESULTS

Youth participants (n=49) enrolled in the program and provided demographic and physical assessment measures. Table 3 shows demographic data of children with the majority being 10 years old (56%), female (65%), and white (61%).

Table 3 Demographics

Variable	Percent
State	
Maine	18%
Nebraska	18%
South Dakota	22%
Tennessee	18%
West Virginia	22%
Age (years)	
9	32%
10	56%
11-12	10%
Gender	
Male	34%
Female	65%
Race	
White	61%
African American	6%
Hispanic	13%
Native American	9%
Other	9%

Table 4 displays Pearson's correlation which was used to determine if there was a linear correlation between the different variables. BMI and SBP were significantly correlated as well as BMI and DBP.

Table 4 Pearson's Correlation

Correlated Variables	R (Baseline) p-value	R (Post) p-value
BMI vs. SBP	0.65 <0.0001	0.65* <0.001
BMI vs. DBP	0.57 <0.0001	0.43* 0.001<0.05
SBP vs. Peds- QoL	0.06 0.6934	-0.03 0.8495
DBP vs. Peds-QoL	-0.05 0.7335	-0.03 0.8477

Table 5 displays results from Matched Paired T Test and failed to reject the null in all but the Peds-QL with an alpha=0.05, t-value of -3.07 and p-value 0.0042.

Table 5 Match Paired T Test

Difference	t Value	P-value
SBP (pre) vs. (post)	0.29	0.7737
DBP (pre) vs. (post)	-0.25	0.8959
BMI (pre) vs. (post)	-0.48	0.6322
Peds-QoL (pre)vs.(post)	-3.07	0.0042*

Alpha= 0.05

CHAPTER VI

DISCUSSION

This study's findings support that the iCook4H 12 week 6 sessions intervention can have a positive impact on improving Peds-QL in youth ages 9-10. The results indicate that a program designed to educate youth in hopes of preventing obesity has a significant positive impact in physical, emotional, and social functioning. It is hypothesized that the classes offered a "group" feel and helped the youth feel more connected to others. This could be accounted to the social cognitive theory used in developing iCook4H curriculum, the "learn by doing" method. It could also be attributed to the relationship with the parent participating in the class and empowering the child through this partnership

The results from this study coincide with the result that Angela Bernendes et al. found when looking at 7,688 youth ages 11-17. Bernendes et al. found no correlation between BP and QoL. The tool used to measure QoL was KINDL-R which is different than the Peds-QL tool used in iCook4H but is comparable. They also found that those who were hypertensive had better quality of life scores in better well-being and low distress. This is the opposite of what one would think but they suggest this could be due to repressed emotions which resulted in elevated blood pressure. Garcia et al was another study that did not have an intervention, but measured QUL and BP in Brazil. They found that high SBP and DBP were significantly higher in children with bad QUL. This study is different from iCook4H because it did not have an intervention; it was solely trying to determine if there is a correlation between BP and QoL in youth.²⁷

Croker et al. was similar to iCook4H in the fact that it did have an intervention between measurements and also used Peds-QL tool to measure QoL in their participants. Croker et al. looked at 72 overweight and obese youth ages 8-12 and found an improvement in BP as well as

an improvement in QoL.²⁹ The main difference in this intervention is that they intentionally recruited children classified overweight where as iCook4H did not narrow their recruitment to a specific classification. Studies looking at BP and QoL in youth are very limited and have resulted in conflicting data. Another study that used FBBT in their intervention saw a significant reduction in systolic BP and improvements in QoL but they recruited adolescents classified as overweight or obese as well. The FBBT asked that the child and guardian attend classes together similar to iCook4H.²⁹ Since there is limited research on quality of life in apparently healthy individuals participating in an intervention more research is needed in this area.

Harvard's School of Public Health states that "as BMI increases, so do blood pressure, LDL, triglycerides, blood sugar, and inflammation."⁴⁰ There was no correlation found between BP and QoL so a Pearson's correlation was run between BMI and BP to ensure data is consistent to previous findings. BP and BMI were found to positively correlate. This is similar to what McNeice et al found in their study looking at 6790 adolescents (11-17 years) in Houston schools.¹¹ Pre-hypertension, stage 1 hypertension, and stage 2 hypertension all showed a statistically significant trend for increasing prevalence with increasing BMI percentile.¹¹

Blood pressure measures from pre to post assessment had no significant change, however normal BP went from 92.5% to 90.1% yet Pre-Hypertension went from 5.7% to 9.1%. The cause of this increase is unknown, but the number of measurements went from 53 to 55 which had some impact on this increase. . Unlike iCook4H's obesity prevention intervention, Kalarchian et al did an obesity treatment intervention where they found that BP decreased significantly after the intervention. The difference in results between this and iCook4H could be attributed to the target population for recruitment (obese vs. apparently healthy) respectively. Many studies done with youth and blood pressure are fairly new in the health population. This is because youth weren't

previously at such an increased risk of developing hypertension. Due to the rise in obesity, hypertension is increasing as a secondary disease and needs to be monitored for adequate treatment and prevention. McNeice et al. found that approximately 20% of adolescents are at risk for hypertension which stresses the importance of more research in this particular field.¹¹

Limitations

This was a pilot study with no control group using a convenience sample of the target population. The purpose it served was large for the understanding of the measures, curriculum effectiveness, feasibility and fidelity. The small participant sample size was small across all state partners therefore its intention was not to measure significant and the researchers realized statistical power was lacking in this pilot study.

Chapter VII

CONCLUSION

Due to the increasing rise in adolescent and pediatric obesity, there is an increase in multiple health complications. Pediatric hypertension is one of the possible complications that can have detrimental effects. Hypertension in children and adolescents persist into adulthood and is a significant risk factor for CVD which is the number one killer in the United States. With the pilot iCook4H study there was no significant change in BP or BMI from pre to post assessment. There was also not a correlation found between BP and Peds-QL however there was a positive correlation found between BMI and BP which is consistent to previous findings in the literature. Lastly, there was a significant improvement in Peds-QL from pre to post assessment.

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APPENDICIES

Appendix A

Institutional Review Board Approval and Consent/Assent and Information Form

WVU IRB Approved Protocol H-24315 Title: iCook Childhood Obesity Prevention Study using Culinary Skills and Family Conversation Time in 9-10 year olds

The 45 page document including consent/assent can be found in the BRAAN 2 system with the tracking number H-24315.

Appendix B
Peds Quality of Life Inventory Survey

Appendix C

Youth Demographics

- When is your birthday?
- What grade are you in school?
- Are you a boy or a girl?
- What is your race?
 - White
 - Black
 - Asian
 - Hispanic
 - Native American
 - Other

Appendix D

Anthropometric, Blood Pressure and Body Composition Measures

General Study Procedures

- All scales must be calibrated prior to use and calibrated periodically during measurement.
- Each anthropometric measurement must be taken at least twice and recorded immediately (consider having a recorder available to facilitate this process and reduce errors).
- Each measurement must be entered into the online database. It is recommended that this be done either during or at the end of each day of measurement.
- An independent observer must verify that the data recorded on the NRI data recording sheet (Appendix) and the data recorded in the Excel database are the same. This observer should initial both copies, verifying that the data are correct. Corrections need to be noted under comments.
- Be mindful of the units of measurement used. For example, if the balance beam scale has both metric and English measures, assessors must be clear about which notch on the beam goes with which type of measure—metric should be used.
- All height and weight data must be reported in metric units: centimeters and kilograms, respectively. Waist circumference will be recorded in centimeters.

Weight Assessment

Body weight is the most common anthropometric measurement used, and has the advantages that it is safe, non-invasive, and inexpensive. Weight measurement is easy to train to unskilled people, and weight reflects past changes and assesses growth and can be used to identify malnutrition. Weight should be the 1st assessment conducted during the assessment appointment.

Required Item(s) for Weight Assessment

- Digital scale
- Standardized weights for calibration
- Stool or chair to allow participant to remove shoes and socks
- Extra t-shirts and shorts available, if needed
- Nearby restroom facilities

Figure 1. Digital Scale

Important Notes

- Due to natural weight fluctuations that occur during the day, it is desirable to weigh the participant at the same time of day (within 2 hours) for each assessment.
- To measure weight accurately, scales should be recalibrated on a regular basis and each time a scale is moved to a different location. Please review your scale manual for proper calibration techniques or contact an appropriate representative.
- The current recommendations for taking weight are to have the participant facing away from the balance beam or digital readout to reduce panicking and moving their hands and body.
- Educate your staff about the importance of not commenting on the participant's weight and not responding if the participant does comment. Staff can say, for example, "thank you for helping us with this measurement."
- **Please ensure the same scale is used for all weight measurements.**

Weight Assessment Protocol

1. Zero the scale. Balance beam scales must be level prior to weighing the participant. The scale must be on a hard, flat surface, not on carpet.
2. Ask participants to empty their bladder prior to being weighed. This is required of all participants.
3. Ask participants to remove excess clothing, shoes, and socks prior to being weighed.
4. Ask the participant step up onto scale fully. Staff must make sure that both feet are completely on the scale.

Figure 2. Feet placement on scale.

5. Ask the participant stand completely still with arms at sides and eyes looking straight ahead.
6. Record weight to the nearest 0.1 kg on the data collection sheet.
7. Repeat measurement. If there is > 0.2 kg difference between measurements, repeat until two measurements are within 0.2 kg. These two agreeing measurements will be the official measurements.
8. Record all measurements on NRI data collection sheet. Be sure to cross out any unofficial measurements (i.e. those discarded due to excess disagreement).
9. Record the average of the two official measurements to two decimal places (e.g., $0.2 + 0.3 = 0.5/2 = 0.25$).

Height Assessment

The measurement of height is also one of the most fundamental and easily obtained measurements. It is measured using a wall-mounted stadiometer, assuming the person is able to stand unassisted. Height should be the 2nd assessment conducted during the assessment appointment.

Required Item(s) for Height Assessment

- SECA 213 Portable Stadiometer

- Step stool or chair

Important Notes

- Be sure that the stadiometer is located in a non-carpeted area.
- For obese participants, it can sometimes be difficult to have four points of contact with the vertical backboard or wall (see Step 4 below). In this case, it is important to have as many contact points as possible (at least two), making sure the subject is looking straight ahead.

Figure 3: Frankfurt Plane

Height Assessment Protocol

1. Ask the participant to remove shoes.
2. Ask the participant to remove hair ornaments, buns, or barrettes that prevent the participant from placing his/her head against the back of the stadiometer.
3. Ask the participant to step completely under the slide of the stadiometer, making sure that the subject is centered with the stadiometer.
4. Ask the participant to stand as straight as possible with feet together and heels, buttock, shoulder blades, and back of head completely touching the wall (or as much as possible). This four-point contact will ensure that body weight is evenly distributed.
5. Be sure that the subject is looking straight ahead and that there is a horizontal plane from the bony socket of the eye to the notch above the projection of the ear.
6. Make sure the black stopper at the top of the stadiometer is pressed against the wall.
7. Ask the participant to take a deep breath in and hold it to straighten the spine and standardize measurement.
8. When the subject inhales, move the height slide to rest lightly on top of the participant's head.
9. Fix the height slide in place and ask the participant to resume normal breathing.
10. Record height to the nearest 0.1 centimeter on the data collection sheet. Be sure to avoid parallax (angular distortion) by bending down, kneeling or standing on a stool and reading the height value at eye level.

Figure 4:
Stadiometer setup

11. Repeat measurement. If there is > 0.2 centimeter difference between measurements, repeat until two measurements are within 0.2 centimeter. These two agreeing measurements will be the official measurements.
12. Record all measurements on the data collection sheet. Be sure to cross out any unofficial measurements (i.e. those discarded due to excess disagreement).
13. Record the average of the two official measurements to two decimal places (e.g., $0.2 + 0.3 = 0.5/2 = 0.25$).

Waist Circumference Assessment

A person's waist circumference is the most practical indicator of fat distribution and abdominal fat. It is often used in combination with BMI in the assessment of obesity. Waist Circumference should be the 3rd assessment to be conducted during the assessment appointment.

Required Item(s) for Waist Circumference Assessment

- Gulick tape measure
- Washable marker

Important Notes

- Measurement of waist circumference may be uncomfortable to some individuals because they are exposing their bellies. Be sure measurements are conducted in a relatively private or screened-off area.
- Two people should work together to take this measurement, if possible, to ensure the tape is in a level horizontal plane and not twisted. A mirror or two corner mirrors are useful in making sure the tape is level.
- If an individual has a large abdominal fat mass, this measurement can be difficult. You must palpate the hip area until you feel the iliac crest.

Waist Circumference Assessment Protocol

1. Ask the participant to adjust his/her shorts or pants to a level just below the top of the hip bones and to raise his/her shirt to just above the umbilicus (belly button).
2. Locate and mark *both* iliac crests with a non-permanent marker. The iliac crests are the tops of the hip bones (see Figure 6).

Figure 6. Waist circumference at the iliac crest.

3. Place the tape measure around the waist of the participant at the level of the marked iliac crests making sure that the tape is in a horizontal plane and not twisted.
4. Ask the participant to exhale to ensure that they are not holding in their belly.

5. Upon the exhale, gently tighten the tape without compressing the skin.
6. Record the measurement to the nearest 0.1 cm on the data collection sheet.
7. Repeat measurement. If there is > 0.5 cm difference between measurements, repeat until two measurements are within 0.5 cm. These two agreeing measurements will be the official measurements.
8. Record all measurements on the data collection sheet. Be sure to cross out any unofficial measurements (i.e. those discarded due to excess disagreement).
9. Record the average of the two official measurements to one decimal place (e.g., $2 + 3 = 5/2 = 2.5$).

Tanner Staging Assessment

Tanner staging maturation level will be completed in a private setting. A line drawing of male anatomy is shown to males and a line drawing of female anatomy will be shown to females. The child points at the appropriate stage of maturation and the iCook-4H study team will document the response on a data collection form. Male researchers will ask male children and female researchers will ask female children. If this is not possible, an older female researcher will ask the question. This survey is required to appropriately classify the child when reporting maturation level and for determining correlations with the child's physical measurement and blood pressure.

Blood Pressure Assessment

Blood pressure should be the 4th assessment to be conducted during the assessment appointment.

Important Information

This procedure needs to take place in a relatively quiet location. The participant should be as still as possible during the readings.

Required Item(s) for Blood Pressure Assessment

1. 2 Omron HEM 907 XL Intellisense Prof. Digital BP monitor

Blood Pressure Assessment Protocol

1. Child should be sitting with arm resting on the table at heart level.
2. Avoid placing the cuff over clothing or a rolled up sleeve that might constrict the arm.
3. Make sure the cuff is the appropriated size
 - a. Cuff width should be $\frac{1}{2}$ to $\frac{2}{3}$ the upper arm length.
4. Palpate for the brachial artery pulse point
 - a. Found in the antecubital space on the little finger side of the palme-up extended arm.
 - b. Gently hyperextending the arm might make this easier to find.
5. Center the bladder over the brachial artery with the lowest edge 2.5 cm above the antecubital space.
6. Obtain palpated systolic pressure and at 30 mmHg
7. Deflate rapidly and wait 30 seconds before reinflating
8. Apply bell head making a light but airtight seal over the palpable artery. The diaphragm end may be adequate, but the bell is preferable and may help block ambient noise.
9. Inflate rapidly to level determined in step 6.
10. Release pressure 2-3 mmHg/sec. (slowly).

11. Listen for onset of 2 consecutive beats, Korotkoff Phase 1, = systolic pressure.
12. Listen for the absence of sound, Korotkoff Phase 5, = diastolic pressure.
13. Deflate cuff and remove. Record reading.

Body Mass Index (BMI)

BMI is an index used as a screening tool to help determine an individual's risk for health problems related to too little or too much body fat. It is a mathematical calculation of the ratio between height and weight and is not a direct measure of body fat. The index is the same for men and women. Note that baseline BMI < 18.5 is an exclusionary criterion for this study.

Table

BMI	Risk for Health Problems
< 18.5	Increased risk
18.5 - 24.9	Lowest risk
25.0 - 29.9	Low risk unless waist circumference is high which slightly elevates risk
30 - 39.9	Increased risk
> 40.0	Higher risk

If BMI is below 18.5 or above 30, one may be at increased risk for health related problems. BMI below 18.5 can be indicative of malnutrition due to low calorie and protein intake, which results in low body muscle and fat (please note that persons with BMI < 18.5 are not eligible to participate in the study). BMI above 30 may increase risk for developing conditions such as diabetes and high cholesterol. A high BMI is not necessarily indicative of risk for individuals with a lot of muscle mass, such as athletes because BMI will reflect muscularity rather than fatness for these individuals.

Waist Circumference

BMI is just one indicator of potential health risks associated with being overweight or obese. The National Heart, Lung, and Blood Institute guidelines also recommend measuring waist circumference because abdominal fat is an independent predictor of risk for obesity-related diseases.

Waist circumference is a common measure used to assess fat around one's waist (abdomen). The presence of excess body fat within the abdomen is considered a risk factor for health problems like diabetes. There are different waist circumference risk cut-points for men and women (see table below). Dietary patterns including whole grains, fruits, and vegetables and physically activity are recommended to minimize health risk.

Sex	Waist Circumference
Male	>102 cm (40 inches)
Female	>88 cm (35 inches)

Interobserver Error Procedure

Purpose

- To assess the degree of variation due to measurement error

Requirements

- At least 5 subjects to be measured
- One expert
- One or more observers
- Data record sheets (example in Appendix)
- Excel file “Height”, “Weight”, and “Waist”

Procedure

1. The expert and all the observers measure height, weight, and waist circumference of all the subjects twice.
2. Record the data immediately on data collection sheet
3. Enter the data into the Excel worksheet “Measurement” (it will automatically calculate the Pearson’s correlations between expert and observers, and the error in the worksheet “Evaluation” in the same Excel file).

Statistical note (Lohman, 1981):

x_i = measures by expert (average of three measurements)

y_i = measures by observer 1 (average of three measurements)

$\bar{X}$ = mean of x_i

$\bar{Y}$ = mean of y_i

S_x = Standard deviation of expert

S_y = Standard deviation of observer 1

$$\text{Pearson's } r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{(n - 1)(S_x)(S_y)}$$

$$S_{\text{pooled}} = \frac{\sqrt{[(S_x)^2 + (S_y)^2]}}{\sqrt{2}}$$

$$\text{Inter observer error} = \frac{S_{\text{pooled}} \sqrt{(1 - r^2)}}{\sqrt{2}}$$

Evaluation

Pearson's r ranges from -1 to $+1$. The closer the Pearson's r to 1 , the higher the correlation of the observer's measurement with the expert's.

Inter-observer error tells how an observer's measurements differ from an expert's. The unit of inter-observer error is the same as the measurement (inch for height, pound for weight, and centimeter for waist circumference).

Physical Assessment Procedure

1. Review Sample Hard Copy of Informed Consent and Assent Forms

2. Before you conduct the physical assessment, review a hard copy of the state-specific informed consent with adult and child and have adult sign the informed consent form. Prior to conducting the assessments, confirm the form you are to use with your PI.
 - a. If adult does not agree to sign the form, thank them for their time, let them know they are ineligible for the study, and follow your state protocol for providing the incentive.
 - b. If planning to take pictures of participants, have them sign the standard university photo release form.
 - c. Build rapport with the participant during this assessment period.
 - d. Keep the signed copy for state records

3. Complete iCook-4H Project Data Collection Form

- a. Check to see that participants have appropriate clothing for the physical assessment. If not, please ask them to change into the clean, light clothing that you have available (i.e. t-shirt and gym shorts).
- b. Fill in the contact information on the top part of the Data Collection Form.
- c. Conduct the physical assessments. You will need to do two measurements of height, weight, waist circumference, and blood pressure and then average the two measurements. See details in the Physical Assessment Manual.
- d. Provide Primary Care Prover Referral (Appendix E) to the following participants.

Baseline Assessment:

- Participants at who have low body mass indices (i.e. $BMI < 18.5$). Student is considered ineligible for the study.

3 Month Assessment, 12 Month, or 24 Month Assessment:

- Participants who have low body mass indices
 - Participants who have risky behaviors
 - Participants who have had at least 10% weight change between assessments
- e. Provide student with incentive using state protocols. Make sure you have them sign that they received it on the Data Collection Form. Each campus coordinator may want to keep a spreadsheet of names, ID numbers and record of compensation for all participants.
 - f. Enter data and contact information (address and phone number) from the Data Collection Form into the iCook-4H website *immediately* after each physical assessment.

4. Enter Physical Assessment Data

- a. Log-on to the website (www.icook4h.com) with your user name and password.
- b. Click on People
- c. Select Participant

d. Enter information in appropriate text box.

5. Securely Store Data Collection Forms

- a. After the physical assessment and/or entering physical assessment data, file the Data Collection Form in a secure location such as in a locked file cabinet.
- b. Once you have completed all baseline, post intervention, and 15 month assessments, send a photocopy of page 2 of each participant's Data Collection Form and mail to Douglas Mathews at Department of Food Science and Human Nutrition 5735 Hitchner Hall Orono, ME 04469.

6. Verify Participant Data

The campus coordinator must designate a person (other than the one who entered the data) to verify the accuracy of each participant's data. Verification is done by checking the data against the Data Collection Form.

Appendix E

A Pocket Guide to BP Measurement in Children

Measurement

- Begin routine blood pressure (BP) measurement at 3 years of age.
- Correct cuff size depends on arm size. Practically speaking, correct cuff size equals largest cuff that will fit on the upper arm with room below for the stethoscope head.
- BP should be measured in the right arm of a relaxed, seated child.
- BP measurement by auscultation is the Gold Standard.
- BP by automated device correlates reasonably well with auscultation, with practical advantages of rapid measurement remote from child and elimination of reader error.
- If BP is high by automated device, repeat by auscultation.

BP Classification/Interpretation

BP is classified by systolic BP (SBP) and diastolic BP (DBP) percentiles for age/sex/height. If SBP or DBP >90th percentile, repeat twice at same office visit before interpreting result.

Normal BP: SBP and DBP <90th percentile

- Recheck in 1 year

Prehypertension: SBP or DBP ≥ 90th percentile to <95th percentile or BP >120/80 mmHg to <95th percentile

- Recheck in 6 months

Stage 1 Hypertension (HTN): SBP and/or DBP ≥ 95th percentile to ≤ 99th percentile plus 5 mmHg

- Recheck in 1 to 2 weeks

- If BP remains at this level on recheck, begin evaluation and treatment including weight management if appropriate.

Stage 2 HTN: SBP and/or DBP >99th percentile plus 5 mmHg

- Begin evaluation and treatment within 1 week, immediately if symptomatic.

Systolic BP Percentile Tables

Since diastolic HTN rarely occurs without systolic HTN in children, the SBP percentile tables on the next page can be used for HTN screening. If a child's SBP on screening is classified as prehypertension or HTN, then both SBP and DBP percentiles should be determined using the tables in the complete report: The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents. *Pediatrics* 2004; 114(4 Suppl 2):555-76, or http://www.nhlbi.nih.gov/health/prof/heart/hbp/hbp_gnd.htm.

Directions for Use of Tables

1. Heights in the table are given for age at midyear. Use closest height to interpret BP.

2. **Prehypertension:** SBP ≥ value from table (90th percentile) to < Stage 1 HTN value, or SBP >120 mmHg to < Stage 1 HTN value.

Stage 1 HTN: SBP ≥ value from the table (95th percentile) to ≤ Stage 2 HTN.

Stage 2 HTN: SBP > value from table (99th percentile plus 5 mmHg).

For more information go to: www.nhlbi.nih.gov

Boys: SBP by Age and Height
(Normal SBP is less than the prehypertensive result.)

Age	BP Classification	Systolic BP (mmHg)									
3	Height (cm)	92	94	96	98	100	102	104	106	108	110
3	Height (cm)	100	101	102	103	104	105	106	107	108	109
	Prehypertension (Stage 1 HTN)	104	105	107	109	110	111	112	113	114	115
	Stage 1 HTN	118	117	118	121	123	125	126	127	128	129
	Stage 2 HTN	122	123	124	127	129	131	133	135	137	139
4	Height (cm)	99	100	102	104	106	108	110	112	114	116
	Prehypertension (Stage 1 HTN)	105	107	109	111	113	115	117	119	121	123
	Stage 1 HTN	120	121	123	125	127	129	131	133	135	137
	Stage 2 HTN	124	125	127	129	131	133	135	137	139	141
5	Height (cm)	104	106	108	110	112	114	116	118	120	122
	Prehypertension (Stage 1 HTN)	110	112	114	116	118	120	122	124	126	128
	Stage 1 HTN	125	126	128	130	132	134	136	138	140	142
	Stage 2 HTN	129	130	132	134	136	138	140	142	144	146
6	Height (cm)	109	111	113	115	117	119	121	123	125	127
	Prehypertension (Stage 1 HTN)	115	117	119	121	123	125	127	129	131	133
	Stage 1 HTN	130	131	133	135	137	139	141	143	145	147
	Stage 2 HTN	134	135	137	139	141	143	145	147	149	151
7	Height (cm)	114	116	118	120	122	124	126	128	130	132
	Prehypertension (Stage 1 HTN)	120	122	124	126	128	130	132	134	136	138
	Stage 1 HTN	135	136	138	140	142	144	146	148	150	152
	Stage 2 HTN	139	140	142	144	146	148	150	152	154	156
8	Height (cm)	119	121	123	125	127	129	131	133	135	137
	Prehypertension (Stage 1 HTN)	125	127	129	131	133	135	137	139	141	143
	Stage 1 HTN	140	141	143	145	147	149	151	153	155	157
	Stage 2 HTN	144	145	147	149	151	153	155	157	159	161
9	Height (cm)	124	126	128	130	132	134	136	138	140	142
	Prehypertension (Stage 1 HTN)	130	132	134	136	138	140	142	144	146	148
	Stage 1 HTN	145	146	148	150	152	154	156	158	160	162
	Stage 2 HTN	149	150	152	154	156	158	160	162	164	166
10	Height (cm)	129	131	133	135	137	139	141	143	145	147
	Prehypertension (Stage 1 HTN)	135	137	139	141	143	145	147	149	151	153
	Stage 1 HTN	150	151	153	155	157	159	161	163	165	167
	Stage 2 HTN	154	155	157	159	161	163	165	167	169	171
11	Height (cm)	134	136	138	140	142	144	146	148	150	152
	Prehypertension (Stage 1 HTN)	140	142	144	146	148	150	152	154	156	158
	Stage 1 HTN	155	156	158	160	162	164	166	168	170	172
	Stage 2 HTN	159	160	162	164	166	168	170	172	174	176
12	Height (cm)	139	141	143	145	147	149	151	153	155	157
	Prehypertension (Stage 1 HTN)	145	147	149	151	153	155	157	159	161	163
	Stage 1 HTN	160	161	163	165	167	169	171	173	175	177
	Stage 2 HTN	164	165	167	169	171	173	175	177	179	181
13	Height (cm)	144	146	148	150	152	154	156	158	160	162
	Prehypertension (Stage 1 HTN)	150	152	154	156	158	160	162	164	166	168
	Stage 1 HTN	165	166	168	170	172	174	176	178	180	182
	Stage 2 HTN	169	170	172	174	176	178	180	182	184	186
14	Height (cm)	149	151	153	155	157	159	161	163	165	167
	Prehypertension (Stage 1 HTN)	155	157	159	161	163	165	167	169	171	173
	Stage 1 HTN	170	171	173	175	177	179	181	183	185	187
	Stage 2 HTN	174	175	177	179	181	183	185	187	189	191
15	Height (cm)	154	156	158	160	162	164	166	168	170	172
	Prehypertension (Stage 1 HTN)	160	162	164	166	168	170	172	174	176	178
	Stage 1 HTN	175	176	178	180	182	184	186	188	190	192
	Stage 2 HTN	179	180	182	184	186	188	190	192	194	196
16	Height (cm)	159	161	163	165	167	169	171	173	175	177
	Prehypertension (Stage 1 HTN)	165	167	169	171	173	175	177	179	181	183
	Stage 1 HTN	180	181	183	185	187	189	191	193	195	197
	Stage 2 HTN	184	185	187	189	191	193	195	197	199	201
17	Height (cm)	164	166	168	170	172	174	176	178	180	182
	Prehypertension (Stage 1 HTN)	170	172	174	176	178	180	182	184	186	188
	Stage 1 HTN	185	186	188	190	192	194	196	198	200	202
	Stage 2 HTN	189	190	192	194	196	198	200	202	204	206

Girls: SBP by Age and Height
(Normal SBP is less than the prehypertensive result.)

Age	BP Classification	Systolic BP (mmHg)									
3	Height (cm)	91	92	93	94	95	96	97	98	99	100
	Prehypertension (Stage 1 HTN)	100	100	102	103	104	104	106	106	108	108
	Stage 1 HTN	104	104	105	107	107	108	109	110	111	112
	Stage 2 HTN	110	110	111	112	112	113	114	115	116	117
4	Height (cm)	97	98	99	100	101	102	103	104	105	106
	Prehypertension (Stage 1 HTN)	103	103	105	106	107	108	109	110	111	112
	Stage 1 HTN	107	107	108	110	111	111	112	113	114	115
	Stage 2 HTN	113	113	114	115	116	117	118	119	120	121
5	Height (cm)	104	105	106	107	108	109	110	111	112	113
	Prehypertension (Stage 1 HTN)	109	109	111	112	113	114	115	116	117	118
	Stage 1 HTN	113	113	114	116	117	118	119	120	121	122
	Stage 2 HTN	119	119	120	121	122	123	124	125	126	127
6	Height (cm)	110	112	113	114	115	116	117	118	119	120
	Prehypertension (Stage 1 HTN)	116	116	118	119	120	121	122	123	124	125
	Stage 1 HTN	120	120	121	123	124	125	126	127	128	129
	Stage 2 HTN	126	126	127	128	129	130	131	132	133	134
7	Height (cm)	116	118	119	120	121	122	123	124	125	126
	Prehypertension (Stage 1 HTN)	122	122	124	125	126	127	128	129	130	131
	Stage 1 HTN	126	126	127	129	130	131	132	133	134	135
	Stage 2 HTN	132	132	133	135	136	137	138	139	140	141
8	Height (cm)	121	123	124	125	126	127	128	129	130	131
	Prehypertension (Stage 1 HTN)	128	128	130	131	132	133	134	135	136	137
	Stage 1 HTN	132	132	133	135	136	137	138	139	140	141
	Stage 2 HTN	138	138	139	141	142	143	144	145	146	147
9	Height (cm)	126	128	129	130	131	132	133	134	135	136
	Prehypertension (Stage 1 HTN)	133	133	135	136	137	138	139	140	141	142
	Stage 1 HTN	137	137	138	140	141	142	143	144	145	146
	Stage 2 HTN	143	143	144	146	147	148	149	150	151	152
10	Height (cm)	131	133	134	135	136	137	138	139	140	141
	Prehypertension (Stage 1 HTN)	138	138	140	141	142	143	144	145	146	147
	Stage 1 HTN	142	142	143	145	146	147	148	149	150	151
	Stage 2 HTN	148	148	149	151	152	153	154	155	156	157
11	Height (cm)	136	138	139	140	141	142	143	144	145	146
	Prehypertension (Stage 1 HTN)	143	143	145	146	147	148	149	150	151	152
	Stage 1 HTN	147	147	148	150	151	152	153	154	155	156
	Stage 2 HTN	153	153	154	156	157	158	159	160	161	162
12	Height (cm)	141	143	144	145	146	147	148	149	150	151
	Prehypertension (Stage 1 HTN)	148	148	150	151	152	153	154	155	156	157
	Stage 1 HTN	152	152	153	155	156	157	158	159	160	161
	Stage 2 HTN	158	158	159	161	162	163	164	165	166	167
13	Height (cm)	146	148	149	150	151	152	153	154	155	156
	Prehypertension (Stage 1 HTN)	153	153	155	156	157	158	159	160	161	162
	Stage 1 HTN	157	157	158	160	161	162	163	164	165	166
	Stage 2 HTN	163	163	164	166	167	168	169	170	171	172
14	Height (cm)	151	153	154	155	156	157	158	159	160	161
	Prehypertension (Stage 1 HTN)	158	158	160	161	162	163	164	165	166	167
	Stage 1 HTN	162	162	163	165	166	167	168	169	170	171
	Stage 2 HTN	168	168	169	171	172	173	174	175	176	177
15	Height (cm)	156	158	159	160	161	162	163	164	165	166
	Prehypertension (Stage 1 HTN)	163	163	165	166	167	168	169	170	171	172
	Stage 1 HTN	167	167	168	170	171	172	173	174	175	176
	Stage 2 HTN	173	173	174	176	177	178	179	180	181	182
16	Height (cm)	161	163	164	165	166	167	168	169	170	171
	Prehypertension (Stage 1 HTN)	168	168	170	171	172	173	174	175	176	177
	Stage 1 HTN	172	172	173	175	176	177	178	179	180	181
	Stage 2 HTN	178	178	179	181	182	183	184	185	186	187
17	Height (cm)	166	168	169	170	171	172	173	174	175	176
	Prehypertension (Stage 1 HTN)	173	173	175	176	177	178	179	180	181	182
	Stage 1 HTN	177	177	178	180	181	182	183	184	185	186
	Stage 2 HTN	183	183	184	186	187	188	189	190	191	192