PHYSICAL ACTIVITY OF 9-12-YEAR-OLD YOUTH IN A COMMUNITY-BASED DIABETES PREVENTION PROGRAM: THE E.P.I.C. KIDS STUDY

By

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ABSTRACT

Background. Childhood type II diabetes (T2D) is increasing at an alarming rate in the United States due to poor dietary choices, decreased physical activity, and increased obesity rates. It is crucial to focus on prevention through emphasizing the importance of healthy lifestyle habits, especially in young populations.

Methods. The first cohort of the pilot E.P.I.C. Kids community-based diabetes prevention program included 28 children ages 9-12 with a BMI ≥ 85th percentile for youth. The participants were asked to wear Actigraph GT3X accelerometers for seven consecutive days at each time point (baseline, 12-week, 24-week). The devices collected activity counts using 30-second epochs and the Evenson cut points for children were applied to determine average minutes per day of moderate-to-vigorous physical activity.

Results. Of the beginning 28 participants, complete physical activity data was collected at baseline and 12-week time periods for 18. The average physical activity time per day for all 18 participants decreased from 26.81 to 25.65 minutes, deeming the results statistically insignificant with a p-value of 0.81.

Conclusion. The majority of children at-risk of developing T2D do not engage in regular physical activity, thus not meeting health-related guidelines, and diabetes prevention programs such as E.P.I.C. Kids may reduce T2D risk.
INTRODUCTION

Type II Diabetes (T2D) is a complicated metabolic disease that is influenced by genetic, behavioral, and environmental risk factors. This disease is currently affecting over 15 million adult Americans and the prevalence among youth is increasing at an astounding rate. In fact, the SEARCH for Diabetes in Youth study estimated that for U.S. youth <20 years old, prevalence of T2D may increase by 13% between 2010 and 2050 (from 0.24/1,000 cases to 0.27/1,000 cases).

T2D in adults has been studied and treated for decades; however, much less is understood about the disease in youth. Evidence suggests that children with T2D experience impaired insulin function and then later develop problems with pancreatic β-cell secretion of insulin. Although the underlying mechanism behind the disease is similar amongst adults and youth, research shows that other factors may influence the disease development in youth, including family history, pubertal insulin resistance, obesity, poor eating habits, and lack of physical activity.

Obesity is a major risk factor for T2D and the prevalence amongst youth is spreading in enormous proportions. According to the National Health and Nutrition Examination Study (NHANES), 15.3% of 6-11 year old children in 1999-2000 had body mass indexes (BMIs) above the 95th percentile, placing them in the obese category. While the prevalence of obesity in children is growing, overall physical activity levels are declining. In 2002, the Centers for Disease Control and Prevention (CDC) conducted a national survey to assess physical activity levels of children from 9-13 years old. They found that 61.5% of these children were not involved in any organized physical activities outside of school and 22.6% did not engage in physical activity in their free time. In 2008, the U.S. Department of Health and Human Services (HHS) issued the latest Physical Activity Guidelines for Americans; these guidelines recommended that children participate in at least 60 minutes of physical activity per day. It
explains further that most of the 60 minutes per day should be comprised of moderate-to-
vigorous aerobic activity and at least three days per week should include vigorous aerobic activity.\(^5\)

The dramatic decline in exercise is problematic as research indicates that T2D risk can
decrease by up to 34\% with moderate, such as walking and household activities $\geq 3$ METs\(^6\),
physical activity.\(^7\) The Diabetes Prevention Program, a multi-center clinical diabetes prevention
trial, conducted a study with 1,079 at-risk adults over 3 years. Study findings suggested that
increased physical activity (at or above 150 minutes per week) paired with adherence to a low-fat
diet reduced body weight by 5\% to 7\%, ultimately reduced T2D risk by 58\%.\(^8\) A Finish
intervention study\(^9\) randomly assigned 522 overweight middle-aged individuals with impaired
glucose tolerance to an intervention or control group. The intervention group received rigorous
lifestyle coaching aimed to reduce total fat intake, increase fiber intake, reduce overall body
weight, and increase physical activity. After an average follow-up time of 3.2 years, the risk of
developing diabetes decreased 58\% within the intervention group.

Moderate to vigorous physical activity is beneficial in decreasing risk of T2D because it
promotes weight loss and affects the amount and distribution of adiposity.\(^10\) Data from the
second NHANES found that T2D is 3.8 times more prevalent in overweight populations (defined
as the 85\(^{th}\) percentile cutoffs for BMI for both men and women 20-29 years old).\(^11\) In addition,
studies show that distribution of excess weight affects T2D; visceral adipose tissue contributes to
insulin resistance more than subcutaneous adipose tissue.\(^8\) While the mechanism linking obesity
and T2D is unclear, the strong association between the two is apparent. There are numerous
studies examining the effects of exercise and weight loss on T2D risk; however, far less data are
available for younger populations. More research must be conducted to achieve a full
understanding of exactly how increased physical activity decreases risk of T2D in children and adolescents.

The Nutritional Sciences Department at the University of Arizona has developed a pilot program called Encourage, Practice, and Inspire Change in Kids (E.P.I.C. Kids) to help at-risk 9-12-year-old children prevent T2D onset through a family-focused, community-based approach. The program is led by YMCA lifestyle coaches and provides participants with opportunities to learn and practice healthy lifestyle habits including quality sleep, nutrient-dense diets, and regular physical activity during weekly sessions at the YMCA. Focusing on prevention by emphasizing healthy lifestyle habits during youth is crucial because an early age of onset equates to a longer duration of the disease. This means higher health care costs, lower quality of life, and increased risk of developing other complications such as blindness and renal disease. Since research surrounding children and effective community-based diabetes prevention programs is limited, the E.P.I.C. Kids study is unique and adds insight that will be useful in the prevention of this disease.

**OBJECTIVE**

The objective of this honors thesis will be to assess if community-based T2D prevention programs, such as E.P.I.C. Kids, increased the physical activity of at-risk 9-12-year-old children.

**METHODS/DESIGN**

The E.P.I.C. Kids intervention was a group-randomized, non-inferiority trial study for 9-12-year-olds and their families at two YMCA locations in Tucson, Arizona. In order to be eligible for the program, the participants had to be 9-12-years-old at time of enrollment, have a BMI at or above
the 85th percentile for age and gender, and display at least one of the following T2D risk factors: first or second degree relative with T2D, ethnic minority, or conditions associated with metabolic syndrome or insulin resistance.12

The first intervention cohort included 28 children and their parents/caregivers and was led by the YMCA lifestyle coaches during a weekly 1.5-hour session over 12 consecutive weeks. Weekly sessions included information and hands-on activities including healthy recipes, setting goals, and learning new methods of physical activity. To evaluate efficacy, anthropometric, behavioral, physiological, and psychosocial data was collected at three time points: baseline, post-intervention (12 weeks), and follow-up (24 weeks).

To measure changes in physical activity and sedentary time, participants were asked to wear Actigraph GT3X accelerometers for seven consecutive days at each time point. The use of these devices to characterize typical physical activity has been validated in youth.13 Participants were instructed by trained staff to wear the accelerometer around their waist for 24 hours per day for seven consecutive days, except for when swimming or bathing. Valid data was defined as having ≥4 days with ≥10 hours of waking wear time in a 24-hour period, including one weekend day.14 The accelerometers collected activity counts using 30-second epochs and the Evenson cut points for children were applied to these data to determine participants’ time spent in sedentary, light, moderate, and vigorous physical activity. Other data collected by the Actigraph GT3X software includes total wear time, average calories expended per day, and time spent asleep.

RESULTS
At the 12-week measurement checkpoint, 18 participants (9 female and 9 male) participated in all of the necessary measurements to have a complete profile. Using the Actigraph GT3X
software, minutes per day of moderate-to-vigorous physical activity were measured and the mean, minimum, and maximum were derived from that data.

The following table depicts the average minutes per day of moderate to vigorous physical activity for all 18 participants.

<table>
<thead>
<tr>
<th>Variable</th>
<th># of Participants</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>18</td>
<td>26.81</td>
<td>17.83</td>
<td>3.25</td>
<td>65.71</td>
</tr>
<tr>
<td>Week 12</td>
<td>18</td>
<td>25.65</td>
<td>16.52</td>
<td>0.00</td>
<td>68.00</td>
</tr>
</tbody>
</table>

As seen in table 1, from baseline to week 12, the average minutes per day of physical activity actually decreased from 26.81 minutes to 25.65 minutes. Using a paired t-test, a p-value of 0.81 was calculated, meaning there was no statistical significant difference in the average minutes per day of moderate-to-vigorous physical activity. It is also interesting to note that the range of average minutes per day was larger during week 12 measurements, with the minimum at 0.00 minutes and the maximum at 68.00 minutes.

Table 2 compares the average minutes per day of moderate-to-vigorous physical activity for the 9 male participants. The mean daily minutes of activity per day also decreased in the male population, dropping from 34.27 minutes to 31.91 minutes. The calculated p-value for this data
was 0.79, also indicating that there was no statistical significant difference in average minutes per day of moderate-to-vigorous physical activity for males.

Table 3. Comparison of Average Minutes/Day of Moderate-to-Vigorous Activity for Females

<table>
<thead>
<tr>
<th>Variable</th>
<th># of Participants</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>9</td>
<td>19.36</td>
<td>4.49</td>
<td>13.47</td>
</tr>
<tr>
<td>Week 12</td>
<td>9</td>
<td>19.39</td>
<td>2.83</td>
<td>8.49</td>
</tr>
</tbody>
</table>

Table 3 compares the average minutes per day of moderate-to-vigorous physical activity for the 9 female participants. The average daily minutes of activity per day only slightly increased in the female population, rising from 19.36 minutes to 19.39 minutes. The calculated p-value for this data was 0.99, also indicating that there was no statistical significant difference in average minutes per day of moderate-to-vigorous physical activity for females.

**DISCUSSION AND FUTURE IMPLICATIONS**

Capturing the participants’ physical activity levels using the accelerometers provided insight to whether or not a diabetes intervention program such as E.P.I.C. Kids leads to increased daily physical activity. For the total 18 participants of the fall cohort, the average minutes per day of moderate-to-vigorous physical activity actually decreased, dropping from 26.81 minutes to 25.65 minutes. Although there was a slight decline in average daily physical activity, these results were not statistically significant (p=0.81). A sample size of only 18 participants was only half of the study cohort, and thus, we were not able to make inferences about the entire sample, or the larger population of youth between the ages of 9- and 12-years-old. The intervention duration (12 weeks) was a relatively short window within which physical activity habits could be established;
this is particularly important when considering that some children might have been attempting to engage in certain physical activities for the first time.

The relatively modest results we observed in our study are consistent with other community-based T2D and obesity intervention programs. In 2004, a similar program was implemented at two middle schools in Connecticut. This 16-week afterschool program had 41 participants ages 10-14 with a BMI ≥ 95th percentile for youth. The participants received nutrition education, physical activity lessons, and coping skills training (CST). The physical activity lessons took place twice each week for 45 minutes and were executed by a licensed personal trainer and a research assistant. When comparing data between baseline and 12 months, weight and BMI actually increased slightly; however, insulin and blood glucose levels decreased, and health behavior outcomes such as typical food choices and nutrition knowledge improved. The study did not directly measure the amount of physical activity the participants were engaging in outside of the scheduled lessons. While the physiological outcomes of weight and BMI may not have been ideal, the results from this program, like E.P.I.C. Kids, suggest that physical activity lessons and nutrition education may be effective in reducing overall risk of T2D.

Another school-based intervention program, Planet Health, aimed to reduce obesity among 1,295 youth in sixth through eight grade by teaching the children to decrease television time, increase fruit and vegetable intake, and increase moderate-to-vigorous physical activity. After two school years, there was a 3.3% reduction in the prevalence of obesity in the intervention group. Again, physical activity data was not measured directly but the results suggest the physical activity education played a key role in reducing prevalence of obesity. In 2008, The Stanford Sports to Prevent Obesity Randomized Trial (SPORT) implemented an intervention program for low-income, overweight children of a minority community. The 6-
month study consisted of 21 fourth and fifth graders with a BMI ≥ 85th percentile, divided into control and intervention groups. The intervention group participated in a soccer program four days per week (initially 3 days but changed by parents’ requests) and engaged in approximately 75 minutes of activity while the control group participated in an afterschool health education program with very little physical activity. Participants wore accelerometers for six consecutive days at baseline, 3-month, and 6-month time points and moderate and vigorous physical activity was determined. In the intervention group, both moderate and vigorous physical activity increased from baseline to 3-month.

The E.P.I.C Kids physical activity data were consistent with national data. The CDC’s national physical activity survey demonstrated that on average, 9- to 12-year-old children do not engage in the recommended 60 minutes of physical activity per day. The average of 26.81 minutes per day of moderate-to-vigorous physical activity does not even meet half of the recommendation of 60 minutes per day. This data suggests that the E.P.I.C. Kids intervention physical activity component did not improve physical activity habits outside of the intervention setting.

There is certainly a variety of research looking at children, physical activity, obesity and T2D; however, it is unclear which approach is the most effective. The aforementioned studies indicate that utilizing accelerometers provides more reliable data than relying on self-reported physical activity. By combining different aspects of these studies, intervention programs could include dedicated physical activity time and physical activity education in order to get the children active on a regular basis, as well as help them to establish long-term habits. Overall, larger sample sizes, longer intervention periods, accelerometer data collection, and engagement
in regular exercise may provide a more accurate picture as to whether or not these types of intervention studies help reduce overall risk of youth developing T2D.
REFERENCES


