Mean Nutrition and Physical Activity Knowledge Score of Children Ages 3-5 years in the iGrow Readers Intervention

Mollie Loes
South Dakota State University

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MEAN NUTRITION AND PHYSICAL ACTIVITY KNOWLEDGE SCORE OF CHILDREN AGES 3-5 YEARS IN THE IGROW READERS INTERVENTION

BY

MOLLIE LOES

A thesis submitted in partial fulfillment of the requirements for the

Master of Science

Major in Nutrition and Exercise Sciences

Specialization in Nutritional Sciences

South Dakota State University

2019
Mean Nutrition and Physical Activity Knowledge Scores of Children Ages 3-5 in the iGrow Readers Intervention

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

Mary Bowne, Ed.D.  
Thesis Advisor

Kendra Kasselmann, Ph.D.  
Head, Department of Health and Nutritional Sciences

Dean, Graduate School

/ Date /
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Second I would like to thank Dr. Jessica Meendering, Dr. Suzanne Stluka, Dr. Matthew Vukovich, and Dr. Kendra Kattelmann for providing me guidance and the opportunity to work with iGrow Readers. I am very thankful for their knowledge and direction through this process.

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</tr>
<tr>
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<td>Coordinated Approach to Child Health for Early Childhood</td>
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<td>Center for Disease Control</td>
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<td>Longitudinal Eating and Physical Activity</td>
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ABSTRACT

MEAN NUTRITION AND PHYSICAL ACTIVITY KNOWLEDGE SCORE OF CHILDREN AGES 3-5 YEARS IN THE IGROW READERS INTERVENTION

MOLLIE LOES

2019

The prevalence of childhood obesity remains high within the United States, which can lead to long-term harmful effects. During the first five years of children’s lives, healthy eating habits and physical activity patterns are formed, so the preschool years are a critical time to begin obesity prevention (4). Because the preschool years are crucial for providing healthy eating habits and physical activity patterns, there is the need for childhood obesity interventions. iGrow Readers is a cluster-randomized control study concentrated on children 3-5 years of age recruited from childcare centers from South Dakota, Nebraska, and Minnesota. Fourteen child care centers with a total of 35 classrooms were enrolled. Intervention classrooms implemented the 8-week iGrow Readers curriculum. The curriculum paired developmentally appropriate children’s books with nutrition and physical activity information and activities. Results: The total study population included 293 children ages 3-5 years. Of the 293 children, 176 were in the intervention group and 117 in the control group. Knowledge scores for nutrition and physical activity were collected and summarized for mean scores based on gender and age, shown in Table 1.1. The children’s mean nutrition and physical activity knowledge scores increased with age in both the control group and intervention group. Discussion: Data between pre, post, and follow-up mean knowledge scores of the intervention and
control group based on age show potential increases in scores. Due to the increase of
knowledge scores with age, the iGrow Readers curriculum has the potential to impart
nutrition and physical activity knowledge, which can then develop nutrition and physical
activity behavior as they continue to age. iGrow Readers curriculum is a feasible
curriculum that can be implemented into childcare centers. Additional statistics and
research need to be conducted to determine knowledge change.
Chapter 1

Introduction

The prevalence of childhood obesity remains high within the United States. In recent years, childhood obesity among children 2-19 years of age has not significantly changed, but still poses as an issue with about 18.5 percent or 13.7 million children classified as obese(1). In children 2-5 years of age, the prevalence of obesity is 13.9% and the percentage increases as the child gets older(1). Childhood obesity is a serious problem in the United States and puts children at risk for poor health. Therefore, obesity prevention and intervention during the preschool years are still needed.

Childhood obesity can have long-term harmful effects. Obese children are at a greater risk for development of cardiovascular disease, type 2 diabetes, sleep apnea, joint problems, and are also at greater risk for social and psychological problems (2) than normal weight children. The causes of obesity are multifactorial and include individual, social, cultural, and environmental factors (3). Prevention is paramount and healthy eating habits and physical activity can assist with the prevention of the negative effects due to obesity.

During the first five years of children’s lives, healthy eating habits and physical activity patterns are developed, thus the preschool years are a critical time to begin obesity prevention.(4) Sixty percent of children six years and younger spend at least twenty-nine hours a week in childcare or preschool settings, giving preschool interventions the potential to positively impact the obesity trend (5). During those first five years, children acquire their eating habits and physical activity patterns through associative learning and imitation from parents, childcare providers and educators. With only 30 percent of children meeting the recommended amount of fruit, vegetable, grains,
meat, and dairy set by the USDA, it is important for parents, caregivers, and teachers to model and teach healthful behaviors (6).

There is also a need for childhood obesity interventions focusing on increasing nutrition and physical activity knowledge. Reading a children’s book and incorporating activities around the book’s theme can create an integrated curriculum approach, which supports children’s engagement, motivation to learn and interests (7,8).

iGrow Readers, an Extension-service based intervention program, is a developmentally appropriate literacy-based curriculum that focuses on nutrition and physical activity activities through the use of children’s books, lessons, and parental newsletters. iGrow Readers, a randomized control study, was instituted to increase the knowledge of nutrition and physical activity in children 3-5 years of age. Increasing knowledge associated with obesity can potentially decrease childhood obesity and continue throughout adulthood. The purpose of the iGrow Readers study described in this paper is to determine the feasibility of delivery and whether an 8-week, literacy-based developmentally appropriate curriculum has the potential to increase children’s nutrition and physical activity knowledge

Statement of the Problem

Children ages 3-5 years continue to be overweight or obese, thus increasing the need for early childhood nutrition and physical activity preventions and interventions.
Significance of the Study

The epidemic of childhood obesity continues to be a problem within the United States. By focusing on early childhood nutrition and physical activity knowledge, childhood obesity can potentially be reduced and carried into adulthood.

Variables

1. Independent Variables
   a. 8-week implementation of the iGrow Readers curriculum
   b. Intervention vs. control group
2. Dependent Variables
   a. Nutrition and physical activity knowledge scores

Limitations

The scope of the study is limited to:

1. Seasonal variability
2. Three state difference
3. Quality of child care facilities
4. Teacher’s comfort level and knowledge base to teach nutrition and physical activity lessons
5. Children’s willingness to answer questions
6. Midwestern states

Delimitations

The scope of the study is delimited to:

1. Population – focusing on 3-5 year olds
2. The number and locations of the child care centers willing to participate
3. Intervention group vs. control group

Assumptions

1. Teachers used the curriculum correctly
2. Children participated in all nutrition and physical activity lessons
3. Child care centers, teachers, and children completed the study from beginning to end
Definition of Terms

1. Childhood obesity – excess amount of body fat, children with a BMI over the 95th percentile measured using height and weight.
2. Physical activity - additional energy expenditure caused by movement or an activity requiring skeletal muscles
3. Child care centers – includes daycare centers, child care centers and preschools

Specific Aims

1. To determine the feasibility of delivering the developmentally appropriate nutrition and physical activity curriculum intervention in child care centers.
2. To compare the intervention and control group’s pre, post and follow up nutrition and physical activity knowledge scores in children ages 3-5 years.

Research Hypothesis

It is hypothesized the iGrow Readers curriculum will be delivered to 3-5 year olds in child care centers and increase 3-5 year old’s nutrition and physical activity knowledge.
Chapter 2
Review of Literature

A review of literature was conducted to understand the current childhood obesity interventions, the need for early childhood obesity interventions, and how those interventions can have an impact on knowledge and behavior. The literature focuses on key components of childhood obesity such as: trends in early literacy and language development, childhood obesity, nutrition and physical activity patterns in children, the best way to assess nutrition and physical activity knowledge, and how early childhood obesity interventions can impact nutrition and physical activity knowledge.

Early Literacy and Language Development

Early literacy and language development are fundamental for young children. When children are born, their brain cells are in place and ready to be utilized, but it requires real experiences and interactions for the cells to form the connections for thinking, language, physical movement, and social and environmental behaviors (9). Children’s language and literacy skills are developed during the early childhood years, making those years a pivotal time to develop those skills (10). According to Schiller, motor development has the greatest enhancement beginning at 2 years; thinking skills have the greatest enhancement starting at 4 years; and language skills have the greatest enhancement beginning at the age of 2 years. Young children are influenced by nature and nurture, nature being the biological forces of development and nurture being the environment and interactions that influence development (11). With the genetics already in place at birth, it is the environment or the nurture that can be influenced. Young children are depended on the interactions with parents, teachers, and caregivers, so the
greater the environmental experiences and the more meaningful the interactions and experiences, the greater the number of connections in the brain are created, which provide the foundation for thinking, reasoning, language, physical movement, social and environmental behaviors (9). The experience creates the connection and repetition of that experience strengthens those connections. Throughout early childhood, interactions and experiences are formed both inside the home and in early care and education settings. Due to the amount of time young children spend in early care and education settings, the settings can play a significant role in the development of a young child’s language and literacy skills (10).

Given the importance of the early childhood period as a time where the foundation is laid, it is important to determine what activities, experiences, and early childhood programs lead to positive outcomes (10). Early literacy lessons can provide preschool children the appropriate environment, materials, skills and social interactions that encourage reading and writing skills (12.) Books for children are instruments that provide understanding and knowledge, while giving the children opportunities to communicate both verbally and with written language. Roskos and colleagues recommend reading aloud to children one or two times per day. Maximum learning potential can be reached when children are given the opportunity to actively participate and respond to the material, provide supportive conversations, before reading activities, which get the children interested in the book, during reading questions that keep children involved, and after reading questions and activities that provide them the opportunity to learn and reflect on the book (12). Hands-on exploration and activities contribute to the understanding of the concepts and to the four critical thinking skills that are essential for
learning: making distinctions, recognizing relationships, organizing systems and taking multiple perspectives.

**Childhood Obesity**

According to the Center for Disease Control and Prevention (CDC), body mass index (BMI) is the measure used to determine childhood overweight and obesity. BMI is calculated by the child’s height and weight and does not measure body fat directly, but is used as a reasonable indicator of body fat (2). BMI for children is determined using age and sex percentiles instead of the categories used for adults. Percentiles are used because children’s body composition varies with age and sex. An overweight child is defined as having a BMI at or greater than the 85th percentile and lower than the 95th percentile, and an obese child is defined as having a BMI greater than the 95th percentile (2). Obesity affects 18.5 percent of the United States children 2-19 years of age, which is triple the rate from one generation ago. Childhood obesity remains high in the United States, but has begun to level off (13). The leveling of childhood obesity is positive, but overall continues to be high. Children who are obese are far more likely to be obese as an adult, and with one-third of adults being obese, the importance of preventing and controlling childhood obesity remains necessary (13). Obesity is a complex problem and a consequence of individual, social, cultural, and/or environmental factors. Action to decrease and prevent obesity has to be a comprehensive approach and come from all levels: individual, family, and community (3, 14).

*Health consequences:* Childhood obesity can be associated with chronic disease, disability, and even death (14). Overweight or obese children are more likely to have sleep apnea, high blood pressure, high cholesterol, type 2 diabetes, fatty liver disease and
are at greater risk of social and psychological problems. The negative effects of childhood obesity affect the quality of life of the individual and then translate into and throughout adulthood. The high rates of childhood obesity are associated with poor diet and lower physical activity levels and help contribute to the risk of chronic disease (15).

**Nutrition and Physical Activity Behavior in Children**

A healthy lifestyle helps prevent obesity and chronic diseases that can be associated with obesity. Healthy eating and physical activity in children are important for proper growth and development (15, 16). The Dietary Guidelines for Americans from the United States Department of Agriculture (USDA) for people two years and older recommend a diet rich in fruits and vegetables, whole grains, and fat-free and low-fat dairy. It is also recommended that children limit intake of solid fats, cholesterol, sodium, and added sugars (15). Unfortunately most children are not meeting the recommendations. Children in the United States are not meeting recommendations for eating fruits and vegetables and do not eat the minimum amount of whole grains which can be associated with obesity. Forty percent of children’s (between 2-18 years of age) daily calories are from consuming empty calories from added sugars and fats. Over half of the empty calories children are consuming come from six sources: pop, fruit drinks, dairy desserts, grain desserts, whole milk, and pizza (15). According to a *Nutrition Insight*, only 36 percent of children 2-3 years of age are seen as having a good diet, and the percentage decreases as age increases (12). Nutrition activities should be targeted starting at the younger ages of 2-5 years old, to prevent and potentially reverse the worsening of diet as they get older into adulthood (12).
Physical Activity Behavior: According to Glickman, physical activity is defined as additional energy expenditure caused by movement or an activity requiring skeletal muscles. In recent years, food consumption has increased and physical activity has decreased helping in the rise of childhood obesity (14). It is recommended by the U.S. Department of Health and Human Services that children participate in at least 60 minutes of moderate physical activity daily, however, most children are not meeting the recommendation (16). Regular physical activity in children helps build healthy bones and muscles, helps control weight, and can boost brain power. Woodward-Lopez completed a review that showed physical activity is critical for brain function and a child’s ability to learn (14). According to Roskos and colleagues, the link between literacy and exercise or play is the most effective way to make literacy activities meaningful and enjoyable for everyone. Childcare centers and schools can promote healthy nutrition and physical activity behaviors, by first setting the foundation of nutrition and physical activity knowledge through developmentally appropriate nutrition and physical activity programs in the early years of life (15, 16).

Nutrition and physical activity behaviors cannot be established without first laying the foundation of knowledge. iGrow Readers is looking to increase nutrition and physical activity knowledge to then have an effect on behaviors as children grow up, a time period when they begin to make independent decisions for themselves.

Programs for Increasing Nutrition and Physical Activity Knowledge

With sixty percent of children six years and younger spending at least twenty-nine hours a week in childcare or preschool settings, preschool intervention and prevention
programs have the opportunity to positively impact childhood obesity trends (5). Preschool years are a critical time to introduce and encourage healthy lifestyle, as early exposure can help establish healthy habits that carry into adulthood (6). Parents and caregivers influence children’s lifestyles in many ways, and due to their large influence, it is important to educate the parents and caregivers as well to help encourage healthy lifestyles to preschoolers (17).

A nine-month study done by Bryars desired to determine if preschool children who participated in a school-based Healthy for Life/PE4ME program would significantly increase physical activity, decrease screen time, improve nutritional knowledge and preferences, and decrease rates of overweight/obesity, using a non-experimental pre-test and post-test (5). Color Me Healthy and SPARK were the curriculums used. Those curriculums were used to stimulate the children’s senses. Parents of the preschooler were asked to complete pre-test questionnaires containing demographics, family medical history, and lifestyle questions related to their children at the beginning of the school year. At the end of the program preschool children completed a picture scale activity asking the students which food or physical activity would be the healthier choice between the two choices (5). Results were compared between obese, overweight and normal weight children. The study provided information showing that preschool environments are a great opportunity to provide and encourage healthy nutrition and physical activity learning experiences. The authors also indicated that more research is needed to justify placing physical activity and nutrition standards into preschools and child care settings (5).
CATCH Early Childhood program was launched in Head Start Centers (3). CATCH Early Childhood is a six-week, preschool-based program aimed at promoting healthy nutrition and increasing physical activity among children 3-5 years old. Teacher and parent focus groups were conducted to assess the feasibility and acceptability of CATCH Early Childhood. Parents of the children completed pre-test, self-reporting questionnaires with demographics, and parental perceptions of their children’s weights. Children’s BMI, physical activity and dietary intake were also measured. CATCH Early Childhood showed to be feasible and accepted within low-income preschoolers, parents and teacher but with no significant difference shown (3).

The Colorado LEAP was a study done over 12 week (nutrition) and 18 weeks (physical activity) to prevent early childhood obesity. Intervention sites received the *Food Friends* nutrition and physical activity program in preschool and the ‘Booster’ program in kindergarten and 1st grade. Assessments were taken at four time points: twice in preschool and once in both kindergarten and 1st grade. Parents provided the information on their child’s diet and eating and physical activity patterns (4). Increasing nutrition and physical activity knowledge and behavior, along with parents’ mealtime behavior can assist in the continuation of declining trends of childhood obesity. Early childhood is a time of rapid development and may be the best opportunity for altering development in way to reduce obesity (4). The LEAP study showed the need to have longitudinal studies along with cross-sectional studies to examine knowledge and behaviors that correlate with childhood obesity.

The above interventions provided background on programs that are currently being used to promote healthy nutrition and physical activity knowledge and behaviors.
These programs show the potential to increase nutrition and physical activity knowledge in child care centers, which then promote healthy lifestyles into adulthood. iGrow Readers is unique compared to the other programs as it was developed by an interdisciplinary team to involve schools, families and the children to achieve health knowledge changes in preschoolers by utilizing social cognitive, ecological, and social learning theories. Using developmentally appropriate preschool-aged children books, including relevant Native American books, to facilitate the themes of healthy behaviors sets iGrow Readers apart from other preschool-aged curriculums focusing on healthy lifestyles and childhood obesity prevention.

**Summary**

Childhood obesity continues to remain high with in the United States. Eighteen and a half percent of children 2-19 years of age are considered obese and 13.9 percent of children between 2-5 years of age are considered obese (13). Childhood obesity has been associated with an increase in negative health risks. Children who are obese are at greater risk for cardiovascular disease, type 2 diabetes, sleep apnea, joint problems, and social and psychological problems (2). Developing healthy eating habits and physical activity behaviors can help in the prevention of the negative effects of obesity. The Dietary Guidelines for Americans recommend a diet rich in fruits, vegetables, whole grains, and fat-free dairy, but most youth are not meeting those guidelines (15). In addition, the physical activity recommendation of sixty minutes of moderate to vigorous activity every day is not being met by most youth. The obesity epidemic is affected by the lack of meeting the recommended dietary and physical activity goals. Children develop eating habits and physical activity patterns within the first five years of life, so the preschool
years are an essential time to begin obesity prevention (4). Preschool interventions and
preventions have the potential to impact the obesity trends because sixty percent of
children under the age of six spend at least twenty-nine hours a week in childcare or
preschool (5). Implementing early childhood programs in preschools that focus on
increasing nutrition and physical activity knowledge and behavior are critical in
continuing decline of childhood obesity.

Early childhood interventions have shown the potential to increase nutrition and
physical activity knowledge and behavior. By utilizing schools and childcare centers to
promote healthy eating and physical activity childhood obesity may continue to
decline(15). These locations have the opportunity to provide students with the chances to
consume an array of foods and beverages and promote nutrition and physical activity
through nutrition and physical activity programs. To continue a decline in obesity rates,
early childhood programs focusing on nutrition and physical activity knowledge and
behavior need to be implemented.
Chapter 3

Manuscript

Abstract

The prevalence of childhood obesity remains high within the United States, which can lead to long-term harmful effects. During the first five years of children’s lives, healthy eating habits and physical activity patterns are formed, so the preschool years are a critical time to begin obesity prevention (4). Because the preschool years are crucial for providing healthy eating habits and physical activity patterns there is the need for childhood obesity interventions. iGrow Readers is a cluster-randomized control study concentrated on children 3-5 years of age recruited from childcare centers from South Dakota, Nebraska, and Minnesota. Fourteen child care centers with a total of 35 classrooms were enrolled. Intervention classrooms implemented the 8-week iGrow Readers curriculum. The curriculum paired developmentally appropriate children’s books with nutrition and physical activity information and activities. **Results:** The total study population included 293 children ages 3-5 years. Of the 293 children, 176 were in the intervention group and 117 in the control group. Knowledge scores for nutrition and physical activity were collected and summarized for mean scores based on gender and age, shown in Table 1.1. The children’s mean nutrition and physical activity knowledge scores increased with age in both the control group and intervention group. **Discussion:** Data between pre, post, and follow-up mean knowledge scores of the intervention and control group based on age show potential increases in scores. Due to the increase of knowledge scores with age, the iGrow Readers curriculum has the potential to impart nutrition and physical activity knowledge, which can then develop nutrition and physical
activity behavior as they continue to age. iGrow Readers curriculum is a feasible curriculum that can be implemented into childcare centers. Additional statistics and research need to be conducted to determine knowledge change.

Introduction

The prevalence of childhood obesity remains high within the United States. In recent years, childhood obesity among children 2-19 years of age has not significantly changed, but still poses as an issue with about 17 percent classified as obese(1). In children 2-5 years of age, obesity has significantly decreased from 13.9 percent in 2003-2004 to 9.4 percent in 2013-2014(1). Even with the decrease in obesity among children 2-5 years of age, childhood obesity remains a problem. Therefore obesity prevention and intervention programs or curriculum during the preschool years is still needed.

Childhood obesity can have long-term harmful effects. Obese children are at greater risk for cardiovascular disease, type 2 diabetes, sleep apnea, joint problems, and are also at risk for social and psychological problems (2). These negative consequences can be contributed by individual, social, cultural, and environmental factors (3). Healthy eating habits and physical activity can help prevent the negative effects of obesity.

During the first five years of children’s lives, they develop healthy eating habits and physical activity patterns, so the preschool years are a critical time to begin obesity prevention(4). Sixty percent of children six years and younger spend at least twenty-nine hours a week in childcare or preschool settings, giving preschool interventions the potential to positively impact the obesity trend (5). During those first five years children acquire their eating habits and physical activity patterns through associative learning and imitation. Since only thirty percent of children are meeting the recommended amount of
fruit, vegetable, grains, meat, and dairy set by the USDA, it is important for parents, caregivers, and teachers to model and teach good examples (6).

There is a need for childhood obesity interventions focusing on increasing nutrition and physical activity knowledge. Using children’s books supports literacy and language development skills in children. Therefore, by reading a children’s book and then incorporating activities around the book’s overall theme, creates an integrated curriculum approach, which supports children’s engagement, motivation to learn and interests (7,8).

iGrow Readers, a randomized control study, was designed to be delivered in child care centers by the center personnel with the intent to increase knowledge of nutrition and physical activity in children 3-5 years of age. Increasing knowledge associated with obesity can potentially decrease childhood obesity and continue throughout adulthood. The purpose of the iGrow Readers study described in this paper is to determine the feasibility of delivery and whether an 8-week, literacy-based developmentally appropriate curriculum has the potential to increase children’s nutrition and physical activity knowledge.

Methods
Study Design
iGrow Readers is a cluster-randomized control study on children 3-5 years of age recruited from child care centers from South Dakota, Nebraska, and Minnesota. Enrolled in the research study were 14 child care centers with a total of 35 classrooms. Intervention class-rooms implemented the 8-week iGrow Readers curriculum. Assessment of nutrition and physical activity knowledge and anthropometric measures were taken at pre-assessment, 8-week post, and a 6-month follow-up. Nutrition and
physical activity knowledge were measured using the *iGrow Readers Curriculum Nutrition and Physical Activity Knowledge tool Prek-1* (appendix 3).

**Recruitment**

Child care center directors were contacted via email and provided background information as well as, asking if they would be interested in participating. Center directors were then invited to an informational session to learn more about the *iGrow Readers* research study. If directors wanted their centers to participate, each director signed a form indicating the center’s willingness to participate. Children and parents were then recruited for the study through recruitment flyers hung in the child care centers. Informational letters for parents were sent home as well. Parental consent and child verbal assent at each data collection were obtained for the child to participate in the study. The study was approved by the Human Subjects Committee at South Dakota State University.

**Measures**

Trained graduate research assistants conducted all assessments. Assessments were conducted at pre-assessment, 8-weeks post assessment, and 6-month follow-up assessment.

*Anthropometric Measurements:* Trained research assistants collected height and weight of the children at each assessment time point on data collection forms (appendix 2). Weight was measured twice to the nearest 0.01 kg using the Electronic Seca Scale 890; a third measurement was taken if there was a >0.2 kg difference between measurements. Height was measured twice to the nearest 0.1 cm with an Adult/Child
Shorrboard; a third measurement was taken if there was a >0.2 cm difference between measurements.

*Nutrition and Physical Activity Knowledge:* Trained research assistants met one-on-one with each child to assess nutrition and physical activity knowledge using the *iGrow Readers Nutrition and Physical Activity Knowledge* tool (appendix 3). Each of the 12 questions and their answers were read aloud to the children, the children pointed to the answer they believed was correct, and the research assistant recorded the answer given by the child.

**iGrow Readers Curriculum and Lesson Implementation**

The iGrow Readers curriculum, developed by an interdisciplinary team through South Dakota State University Extension, was based on tenants of the social cognitive, ecological, and social learning theories. This curriculum paired 31 developmentally appropriate children’s books with nutrition and physical activity information and activities (18). Due to the study sample of children within the 3- to 5-year old age range, only 15 of the 31 books and accompanying lessons were utilized in this study given their developmental appropriateness. iGrow Readers was designed to fill the educational institutions' needs for literacy practice and standards-based education. All books were read during class and the accompanying lessons that promoted healthy eating and physical activity was implemented after reading the book. The nutrition lesson plans focused on increasing consumption of fruits and vegetables, drinking water and low-fat milk over whole milk, increasing understanding of serving sizes and portion control, and/or increasing knowledge of healthy foods. The physical activity lesson plans focused
on increasing physical activity participation through individual activities as well as small and large group activities. Native American themed books were also provided as a part of the curriculum to align with the Oceti Sakowin standards established by the South Dakota Department of Education (19). Newsletters were sent home with parents/guardians after the nutrition or physical activity lesson was implemented, to involve the family in the curriculum. Newsletters consisted of a picture of the book that was read to the class, a description of family activities related to the book, and actionable physical activity- and nutrition-related suggestions. All the equipment needed to complete the activities for iGrow Readers (besides perishable food items) was included in three kits: Kitchen, Art Supplies, and Physical Activity. The Kitchen kit held items like measuring cups, food coloring, cups, sugar, MyPlate Posters, Food Model Cards and plastic silverware. The Art Supplies kit included items like crayons, markers, child-safe scissors, chalk, pencils, glue sticks, drawing paper and tape. Lastly, the physical activity kit included scarves, bean bags, Me! Body Posters, hula hoops, foam balls, Frisbees and more. For more information on the iGrow Readers curriculum visit http://igrow.org/healthy-families/health-and-wellness/igrow-readers/.

For the purposes of the study, teachers assigned to intervention classrooms were asked to implement the 15 selected books of the curriculum over an eight-week period. Teachers were instructed to implement at least one nutrition activity and one physical activity to go with each book. Intervention teachers were given a copy of the curriculum that provided the entire lesson step-by-step. Lessons were implemented during structured large group classroom time with follow-up activities immediately thereafter. Reading the
book and implementing the accompanied nutrition and physical activities took the teachers approximately 30-45 minutes to complete.

**Data analysis**

Descriptive data was run using STATA to determine mean knowledge score of the *iGrow Readers Curriculum Nutrition and Physical Activity Knowledge tool Prek-I* (Appendix 3) at pre, post and follow-up of both control and intervention groups.

**Results**

The total study population included 293 children ages 3-5 years. Of the 293 children, 176 were in the intervention group and 117 in the control group. Mean knowledge scores for nutrition and physical activity were collected and summarized for mean scores based on gender and age, shown in Table 1.3.

**Table 1.1: Child Demographics**

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<td>5y: 35 (12.0)</td>
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<td>Underweight</td>
<td>11 (3.8)</td>
</tr>
<tr>
<td>Normal weight</td>
<td>233 (79.5)</td>
</tr>
<tr>
<td>Overweight</td>
<td>26 (8.9)</td>
</tr>
<tr>
<td>Obese</td>
<td>23 (7.9)</td>
</tr>
</tbody>
</table>
Table 1.2 Parent Demographics by child weight status

<table>
<thead>
<tr>
<th></th>
<th>Normal Weight n=196</th>
<th>Overweight/Obesity n=45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent Gender (male/female)</td>
<td>30/163</td>
<td>10/33</td>
</tr>
<tr>
<td>Parent Race (white/non-white)</td>
<td>117/14</td>
<td>39/2</td>
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</table>

Table 1.3: Mean Nutrition and Physical Activity Knowledge Scores of Participants Enrolled in iGrow Readers

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
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<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Male</td>
<td>Male</td>
<td>Female</td>
<td>Female</td>
<td>Female</td>
</tr>
<tr>
<td>Age in Years</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>N</td>
<td>19</td>
<td>19</td>
<td>12</td>
<td>30</td>
<td>32</td>
<td>5</td>
</tr>
<tr>
<td>Mean Knowledge Score Pre (Obs)</td>
<td>5.9±1.73 (19)</td>
<td>7.3±2.00 (19)</td>
<td>7.3±1.5 4 (12)</td>
<td>6.3±1.60 (29)</td>
<td>6.8±1.35 (30)</td>
<td>8.5±1.05 (5)</td>
</tr>
<tr>
<td>Mean Knowledge Score Post (Obs)</td>
<td>6.4±1.94 (17)</td>
<td>7.1±1.03 (15)</td>
<td>7.5±1.5 1 (11)</td>
<td>6.3±2.15 (26)</td>
<td>7.1±1.66 (26)</td>
<td>7.6±1.95 (5)</td>
</tr>
<tr>
<td>Mean Knowledge Score Follow up (Obs)</td>
<td>6.5±1.99 (14)</td>
<td>7.3±1.45 (15)</td>
<td>8.1±1.1 7 (9)</td>
<td>6.7±1.88 (24)</td>
<td>8.2±1.60 (25)</td>
<td>7.8±1.64 (5)</td>
</tr>
<tr>
<td></td>
<td>Intervention</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in Years</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>N</td>
<td>45</td>
<td>35</td>
<td>7</td>
<td>46</td>
<td>32</td>
<td>11</td>
</tr>
<tr>
<td>Mean Knowledge Score Pre (Obs)</td>
<td>6.7±1.76 (45)</td>
<td>7.3±1.92 (35)</td>
<td>8.3±0.5 2 (6)</td>
<td>6.1±1.6 3 (44)</td>
<td>7.2±1.9 2 (32)</td>
<td>8.3±1.72 (11)</td>
</tr>
<tr>
<td>Mean Knowledge Score Post (Obs)</td>
<td>6.3±1.99 (41)</td>
<td>7.3±1.77 (29)</td>
<td>8±1.83 4 (4)</td>
<td>6.8±1.6 1 (40)</td>
<td>8+1.68 (28)</td>
<td>8.8±1.65 (11)</td>
</tr>
<tr>
<td>Mean Knowledge Score Follow up (Obs)</td>
<td>6.7±2.01 (36)</td>
<td>8.16+1.6 8 (25)</td>
<td>7.7±2.0 8 (3)</td>
<td>7.0±2.0 5 (37)</td>
<td>7.7±1.6 5 (25)</td>
<td>8.5±1.57 (11)</td>
</tr>
</tbody>
</table>

Discussion

The iGrow Readers data between pre, post, and follow-up mean knowledge scores of the intervention and control group based on age and gender showed potential increases in scores based on aging. Due to the children’s knowledge increasing with age, even in the control group, the iGrow Readers Curriculum has the potential to impart nutrition and physical activity knowledge and then develop that nutrition and physical activity knowledge as they continue to age.
In conjunction with other programs, iGrow Readers focused on the 3-5 year old children in childcare settings. This age range is a pivotal time when thinking, language, physical movement and social and environmental behaviors are created and childcare settings provide the potential to positively impact those created behaviors due to the amount of time children spend there each week. The iGrow Readers curriculum is different from previous studies as it is a literacy-based program designed to meet educational requirements, while also providing children the opportunity to actively participate in the book, which creates learning potential, further development and potential interests in literacy.

The strength of this study is that it used random-control design with centers spanning over South Dakota, Minnesota, and Nebraska, and large sample size. An additional strength is that the curriculum was developed to meet education requirements, so it can easily be implemented into the school curriculum. Even with the strengths and the positive correlation, this study also had its limitations that could have had an effect on the data. The first limitation would be the quality and credibility of the centers and their teachers who were implementing the curriculum to the 3-5 year olds. Even with the initial curriculum training for the teachers, the level of education and the comfort level of teaching nutrition and physical activity among the teachers may have varied, which may influence the education provided and potentially the children’s knowledge. An additional limitation would be that the study only took place in Midwestern states. Parts of the intervention took place during the winter months, which had the possibility of limiting physical activity outside and having teachers adapt to doing activities indoors due to the cold and/or snowy conditions. For future studies, it may be interesting to look at
accredited versus non-accredited child care programs and teachers with a teaching degree versus teachers who may not have a teaching degree. A second limitation would be the demographics of our study population, which was primarily Caucasian/White, which is shown in Table 1.2. This limitation only provided us with a look into a certain demographic of children instead of children was a whole. Thirdly, the limitation between the knowledge level of the 3 year olds vs the 4-5 year olds. It would be interesting for future studies to focus on 4-5 years old and see how their knowledge changes. Lastly, the limitation of the difference in when the study was completed, not all the centers completed the curriculum over the same 8-week period due to varying reasons beyond the research’s control.

Conclusion

The iGrow Readers curriculum is a feasible curriculum that can be implemented into child care centers by the center personnel. The developmentally appropriate preschool-aged books used in the iGrow Readers curriculum along with the activities may have the potential to impact 3-5 year olds nutrition and physical activity knowledge. Additional statistics and research need to be conducted to determine actual knowledge change and if that knowledge change can affect behaviors then an in the future.
References


5 Bryars TB, Mouttapa M, McMahan S, Tanjasiri S. The Effects of a School Based Obesity Prevention/intervention Program Targeting Preschool Children: California State University; 2011.


7 Chaille, C. Constrictivism across the curriculim in early childhood classrooms: Big iseeas as inspiration. Pearson Education Inc. 2008

8 Hyson, M. Enthusiastic and engaged learners: Approaches to learing in the early childhood classroom. Teachers College Press. 2008.


19 South Dakota Indian Education Available:

Appendices

Appendix 1

Parental Consent Form

Please read the following and sign if you understand and agree to the following statements:
I will allow my child to take part in the iGrow Readers program evaluations described previously. I will allow the data from my and my child’s evaluations along with the data that I provide on the parent/guardian surveys without individual names to be professionally published and presented.

Child’s Name (please print): ________________________________

Child’s Age: _____    Child’s Birthday: ____/____/____    City/Center: ______________________

What gender best describes your child?    Boy    Girl

Parent/Guardian #1 Name (parent who spends the most time with the child during a typical week) (please print): ________________________________

Parent/Guardian #1 Gender Role (circle one): Mother    Father    Parent/Guardian #1 Age: _____

Parent/Guardian #2 Name (please print): ________________________________

Parent/Guardian #2 Gender Role (circle one): Mother    Father    Parent/Guardian #2 Age: _____

Please provide your contact information:
Home Number: ___________________________    Cell Number: ___________________________

Please provide the e-mail address most commonly checked and ok for us to contact you with:

______________________________________________________________________________

In order to ensure you child wears the physical activity monitor daily, we would like to offer reminders to you and your family throughout the week. If you would like to receive reminders for this study, please rank according to preferred method of communication below (1-most preferred, 4-least preferred).

Email: _____    Home Phone Call: _____    Cell Phone Call: _____    Text: _____

Signature of either mother or father parent/guardian on the line below.

______________________________________________________________________________

Return instructions: Please return page 3 to your child’s teacher.

Please return this page. Thank You
Appendix 2

Data Collection Form

<table>
<thead>
<tr>
<th>CHILD DATA COLLECTION FORM</th>
<th>PRE INTERVENTION/CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td></td>
</tr>
<tr>
<td>ID Code:</td>
<td></td>
</tr>
<tr>
<td>Verbal Assent:</td>
<td>Yes</td>
</tr>
<tr>
<td>Date of Birth:</td>
<td></td>
</tr>
<tr>
<td>School/Site:</td>
<td></td>
</tr>
<tr>
<td>Age:</td>
<td></td>
</tr>
<tr>
<td>Classroom:</td>
<td></td>
</tr>
<tr>
<td>Height (cm):</td>
<td></td>
</tr>
</tbody>
</table>
| 1st Measurement | 2nd Measurement | Average
| Weight (kg):              |                          |
| 1st Measurement | 2nd Measurement | Average
| Percent Body Fat:         |                          |
| Start Date:               |                          |
| End Date:                 |                          |
| Accelerometer #:          |                          |
| Body Stereotypes | iGR Knowledge Tool |
| Friendship Selection      |                          |

<table>
<thead>
<tr>
<th>POST INTERVENTION/CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
</tr>
<tr>
<td>ID Code:</td>
</tr>
<tr>
<td>Verbal Assent:</td>
</tr>
<tr>
<td>Date of Birth:</td>
</tr>
<tr>
<td>School/Site:</td>
</tr>
<tr>
<td>Age:</td>
</tr>
<tr>
<td>Classroom:</td>
</tr>
<tr>
<td>Height (cm):</td>
</tr>
</tbody>
</table>
| 1st Measurement | 2nd Measurement | Average
| Weight (kg):               |                          |
| 1st Measurement | 2nd Measurement | Average
| Percent Body Fat:          |                          |
| Start Date:                |                          |
| End Date:                  |                          |
| Accelerometer #:           |                          |
| Body Stereotypes | iGR Knowledge Tool |
| Friendship Selection      |                          |
### FOLLOW-UP INTERVENTION/CONTROL

<table>
<thead>
<tr>
<th>Verbal Assent:</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

<table>
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<tr>
<th>Name:</th>
<th>ID Code:</th>
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</table>

<table>
<thead>
<tr>
<th>Date of Birth:</th>
<th>School/Site:</th>
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<tr>
<th>Age:</th>
<th>Classroom:</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Height (cm):</th>
<th>1st Measurement</th>
<th>2nd Measurement</th>
<th>Average</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Weight (kg):</th>
<th>1st Measurement</th>
<th>2nd Measurement</th>
<th>Average</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Percent Body Fat:</th>
<th>Accelerometer #:</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Start Date:</th>
<th>End Date:</th>
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</table>

<table>
<thead>
<tr>
<th>Friendship Selection</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Body Stereotypes</th>
<th>iGR Knowledge Tool</th>
</tr>
</thead>
</table>
Appendix 3

iGrow Readers Curriculum Nutrition and Physical Activity Knowledge tool Prek-1

1. Circle the MyPlate diagram.

2. Circle the activity that you should do for only a short time each day.

   Playing video games
   Playing ball games

3. Circle the beverage(s)/drink(s) that helps build strong bones and teeth.

   Fruit Juice
   Low Fat Milk
   Sode Pop
4. Circle the picture that shows energy going into your body.

- Eating lunch
- Walking the dog

5. Circle the vegetable.

- Grapes
- Radishes

6. Circle the activities that are good to do every day.

- Snacking in front of the TV
- Playing outside
7. Circle the food that is an anytime foods, or food you can eat often.

Cookies

An orange

8. Circle the physical activity that builds muscle.

Playing basketball

Playing on the computer

9. Circle the protein or meat.

Chicken

Lettuce
10. Circle the fruit.

Broccoli

Banana

11. Circle the picture showing exercise, which makes your heart beat faster.

Gardening

Taking a nap

12. Circle the grains.

Whole wheat bread

Cheese