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The Effect of iCook 4-H, a Childhood Obesity Prevention Program, on Blood Pressure and Quality of Life in Youth and Adults: A Randomized Control Trial

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Abstract

Objective: Obesity increases the risk of developing hypertension and from population-based samples with estimations that of 2-4% of the U.S. pediatric population has hypertension, which may affect quality of life. This study examined the effects of an obesity prevention program on blood pressure and quality of life in youth and adult participants.

Methods: A multi-state research team recruited treatment dyads (youth and their adult meal preparer) to participate in a 12-week randomized control trial and follow-up through 24 months. The treatment group received a cooking and physical activity intervention, followed by booster sessions and mailed newsletters over the remaining two-year period. The control group received no intervention. Resting blood pressure and health related quality of life (HRQOL) surveys were administered at 0,4,12 and 24 months.

Results: 228 dyads were recruited (n=77 control and n=151 for treatment). Youth and adult systolic blood pressure (SBP) increased over the 24 months (p=0.003 and p=0.03, respectively) with no differences between groups. From baseline to 24 months both control and treatment youths' physical and psychological HRQOL increased (p=0.01 and p=0.002, respectively). At 0 and 4 months, youth and adult SBP was positively correlated (r=0.24, p=0.003 and r=0.33, p<0.001, respectively). In the treatment group, there was an inverse association between adult SBP and youth psychological HRQOL at 4 months (r=-0.20, p=0.04), and a similar trend in adult SBP and youth physical HRQOL at 4 months in the treatment group (r=-0.19, p=0.05).

Conclusion: A youth-adult dyad obesity prevention program consisting of culinary, mealtime and physical activity education, elicited improvements in HRQOL in youth participants.

Keywords: Blood pressure; Youth; Quality of life; Obesity; Nutrition; Exercise; Hypertension

Introduction

As of 2014, 17.5% of youth 6-11 years old are classified as obese [1]. In addition to obesity, hypertension has also undergone an epidemiological shift [2] and is an important risk factor in cardiovascular disease (CVD) [3]. Previously, childhood hypertension was mainly observed in those with renal disease, but it is now often identified in apparently healthy, obese youth [2]. From several population-based samples it is estimated that 2-4% of the US pediatric population has hypertension and up to 10% are categorized as pre-hypertensive [4], which, if left unreported or untreated, has been shown to persist into adulthood. With the increasing rates of childhood obesity and hypertension, interventions that can modify both and are targeted towards children are necessary.

As childhood obesity increases, health professionals concern for the wellbeing of youth rises. Indeed, investigators have examined the impact of obesity on health related quality of life (HRQOL) [5], including how disease/health status affects physical and mental health [6]. Evidence has shown that HRQOL is lower in adults with hypertension compared with normotensive peers [7,8]. However, diastolic blood pressure (DBP) is inversely associated with well-being, suggesting that reductions in diastolic blood pressure could improve overall well-being [9]. However, this does not seem to be the case for younger populations. Compared with normotensive peers, hypertensive adolescents had significantly higher HRQOL in family life, self-esteem, and physical well-being. Authors of these findings speculated that adolescents may be more focused on reaching particular goals that could increase self-esteem and HRQOL, but result in higher blood pressure and stress [10]. With the conflicting and limited data presented, more research is needed to conclude the impact of hypertension on the pediatric population and their HRQOL.

Currently, few studies that have examined the impact of childhood obesity prevention program on hypertension and children's perception of QOL. Evidence-based lifestyle programs that encourage dietary changes, physical activity, and moderate weight loss for children recommend the inclusion of both youth and adults [11]. Childhood obesity intervention programs are most successful when parents were directly engaged in the intervention process [12,13]. Caregivers model and reinforce eating and physical activity behaviors, regulate the amounts and type of food available in the home, and reinforce behaviors by creating and reinforcing rules [14]. Indeed, the most nutritionally adjusted children are raised in households where feeding style is characterized by parents setting appropriate boundaries while still including the child in food-related decisions [15,16]. The impact of adults participating in childhood obesity interventions cannot be overstated because children model adult eating and physical activity habits; therefore, the inclusion of a youth and adult dyad is critical in childhood obesity prevention programs. However, few studies have put these suggestions into practice and examined the effects on blood pressure and HRQOL in both participants. Therefore, the objective of the present study was to investigate the effects of a 2-year obesity prevention program intervention in youth and their primary adult meal preparer (dyads) on blood pressure and HRQOL.

Methods

Study design

A randomized, controlled intervention study was conducted over two years in five states (Maine, Nebraska, Tennessee, South Dakota, and West Virginia) with a convenience sample of interested youth and their primary adult meal preparer. These five states allowed for a geographically diverse representative sample and the universities were selected based on their status as a land-grant institution and successful collaboration between researchers, extension specialists, community members, and stakeholders. This group is part of a land-grant university multistate research team who has been conducting USDA funded projects since 2001. This particular groups of 5 states was interested in the USDA childhood obesity grants.

Recruitment goal was set at 274 based on an a priori power analysis for the primary outcome variable BMI of 9-10-year-old youth at 24 months. Previous literature shows BMI changes in behavioral interventions for youth resulting in a mean difference in BMI change of -0.85 ± 2.5 kg/m^2. Therefore, a mean of -0.85 was used for calculation [17]. Significance level was set at 0.05 with a power of 0.80, resulting in a sample of 274 to detect the difference in mean BMI. Recruitment was increased to overcome attrition, with 500 dyads recruited based on an attrition of 20% expected at 4 months and 30% expected at 12 and 24 months.

Recruitment started in September 2013 through newspaper advertisements, flyers, emails, and word of mouth at schools, community organizations and local fairs and camps. In order to be eligible to participate in the program, youth had to be at least 9 years of age before sessions started in September 2013 and not turn 11 by December 31, 2013. They were required to be free of food allergies, have no dietary restrictions, no existing life-threatening medical illnesses and have access to a computer with Internet.

Recruited adults were contacted by researchers via telephone to confirm eligibility, review the consent form, and schedule assessments. As they were confirmed, dyads were randomized on a one-to-one basis into control or treatment group on a state by state basis. However, as recruitment progressed and fewer than desired dyads were responding, a protocol change was made to randomize on a two-to-one basis with the goals of having more treatment than control in the study.

Assessments were conducted at 0,4,12 and 24 months in university research facilities, local extension offices, and schools. At each assessment period, physical measures were taken in private settings and online surveys were completed using computers/laptops provided by the researchers or participants' personal tablets. Questionnaires were uploaded via Qualtrics software (Provo. 2013, www.qualtrics.com) hosted on a secure server. State campus coordinators were trained and verified on standard anthropometrics measurement techniques by the project coordinator. Within each state, student researchers were trained on all protocols and approved to conduct physical assessments when they met inter-rater reliability of >0.80%. Physical assessment measures were collected on hard copy forms, designed for data collection and verification at each of the four assessment periods. Data were entered into an online database, verified and submitted for centralized data analyses. The survey was pretested prior to administration by the researchers and members of the target population.

While BMI was the primary outcomes for the overall study, this investigation is an analyses of secondary outcomes, specifically quality of life and blood pressure. Youth assessments included blood pressure, anthropometric measurements, and surveys. Adult assessments included blood pressure and surveys. The treatment group participated in an obesity prevention program called iCook 4-H, a 12-week program for the dyads to increase culinary competence, family meal time, and physical activity, coined, 'cooking, eating and playing together'. Teams of co-operative extension and community educators with university student researchers led the intervention program. The researchers and students continued after the 12-week program with booster sessions and monthly newsletters. The control group received no intervention, but completed the same assessments and surveys at the same time points. Study details are published elsewhere [18]. Each participating state's Human Subjects Institutional Review Board (IRB) approved all methodologies and any researcher involved received training in human subjects research. This study was retrospectively registered on ISRCTN (#54135351).

Demographics and anthropometrics

Adult gender, race, education attainment, marital status, child race, and participation in government food assistance programs were collected through surveys. Youth surveys assessed their state of residence, gender, and date of birth. Weight was measured to the nearest 0.1 kg with SECA Health Meter digital scales. Height was measured to the nearest 0.1 cm using SECA 213 Portable and Charder HM 200p Stadiometers. All measurements were taken twice and averaged. BMI was calculated as weight (kg)/height (m) squared. BMI for age z-score was calculated using LMS parameters and represents the number of standard deviations away from the mean for a child of that sex and age (in months).

Blood pressure

Blood pressure was measured by trained researchers using published guidelines [19]. Youth and adults were in a seated position and rested for five minutes with feet on the floor with the arm supported at heart level. Measurements for the youth were taken from the right arm and the adults were taken from the left arm. The Omron automated digital blood pressure cuff was used to measure blood pressure.

Quality of life

The Pediatric Quality of Life Inventory, Version 4.0 (PedsQL™), is a well-established tool delineated by the World Health Organization to assess health-related quality of life (HRQOL) in both the youth and the adult [20-22]. The questionnaire consists of 23 self-report questions assessing and yielding cumulative scores of physical, psychosocial (summary of social, emotional, and school/work functioning), and total HRQOL. Response choices were on a Likert scale from 0 to 4 (0=never to 4=almost always). All responses were reverse coded then scaled from 0 to 100, where 0=100, 1=75, 2=50, 3=25, and 4= 0. Higher scores indicated better HRQOL [23]. A total HRQOL score is calculated by summing all questions and dividing by 23. Scores for subscales (i.e. emotional, physical, social and school/work) were calculated by summing the scores of the questions associated with the category and dividing by that number of questions. To get a psychosocial health summary score, the emotional, social, and school/work functioning questions were summed and divided by 15, which was the total number of questions in the three subscales.

Statistics

Descriptive statistics were used to analyze subject characteristics of youth and adult participants and are presented as frequencies for categorical variables and means ± standard deviations (SD) or standard errors (SE) for continuous variables. Pearson's correlation was used to study associations between continuous outcomes (i.e. blood pressure and HRQOL) and repeated measures ANOVA was used to assess differences in variables between groups (control and treatment) and time. Likelihood ratio tests were run adjusting for cofounders (sex, parent education, and race). To asses model fit, residuals versus fitted value plots and residual QQ plots were inspected. Data were analyzed using SAS software (SAS®, Version 9.4, SAS Institute Inc., Cary, NC, Copyright 2002-2012) and R version 3.4 (Vienna, Australia). Significance criterion alpha for all tests was 0.05.

Results

Demographics

Of 228 dyads enrolled 102 dropped out, where a drop out was defined as any dyad not having youth BMI z-scores at 24 months. The remaining 126 dyads (n=35 for control and n=91 for treatment) were included in the present analyses. Subject characteristics for youth and adult participants are presented in Tables 1 and 2, respectively. Average age of youth was 9.3 ± 0.7 years for the control group and 9.4 ± 0.6 years for the intervention group. The majority of youth participants self-identified as white (68%) and female (55%) (Table 1). Youth baseline BMI z-score was 0.69 ± 1.09 for the control group and 0.59 ± 1.17 for the treatment group. For the adult, 68% had at least some college education (Table 2). Additionally, most adults were female (90%), married (69%) and white (74%). Lastly, 42% reported of adults reported participating in government food assistance programs (data not shown).

Table 1: Youth subject characteristics.

Demographic Characteristics	Control (n=77) n(%)	Treatment (n=151) n(%)	Total (n=228) n(%)
Gender			
Male	30(39)	73(48)	103(45)
Female	47(61)	78(52)	125(55)
Age			
Mean ± SD	9.3 ± 0.7	9.4 ± 0.6	9.4 ± 0.7
8	11(14)	10(7)	21(9)

9	36(47)	74(49)	110(48)
10	29(38)	64(42)	93(41)
11	1(1)	3(2)	4(2)
Race			
White	47(65)	96(69)	143(68)
Black	9(13)	16(12)	25(12)
Asian	2(3)	0(0)	2(1)
Hispanic	11(15)	19(14)	30(14)
Native American	1(1)	5(4)	6(3)
Other	2(3)	3(2)	5(2)
Percentages calculated using number of participants who answered question. Number per question may not equal sample size because of missing participant responses.			

Table 2: Adult subject characteristics.

Demographic Characteristics	Control (n=77) n(%)	Treatment (n=151) n(%)	Total (n=228) n(%)
Gender			
Male	12(16)	9(7)	21(10)
Female	62(84)	126(93)	188(90)
Age			
Mean ± SD	39.2 ± 9.1	38.8 ± 7.5	39.0 ± 8.0
Race			
White	50(69)	106(76)	156(74)
Black	5(7)	13(9)	18(9)
Asian	1(1)	1(1)	2(1)
Hispanic	13(18)	16(12)	29(14)
Native American	0(0)	3(2)	3(1)
Other	3(4)	0(0)	3(1)
Marital Status			
Married	50(68)	97(69)	147(69)
Widowed	0(0)	2(1)	2(1)
Divorced	10(14)	11(8)	21(10)
Single	9(12)	17(12)	26(12)
Committed Relationship	5(7)	13(9)	18(8)
Education			
Less than High School	4 (5)	8(5)	12(5)
High School	5 (7)	22(15)	27(12)
Some College/Associates Degree	36 (48)	51(34)	87(39)
Bachelor's Degree	21 (28)	45(30)	66(29)
Advanced Degree	9 (12)	23(15)	32(14)
Body Mass Index (kg/m^2)			

Underweight	1 (1)	1(1)	2(1)
Normal	21 (29)	41(32)	62(30)
Overweight	17 (23)	38(29)	55(27)
Obese	34 (47)	50(39)	84(41)

Percentages calculated using number of participants who answered question.
Number per question may not equal sample size because of missing participant responses.

BMI

A group by time interaction was found for youth BMI z-score (p=0.041) after adjusting for confounders (sex, parent education, and race). For individuals in the control group, the monthly change in BMI z-score was about -0.004 point/month while individuals in the treatment group had a monthly change in BMI z-score of about 0.004 points/month.

Blood pressure

From baseline to 24 months, all youth SBP increased (p=0.003) with no differences between groups (Table 3). Adult SBP was higher in the control group (p=0.004) and increased across over time in both groups (p=0.03), but there was no time by treatment effect (p=0.69), as seen in Table 3. There was a significant increase from 0 to 24 months for adult and child DBP (p=0.007 and p=0.001, respectively), but no time by treatment effect was found.

Table 3: Blood pressure measurements for youth and adult participants.

Measure	Group	Time (month)			
		0	4	12	24
SBP (mmHg)	Youth				
	Control	104 ± 12	102 ± 13	102 ± 10	106 ± 12*
	Treatment	103 ± 11	101 ± 11	101 ± 10	105 ± 11*
	Adult				
	Control	118 ± 14	120 ± 14	116 ± 14	119 ± 15*
	Treatment	114 ± 14	114 ± 15	112 ± 11	114 ± 12*†
DBP (mmHg)	Youth				
	Control	63 ± 10	62 ± 9	59 ± 8	61 ± 9*
	Treatment	62 ± 10	62 ± 9	59 ± 8	62 ± 8*
	Adult				
	Control	78 ± 11	79 ± 10	74 ± 10	75 ± 11*
	Treatment	74 ± 12	74 ± 12	71 ± 10	73 ± 11*

Repeated Measures ANOVA was utilized to determine significant difference in blood pressure over time and between groups.
*Significant difference over time p<0.05
† Significant group difference p<0.05

Health related quality of life

From 0 to 24 months, all youth increased physical HRQOL (p=0.01) and psychological HRQOL (p=0.002), but there were no differences between groups (Table 4). No changes were seen in physical or psychological HRQOL in the control or treatment adult groups (Table 4).

Table 4: Quality of life scores for youth and adult participants.

Measure	Group	Time (month)			
		0	4	12	24
Physical HQOL	Youth				
	Control	82 ± 14	83 ± 14	86 ± 15	87 ± 12*
	Treatment	82 ± 18	86 ± 14	87 ± 15	86 ± 14*
	Adult				
	Control	78 ± 19	80 ± 17	78 ± 23	77 ± 21
	Treatment	75 ± 20	77 ± 22	78 ± 19	79 ± 21
Psychological HQOL	Youth				
	Control	74 ± 14	79 ± 14	78 ± 14	81 ± 14*
	Treatment	77 ± 15	79 ± 14	81 ± 13	80 ± 15*
	Adult				
	Control	79 ± 13	81 ± 14	82 ± 9	83 ± 12
	Treatment	82 ± 11	84 ± 12	83 ± 12	85 ± 13

Repeated Measures ANOVA was utilized to determine significant difference in health related quality of life over time and between groups.

*Significant differences over time p <0.05

Correlations between BP and HRQOL

There were no significant relationships between youth or adult blood pressures and psychological or physical HRQOL in the control group at any time point. In the treatment group, there was a significant relationship between youth and adult SBP at baseline (r=0.24, p=0.003) that persisted at 4 months (r=0.33, p<0.001). In the treatment group, there was an inverse association between adult SBP and youth psychological HRQOL at 4 months (r=-0.20, p=0.04), and a similar trend in adult SBP and youth physical HRQOL at 4 months in the treatment group (r=-0.19, p=0.05).

Discussion

The purpose of this study was to investigate the effects of a 2-year obesity prevention program intervention in youth and their adult pair (dyads) on blood pressure and HRQOL. The main findings of the present study included increases in youth systolic and diastolic blood pressure, improvements in youth physical and psychological HRQOL, and an inverse association between adult SBP and youth psychological HRQOL. The objective of the healthy lifestyle intervention described in the present study was to improve nutrition and physical activity habits of both adult and youth participants with the expectation that this would elicit improvements in HRQOL and BP. Instead, adult SBP and DBP increased over time in both groups. However, it should be noted that these increases were minimal and the averages for both groups at all time-points were still considered “normal” according to established blood pressure guidelines [19]. Had the population been classified as hypertensive, the healthy lifestyle intervention might have had a more dramatic effect on blood pressures. The youth blood pressure demonstrated increases over time in both the control and treatment groups with no differences between groups. These increases are attributed to the expected physiological increase in blood pressure associated with normal growth and development.

Programs that elicit reductions in blood pressure and improve HRQOL among younger generations is desired; however, few studies to date have investigated this. A similar childhood obesity prevention program for youth/adult dyads found baseline HRQOL was worse in healthy children and adolescents across multiple domains. At 6 months, the children experienced significant increases in HRQOL and reported the biggest improvement in emotional functioning, whereas the parents believed the biggest improvement were seen in child’s physical HRQOL [24]. In a randomized control trial using family base behavioral therapy (FBBT) the treatment group showed a significant reduction in SBP and improvements in HRQOL and eating attitudes with no significant change in the control group after one year [25]. As with these studies, the results in our study showed improvements in both physical and psychological HRQOL after a 24-month program focusing on changing health behaviors. However, while we found no changes in HRQOL in adults, physical and psychological HRQOL increased for youth in both groups.

Additionally, there was a negative association between adult systolic blood pressure and youth psychological HRQOL and a similar relationship with youth physical HRQOL following this program. These relationships illustrate that adult blood pressure and HRQOL may impact the youth’s blood pressure and HRQOL.

Other researchers advise using a similar treatment intervention of both the youth and adult [26] due to parental influence being a robust predictor of health outcomes in children. This impact on children has been described in various conceptual models and theories for understanding the processes for changing health behaviors. For instance, when looking at adolescents' eating behavior, the family unit has substantial impact due to being the provider of food and the major influencer of eating attitudes, preference, and values [27]. Therefore, more research would benefit from considering parental inclusion in the intervention to shape adolescent clinical response.

Although this study is novel in its design and is geographically diverse, there are several limitations. While the study represents a large sample examining pediatric blood pressure and HRQOL, a larger sample may have yielded different results. Our sample can also be described as a convenience sample comprised of individuals interested in health and wellness, therefore these results cannot be generalized to all individuals, especially a more diverse and lower socioeconomic population. HRQOL was self-reported and assessed during the school year, therefore stress and emotional situations at this time could influence potential outcomes.

Conclusion

Hypertension in children often persists into adulthood and is a significant risk factor for CVD. Individuals with higher blood pressure typically have lower HRQOL, which has important clinical implications for positive treatment outcomes. However, following an obesity prevention program consisting of culinary, mealtime and physical activity education, elicited improvements in HRQOL in youth participants. These findings strongly demonstrate that childhood quality of life is improved by participating in a healthy lifestyle intervention with the primary adult meal preparer. Future research would benefit from a similar design with longer treatment and follow-ups in which focus on adolescent blood pressure and its relationship with HRQOL following a program impacting health behaviors.

Declarations

Funding

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Clinical trial registration

Data for this study was taken from the iCook 4-H study, retrospectively registered on November 1, 2018 (ISRCTN54135351).

Ethics approval and consent to participate

All procedures were reviewed and approved from each university's Internal Review Board. Informed consent was collected from each participant prior to enrollment.

Consent for publication

Not applicable

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Contributions

Research design was developed by the multidisciplinary team MDO, AAW, LFC, KKK, and SEC. Data analysis was done by MMK and MDO and statistical analysis was carried out by OAF and MMK. Writing of the manuscript was done by ES, SF, MMK, OAF, MPL, and MDO and final content was reviewed by all authors. All authors have read and approved the final manuscript.

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