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iCook 4-H: 0 to 24-Month Accelerometer-Derived Physical Activity and Sedentary Time in Youth

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iCOOK 4-H: 0 to 24-MONTH ACCELEROMETER-DERIVED PHYSICAL ACTIVITY AND SEDENTARY TIME IN YOUTH

BY

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This thesis is approved as a credible and independent investigation by a candidate for the Master of Science in Nutrition, Exercise and Food Science degree and is acceptable for meeting the thesis requirements of this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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ABSTRACT

iCOOK 4-H: 0 to 24-MONTH ACCELEROMETER-DERIVED PHYSICAL ACTIVITY AND SEDENTARY TIME IN YOUTH

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To assess accelerometer-derived physical activity and sedentary time from 0 to 24-months in youth in the iCook 4-H program. The iCook 4-H Program was a 5-state, randomized, control-treatment, family-based childhood obesity prevention intervention promoting cooking, eating and playing together. Youth, 9-10 years old, and their main adult meal preparer, participated in the 12-week program followed by monthly newsletters and bi-yearly booster sessions until 24-months. Physical activity and sedentary time were determined for youth who wore an Actigraph GT3X+ accelerometer for 7 days at 0, 4, 12, and 24-months and met defined accelerometer compliance standards. Mean daily minutes of sedentary time and light, moderate, vigorous, and moderate-to-vigorous physical activity were evaluated during waking hours. Group differences were analyzed from 0 to 24-months using liner mixed models and likelihood ratio tests ($p \leq 0.05$) with R data analysis software (R, 3.2.3, Vienna, Austria, 2015). There were no differences in physical activity or sedentary time between treatment and control groups at any time-point. Physical activity at all intensity levels decreased and sedentary time increased within treatment and control groups from 0 to 24-months ($p \leq 0.001$). The percent of youth meeting the physical activity guidelines, defined as an average of ≥60 minutes of MVPA per day, decreased from 0-months (30.7% treatment, 41.7% control) to 24-months (8.0% treatment, 0.0% control). Youth responses on the

program evaluation survey indicated a trend in differences by group for the amount of time their family spent playing actively together (p=0.08) and how often their heart pumped hard when they were being physically active (p=0.07). The iCook 4-H Program was a multicomponent program following 9-10 year old youth for 24-months that focused on cooking skills, mealtime behavior and conversation, and enhancing physical activity through daily activities. Greater emphasis on developing physical activity skills, improving environmental factors, and increasing physical activity both in school and after school may be needed to prevent the decrease in activity that occurs as children age into adolescence. Interventions may also need to focus on overcoming facilitators for sedentary time and barriers to physical activity. Furthermore, children in the current study demonstrated a more positive outlook on "playing" versus being physically active, which may indicate that future interventions should focus on increasing physical activity through play.

CHAPTER 1

INTRODUCTION

Childhood obesity remains a significant problem in the United States.[1] Despite recent declines in certain age groups, 34.2% of 6-11 year olds remain overweight or obese.[1] Childhood obesity is influenced by demographic factors and eating behaviors, as well as physical activity factors, which includes low physical activity levels and high amounts of sedentary time.[2,3]

Irrespective of the cause of childhood obesity, the outcomes remain the same. Overweight and obese children are at an increased risk for health consequences including high blood pressure, insulin resistance, type 2 diabetes, elevated cholesterol, cardiovascular disease, and some cancers.[4,5] The World Health Organization suggests that overweight and obese children and adolescents will grow into overweight and obese adults, leading to an increased number of health concerns later in life.[4] This assumption is in line with results from a systematic review that reported an association between overweight and obesity in childhood, and an increased risk of type 2 diabetes, hypertension, coronary heart disease, and mortality in adulthood.[6] McLoone and Morrison also revealed that as the body mass index (BMI) of the parent increased, so did the prevalence of obesity in the child, suggesting a need for interventions aimed at both the parent and child. [7]

Although some of the causes and consequences of childhood obesity are known, the best and most effective way to prevent childhood obesity is still under debate. It is known that increasing physical activity can play an important role in preventing childhood obesity.[8,9] Cited benefits of physical activity for children include maintaining a

healthy weight, better coordination and movement, healthier musculoskeletal tissues and a healthier cardiovascular system.[9] Maintaining a healthy weight can also improve self-esteem and body image.[5,10]

According to the 2008 Physical Activity Guidelines for Americans, children and adolescents should engage in at least 60 minutes of moderate-to-vigorous physical activity (MVPA) each day to help prevent the risk of chronic diseases.[8] MVPA includes activities such as biking, running, or jumping rope, and is defined as an effort of 5-8 on a scale of 0-10.[8] However, despite this recommendation, most children and adolescents in the United States are not meeting the guidelines.[11-15] In 2008, Troiano and colleagues reported that 58% of 6-11 year olds were not meeting guidelines,[14] and in 2012, Fakhouri and colleagues reported that 75.2% of 12-15 year olds were not meeting the guidelines.[15] These results indicate that there is a decline in physical activity that occurs with age - a theme that has also been confirmed by Belcher and colleagues.[16] It has been estimated that internationally only 9% of boys and 1.9% of girls aged 5-17 years are achieving 60 minutes of MVPA per day.[12]

Reducing sedentary time may also play a role in decreasing and preventing childhood obesity, independently of physical activity. Examples of sedentary behaviors include sitting, sleeping, lying down, and reclining, which are often activities that children do while watching TV or playing video games.[17,18] Similar to the consequences of low physical activity, sedentary time is negatively associated with metabolic outcomes.[19,20] Multiple studies have found a positive association between breaking up sedentary time and health outcomes such as anthropometric measurements, insulin sensitivity, and lipid levels.[21-23]

Currently, two types of interventions, school-based and family-based, have aimed at increasing physical activity and reducing sedentary time to combat childhood obesity.[3,24-29] While some school-based interventions have had positive outcomes, they tend to lack long-term impacts and are reported to be more successful when the parent or family is involved.[24,29,30] Studies from Li and colleagues and Khambalia and colleagues, both supported that school-based interventions were more effective when they include a family component.[24,25]

Recent literature suggests that family-based interventions may be more effective.[27-35] Family-based interventions may lead to longer-term success due to parental involvement, which helps transition the learned behavior into the home.[27,28,31] It is also known that children model the behaviors of their parents, which additionally supports the need for family-based obesity interventions.[32-35] Recent literature suggests that multi-component programs (those including nutrition, physical activity, cooking, etc.) tend to be more successful as well.[27,36-38]

Based on the above noted evidence, there is a need for effective multi-component, family-based interventions to support healthful behaviors to enhance obesity prevention throughout life.[27,32,34-36,39-42] The purpose of this study was to determine if the iCook 4-H Program increased physical activity and decreased sedentary time in 9-10 year old youth who participated in the iCook 4-H Program. The iCook 4-H Program was a 12-week, multi-component, family-based obesity prevention intervention aimed at increasing basic cooking skills, family meal times, and physical activity in participants in Maine, Nebraska, South Dakota, Tennessee, and West Virginia.

Statement of the Problem

Low physical activity levels combined with high amounts of sedentary time have played a role in increased childhood obesity rates in the last few decades.[2,3] With roughly one-third of America's youth considered overweight or obese, and very few youth meeting recommended physical activity levels, there is a need for more family-based childhood obesity interventions to prevent further decreases in physical activity and increases in sedentary time.[1,4,12]

Significance of the Study

Implementing a childhood obesity intervention aimed at increasing physical activity levels and decreasing amounts of sedentary time through a multi-component program will be beneficial in preventing further rises in childhood obesity rates. The iCook 4-H Program focuses on teaching information related to cooking skills, family mealtime, physical activity, and goal setting with the overall goal to teach families to "Cook, Eat, and Play Together" for obesity prevention.

Variables

Independent:

1. Treatment Group: iCook 4-H participants
2. Control Group: Non-treatment participants

Dependent

1. Physical Activity: objectively measured using accelerometers
2. Sedentary Time: objectively measured using accelerometers

Limitations

1. Seasonal difference in physical activity levels

2. Limited study sample (low income/Expanded Food and Nutrition Program [EFNEP] population)
3. Convenience sample of the population interested in health and wellness
4. Treatment and control participants were required to have internet access
5. Treatment and control participants were required to eat meat and dairy

Delimitations

1. Defined population: 9-10 year old youth
2. Treatment versus control group study
3. Participants were required to be free from food allergies
4. Participants were required to be free from physical and medical limitations

Assumptions

1. Youth will not increase physical activity when wearing accelerometers
2. Accelerometers will accurately measure physical activity and sedentary time

Definition of Terms

1. Childhood overweight: a BMI $\geq 85^{th}$ percentile and $<95^{th}$ percentile for the youth of the same age and sex[43]
2. Childhood obesity: a BMI $\geq 95^{th}$ percentile for youth of the same age and sex[43]
3. Physical activity: movement of the body produced as a result of skeletal muscle movement and requires energy to be expended[44]
4. Sedentary time: behaviors that do not raise energy expenditure substantially above the resting rate; includes activities like sleeping and sitting down[17]
5. Accelerometers: an electronic device used to objectively measure physical activity by recording frequency, duration, and intensity of activity[45,46]

Research Hypothesis

Hypothesis 1: Treatment participants will have increased physical activity after completing the iCook 4-H Program compared with participants in the control group.

Hypothesis 2: Treatment participants will have decreased sedentary time after completing the iCook 4-H Program compared with participants in the control group.

CHAPTER 2

REVIEW OF LITERATURE

Childhood Obesity

It is well known that childhood obesity is a problem in the United States. Currently 34.2% of children aged 6-11 years are overweight or obese,[1] and according to the American Heart Association, obesity rates in children tripled from 1971 to 2011.[5] Furthermore, the data over the years shows that as children age, they become heavier - a trend that is predicted to continue into adulthood.[1,6,47]

Childhood obesity causes health issues such as cardiovascular disease, insulin resistance (which often leads to type 2 diabetes), musculoskeletal disorders, and even some cancers.[4,5] It has been suggested that overweight and obese children will continue to have above-normal weights, leading to health concerns later in life.[4] A systematic review by Park and colleagues reported that overweight and obesity in childhood increased the risk of type 2 diabetes, hypertension, and coronary artery disease in adulthood.[6]

Physical Activity

Increasing physical activity, specifically to meet the recommended guidelines, is a known way to prevent the risk of obesity in children.[8] The 2008 Physical Activity Guidelines for Americans suggest that children and adolescents should achieve at least 60 minutes of MVPA daily to prevent the risk of chronic disease.[8] This activity should include aerobic movement, such as running or biking, every day, along with muscle-strengthening and bone-strengthening exercises at least three days per week.[8] The World Health Organization cites multiple benefits of physical activity in children and

adolescents, including healthy musculoskeletal tissues and cardiovascular systems, better coordination and movement, and a healthy body weight.[9]

Even with the recommendations and known benefits to physical activity, most children are not meeting the recommended guidelines. Furthermore, as children age they are becoming less physically active and more sedentary.[12,14-16] A study published in 2008 reported that 42% of 6-11 year olds met recommended guidelines, whereas a study published in 2014 reported that only 24.8% of 12-15 year olds met the recommended guidelines.[14,15] Belcher and colleagues also reported that 6-11 year olds recorded 88 minutes per day of MVPA based on accelerometer data, while 12-15 years olds and 16-19 years olds only recorded 33 and 26 minutes per day of MVPA, respectively.[16] An international study reported that physical activity levels might even be as alarmingly low as 9% of boys and 1.9% of girls meeting 60 minutes per day of MVPA.[12] This study also found that children increased physical activity levels until age 5-6 years, and then activity levels slowly declined with age.[12] In contrast, at age 5-6 years, sedentary time started to increase and the trend continued into adolescence.[12] Multiple studies have also established that boys are generally more active than girls.[12,16,27]

Scheafer and colleagues studied the effects of physical activity related to time spent outdoors.[48] They found that those children who spent most and all of their time outdoors recorded 70 minutes per day of MVPA while children who did not spend time outdoors recorded only 49 minutes per day of MVPA.[48] This equated to a 2.8-fold greater likelihood of the child achieving the recommended 60 minutes of MVPA per day.[48] A study on transportation modes also revealed that in 1969, 49.3% of children aged 5-11

years walked or biked to school, compared to only 13.1% in 2009, which is a potential risk factor for less time spent outdoors and low activity levels.[49]

Sedentary Time

A high amount of sedentary time also significantly contributes to childhood obesity, and is an independent risk factor for childhood obesity. In a world where technology is becoming increasingly more available, children have almost-constant access to tablets, iPhones, iPads, computers, laptops, television, etc. at school and at home, contributing to increased sedentary time.

Reducing or breaking up sedentary time has been shown to have several positive health benefits. Belcher and colleagues reported an improvement in short-term metabolic outcomes, including insulin sensitivity, when sitting time was interrupted with walking.[20] Duvivier and colleagues reported a positive significant effect on triglycerides and non-HDL cholesterol when six hours of sitting was replaced with four hours walking and two hours standing.[22] Additionally, Katz and colleagues used brief physical activity breaks to replace sedentary time in the classroom and found that strength and flexibility improved, and participants were able to reduce certain medications, including those for asthma and ADHD.[21] Overall, reducing sedentary time can play a role in preventing obesity as well as improving metabolic outcomes.

Relationship of Physical Activity and Sedentary Time

It is important to understand that sedentary time and physical activity are different. Sedentary time refers to activities such as sitting and sleeping that do not require high energy to be expended.[17] Contrarily, physical activity refers to activities or movements that expend more energy, such as running or jumping jacks.[44] Physical

activity must be of the moderate-to-vigorous intensity level to prevent the risk of health conditions that are associated with overweight and obesity in children. Therefore, increasing physical activity to the moderate-to-vigorous intensity level, and reducing sedentary time can independently prevent and reduce the risk of overweight and obesity in childhood. But more importantly, when combining more time spent in MVPA with lower amounts of sedentary time, the potential for health benefits may be even higher than just one of these activities alone.

As previously noted, the recommendation for children and adolescents is to achieve 60 minutes of MVPA daily to prevent the risk of chronic disease.[8] However, there is no recommendation for sedentary time in these younger age groups.[8] The Physical Activity Guidelines for Americans for adults does recommend reducing or avoiding inactivity (sedentary time) while also achieving the recommended level of MVPA.[8] The recommendation for adults to reduce sedentary time as well as increase MVPA is likely based on the fact that most research on the effects of low MVPA combined with high amounts of sedentary time is done on adults. Evidence shows that adults who have levels of MVPA to meet the Physical Activity Guidelines (150 minutes per week), but also have high amount of sedentary time, are still at an increased risk for certain health conditions.[50,51]

Chastin and colleagues reported on the combined effects of physical activity and sedentary time together.[50] They found that when MVPA was replaced with sedentary behaviors and some light physical activity, there was a negative effect on certain cardiometabolic markers.[50] However, when MVPA remained constant and the light physical activity was replaced with additional sedentary time, the health risk/mortality

was even higher.[50] This suggests that even small increases in sedentary time may have large impacts on health.[50] This same study also reported that as MVPA increased, and sedentary time decreased, BMI remained normal. But, as sedentary time increased, BMI trended to the overweight category. Interestingly, the latter trend was also found for waist circumference inches.[50]

Schmid and colleagues reported on the risk of all-cause mortality in relation to low physical activity and high sedentary time.[51] The relative risk of all-cause mortality was 7.79 in those with high sedentary time and low MVPA levels, while the relative risk was only 2.79 in those with high sedentary time, but also high levels of MVPA.[51] This indicates that achieving adequate MVPA is important to reduce the risk of mortality. Additionally, the study noted that participants with high amounts of sedentary time more often had a medical history including diabetes, cardiovascular disease, cancer, and mobility limitations.[51]

Even though the evidence for health outcomes and mortality due to high amounts of sedentary time and low physical activity levels is mostly for adults, there is evidence on the positive effects of breaking up sedentary time in children.[21,22,50] To prevent the risk of chronic disease in children, it is important for them to achieve the recommended 60 minutes per day of MVPA. However, participating in light or moderate-intensity physical activity can break up sedentary time. Furthermore, breaking up sedentary time with light or moderate-intensity physical activity is essentially still burning calories, thus, it may help prevent or reduce the risk of overweight and obesity. Based on the available evidence, it is most important for children to find a balance between meeting the recommendation for MVPA, while also reducing sedentary time.

Measuring Physical Activity and Sedentary Time

Physical activity and sedentary time can be subjectively measured through self-report surveys, or objectively measured using accelerometers.[45] Accelerometers are considered the gold standard for measuring physical activity and sedentary time because they provide information on the duration, frequency, and intensity of activity.[45] Adamo et al reports that using objective measures of activity, such as accelerometer data, provides more accurate results, but is also more expensive to collect.[52] However, while self-report data is less expensive, self-report measures tend to over or under report minutes of activity and are thus, less accurate.[52]

Accelerometer data is categorized into five intensity levels: sedentary time, light physical activity, moderate physical activity, vigorous physical activity, and MVPA.[45] An accelerometer collects data during a defined epoch length, which is the number of seconds over which activity counts are collected and summed.[56] Common epoch lengths are 5, 10, 15, 30, or 60 seconds, and data is often collected at frequencies of 10-60 Hertz per second. [56] For example, collecting data over a 5-second epoch means that activity counts are recorded over that length of time, and collecting data at a frequency of 10 Hertz means that 10 activity counts are recorded each second during the specific epoch length (i.e. 5 seconds).[53] The 10 activity counts recorded per-second during the defined 5-second epoch are summed to provide a total activity count for the 5-second epoch length.[53] In total, collecting data for a 5-second epoch at 10 Hertz would result in 50 activity counts collected during that epoch.[53] Because children move more quickly, and their activities are often sporadic, the literature recommends using shorter epoch lengths,

such as 5 or 10 seconds, for a more accurate measure. [53,54] By collecting data in shorter epochs, more data is being collected to account for the quicker movements of the child.

The data that is collected during each epoch is defined as one of the five intensity levels based on specified cut-points. The cut-point is the number of activity counts that define if the activity is sedentary or light, moderate, vigorous, or MVPA. The scientific literature has determined valid cut points for certain age groups.[46] According to a study by Evenson and colleagues, an activity count of 0-25 over a determined epoch would classify that movement as sedentary activity.[46]

School-Based Interventions

Since the statistics on childhood obesity and physical inactivity have been recognized, a growing number of interventions have aimed to combat these issues. School-based interventions have attempted to increase physical activity of youth in a school setting.

A non-randomized controlled trial in China provided a multi-component physical activity program over twelve weeks in four schools.[25] Students were exposed to new activities and information through Physical Education (P.E.) programs, extracurricular physical activity, physical activity at home, as well as lectures provided for students and parents.[25] The study reported a significant reduction in mean BMI, waist circumference, skinfold thickness, serum lipids, and fasting glucose in the treatment group.[25]

Another school-based intervention by Rausch and Berger-Jenkins titled Choosing Healthy and Active Lifestyles/Healthy School, Healthy Families (CHALK/HSHF) aimed to increase physical activity in the classroom, as well as during recess and P.E. class.[30] While the program was aimed at schools, it also included social marketing components at

clinics and community locations to expose children and parents to the information in multiple locations.[30] An increase in parents' readiness to change and be more physically active was the only reported statistically significant outcome of the intervention.[30]

Finally, a review by Khambalia and colleagues looking at five systematic reviews and three meta-analyses, reported on the success of school-based interventions.[24] An included meta-analysis by Gonzalez-Suarez reported that school-based interventions were effective at reducing childhood obesity, however, only in the short-term.[24] There was also one study that was included in all eight reviews, and reported that a six-month diet and physical activity program in schools successfully reduced BMI z-score in the treatment group.[24] However, overall, Khambalia and colleagues found that only certain components of school-based interventions were successful, including programs that combined diet and physical activity, programs that included a family component, and longer (one year) rather than shorter programs seemed to have better results.[24]

While some school-based interventions have been successful, overall, they tend to lack long-term outcomes and are more successful when they include a family component.[24,29,30] Birch and Ventura noted in their review of obesity preventions that childhood obesity approaches should focus primarily outside of schools so that more risk factors for childhood obesity can be addressed with each intervention.[3]

Family-Based Interventions

Most literature points to family-based interventions as the more effective approach to childhood obesity prevention and reduction.[3,26-28,31] The need for family-based interventions was recognized over ten years ago[42] and since then, multiple studies have recommended and provided examples of family-based interventions for reducing

rates of childhood obesity.[26-28,31,40] The success of family-based childhood obesity interventions can be attributed to multiple factors. Children tend to learn and model the behaviors of their parents, which allows behaviors to transfer into the home,[33-35] and when the parent is involved in the intervention, the results tend to last longer.[27-29,31]

Golan and colleagues conducted a study in which the intervention group included only parents who attended fourteen one-hour sessions about diet and physical activity over the course of one year.[33] The control group included only children who also attended one-hour sessions on the same topics.[33] Results showed that children of parents in the treatment group had a significant reduction in weight compared to the control group.[33] A study by Van Allen and colleagues provided weekly sessions about nutrition and physical activity over ten weeks.[27] Results indicated that the treatment group showed higher levels of physical activity at twelve-month follow up compared with the active control group, when there was no difference in physical activity levels at baseline.[27] Additionally, parental increase in physical activity was coordinated with child increase in activity.[27]

Epstein and colleagues also looked at the long-term effectiveness of four family-based interventions ten years after completion of the studies.[28] They found that in three of four studies, there were significant differences between treatment and control groups.[28] Children in the first family-based treatment group showed a decrease in percentage overweight by 15.3% over ten years, while the control group had an increase in overweight by 7.6%.[28] The second intervention found that children with non-obese parents had a greater decrease in percentage overweight compared to children of obese parents.[28] The final study reported that children in the treatment groups who were taught

lifestyle or aerobic interventions showed significant decrease in percentage overweight compared to a control group.[28]

Another intervention, the Getting Our Active Lifestyles Started (GOALS), by Watson and colleagues focused on overall lifestyle changes.[31] The intervention was offered in a community setting and provided weekly sessions focused on physical activity and dietary changes from September to March.[31] Families were encouraged to set small, realistic goals to implement the lifestyle change, and also met with a personal mentor every few weeks to monitor changes.[31] The study was successful in significantly improving BMI z-score from baseline to post-intervention, and the change in BMI z-score was sustained at a twelve-month follow-up assessment.[31]

Weaver and colleagues designed a multi-component family-based intervention titled Fit and Healthy Family Camp.[26] Objectives of the program included teaching about cooking skills, healthy food choices, physical activity, and sedentary time during eight, one and one-half hour sessions.[26] Families also attended group medical visits combined with healthy living workshops during the intervention period. Results found an increase in consumption of healthy food choices and a decrease in screen time.[26]

It is evident from the literature that family-based childhood obesity prevention interventions have been successful at reducing mean BMI or BMI z-score, increasing physical activity, reducing screen time (sedentary time), and increasing healthy food choices.[26,28,31,40] Because children model behaviors of their parents, parental involvement in the intervention helps reinforce the behavior at home. Reinforcing learned behaviors in the home setting also helps maintain outcomes in the long-term.

The iCook 4-H Program is a novel family-based intervention because it combines some of the most successful components of the aforementioned interventions - being family based and being a multicomponent program. Additionally, the iCook 4-H Program includes one parent and one child from each family, allowing for one-on-one time to build a parent-child relationship while also learning healthy habits.

Community Based Participatory Research Design

The community based participatory research (CBPR) design is a research approach that utilizes partnerships between the community and the research team for the development and implementation of obesity interventions, and is a well-recognized model.[55,56] CBPR strives to involve the community in all steps of the research process. Berge and colleagues successfully used the CBPR model in developing and implementing their "Play it Forward" obesity intervention. Additionally, Mayan and Daum reviewed the literature on the CBPR design and reported that developing relationships with a community is a vital step in the research process.[56]

CHAPTER 3

MANUSCRIPT

Introduction

Childhood obesity remains a significant problem in the United States.[1] Despite recent declines in certain age groups, 34.2% of 6-11 year olds remain overweight or obese.[1] Childhood obesity is influenced by demographic factors and eating behaviors, as well as physical activity factors, which includes low physical activity levels and high amounts of sedentary time.[2,3]

Irrespective of the cause of childhood obesity, the outcomes remain the same. Overweight and obese children are at an increased risk for health consequences including high blood pressure, insulin resistance, type 2 diabetes, elevated cholesterol, cardiovascular disease, and some cancers.[4,5] The World Health Organization suggests that overweight and obese children and adolescents will grow into overweight and obese adults, leading to an increased number of health concerns later in life.[4] This assumption is in line with results from a systematic review that reported an association between overweight and obesity in childhood, and an increased risk of type 2 diabetes, hypertension, coronary heart disease, and mortality in adulthood.[6] McLoone and Morrison also revealed that as the body mass index (BMI) of the parent increased, so did the prevalence of obesity in the child, suggesting a need for interventions aimed at both the parent and child. [7]

Although some of the causes and consequences of childhood obesity are known, the best and most effective way to prevent childhood obesity is still under debate. It is known that increasing physical activity can play an important role in preventing

childhood obesity.[8,9] Cited benefits of physical activity for children include maintaining a healthy weight, better coordination and movement, healthier musculoskeletal tissues and a healthier cardiovascular system.[9] Maintaining a healthy weight can also improve self-esteem and body image.[5,10]

According to the 2008 Physical Activity Guidelines for Americans, children and adolescents should engage in at least 60 minutes of moderate-to-vigorous physical activity (MVPA) each day to help prevent the risk of chronic diseases.[8] MVPA includes activities such as biking, running, or jumping rope, and is defined as an effort of 5-8 on a scale of 0-10.[8] However, despite this recommendation, most children and adolescents in the United States are not meeting the guidelines.[11-15] In 2008, Troiano and colleagues reported that 58% of 6-11 year olds were not meeting guidelines,[14] and in 2012, Fakhouri and colleagues reported that 75.2% of 12-15 year olds were not meeting the guidelines.[15] These results indicate that there is a decline in physical activity that occurs with age - a theme that has also been confirmed by Belcher and colleagues.[16] It has been estimated that internationally only 9% of boys and 1.9% of girls aged 5-17 years are achieving 60 minutes of MVPA per day.[12]

Reducing sedentary time may also play a role in decreasing and preventing childhood obesity, independently of physical activity. Examples of sedentary behaviors include sitting, sleeping, lying down, and reclining, which are often activities that children do while watching TV or playing video games.[17,18] Similar to the consequences of low physical activity, sedentary time is negatively associated with metabolic outcomes.[19,20] Multiple studies have found a positive association between breaking up

sedentary time and health outcomes such as anthropometric measurements, insulin sensitivity, and lipid levels.[21-23]

Currently, two types of interventions, school-based and family-based, have aimed at increasing physical activity and reducing sedentary time to combat childhood obesity.[3,24-29] While some school-based interventions have had positive outcomes, they tend to lack long-term impacts and are reported to be more successful when the parent or family is involved.[24,29,30] Studies from Li and colleagues and Khambalia and colleagues, both supported that school-based interventions were more effective when they include a family component.[24,25]

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Based on the above noted evidence, there is a need for effective multi-component, family-based interventions to support healthful behaviors to enhance obesity prevention throughout life.[27,32,34-36,39-42] The purpose of this study was to determine if the iCook 4-H Program increased physical activity and decreased sedentary time in 9-10 year old youth who participated in the iCook 4-H Program. The iCook 4-H Program was a 12-week, multi-component, family-based obesity prevention intervention aimed at increasing basic

cooking skills, family meal times, and physical activity in participants in Maine, Nebraska, South Dakota, Tennessee, and West Virginia.

Methods

The iCook 4-H Program is a family-based, control/treatment, childhood obesity intervention for 9-10 year old youth and their main meal preparer (also referred to as a dyad) in Maine, Nebraska, South Dakota, Tennessee, and West Virginia. A community based participatory research (CBPR) approach was used in designing, implementing an evaluating the intervention. Steering committees were formed in each state, and included members from the research team, Extension/4-H staff, Expanded Food and Nutrition Education Program staff (EFNEP), community members, and graduate students.

The 4-H model was used to build the curriculum, with the following mission of 4-H in mind: "4-H empowers youth to reach their full potential, working and learning in partnership with caring adults."[57] By using the 4-H model as the basis for the iCook 4-H Program, youth and adults were encouraged to work together while learning new skills and information. EFNEP personnel were included in the program design to ensure that curriculum was appropriate for EFNEP programming, which is typically aimed at low-income populations.

iCook Leaders and Training: Extension or EFNEP staff served as the iCook leaders. iCook leaders were trained by the research staff on how to deliver the curriculum. To ensure that all leaders received the same training, training modules were developed and recorded by the research staff. All iCook leaders were required to complete the Collaborative Institutional Training Initiative to ensure they understood all details of the research process.

Recruitment and Participant Selection: iCook leaders recruited participants for their classes using flyers, newspaper advertisements, word of mouth, and social media. The following locations were targeted: community organizations, schools, churches, local businesses, 4-H and Extension offices, and medical offices/clinics. Recruitment was aimed at low-income, rural populations. Participating youth had to be 9 years old before the start of classes in September 2013 and could not turn 11 years old before December 31, 2013. Additionally, dyads were only eligible to participate if they were free of food allergies, free of medical and physical limitations that would hinder participation, willing to eat meat and dairy, and had access to the Internet in their home. Participants did not have to be current 4-H members or participants in any EFNEP program to participate in the iCook 4-H Program.

The iCook 4-H Program was a control/treatment study and used a convenience sample of the population. Those interested in food and nutrition programs were typically who responded to recruitment efforts. A goal of 500 dyads (100 per state) was set when the study began and dyads were to be randomized one control to one treatment as they confirmed their participation in the study. However, recruitment did not yield the desired number of dyads, so a protocol change was made to randomize one control dyad to two treatment dyads, with a goal of having more treatment than control participants. Both control and treatment group youth participated in anthropometric and survey assessments at four time points: 0, 4, 12, and 24-months.

All youth participants provided verbal assent, and parents provided written informed consents. The study was approved by each participating state universities' (ME, NE, SD, TN, WV) Institutional Review Board for the Protection of Human Subjects.

The iCook 4-H Intervention: The iCook 4-H intervention included six classes, each 2 hours long, over the course of 12-weeks from September to December 2013 in all 5 participating states. The curriculum focused on basic cooking skills, family mealtime, physical activity, and goal setting in an effort to teach dyads to "Cook, Eat, and Play Together". iCook was designed as a bi-weekly curriculum so that participants were allowed time between lessons to apply their learned skills and behaviors before returning for another lesson.

During an iCook class, dyads were taught a cooking skill(s), allowed to apply that skill(s) to make a recipe, participate in a "family" mealtime, and then end class by setting goals together as a family. To incorporate physical activity into the curriculum, a 15-20 minute activity was included in each lesson. Dyads were taught the importance of physical activity as well as ways to be physically active in an everyday setting. Some activities encouraged increasing physical activity, while others taught behaviors to reduce sedentary time (Figure 1). The number of dyads per class was limited to 6, for a total of 12 participants, including youth and adults.

Another key component of the iCook intervention was a website where participants from all five states could interact (Figure 2). Youth were encouraged to share videos and pictures of them using their new cooking skills or participating in physical activity at home. All dyads were provided with a video camera to record activities, and

were instructed how to upload videos and pictures to the website. iCook leaders instructed dyads to share one video or picture per week on the interactive website.

To keep participants engaged in iCook 4-H, the interactive website remained in use until the 24-month follow-up point. Monthly challenges for cooking and physical activity encouraged youth to continue posting pictures or videos on the website. Any child that posted a picture or video for the challenge was entered into a drawing for a $25 or $50 gift card, and one winner was chosen for each challenge monthly. In addition to the website, a monthly newsletter was sent out that included the monthly challenge winners as well as healthy recipes and word searches. Booster events were held twice each year to keep treatment participants interactive with the other families in their classes. States planned booster events individually, but all states tried to keep activities within the cooking or physical activity areas. An example of a booster event included going to SkyZone, an indoor trampoline park.

Data Collection Procedures: Control and treatment youth participated in assessments at 0, 4, 12, and 24-months by trained researchers. Anthropometric measurements were taken, accelerometer data was collected, and surveys were administered at each of the time points. Youth were compensated $20 for each of the four assessment times.

Anthropometric Assessments: Anthropometric assessments included height and weight. Height measurements were taken twice, and measured to the nearest 0.1 cm using a SECA 213 or a Charder HM 200P portable standiometer. Weight measurements were also taken twice, and measured to the nearest 0.1 kg using a SECA 874 digital scale or HealthOMeter 752KL portable health scale. Trained researchers took all measurements,

(inter-rater reliability of Pearson correlation coefficient ≥0.80) and the average of the two measurements for both height and weight was used. Instruments were calibrated prior to assessment.

Assessment of Physical Activity and Sedentary Time: Physical activity and sedentary time were objectively measured using accelerometers in a subset of the total sample of 228 control and treatment youth. At baseline, a goal of fitting 25% of the sample with accelerometers was set. However, based on the total sample recruited and timing of assessments, accelerometers were provided to the first 156 (68%) youth to measure the frequency, duration, and intensity of activity. Selected youth were given an ActiGraph GT3X+ accelerometer on an elastic belt of their color choice, along with instructions on how to wear the accelerometer. Log sheets were provided for youthto manually record times when the accelerometer was taken off and for what reasons. Accelerometers were initialized to collect data in 10-second epochs at 30 Hertz, for a seven-day duration. Youth were instructed to wear the device a set 7-day period. Accelerometers were collected after the seventh day.

Compliance for the accelerometers required that it be worn for three valid weekdays, and one valid weekend day. A valid day included a minimum of 9 hours of wear time between 7 a.m. – 9 p.m.; with non-wear time defined as ≥60 consecutive minutes with no activity counts. Any day with ≥6 periods of non-wear time was considered noncompliant, and that single day was excluded from the analysis. If >9 hours/day were compliant, all compliant hours were included in the analysis. Accelerometer data provided the average minutes of sedentary time, light physical activity (LPA), moderate physical activity (MPA), vigorous physical activity (VPA), and

MVPA. Cut-points for accelerometer data were defined based on the number of activity counts per epoch as defined by Evenson and colleagues, and were as follows: sedentary time 0-16 counts, LPA 17-382 counts, MPA 383-668 counts, VPA ≥669 counts, and MVPA ≥383 counts.[46]

An additional measure of activity was a program evaluation survey that was created by the research team and completed at all assessment time points by treatment and control youth. This evaluation was used to query youth on a scale of 1 to 5 with responses coded as the following: 1=never, 2=rarely, 3=sometimes, 4=most of the time, and 5=always. Physical activity questions on the program evaluation survey included the following:

- When you think about each day of the week, how often are you physically active for at least 60 minutes each day?
- When you think about each day of the week, how often does your heart pump hard and you sweat when you are being physically active?
- How often does your family play actively together?

Data Analysis: R data analysis software (R, 3.2.3, Vienna, Austria, 2015) was used to calculate descriptive statistics for accelerometer data. Likelihood ratio tests were used to analyze associations in minutes per day of sedentary time and physical activity intensities at each time point. Linear mixed models were used to analyze differences in program evaluation survey data. A p-value of ≤0.05 was set as statistically significant for both likelihood ratio tests and linear mixed models. The number of youth meeting the physical activity guidelines was also calculated. Meeting the physical activity guidelines was defined as achieving an average of 60 minutes per day of MVPA.

Results

The iCook 4-H program included a total of 228 dyads. Of these participants, 68% were Caucasian, 12% African American, 1% Asian, 14% Hispanic, 3% Native American, and 2% other. At baseline, 156 youth were given accelerometers, with 124 youth (88 treatment; 36 control) meeting accelerometer compliance standards. Subsequently, 84 youth (55 treatment; 29 control) met accelerometer compliance standards at 4-months, followed by 51 youth (34 treatment; 17 control) at 12-months, and 33 youth (25 treatment; 8 control) at 24-months.

Mean minutes of physical activity and sedentary time are outlined in Table 1. After controlling for group and gender, time was a significant predictor of both physical activity and sedentary time from 0 to 24-months. Physical activity minutes per day steadily decreased from 0-24 months for all intensity categories, and sedentary time steadily increased from 0-24 months. There were no significant differences in physical activity or sedentary time between treatment and control groups at any time point. Gender was a significant predictor of MPA ($p=0.02$), VPA ($p=0.02$), and MVPA ($p=0.01$) levels, with males reporting an average of 4 more minutes of MPA, 2.9 more minutes of VPA, and 7 more minutes of MVPA per week.

The percentage of youth meeting the physical activity guidelines is reported in Table 2. Those meeting the guidelines decreased from 0 to 24-months. At 0-months, 30.7% of treatment and 41.7% of control youth were meeting PA guidelines, whereas at 24-months, only 8.0% of treatment and 0.0% of control youth met guidelines.

Program evaluation data is reported in Table 3. Over time, the data showed a trend that there were differences between groups for how often youth reported playing

actively together with their families (p=0.08). Treatment youth reported an increase in playing together while control youth reported a decrease. The data also showed a trend over time that there were differences by group for how often youth engaged in physical activity that made their heart pump hard and made them sweat (p=0.07). The treatment group reported a slight increase and the control group stayed the same over time.

Discussion

The objective of the current study was to assess physical activity and sedentary time from 0 to 24-months in youth who participated in the iCook 4-H Program. Mean daily minutes of physical activity decreased for all intensity levels, sedentary time increased, and the percentage of youth meeting physical activity guidelines decreased. Program evaluation survey results also indicated that youth responses trended for differences by group and time for how often they played actively together, and how often they participated in activity that made their heart pump hard and made them sweat.

Time was a statistically significant predictor of activity level including physical activity at all intensity levels and sedentary time, while gender was a statistically significant predictor of MPA, VPA, and MVPA. It is established that physical activity decreases and sedentary time increases with age.[12,16] Previous researchers have looked at factors affecting activity levels and reported that age, gender, and type of activity all play a role in activity levels. An intervention by Vanhelst and colleagues reported that the physical activity program was more effective for youth less than 12 years old, suggesting the need to aim physical activity interventions at younger age groups.[58] This study also reported that team sports had better outcomes than net sports (i.e. volleyball, tennis), and that activities should be age and/or gender specific to have the greatest impact.[58]

Additionally, Jago and colleagues reported in a quantitative study on the Action 3:30 Program that children enjoyed a program that offered variety, the children enjoyed leading the activities, as well as enjoyed when their session leader joined them in activities.[59] Children also reported that they wanted games that were challenging enough for them (age-appropriate) and that they did not like elimination games such as dodge ball. Results from Jago and colleagues also suggested the need for age- and gender-specific physical activity programs.[59]

It is also important to consider factors such as time spent in school, which can significantly influence activity levels. On average, children in the United States spend a majority of their day in school, roughly 6.64 hours per day.[60] While schools provide multiple opportunities for students to be physically active, including Physical Education class, recess, standing desks, and activity breaks, these opportunities are not always utilized. Many schools do not have the budget or space for Physical Education classes, and choose to cut recess time for more time in the classroom.[61,62] However, it is important to note that assessment times for the iCook 4-H Program typically occurred during the summer months (July-August) when youth should not have been accumulating high amounts of sedentary time due to school. This factor suggests that youth in the current study may have recorded even more sedentary time if assessments had been done during the school months.

Environmental factors, which are not readily changed, are also important to consider, and have been reported in multiple studies. Taylor and colleagues conducted a Physical Activity Friendliness Audit and reported that accessibility and safety were predictors of obesity, likely as a result of less physical activity.[63] A review by Safron and

colleagues also reported that neighborhood crime rates, cost of facilities (gyms, wellness centers, etc.), and availably within the community for exercise were all factors that affected physical activity levels of children and adolescents.[64]

Knowledge of physical activity and skill for performing activities may also be predictors of activity levels. Jaakkola and colleagues reported that fundamental movement skills, (locomotor, manipulative, and balance skills) and physical fitness (cardiorespiratory endurance and muscle strength) in youth were predictors of physical activity levels later in life. [65] Cohen and colleagues also reported a correlation between fundamental movement skills with physical activity levels and cardiorespiratory fitness.[66] Both studies provide support for improving knowledge and competence of movement as a foundation for increasing physical activity and decreasing sedentary time.

The type of intervention aimed at improving activity levels is another factor to consider. Li and colleagues used the Social Ecological Model (SEM), which includes individual, interpersonal, organizational, community, and public policy levels, as the basis for a physical activity intervention.[25] The intervention was multicomponent and included requirements for Physical Education, physical activity during the school day, and also had take-home components, which included Physical Education as a homework assignment. The intervention did see a change in mean BMI; triceps, subscapular, and abdominal skinfold thickness; and fasting glucose.[25] This intervention is an example of how using a framework, such as the SEM, can help shape interventions to impact all applicable factors, and is also an example of an intervention focused on just one risk factor for obesity - physical activity.[25]

For the program evaluation question, "When you think about each day of the week, how often does your heart pump hard and you sweat when you are being physically active?" treatment youth responses indicated a trend that youth increased how often they participated in these types of activities, while control group youth responses stayed the same. However, according to the subjective accelerometer data, minutes per day of activity for both treatment and control youth decreased over time. This finding suggests that youth may not have an accurate perception of what physical activity is, and reinforces the importance of creating programs that provide instruction on physical activity behaviors that can be adopted as a lifelong habit. This finding may also suggest that the intervention needed to have a greater emphasis on physical activity for the desired change (an increase in activity) to be acquired.

The most significant finding in the program evaluation survey was the trend seen in how often youth participants reported their family played actively together, with the treatment group reporting an increase and the control group reporting a decrease. This indicates that the iCook 4-H Program may have had effect on "playing", which youth may perceive differently than physical activity. This may be an important finding, as children tend to have a more positive view of playing versus being physically active.[67,68]

Conclusion

Although the iCook 4-H program did not significantly increase physical activity or decrease sedentary time, the study did follow youth over 2 years, providing valuable information on the activity patterns of the youth participants. The iCook 4-H Program was a multicomponent program, with the primary focus on cooking skills, mealtime behavior, and family conversation, all areas that did have significant positive outcomes.

Because multicomponent programs present information on several topics in one sitting, it can be more difficult for participants to successfully apply all the presented material.

In the iCook 4-H Program, physical activity was meant to be incorporated in daily living activities, with an overall goal to reduce sedentary time. Therefore, the results of the current study imply that obesity prevention interventions aimed at increasing physical activity or decreasing sedentary time may need to put greater focus on those specific intended outcomes. It may also be important to put focus on identifying barriers to physical activity and facilitators for sedentary time, and creating interventions to combat these barriers and facilitators.

Additional factors to consider for childhood obesity interventions include placing greater emphasis on developing physical activity skills, as well as teaching youth what constitutes physical activity. Furthermore, focus should be placed on changing environmental factors and increasing physical activity both during and after school. Age and gender should also be taken into consideration for childhood obesity interventions aimed at physical activity.

Sedentary time and physical activity are independent risk factors for obesity and chronic diseases. In order to increase physical activity for obesity prevention, it must be of the moderate-to-vigorous intensity level. Therefore, reducing sedentary time may provide a second angle for preventing childhood obesity within an intervention. Overall, more interventions are needed to prevent the decrease in physical activity and increase in sedentary time that results as children age into adolescence. More research is needed on specific interventions aimed solely at increasing physical activity and decreasing sedentary time in youth.

FIGURES

Figure 1: iCook 4-H Physical Activity Components by Session

Session 1	**Getting-To-Know You Circle Game**	A way for participants to get to know each other, and learn a game that can be played at home
Session 2	**Know Your Heart Rate**	Dyads checked their heart rate during different activities to learn about physical activity intensity
Session 3	**Activity Charades**	Learn what muscles are being used while doing certain activities
Session 4	**Stretching**	Learn the importance of stretching – injury prevention and flexibility
Session 5	**iCook Shuffle**	An example of a way to be active at home
Session 6	**Cup Stacking Game**	An example of a way to be active at home

Figure 2: iCook 4-H Website

TABLES

Table 1: Physical Activity and Sedentary Time Minutes Per Day in iCook 4-H Youth from 0 to 24-Months.

	Treatment Group (Minutes/Day±SD)				**Control Group (Minutes/Day±SD)**				**Time**	**Group**	**Gender**
	0 Months (n=88)	**4 Months** (n=55)	**12 Months** (n=34)	**24 Months** (n=25)	**0 Months** (n=36)	**4 Months** (n=29)	**12 Months** (n=17)	**24 Months** (n=8)			
Sedentary Time	547±56	582±61	609±84	676±85	548±71	564±66	576±74	632±100	**<0.01**	0.22	0.29
LPA	241±46	217±50	191±68	137±69	239±57	225±51	216±52	174±90	**<0.01**	0.39	0.61
MPA	34±10	28±9	21±12	19±13	35±12	34±13	32±15	21±12	**<0.01**	0.06	**0.02**
VPA	17±9	13±7	16±9	8±6	18±9	17±9	16±13	9±7	**<0.01**	0.10	**0.02**
MVPA	52±18	41±15	39±19	27±18	53±21	51±21	48±27	29±18	**<0.01**	0.07	**0.01**

Likelihood ratio tests were used to calculate p-values using R data analysis software.
Significance was set at $p \leq 0.05$.

Table 2: Percentage of Youth With Accelerometers Meeting Physical Activity Guidelines.

Youth Meeting Physical Activity Guidelines	Treatment Group				Control Group			
	0 Months (n=88)	4 Months (n=55)	12 Months (n=34)	24 Months (n=25)	0 Months (n=36)	4 Months (n=29)	12 Months (n=17)	24 Months (n=8)
	30.7%	7.3%	14.7%	8.0%	41.7%	24.1%	17.6%	0.0%

Meeting physical activity guidelines was defined as an average of ≥60 minutes/day of MVPA.

Table 3: Youth Program Evaluation Survey Responses About Physical Activity.

Youth Survey Question	Treatment (Mean ± SD)				Control (Mean ± SD)				Group x Time
	0 Months	4 Months	12 Months	24 Months	0 Months	4 Months	12 Months	24 Months	
How often does your family play actively together?	2.7±1.0	3.0±1.1	3.1±1.1	3.1±0.9	3.0±1.1	2.8±1.0	2.9±0.9	2.8±0.9	0.08
When you think about each day of the week, how often does your heart pump hard and you sweat when you are being physically active?	3.6±1.2	3.8±1.1	3.9±1.0	3.8±0.9	3.8±1.1	3.5±1.2	3.7±1.3	3.8±0.8	0.07

Linear mixed models were used to calculate p-values using R data analysis software.
Significance was set at $p \leq 0.05$.
Program evaluation survey questions were coded as the following: 1=Never, 2=Rarely, 3=Sometimes, 4=Most of the time, 5=Always.

APPENDIX

4-H Food & Fitness Research Study

to learn about food and physical activity habits of youth
to help them grow strong and have healthy lives

Starting late July
Do not have to be a current 4-H member
9 & 10 year old youth and meal preparing adult
Receive up to $80 for being in the 2 yearlong study

Some families will be asked to attend 4-H cooking classes this fall. All families will have blood pressure taken and complete surveys and youth will have physical measurements taken 4 times over the next 2 years. Youth will have physical measurements taken.

To participate, youth and adults will need to:

- Be free from food allergies and/or activity-related medical restrictions that would prevent you being in a face-to-face food and fitness program
- Eat meat and dairy, as vegetarian options may not be available in the food and fitness program.
- Have a computer at home with Internet

Space is limited! Call (605) 688-6199 if interested!

Consent Form-Intervention Treatment Group

Thank you for your interest in the iCook Project, which is a 4-H program and a research study. Adrienne White and her team at the University of Maine, including Cooperative Extension staff, are studying health and fitness of children between 9-10 years old and the adult in their home who makes most of the food. To participate, you and your child must be free from food allergies and/or activity-related medical restriction that would prevent participation in a face-to-face food, nutrition and fitness program. We want to study you and your child over 2 years to help understand the impact of physical growth, nutrition and physical activity on health and fitness.

The purpose is to study how to help children make choices about what they eat and how physically active they are so that they will grow strong and have healthy lives.

You will be part of a 5-state study about children's nutrition and physical health. The four other researchers are at South Dakota State University, the University of Nebraska, University of Tennessee, and West Virginia University.

There will be 6 cooking classes every other week from August through November. Each cooking session will take about 2 hours and will take place at _____. In addition to the cooking sessions, you will be asked to participate in other activities that will be primarily online thorough an educational community for parents and children. The project will last for 2 years so that eating habits and physical activity can be assessed long term to see their impact on health and fitness.

What Will You Be Asked to Do?
You will be asked to have your blood pressure measured and complete a 30-minute online survey at the start of the program, and then at 4 months, 12 months and 24 months.

Sample questions for the online survey are:

- How often do you compare prices before you buy food?
- How concerned are you about your child eating too much when you are not around him or her?
- During the past 30 days, for how many days have you felt very healthy and full of energy?
- I worry about what will happen to me.

You will be asked to visit the program website regularly, at least once per week during the fall sessions, and help upload videos your child has made about cooking, being physically active and eating as a family. You will be given a login and password for security.

You will be asked to be assessed in August and November of this year and then in August of 2014 and August of 2015 to complete the 2 year study. At each

Risks to Participation
There is minimal risk to participating in the study, primarily due to time and inconvenience. Normal kitchen risk is possible.

Compensation
You and your child will receive $10.00 each time you complete the assessments for a total of $80.

Program Resources
You will receive $10 each time you come to one of the six cooking sessions for a total of $60. Your child will receive a video camera to shoot the requested videos on family activities around cooking, mealtime and recreation. This camera will be the child's to keep.

Confidentiality
All information that is provided is confidential and protected. All data collected will be kept on the researcher's password protected computer and in the University of Maine, Nutrition Education and Behavior Laboratory, for up to four years and then destroyed. Not identifiable information will be stored indefinitely in an electronic version accessible to the researchers who are part of the 5-state study.

Website data collection and educational intervention will be password protected. Your contact information will be requested for payment purposes and for contacting you for follow up assessments. This information will be destroyed once you are paid at the end of the study. All data will be reported in summary format and no names will be used.

Voluntary
Participation in this study is voluntary. If you choose to take part in this study, you may stop at any time. If you choose to stop you will only receive incentives for the assessments and program activities that you have completed.

Contact Information
Contact Adrienne White for questions about the research project at 581-3134, at the University of Maine. For questions about your rights as a study participant, contact Gayle Jones, Assistant to the Maine's Protection of Human Subjects Review Board, at 581-1498.

Your signature below indicates that you have read, understand the above information, and that you agree that you and your child will participate in the iCook-4H Research Program. You will receive a copy of this form for your records.

_____
_____

assessment period we will ask you to take the 30 minute survey and have your blood pressure measured.

What will your child be asked to do?
Your child will be asked to complete a 50 minute assessment that includes 30 minutes for an online survey and 20 minutes for physical assessments (e.g. height, weight, waist circumference; blood pressure). Your child will be asked to pick the outline of a girl's/boy's body that looks most like she/he does. The reason for this assessment is because children often grow and mature very quickly between 9-10 years old and we want to measure that growth. The body outline question will be asked by an older female researcher or a male researcher for boys and a female researcher for girls. Assessments will be at the start of the program, and then at 4 months, 12 months, and 24 months.

Sample questions for the online survey your child will be asked are:

- During the past week, how many days did you eat breakfast?
- I can follow a recipe by myself (answer from agree to disagree)
- I worry about what will happen to me (answer from never to almost always)

In addition your child will be asked to make and share video clips with camera equipment provided by the program staff about themselves and your family cooking, eating, and being active together. These videos will be hosted on a private YouTube channel and will only be accessible to other people participating in the project.

During the 2-year period, your child may be asked to wear a waistband that contains an activity monitor for a week each time physical assessments are taken. This device records your child's activity (e.g., step and movement during day and night).

What will both of us be asked to do?
For the first twelve weeks you and your child will be asked to participate in 2-hour cooking sessions every other week with your child. Between sessions you and your child will be asked to cook together, participate in family meals, and be physically active.

Following the first twelve weeks, you and your child will be asked to participate for 22 months in an online community website that is developed just for this study. The website will have educational sections designed for both the adult and the child. You will be able to interact with your peer group in forums moderated by program staff. Your child will also be able to continue creating and sharing videos. Online activities can be done from home or anywhere you have an Internet connection. The site is mobile friendly.

Benefits to Participation
You will gain knowledge and experience to improve culinary skills, child feeding practices, family meal times, and physical activity. Your family's participation in this study may lead to better understanding of the role of nutrition and fitness in childhood obesity.

Printed Name Signature

_____
Date

_____
Your child's first and last name

Consent Form- Control Group

Thank you for your interest in the iCook Project, which is a 4-H program and a research study. Adrienne White and her team at the University of Maine, including Cooperative Extension staff, are studying health and fitness of children between 9-10 years old and the adult in their home who makes most of the food. To participate, you and your child must be free from food allergies and/or activity-related medical restriction that would prevent participation in a face-to-face food, nutrition and fitness program. We want to study you and your child over 2 years to help understand the impact of nutrition and physical activity on health and fitness.

The purpose is to study how to help children make choices about what they eat and how physically active they are so that they will grow strong and have healthy lives.

You will be part of a 5-state study about children's nutrition and physical health. The four other researchers are at South Dakota State University, the University of Nebraska, University of Tennessee, and West Virginia University. We want to study you and your child over 2 years to help understand the impact of physical growth, nutrition and physical activity on health and fitness.

What Will You Be Asked to Do?
You will be asked to have your blood pressure measured and complete a 30-minute online survey at the start of the program, and then at 4 months, 12 months and 24 months.

Sample questions for the online survey are:

- How often do you compare prices before you buy food?
- How concerned are you about your child eating too much when you are not around him or her?
- During the past 30 days, for how many days have you felt very healthy and full of energy?
- I worry about what will happen to me

What will your child be asked to do?
Your child will be asked to complete a 50 minute assessment that includes 30 minutes for an online survey and 20 minutes for physical assessments (e.g. height, weight, waist circumference; blood pressure). Your child will be asked to pick the outline of a girl's/boy's body that looks most like she/he does. The reason for this assessment is because children often grow and mature very quickly between 9-10 years old and we want to measure that growth. The body outline question will be asked by an older female researcher or a male researcher for boys and a female researcher for girls. Assessments will be at the start of the program, and then at 4 months, 12 months, and 24 months.

Sample questions for the online survey your child will be asked are:

- During the past week, how many days did you eat breakfast?
- I can follow a recipe by myself (answer from agree to disagree)
- I worry about what will happen to me (answer from never to almost always)

During the 2-year period, your child may be asked to wear a waistband that contains an activity monitor for a week each time physical assessments are taken. This device records your child's activity (e.g., step and movement during day and night).

Benefits to Participation
We will provide you and your child with your blood pressure assessment in writing within a month of each assessment period. Your family's participation in this study may lead to better understanding of the role of nutrition and fitness in childhood obesity.

Risks to Participation
There is minimal risk to participating in the study, primarily due to time and inconvenience.

Compensation
You and your child will receive $10.00 each time you complete the assessments for a total of $80.

Confidentiality
All information that is provided is confidential and protected. All data collected will be kept on the researcher's password protected computer and in the University of Maine, Nutrition Education and Behavior Laboratory, for up to four years and then destroyed. Not identifiable information will be stored indefinitely in an electronic version accessible to the researchers who are part of the 5-state study.

Your contact information will be requested for payment purposes and for contacting you for follow up assessments. This information will be destroyed once you are paid at the end of the study. All data will be reported in summary format and no names will be used.

Voluntary
Participation in this study is voluntary. If you choose to take part in this study, you may stop at any time. If you choose to stop you will only receive incentives for the assessments that you have completed.

Contact Information
Contact Adrienne White for questions about the research project at 581-3134, at the University of Maine. For questions about your rights as a study participant, contact Gayle Jones, Assistant to the Maine's Protection of Human Subjects Review Board, at 581-1498.

Your signature below indicates that you have read, understand the above

information, and that you agree that you and your child will participate in the iCook-4H Research Program. You will receive a copy of this form for your records.

_____
_____
Printed Name Signature

_____
Date

_____
Your child's first and last name

Training Modules for iCook 4-H Leaders

The following were recorded videos for all iCook leaders to view prior to teaching classes:

1. iCook 4-H Program Welcome and Overview
2. iCook 4-H Curriculum Overview
3. Recruiting Participants
4. Creating Participant User Accounts on myicook4h.com
5. Participant Program Evaluation Surveys
6. Participant Process Evaluation Surveys
7. Uploading Participant Videos to myicook4h.com

Physical Assessment Protocol

Responsibility of Site Primary Investigators

- Site PIs are ultimately responsible for ensuring that assessment protocols described in this manual are followed precisely.
- Proper training of all those who will conduct the assessments is required.
- The site PI is responsible for calculating the inter-rater reliability for all assessors at the site after training and before measurements start.

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 (See Figure 3).

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.

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 (Frankfurt Plane; see Figure 3).
6. Make sure the black stopper at the top of the stadiometer is pressed against the wall. (Figure 4: Stadiometer setup)

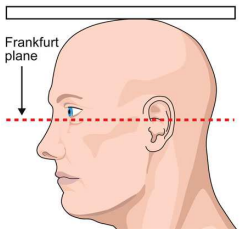


Figure 3: Frankfurt Plane

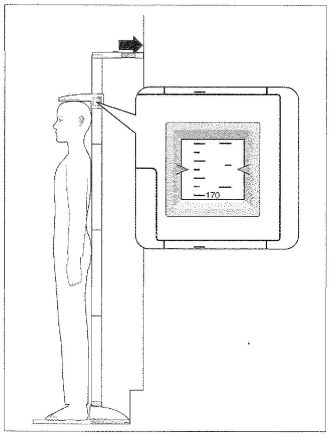


Figure 4: Stadiometer setup

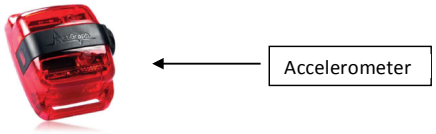
7. Ask the participant to take a deep breath in and hold it to straighten the spine and standardize measurement.
8. Fix the height slide in place and ask the participant to resume normal breathing.

9. 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.
10. 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.
11. Record all measurements on the data collection sheet. Be sure to cross out any unofficial measurements (i.e. those discarded due to excess disagreement).
12. Record the average of the two official measurements to two decimal places (e.g., 0.2 + 0.3 = 0.5/2=0.25).

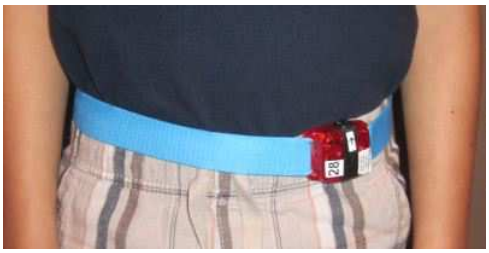
Dear Participants of the iCook 4-H program,

Thank you for agreeing to participate in the iCook 4-H program. An important part of the iCook 4-H program is to promote physical activity and help you and your children lead a more active lifestyle. This week we will be assessing physical activity in your child. Your child will wear a small red device that measures physical activity for the next several days. The device needs to be worn on a belt around the waist 24 hours a day except during bathing. The device is called an accelerometer. In order to make our data collection process go smoothly, here are a few tips and pointers that will help us to assess your child's physical activity.

- All child participants will be wearing the device shown below:



- The accelerometer should be worn at the waist on the belt provided. The accelerometer should be placed over one hip. As shown in the picture below:



- The accelerometer has an arrow on it, please make sure this is pointing upwards (towards the sky).
- The belt can be worn above or beneath your clothing.
- The accelerometer can NOT get wet. Therefore, it needs to be removed in all instances where it would get wet, such as: bathing, swimming, heavy rain.
- The accelerometer should be worn 24 hours a day. Please help your child remember to take the accelerometer off before swimming or bathing and put on after swimming or bathing.
- Attached is a physical activity log to help track and monitor activity throughout the week. We ask for your assistance to help your child fill out the log each day. Please record what time the accelerometer is put on and taken off.
- If you forget to wear your accelerometer at any point throughout the week make sure you put it back on as soon as you remember.

The accelerometer will be worn from today _____through _____.
A research assistant from the iCook program will be picking up the device and the iCook 4-H Physical Activity Log from your child at _____on _____.

Thank you very much for your participation. If you have any questions or concerns, please feel free to contact the iCook program faculty below:

Celine Kabala
Phone: 605-688-6199
E-mail: Celine.Kabala2@sdstate.edu

iCook 4-H PHYSICAL ACTIVITY LOG

CHILD NAME: **Accelerometer Number:**

The accelerometer will be worn from today **8/11** through when your child wakes up on **8/18** . Place the belt and device in the bag provided on this date. Please drop off the device at your post assessment **4-H Extension Building where you did your assessments.**

Document when the Accelerometer is not worn.

DATE	TIME ON	TIME OFF	COMMENTS*
11/			
11/			
11/			
11/			
11/			
11/			
11/			
11/			

*Include in comments if belt was taken off during the day (forgot, swimming, bathing, etc.)

*Also include any circumstances that may affect your child's physical activity (sick, out-of-town, etc.)

Youth Survey Questions

When you think about each day of the week, how often are you physically active for at least 60 minutes each day?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Most of the time (4)
- Always (5)

When you think about each day of the week, how often does your heart pump hard and you sweat when you are being physically active?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Most of the time (4)
- Always (5)

How often does your family actively play together?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Most of the time (4)
- Always (5)

Data Collection Form

iCook 4-H DATA COLLECTION FORM

Adult Name: Last, First Website Username: **Child Name:** Last, First Website username:	**Gender** (circle) Male Female **Gender** (circle) Male Female
Adult Birthdate (mo/day/yr) **Child Birthdate** (mo/day/yr)	**Year in School** (circle) First Second Third
HOME ADDRESS:	

DAY PHONE # (with area code):	**CELL PHONE #** (with area code):	**EMAIL ADDRESS**:
BEST WAY TO CONTACT (check any applicable box): email day phone cell phone Other, specify:		

	Baseline (September 2012)	**3-Month Follow Up (November 2012)**
Compensation given at time of assessment?	YES NO	YES NO
Signature		
Date		

	Baseline			**Follow-Up**		
	Consent	**Survey**	**Measurements**	**Consent**	**Survey**	**Measurements**
Did the participant do …						

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