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A Thesis Approved on

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DEDICATION

This thesis is dedicated to my parents

who have given me invaluable educational opportunities,

and boyfriend who has supported me

along the way.

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I would like to thank my mentor, Dr. Kristi King, for her guidance and patience. She encouraged me to keep going and pushed me to do things I didn't think possible. I would also like to thank the other committee members, Dr. Jason Jaggers and Dr. Lindsay Della, for their comments and assistance over the past two years. I would also like to express my thanks to my boyfriend, Will Sketch, for his patience, understanding, and support during those times when I needed it most. Finally, many thanks to my parents, Mr. and Mrs. Bruce Kozerski, for your unconditional love and support throughout the ups and downs over the past few years.

ABSTRACT

HEMOGLOBIN A1C LEVELS AND SPORT PARTICIPATION IN CHILDREN WITH TYPE 1 DIABETES

Amy E. Kozerski

April 9, 2019

This study's purpose was to determine a possible difference in hemoglobin A1c levels and sport participation in children with type 1 diabetes. Patients with provided consent via an iPad electronic informed consent/assent (preamble) completed a physical activity and sport participation survey. The survey was linked to their medical chart including demographic and diabetes medical history (e.g. HbA1c). The analyses provided a sample of 120 participants, 40 in the no sport participation group and 78 in the sport participation group with 56 females and 64 males, with an average age 12.94 ± 2.8 years. An independent sample *t*-test, removing one outlier from the sport participation group, showed no statistically significant difference in HbA1c levels for children who participated in sports (M = 8.61, SD = 1.61) versus those who did not participate in sports (M = 9.03, SD = 2.24); $t(115) = 1.36$, $p = .178$. Although the data showed no statistical significance, important clinical implications were discovered.

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

CHAPTER 1

INTRODUCTION

Diabetes mellitus affects 29 million people, or 9.3% of the United States population. Of those 29 million people, 28% of them are undiagnosed (ACSM, 2018). Type 1 diabetes (T1D) accounts for 5%-10% of all cases. Participation of at least 60 minutes of physical activity per day is important for children with type 1 diabetes (T1D) however, care must be taken to prevent or address low blood glucose levels (hypoglycemia) or high blood glucose levels (hyperglycemia). Hemoglobin A1c (HbA1c), a blood test measuring average blood glucose levels over the past 3 months (a lower score typically indicates better blood glucose control), can be improved with regular physical activity. Children managing T1D should strive for HbA1c values less than 7.5%. Research indicates children with T1D are less physically active than children without T1D. Sport participation can be a way for T1D patients to be physically active and perhaps improve HbA1c (Sheri R. Colberg, Laan, Dassau, & Kerr, 2015).

Need for the Study

There have been a number of studies looking at T1D and a sedentary lifestyle versus active lifestyle (Åman et al., 2009; Elmesmari, Reilly, Martin, & Paton, 2017; Galler, 2011; Valerio, 2007), but no research studies have analyzed the differences in hemoglobin A1c (HbA1c) levels and sport participation in children with T1D. Previous

studies have looked into the effects of physical activity and a child's physical fitness on their HbA1c, but this study will focus on the possible differences of HbA1c levels and if a child with T1D does or does not participate in sports.

Purpose

The purpose of this study was to determine if there was a difference in HbA1c levels among children with T1D who participate in sports compared to those who don't. The children's age, ethnicity, race, gender, insurance type, BMI, duration of diabetes, diabetes treatment plan and glucose monitoring were also explored. The data collected at the Wendy Novak Diabetes Center were utilized in the assistance of educating children and their family of how to safely participate in exercise.

Research Question

1. Is there a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports?

Hypothesis

1. There is not a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports.

Significance of Study

Research previously conducted focused on physical activity and fitness, as well as sedentary time, in regards to children, adolescents, and adults diagnosed with T1D. The focus of the research was on glycemic control during physical activity, or the effect of sedentary time on glycemic control (Åman et al., 2009; Cuenca-García, Jago, Shield, &

Burren, 2012; MacMillan et al., 2014; Nguyen et al., 2015). The current study focused on children diagnosed with T1D HbA1c levels and if they did or did not participate in sports. The goal of the study is to determine if sport participation and no sport participation have an effect on children diagnosed with T1D HbA1c levels.

Previous studies have found conflicting results in regards to the effect of exercise and physical activity on a child with T1D HbA1c levels (Åman et al., 2009; Cuenca-García et al., 2012; MacMillan et al., 2014; Nguyen et al., 2015). The purpose of this study was to determine if there was a difference in HbA1c levels among children with T1D who participate in sports compared to those who don't.

Definition of Terms

The following definitions were used in this study:

Diabetes Mellitus: a group of metabolic diseases characterized by an elevated blood glucose concentration as a result of defects in insulin secretion and/or an inability to use insulin (ACSM, 2018).

Type 1 Diabetes Mellitus: Juvenile diabetes; most often caused by the autoimmune destruction of the insulin producing beta cells of the pancreas. Some cases are idiopathic in origin (Eckel et al., 2014). In this thesis, the term Type 1 Diabetes (T1D) will be used.

Glucose: A type of sugar; the main source of energy for living organisms (National Cancer Institute, 2018)

Blood Glucose: The amount of glucose in the blood (Kids Health, 2018)

Hemoglobin: an iron-containing protein within red blood cells that carries oxygen from the lungs to the tissues and organs, as well as carbon dioxide back to the lungs (National Cancer Institute, 2018)

Hemoglobin A1c: HbA1c and glycolated hemoglobin can be used interchangeably; a blood chemistry test that reflects mean blood glucose control over the past 2-3 months (Eckel et al., 2014)

Normal: < 5.7%, Plasma Glucose <140mg/dL (ACSM, 2018)

Prediabetes: 5.7% - 6.4%, Plasma Glucose 140-199mg/dL (ACSM, 2018)

Diabetes Mellitus: ≥ 6.5%, Plasma Glucose ≥200mg/dL (ACSM, 2018)

Hyperglycemia: Also known as high blood sugar; Higher than normal amount of blood glucose (National Cancer Institute, 2018)

Hypoglycemia: low blood sugar; abnormally low blood glucose (National Cancer Institute, 2018)

Ketones: produced as a by-product when the body tries to utilize fat as an alternative fuel, indicating a lack of insulin in the body (S.R Colberg, 2008)

Diabetic Ketoacidosis: a condition resulting from the combination of elevated blood sugars and insulin deficiency causing the liver to produce ketones that make the blood too acidic; can be life threatening (S.R Colberg, 2008)

Team Sport: players working together toward a shared objective. An activity in which a group of individuals, on the same team, work together to accomplish and ultimate goal, usually to win (Freebase, 2018).

Individual Sport: a sport in which participants compete as individuals. A sport that is practiced by two opposing individuals or one individual (Freebase, 2018).

CHAPTER 2

LITERATURE REVIEW

Purpose

The purpose of this study was to determine if there was a difference in HbA1c levels among children with T1D who participate in sports compared to those who don't. The children's age, ethnicity, race, gender, insurance type, BMI, duration of diabetes, diabetes treatment plan and glucose monitoring were also explored.

Type 1 Diabetes

The diagnosis of T1D occurs mostly in children and young adults, resulting in the previously known name of juvenile diabetes. Of all diabetes cases, only 5% of people have this form (American Diabetes Association, 2018). The most common cause of T1D is the autoimmune destruction of the insulin producing beta cells of the pancreas. In some cases, however, it is idiopathic in origin. When looking at an individual diagnosed with T1D, their primary characteristics include nearly absolute insulin deficiency and a high tendency for ketoacidosis (Eckel et al., 2014).

After a T1D diagnoses, management is key and composed of a number of elements, blood glucose control and insulin management, exercise, nutrition, and support. Management of blood glucose and insulin levels are crucial to management of T1D. Blood glucose monitors utilize blood from the individual to measure blood glucose levels

through fingerstick and/or continuous glucose monitor. With the information provided from the monitor, an appropriate amount of insulin can be administered via daily injections with insulin pens, syringes, or an insulin pump. Additional injections may be needed when eating carbohydrates based on the individual's carbohydrate ratio. Insulin type and amount are determined by the individual's physician. Exercise, along with many other health benefits, can help with an individual's diabetes management by responding with more stable blood glucose levels and less insulin needs. When managing either T1D or type 2 diabetes, nutrition is one of the most important elements when preventing hypoglycemia and providing the body with fuel during exercise. Understanding how various foods affect blood glucose and having solid meal plans will help maintain stable blood glucose levels. (American Diabetes Association, 2018).

Hemoglobin A1c

Hemoglobin A1c (HbA1c) is a blood test result utilized to diagnose both type 1 and type 2 diabetes, as well as to gauge how well an individual is managing their diabetes (Association, 2014; Mayo Clinic, 2018). The HbA1c test measures what percentage of the body's hemoglobin is coated in sugar, or is glycated. This blood test is performed during routine doctor visits and measures an individual's average blood glucose levels over the last 3 months. Due to the test occurring every two to three months, there is a better representation of how well an individual's diabetes treatment plan is working. A high HbA1c represents poor blood glucose control and put individuals at a higher risk for diabetes related complications (Mayo Clinic, 2018).

The American Diabetes Association recommends that children under the age of 19 years diagnosed with T1D should maintain a HbA1c level less than 7.5%. Although

this is a target percentage, HbA1c levels are individualized to safely achieve the best outcomes for the child. Research has discovered that prolonged hyperglycemia can lead to serious complications in children, including cardiovascular and kidney disease (American Diabetes Association, 2014).

Public Health Concern

Healthy People 2020 is the national health agenda for disease prevention and provides goals and objectives for health improvement. The four overarching goals are to "attain high-quality, longer lives free of preventable disease, disability, injury, and premature death, achieve health equity, eliminate disparities, and improve the health of all groups, create social and physical environments that promote good health for all, and promote quality of life, healthy development, and healthy behaviors across all life stages" (Centers for Disease Control and Prevention, 2011). *Healthy People 2020* has forty-two topic areas that contains more than 1,200 objectives. Of those objectives, a small portion, the Leading Health Indicators, have been chosen to represent high-priority health issues and various actions that can be taken to address them (USDHHS, 2018).

In the mid-1990s, the American College of Sports Medicine (ACSM) partnered with the United States Centers for Disease Control and Prevention (CDC) in publishing public health recommendations on physical activity (Russell R. Pate, Yancey, & Kraus, 2009). These public health recommendations stated that adults should accumulate 30 minutes or more of moderate intensity physical activity on most, but preferably all days of the week. Starting in 1980, the United States government has provided *Dietary Guidelines* for Americans, with updates every five years. For the first time in 2005, emphasis was put on physical activity, especially in regards to its effects on diet, energy

balance, body composition, weight status, and obesity. In 2008, the United States government published the *Physical Activity Guidelines for Americans,* which contain recommendations in regards to the quantity and quality of physical activity that people should perform. These guidelines contained specific information pertinent to youth, adults, and older adults, as well as special populations, such as those with disabilities (Russell R. Pate et al., 2009).

A study conducted in 2006 discovered physically active adolescents were less likely to engage in risk behaviors, including cigarette smoking, truancy, delinquency, and sexual intercourse (Nelson & Gordon-Larsen, 2006). Through physical activity, adolescents reported having higher self-esteem and better grades (Nelson & Gordon-Larsen, 2006). For those who were not physically active, there were reports of higher levels of stress and anxiety when compared to their active peers (ADAA, 2010; Calfas & Taylor, 1994). Among adolescents, there is a positive association between emotional well-being and participation in vigorous recreation and sport (Eime, Young, Harvey, Charity, & Payne, 2013; Steptoe & Butler, 1996).

Diabetes

Of particular concern to health educators is the rise in physical inactivity and overweight and obesity rates among children, especially those diagnosed with T1D. Diabetes, although manageable, is a very serious, common, and costly disease. In the United States, it is one of the top ten leading causes of death and affects almost 26 million people with 7 million being undiagnosed. Diabetes is the leading cause of non-trauma related lower-limb amputation, new cases of blindness, and kidney failure. It is

also a major contributor to cardiovascular disease (Centers for Disease Control and Prevention, 2011).

Type 1 diabetes incidence reaches a peak at puberty and declines rapidly thereafter. T1D diagnoses in older adults becomes more difficult the older an individual is. There is a higher incidence of the disease in males when compared to females, and the overall incidence of the disease continues to increase. At the beginning of the 20th century T1D was a rare condition. From the middle and soon after the 20th century a number of populations showed an increase in the incidence, which is a continuing trend as of 2014. The most rapid increase in incidence is seen between the ages of 0 to 5 years and is predicted to double by 2020 (Gale, 2014; Patterson, Dahlquist, Gyürüs, Green, & Soltész, 2009).

Physical Activity Recommendations for Children

Physical activity recommendations start at an early age. MacMillan et al. (2014) states children are to achieve a minimum of 60 minutes of moderate to vigorous physical activity per day. The United States Department of Health and Human Services (2018) put out specific recommendations depending on the age of the individual. Preschool aged children, ages 3 to 5 years, should be physically active throughout the day in order to enhance their growth and development. Adults with or working with preschool aged children should promote and encourage active play including a variety of activity types. Children ranging from the ages of 6 to 17 years should participate in aerobic, muscle-strengthening, and bone-strengthening activities. Each recommended activity should be participated in a minimum of 3 days a week for a minimum of 1 hour. Aerobic activities should be of moderate or vigorous intensity. Muscle-strengthening physical activity is

any activity that causes the muscle to work harder than performing activities of daily living. Bone-strengthening physical activity is any activity that produces force on the bones that promotes bone growth and strength (USDHHS, 2018).

For children 4 to 12 years, gender, self-efficacy, and parental support are major factors leading to a positive association with physical activity (Office of Disease Prevention and Health Promotion, 2018; Van Der Horst, Paw, Twisk, & Van Mechelen, 2007). For adolescents 13 to 18 years, parental education, gender, personal goals, physical education/school sports, self-efficacy, and support of friends and family are major factors leading to a positive association with physical activity (Office of Disease Prevention and Health Promotion, 2018; Van Der Horst et al., 2007). Among both children and adolescents, boys are more likely to participate in physical activity when compared to girls. Environmental influences, including presence of sidewalks, having a destination/walking to a particular place, access to public transportation, low traffic density, and access to neighborhood or school play area, are positively associated with physical activity. These factors include (Davison & Lawson, 2006; Office of Disease Prevention and Health Promotion, 2018).

The National Association for Sport and Physical Education (NASPE) is a leading professional organization consisting of health and fitness researchers and experts, who summarized physical activity studies and their recommendations for children 5 through 12 years of age (NASPE, 1998, 2004). These recommendations, however, are only minimal suggestions. For a child to improve their health, accumulating additional activity is needed. Table 1 identifies the NASPE physical activity guidelines.

Table 1. NASPE Physical Activity Guidelines for Children

Guideline 1.	Children should accumulate at least 60 minutes, and up to several hours, of age-appropriate physical activity on all, or most days of the week. This daily accumulation should include moderate and vigorous physical activity with the majority of the time being spent in activity that is intermittent in nature.
Guideline 2.	Children should participate in several bouts of physical activity lasting 15 minutes or more each day.
Guideline 3.	Children should participate each day in a variety of age-appropriate physical activities designed to achieve optimal health, wellness, fitness, and performance benefits.
Guideline 4.	Extended periods (periods of two hours or more) of inactivity are discouraged for children, especially during the daytime hours.

Healthy People 2020 designated health objectives specifically for children, adolescents, and adults (Office of Disease Prevention and Health Promotion, 2018). These physical activity objectives were created to reflect the science supporting regular physical activity and the health benefits discussed in the Physical Activity Guidelines for Americans (Office of Disease Prevention and Health Promotion, 2018). Table 2 identifies *Healthy People 2020* objectives specifically targeting physical activity education and participation.

Table 2. *Healthy People 2020* Physical Activity Objectives for Children and Adolescents

Objective 3	Increase the proportion of adolescents who meet current Federal physical activity guidelines for aerobic physical activity and for muscle-strengthening activity.
Objective 5	Increase the proportion of adolescents who participate in daily school physical education.
Objective 11	Increase the proportion of office visits that include counseling or education related to physical activity.
Objective 11.1	Increase the proportion of office visits made by patients with diagnosis of cardiovascular disease, diabetes, or hyperlipidemia that include counseling or education related to exercise.
Objective 11.2	Increase the proportion of physician visits made by all child and adult patients that include counseling about exercise.
Objective 13.2	Increase the proportion of trips of 1 mile or less made to school by walking by children and adolescents aged 5 to 15 years.
Objective 14.2	Increase the proportion of trips of 2 miles or less made to school by bicycling by children and adolescents aged 5 to 15 years.

The most recent physical activity and health recommendations from a *Report of the Surgeon General* stated that adolescents and young adults needed to participate in moderate intensity physical activity daily (National Prevention Council, 2004; USDHHS, 1996). This report gave a number of suggestions to communities to assist with improved physical activity participation in adolescents and young adults. Table 3 identifies *Report of the Surgeon General* Physical Activity and Community Involvement objectives.

Table 3. *Report of the Surgeon General*: Physical Activity and Community Involvement

Objective 1	Create opportunities for physical activities that promote adolescents' and young adults' physical activity self-efficacy, are enjoyable, and involve friend, peer, and parent involvement
Objective 2	Provide appropriate physically active role models for youth
Objective 3	Provide access to school and community facilities that provide safe participation in physical activity
Objective 4	Provide a range of extracurricular programs in schools and community recreation centers that meet the needs and interests of adolescent and young adult populations, such as racial and ethnic minority groups, females, persons with disabilities, and low-income groups

Physical Activity Recommendations for Children with Type 1 Diabetes

Children with T1D should follow the same physical activity recommendations as those unaffected by T1D, a minimum of sixty minutes of moderate to vigorous physical activity per day (ACSM, 2018; MacMillan et al., 2014). It is important for children and adolescents with T1D to participate in regular physical activity as a way to manage their diabetes and assist with the development of bone growth and motor skills (ADA, 2004; Valerio, 2007. Participation in sports is an excellent way for children to accumulate physical activity (Committee on Physical Activity and Physical Education in the School Environment, Food and Nutrition Board, & Institute of Medicine, 2013). Physical activity and exercise allow the body to build muscle and lose body fat, suppress appetite, eat more without gaining fat weight, enhance mood, reduce stress and anxiety, increase energy level, improve immune system, keep muscles and joints more flexible, and improve quality of life (S.R Colberg, 2008).

Monitoring blood glucose prior to, during, and following exercise can be very important in managing insulin and blood glucose levels while participating in exercise. Muscular activities increase the body's use of blood glucose, causing a risk of hypoglycemia, higher than normal blood glucose levels, during, or following exercise. If an individual were to exercise with hypoglycemia, especially with ketones, a by-product when the body tries to used stored fat as an alternative fuel source, present, it could cause their blood glucose levels to continue to increase. If exercise were to continue, an individual can be put into diabetic ketoacidosis (S.R Colberg, 2008).

There are a number of variables than can affect blood glucose responses to exercise, including energy system used, blood sugar at the start of the activity, type of exercise performed, timing of last insulin dose, type of food eaten, and time of last meal. Other variables can be found in table 4 below. After an individual has learned to manage these variables and understands their individual responses to these variables, they can better predict their blood glucose responses to exercise (S.R Colberg, 2008).

Table 4. Variables Affecting Blood Glucose Responses to Exercise

Types of insulin used	Time of day when exercise occurs
Training status (i.e. new versus usual activity)	Previous episode of hypoglycemia
Prior exercise (same day or day before	Other glucose-lowering medications taken
Recent or current illness	Level of hydration
Temperature and other environmental conditions	Pregnancy (women only)
Phase of menstrual cycle (women only)	

Adapted from Colberg, pg. 22, 2018

Physical Activity Prevalence for Children with Type 1 Diabetes

There are conflicting results that arise in regards to children with T1D meeting the physical activity recommendations. Research has shown that children diagnosed with T1D are often less active than children without T1D. The inactivity observed among this population is seen particularly in girls beginning in early childhood (Leclair, de Kerdanet, Riddell, & Heyman, 2013; Sundberg, Forsander, Fasth, & Ekelund, 2012). Two possible barriers to physical activity among children with T1D include fear of exercise induced hypoglycemia and physical fitness impairment. There is literature to support that aerobic fitness in young T1D decreased with age, possibility resulting in a decrease in physical activity (Leclair et al., 2013).

MacMillan et al (2014) analyzed accelerometer data, as well as demographic questionnaires and physical activity/sedentary behavior questionnaires. The study collected data over the course of two visits, that occurred at least eight days apart, taking place at the child's home, clinic, or another location suitable for the purpose of the study. It was determined that, for the full sample, the children averaged 43.2±23.8 minutes/day of moderate to vigorous physical activity, and 10.2±1.7 hours/day of sedentary time. Of the forty participants from this study only two achieved the recommended ≥60 minutes of moderate to vigorous physical activity every day that the accelerometer was worn. There were nineteen children who did not meet the recommendation any day that they wore the accelerometer (MacMillan et al., 2014).

It is recommended that all children participate in physical activity daily (NASPE, 2004; USDHHS, 2000; USDHHS & CDC, 1996, 1997; USDHHS, PHS, & OSG, 2001). School-based programs such as physical education, daily recess, incorporation of

physical activity into regular classroom lessons, and before and after school programs, help to increase daily physical activity participation for children (CDC & OADP, 2018). Outside of school hours, there are a number of places a child can purse activity, including, but not limited to, playgrounds, parks and recreation centers, trails, camps, and religious communities (USDHHS & CDC, 1997). Typically, young people pursue activities such as walking, bicycling, dancing, structured (sports) and unstructured (playing), and household or occupational work (CDC & USDHHS, 2003).

Physical Education

According to the National Association for Sport and Physical Education (NASPE, 1998), the goal of physical education in schools is to develop the individuals participating, students, to have the knowledge, skills, and self-efficacy to enjoy a lifetime of healthful physical activity. This association believes that students from kindergarten throughout high school in the United States should have the opportunity to participate and receive quality physical education classes (NASPE, 1998).

In the winter of 2009-2010, the National Association for Sport and Physical Education (NASPE), as an association of the American Alliance for Health, Physical Education, Recreation, and Dance (AAHPERD), and the American Heart Association (AHA) developed the Shape of the Nation Report. Its purpose is to provide the most recent status and information of physical education in the United States. Not only does this report bring attention to the importance of the quality of daily physical education programs for all school-aged children, but it also provides useful information for improving and expanding current physical education programs (NASPE & AHA, 2010).

SHAPE America: Society of Health and Physical Educators is an organization defining excellence in physical education and their national standards serve as the foundation for well-designed and executed physical education programs across the United States (Society of Heath and Physical Educators, 2013). In 2016, SHAPE America along with the American Heart Association, and Voices for Healthy Kids, came out with an updated Shape of the Nation: Status of Physical Education in the USA (SHAPE, AHA, & VHK, 2016). In this report, a set of national standards and grade-level outcomes for physical education courses for children in kindergarten through twelfth grade were published. The *SHAPE America's National Standards & Grade-Level Outcomes for K-12 Physical Education* define what each student should know and be able to do after completing their grade levels highly effective physical education program. The standards can be found below in Table 5 (Society of Heath and Physical Educators, 2013).

Table 5. SHAPE America's National Standards & Grade-Level Outcomes for K-12 Physical Education

Standard 1	The physically literate individual demonstrates competency in a variety of motor skills and movement patterns.
Standard 2	The physically literate individual applies knowledge of concepts, principles, strategies and tactics related to movement and performance.
Standard 3	The physically literate individual demonstrates the knowledge and skills to achieve and maintain a health-enhancing level of physical activity and fitness.
Standard 4	The physically literate individual exhibits responsible personal and social behavior that respects self and others.
Standard 5	The physically literate individual recognizes the value of physical activity for health, enjoyment, challenge, self-expression and/or social interaction.

In 2004, NASPE put out *Moving into the Future: National Standards for Physical Education, 2nd edition,* highlighting the recommendations and framework for physical education courses. The National Standards for Physical Education, developed by NASPE, set recommendations for students in elementary school, middle school, and high school. At the elementary school level, students should be receiving 150 minutes of physical education classes per week, while middle school and high school students should receive 225 minutes of physical education classes per week (NASPE, 2004).

The 2016 Shape the Nation Report states that only 86.3% of states require elementary schools to provide a physical education program for their students and 76.5% of states require students to take a physical education class in one or more elementary school grades. Of the states where elementary schools provide physical education classes, 87.2% require children in kindergarten to participate in the provided classes. In 80.4% of states, middle schools are required to provide a physical education course, and 72.5% of states require their students to take one or more years of physical education throughout middle school. In high schools, physical education courses are required in 90.2% of states and 86.3% of states require high school students to participate in one or more years of physical education courses (SHAPE et al., 2016).

Recess

According to the Institute of Medicine (IOM), school-age children should be allowed a minimum of 30 minutes of physical activity during the school day (IMNA, 2004; Koplan, Liverman, & Kraak, 2005). Recess is a time for children to engage in physical activity through unstructured play. NASPE states that recess gives children the opportunity to develop physical activity competence, positive personal and social

behavior, and physical activity enjoyment so they will continue to be physically active throughout their lifetime (NASPE, 2006). It is recommended that there be at least one daily 20-minute period of supervised recess offered by schools. According to the School Health Policies and Programs Study, states that supported regularly scheduled recess policies in their states elementary schools, increased from 2000 to 2006, 4.1% to 11.8% (Kann, Brener, & Weschler, 2007).

After School

Children and adolescents spend a majority of time being physically active during non-school hours (Simons-Morton et al., 1990). The National Coalition for Promoting Physical Activity is a coalition of leading health and fitness organizations including the following, NASPE, the American College of Sports Medicine (ACSM), the American Cancer Society, and the American Heart Association. This coalition recommends that children utilize the hours 3:00p.m. to 6:00p.m., or the after-school hours, for physical activity (National Coalition for Promoting Physical Activity, 2018). They also recommend and support children's participation in either unstructured (free-play) or structured (organized sports) activities.

There have been a number of studies conducted assessing physical activity accumulation throughout a full day, but none specifically looking at after school activity (Scruggs et al., 2003; Tudor-Locke, Lee, Morgan, Beighle, & Pangrazi, 2006; Wilde, Corbin, & Le Masurier, 2004). One study conducted by Tudor-Locke et al. (2006) found that in the hours immediately after school, half of a child's daily physical activity is accumulated. More specifically, it was determined that only 8 to 9% of children's daily steps were taken during a typical school day and recess, 15-16% were taken at lunchtime

recess, 8-11% were taken during physical education classes, and the rest of the step accumulation were after school. Even though school takes up a large portion of a child's day, physical activity primarily takes place after school in home or community settings (Gorden-Larsen, McMurray, & Popkin, 2000; Koplan et al., 2005; R.R. Pate et al., 2003; Tudor-Locke et al., 2006).

Physical Activity and Sport Opportunities for Children with Type 1 Diabetes

A number of health benefits that come with exercise while having a diagnosis of T1D exists, but there is evidence showing that children with T1D find exercise and physical activity participation as an insignificant aspect of their life (Leclair et al., 2013). There is limited information in regards to physical activity and sports participation available for young patients with T1D (Valerio, 2007).

Individuals with T1D can participate in any activity that an average individual can, with minor adjustments made on an individualized basis for diet and medications. T1D patients can participate in activities such as average fitness activities (i.e. walking, resistance training, and aerobics), endurance sports (i.e. running, swimming, and triathlons), endurance – power sports (i.e. basketball, ice hockey, and rowing), power sports (i.e. bodybuilding, baseball, and field events), and various outdoor recreational activities and sports (i.e. kayaking, snowboarding, and hiking). As discussed in a previous section, there are variables that affect an individual's blood glucose levels, but as they begin to understand these variables and the signs of hyper- and hypoglycemia, an individual is free to participate in any activity as long as it is performed safely (S.R Colberg, 2008).

Participation in physical activity and sport among children and adolescents promotes healthy bones and muscles, as well as assisting with maintenance in body weight, reducing body fat, feeling of depression and anxiety, and promoting psychological well-being (Physical Activity Guidelines Advisory Committee. 2008). Regular participation in physical activity and sport also decreases an individual's risk of high blood pressure, heart disease, diabetes, obesity, and premature death (Physical Activity Guidelines Advisory Committee. 2008).

Psychology of Sport

A key issue relevant to social behavior and youth development is the interaction between individuals and their peers (Bandura, 1991; Benson & Bruner, 2018). Sport offers a plentiful amount of opportunities to meet and interact with other children (Smith, 2003). There is some evidence suggesting that young athletes enjoy greater popularity and status due to participation in a distinct social group (Sussman, Pokhrel, Ashmore, & Brown, 2007). In 2016, Al-Yaaribi, Kavussanu, and Ring is a cross-sectional study showing that receiving more frequent positive interactions, such as encouragement and beneficial acts, from teammates corresponds to greater enjoyment, higher levels of perceived performance, and more effect (Al-Yaaribi, Kavussanu, & Ring, 2016).

Group task characteristics, group productivity norms, desire for group success, group roles, group position, and team stability are grouped together as team factors. It was suggested that a team that has been together longer has a strong desire for group success and demonstrate higher levels of group cohesion (Carron, 1982; Weinberg & Gould, 2011). If the group were to share in experiences together, such as a great success or failure, cohesion of the group will become greater (Brawley, 1990; Weinberg &

Gould, 2011). A number of other studies state that recent factors of collective efficacy has a positive relationship to perceptions of the team's cohesion (Carron & Dennis, 2001; Paskevich, 2001; Weinberg & Gould, 2011).

Team Sports

A group can be defined as two or more individuals who interact with and apply mutual influence on each other (Aronson, Wilson, & Akert, 2002; Weinberg & Gould, 2011). A team and a group, although similar, are not necessarily interchangeable. For both, each individual may interact and enjoy each other. They can both have common goals. The differentiation between the two is that a team is a specific type of group. Teams have four major characteristics used to define it and are as follows: collective sense of identity, distinctive roles, structured modes of communication, and norms (Weinberg & Gould, 2011).

In the team setting, social support is a key factor. It refers to exchanging resources between two or more individuals with the intention of enhancing the well-being of one of the individuals (Shumaker & Brownell, 2010). Positive social support can have a positive impact on a number of factors including recovering from injury, coping with stress, burnout, youth physical activity, and overall performance (Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997; Duncan, Duncan, & Strycker, 2005; Gould, Tuffey, Udry, & Loehr, 1996a, 1996b; Rees & Hardy, 2000; Rees, Ingledew, & Hardy, 1999). A link has been found between social support and increases in team climate and cohesion (Weinberg & Gould, 2011). The social support that an individual receives is positively related to the perception that individual has on the team's group cohesion (Rees & Hardy, 2000).

Research Question

1. Is there a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports?

Hypothesis

1. There is not a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports.

CHAPTER 3

METHODS

Study Design

This overall study is being conducted to help the Department of Pediatrics-Endocrinology research staff identify patient's engagement in physical activity or sport(s) and how often. This thesis is a sub-study conducted within an overarching study. Data for this thesis were collected from January 14, 2019 until March 19, 2019. The participant completed an electronic informed consent/assent to participate in this survey study. The survey is linked to the Pediatric Endocrinology Database Registry through a pre-assigned study ID number. The clinical database includes all patients cared for in the University of Louisville Pediatric Endocrinology clinic for type 1 diabetes, type 2 diabetes, or prediabetes. The primary research activity for this thesis study was an electronic questionnaire known as the Physical Activity and Sport Participation Survey (PASPS). Participants completed the PASPS using an iPad.

Inclusion and Exclusion criteria

The inclusion criteria for this thesis study was children age 7 to 17 years old with type 1 diabetes cared for in the University of Louisville Pediatric Endocrinology Clinic. Exclusion criteria includes non-English speaking and those who were under 18 without a parent or legal guardian with supporting documentation present.

Research Question

1. Is there a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports?

Hypothesis

1. There is not a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports.

Instrumentation

Survey

Patients presenting for diabetes care in the Pediatric Endocrinology clinic or for participation in another activity in the clinic were invited to participate in the survey during the check-in process. They were given an iPad to complete the electronic informed consent/assent (preamble) process. Those completing this process were prompted to complete the Physical Activity and Sports Participation Survey (PASPS) on the iPad. The survey was administered through REDCap which is housed in UofL's secure server. A participant could quit the survey at any time. See Appendix for survey.

Physical Activity and Sport Participation Survey (PASPS)

The 18-item "Physical Activity and Sport Participation Survey" (PASPS) assesses physical activity and sport participation for children over the past year. An electronic survey was developed using a compilation of items selected from pre-established surveys. A short description and rationale for selection and measurement of the variables follows. The PASPS is composed of two survey questions from the 2017 Youth Risk Behavior

Surveillance System (YRBSS) questionnaire (Kann, McManus, Harris, …, Ethier, 2018), ten questions, which were adapted from Booth et al.'s (2002) *Adolescent Physical Activity Recall Questionnaire*, and the remaining questions were developed by the research team.

Physical Activity and Sport Participation

The YRBSS is a valid and reliable instrument for use with high schoolers and the MSYRBS is valid and reliable for use with middle school age children (Kann et al., 2018). The item on the Youth Risk Behavior Surveillance Survey (YRBSS) pertaining to physical activity accumulation during the past week asked, "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? (Add up all the time you spend in any kind of physical activity that increases your heart rate and makes you breathe hard some of the time.)" Responses ranged from 0 days to 7 days. Responses were "0-29 minutes," "30 minutes (½ hour) – 59 minutes," "60 minutes (1 hour) – 89 minutes," "90 minutes (1½ hours) – 119 minutes," and 120 minutes (2 hours) or more" for each day of the school week. The question was designed to assess frequency (number of days per week), intensity (moderate to vigorous intensity), and duration (minutes) of after-school physical activity.

The specific question that was used as the independent variable (groups) to identify if a child did or did not participate in sports was taken from the YRBSS. The question reads "During the past 12 months, on how many sports teams did you play? (Include any teams run by your school or community)." The response items are "0 teams," "1 team," "2 teams," or "3 or more teams." If a child selected "0 teams," a "0" was recorded in the data set to signify no sport participation. If a child selected "1 team,"

"2 teams," or "3 or more teams," a "1" was recorded in the data set to signify sport participation. For the purpose of this study, this question will be utilized to measure whether sport participation has an effect on the control an individual diagnosed with T1D has over the disease.

Adolescent Physical Activity Recall Questionnaire

The Physical Activity and Sport Participation survey was developed by the research team based on Booth, Okely, Chey, & Bauman's (2002) physical activity questionnaire. Data collected on specific activities are more useful than data collected on broad classes of activity (i.e. moderate intensity), when looking at activities that young people participate in. Frequency and average duration of participation information in the specific activities, when compared to total duration, contributes to understanding physical activity patterns among young people. Data collected in regards to season of participation allows for possible variability among seasons and the prevalence of participation.

The survey produced by Booth et al. (2002) collected self-report information. The questionnaire items focused on two main components, participation in games, organized sports, and other activities and participation in nonorganized physical activities. The questionnaire included demographic information, as well as amount of time spent sedentary, attendance at physical education (PE) classes, enjoyment of PE, and individual factors associated with sport and other physical activity participation based on the Social Cognitive Theory.

The results of Booth et al.'s (2002) study suggests that the Adolescent Physical Activity Recall Questionnaire has an acceptable to good test-retest validity and reliability. The values of intraclass correlation coefficients and kappa were characterized by the

following: <0.40 showed poor agreement, 0.40 – 0.75 showed fair to good agreement, and values >0.75 showed excellent agreement. Percent agreement ranged from 67-80% for summer terms and 73-83% for winter terms for the three-category measure of physical activity. Weighted kappa ranged 0.33-0.71 for summer term and 0.39-0.71 for winter term. Girls values tended to be higher than boys, as did older students when compared to younger students, within sex. When looking at a two-category measure, percent agreement ranged 81-90% for summer terms and 76-88% for winter terms. Kappa values ranged 0.34-0.74 for summer terms and 0.25-0.68 for winter terms. As with the three-category measure, girls values tended to be higher than boys.

Pediatric Endocrinology Database Registry

This clinical database is maintained as part of routine care in the Pediatric Endocrinology Clinic. Variables included are birthdate, height, weight, body mass index (BMI), ethnicity, race, gender, zip code, diagnosis date, insurance type, hemoglobin A1c (HbA1c), HbA1c date, treatment plan, and continuous glucose monitor use. The PASPS survey was linked to this database utilizing the medical record number, participant name, and date of birth. Once merged, a study ID was assigned and the full dataset was de-identified. The specific item in the database registry that was used as the dependent variable to quantify HbA1c will range from “less than 6.4” to “14.0 or greater” with 76 options in total.

Activities Preparatory to Research

To ensure instrument readability and comprehension as well as ease of administration of the Physical Activity and Sport Participation Survey two approaches of instrument and pilot testing occurred – a review by a panel of experts and cognitive pilot

testing. These approaches determined if the survey and/or its administration procedures should be modified before full-fledged administration began. If significant modifications to the survey or administration process were recommended, an amendment for review was submitted to the Human Subjects IRB prior to administration to participants for data collection. The data collected during these activities preparatory to research were not used for data analysis purposes.

Panel of Experts Review

A panel of 3-5 individuals who have expertise in a clinical practice for children were selected to review the Physical Activity and Sport Participation Survey for readability, clarity, and/or potential administration problems. The researchers approached experts individually and asked if they were willing to provide a review. If the expert agreed, the researcher gave the expert the "Script for Survey Administration" and then used the iPad to take the survey. The participant was encouraged to take the survey several times, selecting different answers each time, in order to immerse themselves in the survey content and process. An evaluation sheet, "Physical Activity and Sport Participation Survey Evaluation Sheet," was given to the experts to complete regarding their comments, suggestions, concerns regarding the survey or process of completing it. The experts helped uncover questions that might produce multiple interpretations or confusion for the future participants. Once the expert panel evaluations were collected, modifications in the survey or administration process were made by the research team. It was anticipated by the research team that the review will take approximately 20 minutes of the expert's time.

Cognitive and Process Pretesting

Cognitive pretesting was conducted face-to-face where the researcher watched for points of confusion, then asked probing and follow-up questions to capture what the respondents thought about the questions. Conducting a pretest allows the researcher to make sure that the survey items and the process of taking the survey are fully vetted before implementation to the entire clinic patients begins (i.e., the idea is to try to avoid unanticipated procedural hiccups during administration).

A convenient selection of a sampling of participants ages of 6 participants was considered sufficient - 3 children age 12 and under (e.g. elementary school age children) and 3 children over 12 years (e.g., middle school or high school). The researchers asked the care team to identify participants who they felt may be willing to take the pretest on their next regularly scheduled visit. A member of the research team met the participant upon "check in" and asked the participant if he/she was willing to sit with the researcher in a meeting room to complete the survey while the participant waited to see his/her medical care team. The researcher encouraged the participant to take the survey a few times while the participant waited to see his/her medical care team, selecting different answers each time, in order to immerse themselves in the survey content and process. The researcher had an evaluation sheet, "Physical Activity and Sport Participation Survey Evaluation Sheet," to compete regarding the participant's comments, suggestions, concerns regarding the survey items or process of completing. It was anticipated by the research team that the review would take approximately 10 minutes of the child's time and would not interfere with the child's time with their medical care team.

Results of Panel of Experts Review and Cognitive and Process Pretesting

The survey was reviewed by a panel of experts for readability, clarity, and/or potential administration problems. Cognitive pretesting was conducted on 9 individuals (3 adults, 3 age 8-11 years old, and 3 age 12-17 years old) face-to-face with a researcher, followed by questions to capture what each respondent thought about the questions. Two suggestions were made and the survey was revised. An adult suggested adding "camp" to each question in regards to attendance at a camp. An 11-year-old participant suggested adding the option "none" to each question of the survey.

The results of the pilot study survey evaluation were positive. The mode of administration through surveys on an iPad was efficient and deemed worthy of replication with the primary data collection method, administration during check-in at the pediatric endocrinology clinic. The modifications to the survey were made and resubmitted to the Institutional Review Board as an amendment. One week after the submission, the review was granted and the study began on January 14, 2019.

Setting

Data were collected at the Wendy Novak Diabetes Center, located on the 7th floor of the Novak Center for Children's Health in downtown Louisville, Kentucky. When the children arrived for their appointments, they sat in the lobby on the 7th floor at the Wendy Novak Diabetes Center where they filled out the survey utilized for data collection. The rest of the physiological data collected was taken from the child's medical records located in the University of Louisville Physicians database.

Participants

Individuals were invited to participate during check in for their scheduled clinical visit. Only established patients of University of Louisville Pediatric Endocrinology were

invited to participate. The PASPS was administered to each child who presented to the Pediatric Endocrinology clinic with a diagnosis of type 1 diabetes and met inclusion criteria and no exclusion criteria. See attached "Instructions for Administering Survey" in Appendix.

Human Subjects Informed Consent

This study utilized an electronic informed consent/assent document. Children presenting to the University of Louisville Pediatric Endocrinology clinic were invited to participate. Those expressing interest were given an iPad to complete an informed consent/assent process. The first question asked if they were 18 years of age or older. If they replied yes, they were presented with an electronic informed consent document. This document was developed using the University of Louisville's biomedical preamble template. For those who were less than 18 years of age, a prompt for a parental informed consent was presented. Patients presenting for care must be accompanied by a parent or a legal guardian. If accompanied by a legal guardian, supporting documentation was presented and scanned to the medical record as part of the standard check-in process. As per the exclusion criteria, only those who were accompanied by a parent or legal guardian with supporting documentation, were invited to participate. Once completed by their parent/guardian a prompt for an assent appeared. The participant was asked to read and complete the electronic assent that was developed using the University of Louisville biomedical child assent template.

If the participant or parent/legal guardian had questions regarding the electronic informed consent, a member of the research staff was available to fully answer all questions. When the participant turned the iPad back in after completing the survey, the

staff had available paper copies of the electronic informed consent form for the participant. For this thesis study, data from only the 7-17 year old children were used.

Data Collection

As described in detail above, the main procedure involved with this research study involved data collection by survey methods to better understand the sports patients in the clinic participated in and their HbA1c levels. This study did not involve any type of intervention, nor was anyone randomized. Eligible participants were approached in-person by a member of the staff during their clinic visit to determine their interest in participating. If the patient was younger than 18 years old, then the patient was accompanied by a parent or legal guardian who could help fill out the survey. The survey was administered on an iPad. If the participant or parent/legal guardian had any questions or concerns regarding the survey, a research staff member could answer any questions.

Data Preparation

Each item on the survey and medical record, including items left blank, was coded and the data were organized into an excel spreadsheet. Blank items were coded as "." To represent missing data. Once data entry was complete, data were imported into IBM SPSS version 25 for analysis. Tests of the underlying assumptions of the t-test included normality of the dependent variable data within each group of independent variables, outlier analysis and decisions, and Levene's test for the homogeneity of group variance.

Data Analysis

This study investigated the relationship of sport participation on a child with T1D HbA1c levels. The independent variable consisted of two groups, either sport

participation or no sport participation [no sports (0); sports (1, 2, 3+)], with the dependent variable being HbA1c levels. Descriptive statistics included demographic and diabetes-related characteristics of the participants, as well as physical activity and sport participation, and diabetes-related characteristics of the participants. Relationships among these variables were explored using inferential testing. Data were considered statistically significant if $\alpha \leq 0.05$. A G-Power analysis was conducted and an effect size of $d = 0.69$ is needed for adequate power. An independent samples *t*-test was utilized.

The concept of an independent samples *t*-test is an inferential statistical test determining whether there is a statistically significant difference between the means of two groups. This study investigated the effects of sports a child participates in on their HbA1c.

CHAPTER 4

RESULTS

The purpose of this chapter is to present the results of the thesis research study. A description of the sample will be presented and the results answering the research question will be explained along with the statistical products utilized to conduct the analyses.

Purpose of the Study

The purpose of this study was to determine if there was a difference in HbA1c levels among children with T1D who participate in sports compared to those who don't. The children's age, ethnicity, race, gender, insurance type, BMI, duration of diabetes, diabetes treatment plan and glucose monitoring were also explored.

Research Question

1. Is there a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports?

Hypothesis

1. There is not a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports.

Description of Sample

Demographic Characteristics

The thesis study population consisted of approximately 120 pediatric endocrinology patients from the Wendy Novak Diabetes Center. A total of 120 preambles were received (100% response rate). All forms granted parent/legal guardian permission for the child to participate in the study. A total of 118 surveys were completed (98.3% participation rate), 2 of the participants did not answer the two questions involving sport participation and physical activity participation, and removed prior to data analyses.

The most frequently reported ages were 13 years old (14.2%) and 15 years old (14.2%), then 11 years old (13.4%), 17 years old (11.7%), and 16 years old (10.0%). Participants ages 8, 9, 10, 12, and 14 years old were also present in the data, but percentages were less than or equal to 9.2%. The gender classification of the sample was almost even, 56 females (46.7%) and 64 males (53.3%). A majority of the children recruited were White (n = 104, 86.7%), with 12 being Black or African-American (10.0%), and 4 having an unknown/not reported race. None of the participants reported being American Indian/Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, or of more than 1 race. All participants in this study had documented T1D. Table 6 presents the characteristics of the participants. Table 7 presents the diabetes care plan of the participants.

Table 6. Characteristics of the Participants ($N = 120$)

Descriptive Variable	Frequency (n)	Percentage (%)
Ethnicity		
Hispanic or Latino	4	3.3
Not Hispanic or Latino	116	96.7
Total	120	100.0
Race		
Black or African American	12	10.0
White	104	86.7
Unknown/Not Reported	4	3.3
Total	120	100.0
Gender		
Female	56	46.7
Male	64	53.3
Total	120	100.0
Insurance type		
Private Insurance Company		
Yes	65	54.2
No	55	45.8
Total	120	100.0
Medicare/Medicaid		
Yes	95	79.2
No	25	20.8
Total	120	100.0
No Health Insurance or Coverage		
Yes	2	1.7
No	118	98.3
Total	120	100.0

Table 7. Patients Diabetes Care Plan (*N* = 120)

Descriptive Variable	Frequency (*n*)	Percentage (%)
CGM[a]		
Use CGM	59	49.2
Do not use CGM	61	50.8
Total	120	100.0
Insulin Pump		
Use Insulin Pump	96	80.0
Do not use Insulin Pump	24	20.0
Total	120	100.0

[a] CGM = Continuous Glucose Monitor

Table 8 presents descriptive statistics of select questions from the survey and medical chart characteristics. Participant age ranged from 7 to 17 years old, with a mean age of 12.94 ± 2.8 years. Body Mass Index (BMI) ranged from 14.84 to 37.62 with a mean score of 22.16 ± 4.7. T1D diagnosis duration ranged from 0 to 15 years, with a mean duration of 4.75 ± 3.86. Physical activity over the past week ranged from 0 to 7 days, with a mean score of 3.47 ± 1.94. HbA1c levels ranged from 5.5% to 14.9% with a mean percent of 8.75 ± 1.86.

Table 8. Descriptive Statistics ($N = 120$)

Descriptive Variable	N	Minimum	Maximum	Mean	Std. Deviation
HbA1c values	120	5.5	14.9	8.753	1.86
Days active past week	118	0	7	3.47	1.94
Age	120	7	17	12.94	2.8
BMI	120	14.84	37.62	22.16	4.7
T1D diagnosis years	120	0	15	4.75	3.86
Valid N (listwise)	118				

Physical Activity Level

Physical activity level was determined based off survey data collected. The survey was completed by 118 children, resulting in a 98.3% response rate. Days active over the past week ranged from 0 to 7 days. The most frequently reported active days per week were 5 days out of the week (n = 23, 19.2%). The second most frequently reported days were 3 days out of the week (n = 21, 17.5%).

Underlying Assumptions of the T-Test Analysis

In order to determine the normality of the data, a test of the underlying assumptions of the t-test, a stem and leaf plot showed that that the data were fairly normally distributed within each group of the independent variable on the dependent variable. See Table 9.

Table 9. Stem and Leaf Plot Presenting Frequency of HbA1c Levels in Sport Participation and No Sport Participation Groups

a.

hba1c_yr3_value1 Stem-and-Leaf Plot for
pastyear_sportsteam= 0

Frequency	Stem &	Leaf
2.00	6 .	14
3.00	6 .	889
3.00	7 .	034
4.00	7 .	5688
10.00	8 .	0012223444
6.00	8 .	667889
1.00	9 .	0
2.00	9 .	79
2.00	10 .	03
.00	10 .	
2.00	11 .	24
1.00	11 .	7
4.00	Extremes	(>=13.9)

Stem width: 1.0
Each leaf: 1 case(s)

b.

hba1c_yr3_value1 Stem-and-Leaf Plot for
pastyear_sportsteam= 1

Frequency	Stem &	Leaf
5.00	5 .	56689
9.00	6 .	255778899
12.00	7 .	123567888888
23.00	8 .	01112223444556667788889
13.00	9 .	0002333378899
10.00	10 .	0002444678
3.00	11 .	035
2.00	12 .	03
1.00	Extremes	(>=13.0)

Stem width: 1.0
Each leaf: 1 case(s)

A boxplot analysis was employed testing the underlying assumptions of the t-test. See Figure 1 below. The SPSS results identified several potential outliers, but that conceptually only participant 70 was identified as a true outlier and eliminated from the analysis.

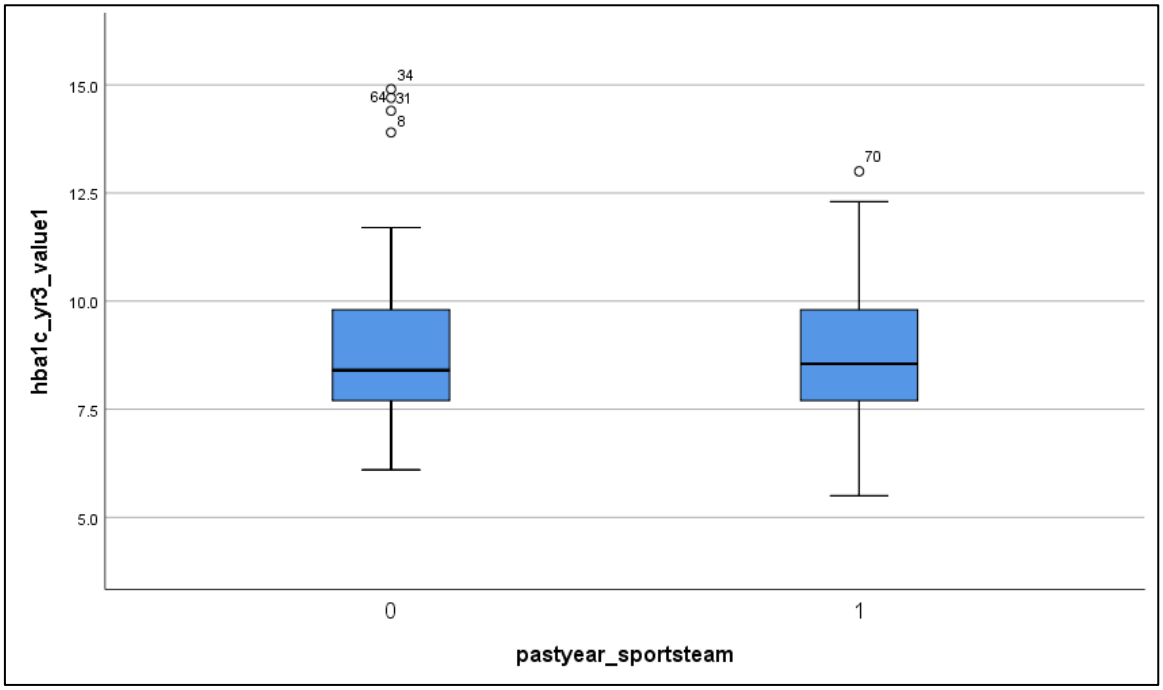

Figure 1. HbA1c and Sport Participation Outliers Box Plot

Independent Samples *t*-test with Sport Participation Outlier Removed

An independent sample *t*-test, removing one outlier from the sport participation group, showed no statistically significant difference in HbA1c levels for children who participated in sports (M = 8.61, SD = 1.61) versus those who did not participate in sports (M = 9.03, SD = 2.24); $t(115) = 1.36$, $p = .178$. The results of this analysis showed a lower p-value, but still no significance was achieved. Table 10 displays the independent samples *t*-test with sport participation outlier removed output data.

Table 10. Independent Samples Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
hba1c_yr3_value1	Equal variances assumed	3.657	.058	1.355	115
	Equal variances not assumed			1.209	58.722

Independent Samples Test

		t-test for Equality of Means		
		Sig. (2-tailed)	Mean Difference	Std. Error Difference
hba1c_yr3_value1	Equal variances assumed	.178	.4769	.3518
	Equal variances not assumed	.232	.4769	.3946

Independent Samples Test

		t-test for Equality of Means	
		95% Confidence Interval of the Difference	
		Lower	Upper
hba1c_yr3_value1	Equal variances assumed	-.2201	1.1738
	Equal variances not assumed	-.3128	1.2665

Further Exploration of the Data

The sport participation group consisted of one outlier, and the no sport participation group consisted of four outliers. Although independent sample t-tests did not indicate statistical significance found, exploration of stem and leaf and box plot show that outliers existed. Below is an explanation of all data included in the sample, no sport participation outliers removed, and all outliers removed.

Independent Samples *t*-test With All Data Included

An independent samples *t*-test was performed to determine if there was a difference in HbA1c and sport participation. Data were missing from 2 participants therefore the total number in the sample was 118 for this analysis. The results indicated there was not a statistically significant difference in HbA1c and sport participation, $t(116) = 1.171$, $p = 0.244$. Degrees of freedom were calculated by $n - 2$. Table 11 displays the independent samples *t*-test output data. Figure 2 depicts HbA1c and sport participation.

Table 11. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
hba1c_yr3_value1	Equal variances assumed	2.835	.095	1.171	116	.244	.4198	.3586	-.2904	1.1300
	Equal variances not assumed			1.056	60.321	.295	.4198	.3977	-.3756	1.2152

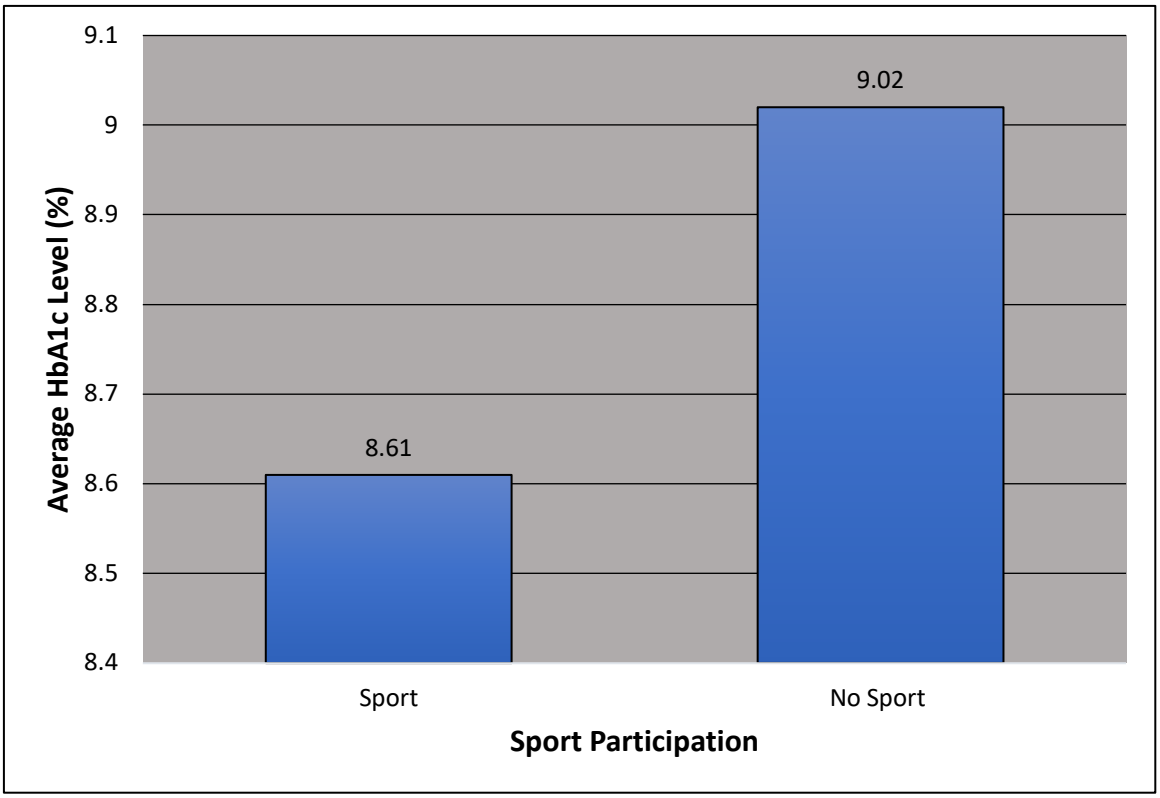

Figure 2. HbA1c and Sport Participation

Independent Samples *t*-test with No Sport Participation Outliers Removed

After removal of the four outliers from the no sport participation group, a *t*-test was performed. The results indicate no statistical significance of sport participation on HbA1c was achieved, $t(112) = -.602$, $p = .548$. Table 12 displays the independent samples *t*-test with no sport participation outliers removed output data.

Table 12. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
hba1c_yr3_value1	Equal variances assumed	1.861	.175	-.602	112	.548	-.1855	.3081	-.7959	.4250
	Equal variances not assumed			-.645	81.053	.521	-.1855	.2877	-.7579	.3870

Independent Samples *t*-test with All Outliers Removed

After removal of all five outliers from the sample, a *t*-test was performed. The results indicate no statistical significance of sport participation on HbA1c was achieved, $t(111) = -.431$. Table 13 displays the independent samples *t*-test with all outliers removed output data.

Table 13. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
hba1c_yr3_value1	Equal variances assumed	1.439	.233	-.431	111	.668	-.1284	.2983	-.7196	.4627
	Equal variances not assumed			-.453	78.037	.652	-.1284	.2834	-.6926	.4357

Summary

This chapter presented the results of the thesis research question based upon the sport participation survey data collected, along with demographic and diabetes related characteristics from the patient's medical chart. The sample of 120 Pediatric Endocrinology patients were recruited and the 118 completed surveys were analyzed. The research question examined if there was a difference in HbA1c levels in children with T1D who play one or more sport compared to those who do not. Results from the independent samples *t*-test concluded that there was not statistical significance in HbA1c and sport participation. Further exploration of the data was presented.

CHAPTER 5

DISCUSSION

This chapter presents the summary of the study results as well as a discussion of the findings. This chapter also explains the limitations of the study and suggestions for future research.

Purpose of the Study

The purpose of this study was to determine if there was a difference in HbA1c levels among children with T1D who participate in sports compared to those who don't. The children's age, ethnicity, race, gender, insurance type, BMI, duration of diabetes, diabetes treatment plan and glucose monitoring were also explored.

Research Question

1. Is there a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports?

Hypothesis

1. There is not a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports.

Summary

Regular physical activity participation is important for children and adolescents with T1D as a way to manage their diabetes, and sport participation is a way for children

to accumulate time spent being physically active (American Diabetes Association, 2014; Environment et al., 2013). Due to the lack of research literature addressing the role of sport participation on HbA1c levels, this study sought to determine if sport participation effects HbA1c levels in children ages 7 to 17 years old. Research has shown that individuals diagnosed with T1D are often less active than those without T1D, and as a result have increased HbA1c levels (American Diabetes Association, 2014; S.R Colberg, 2008; Leclair et al., 2013).

Sport participation can assist with the interaction between individuals and their peers, resulting in increased physical activity levels (Bandura, 1991; Benson & Bruner, 2018). With sport participation, there are a number of opportunities to meet and interact with other children (Smith, 2003). Carron (1982) and Weinberg and Gould (2006) both discussed team atmospheres and stated the longer a team has been together, the higher level of group cohesion is present and there is a larger desire for the group to succeed. In addition to group success, studies have looked at the idea of collective efficacy of the group, and found that there is a positive relationship to perceptions of team cohesion, resulting in an increase in sport participation (Carron & Dennis, 2001; Paskevich, Estabrooks, Brawley, & Carron, 2001; Weinberg & Gould, 2006).

Based on these descriptions and needs for understanding children's sport participation and HbA1c levels, the following research question was addressed in this study:

1. Is there a difference in hemoglobin A1c levels among children with type 1 diabetes who participate in sports compared to those who do not participate in sports?

The study was conducted at the Wendy Novak Diabetes Center Pediatric Endocrinology Clinic. Patients who received parent/legal guardian electronic informed consent and gave electronic assent, via the preamble presented before each survey, participated in the survey research study. Of the 120 participants with provided consent and assent preambles, 118 surveys were completed (98.3% response rate).

To answer the research question, an independent samples *t*-test was performed and descriptive statistics were reviewed. The descriptive statistics assessed in this study include demographic characteristics (age, ethnicity, race, gender, insurance type, BMI), diabetes-related characteristics (duration of diabetes, diabetes treatment plan and glucose monitoring), and physical activity levels (sport participation in the past year and days active in the past week). The independent variable was sport participation or no sport participation in the past year. The dependent variable was HbA1c levels of the participants. Descriptive statistics were calculated for all demographic, independent, and dependent variables. There were fewer females (n = 56, 46.7%) than males (n = 64, 53.3%) in the sample. The sport participation (n = 78) and no sport participation (n = 40) groups did not have an equal representation.

An independent sample *t*-test, removing one outlier from the sport participation group, showed no statistically significant difference in HbA1c levels for children who participated in sports (M = 8.61, SD = 1.61) versus those who did not participate in sports (M = 9.03, SD = 2.24); $t(115) = 1.36$, $p = .178$. Although there was no statistical significance, from the box plot in figure 1 it was seen that there were 4 outliers in the no sport participation group and 1 in the sport participation group. The 4 outliers in the no sport participation group were clinically too high for children with T1D. HbA1c levels

>12 are considered too high and special treatment must occur. These high HbA1c levels were not seen in the sport participation group after the removal of the outlier.

After removal of the 4 not sport participation outliers, an independent samples *t*-test was conducted. The results showed that there was still no statistical significance achieved ($p = .548$). After removal of all outliers from the sample, another independent samples *t*-test was conducted. The results showed that there was still no statistical significance achieved ($p = .668$).

Analytical Comment

Sport participation is a way for children to increase duration in physical activity and improve overall health and T1D management. Although no statistical significance was achieved, important clinical implications are apparent. Even without statistical significance, the most important clinical implications in this study were the 4 outliers in the no sport participation group and the 1 outlier in the sport participation group. The mean HbA1c level for the no sport participation group (M = 9.028, SD = 2.24) was also higher than that of the sport participation group (M = 8.608, SD = 1.61). A lower HbA1c is better.

Previous research has shown physical activity does affect HbA1c levels, the more days active, the lower an individual's HbA1c level (Beraki, Magnuson, Särnblad, Åman, & Samuelsson, 2014). Beraki et al. (2014) conducted a study evaluating the association between physical activity and metabolic control in children and adolescents with T1D. With a sample size of 4655 patients it was discovered that the least physically active group had an average HbA1c level of 8.8 ± 1.5, while the most physically active group had an average HbA1c level of 7.7 ± 1.0 (Beraki et al., 2014).

Since this thesis study is a subset of a larger study, the data collection is ongoing. Revisiting the thesis research question with additional subjects may show different findings. The practical implications, although not statistically significant, are important. Children with T1D who did not participate in sports did have higher HbA1c levels and four of these children had exceedingly high HbA1c levels. Clinical applications of this study would be to discuss with healthcare providers the potential for their patients with T1D to have high HbA1c levels if they do not engage in sports.

Considerations for the healthcare providers could be to consider a variety of demographic factors that may influence physical activity behavior as these may also be a limitation of this thesis study (Brown & Roberts, 2011). Demographic factors include, but are not limited to age, gender, and socioeconomic status (Brown & Roberts, 2011; USDHHS & CDC, 1997; Welk, 1999). When looking at children compared to adults, children are more physically active, but as a child gets older, their activity level decreases (Environment et al., 2013; USDHHS & CDC, 1996). Following this trend, it is shown that younger children are more physically active than older children (Sallis, Prochaska, & Taylor, 2000). Of any school age group, the most drastic decline in physical activity levels is in middle school children, especially in girls (Kimm & Obarzanek, 2002; J. F. Sallis, 2000). Further, gender is an important predictor of physical activity status. On average, girls are less active than boys (Kimm & Obarzanek, 2002; Lauderdale, Yli-Piipari, Irwin, & Layne, 2015; Motl et al., 2005; Sallis et al., 2000; J. F. Sallis, 2000) and have different preferences for physical activity (CDC & USDHHS, 2003). Girls have a tendency to participate in more aerobics or dance, while boys prefer team sports. Also, boys typically show higher competence and self-efficacy for physical activity than girls.

Competition is a high motivator for boys to participate in physical activity, while girls are more motivated by weight management (Lauderdale et al., 2015; Tappe, Duda, & Ehrnwalk, 1989).

The socioeconomic status of a family may or may not have an effect on a child's physical inactivity (Gustafson & Rhodes, 2006; Sallis et al., 2000). Income, education, occupation, and home ownership into the class description, race/ethnicity, family income, family size, poverty index, or employment status may serve as predictors (Dowda, Ainsworth, Addy, Saunders, & Riner, 2001; Gidlow, Johnston, Crone, Ellis, & James, 2006; Seo & Torabi, 2007). Yang et al. (2007) stated that parental income and educational attainment can be a predictor of a child's likelihood to be active and participate in sports. From this, the assumption can be made that the socioeconomic status of the child may influence his/her participation in physical activity and physical activity resources, such as sports (Gustafson & Rhodes, 2006; Welk, Wood, & Moross, 2003). Gustafson and Rhodes (2006) recommend that researchers investigate if families' socioeconomic status, single- or two-parent households, and ethnicity play a role on the impact on a child's physical activity, more than just sport involvement.

Limitations and Future Research

The data collected from the current thesis study presents limitations due to having a small sample size, power was not reached. Also, age and physical maturity of the participants, including patients with diagnosis duration < 1 year, and not taking into account days physically active for those in the no sport participation group. Future studies should look at diagnosis duration, specifically < 1 year, as a factor, type of foods eaten and when, type of insurance as a factor, and age of the participants. Children ages 13 to

17 years old are likely going through, or have gone through puberty, and with the hormone changes occurring there could be an effect on HbA1c levels. Also, analyses of future research could factor in non-sport related physical activity as a covariate, because unstructured, or non-organized, physical activity might have influenced the outcome of this thesis analysis.

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APPENDICES

APPENDIX A

Physical Activity and Sport Participation Survey (participant is between 7 and 17 years old) November 1, 2018

Dear Parent or Guardian of Novak Participant,

You child is being invited to participate in a research study by 1). answering a survey about his/her physical activity and sport participation and 2). allowing us to look at his/her chart for demographic information and medical history related to diabetes and other autoimmune related conditions. There are no known risks for his/her participation in this research study. The information collected may not benefit him/her directly. The information learned in this study may be helpful to others through programming and polices that may support health. This survey will take approximately 5 to 15 minutes to complete.

It is important for your child's rights as a research subject that we receive consent from the parent or legal guardian. If you are not the biological parent of the child taking this survey, please do not continue with the survey yet until you have informed the research staff.

This study requires the use of protected health information (PHI). Examples of PHI are identifiers such as your child's name or birthdate together with his/her health information. The Health Insurance Portability and Accountability Act (HIPAA) provides federal safeguards for your PHI. In this study we will use your child's medical record number, name, birthdate, height, weight, body mass index (BMI), race, ethnicity, gender, zip code, date of diagnosis, type of insurance, along with his/her health information relevant to this study such as hemoglobin A1C, diabetes treatment plan and glucose monitoring. We will keep this data safe by providing the following safeguards: storing it electronically in a secure encrypted server managed by the University and destroying all identifiers when they are no longer needed for the study.

Individuals from the Department of Health and Sports Sciences, Department of Pediatrics- Endocrinology, the Institutional Review Board (IRB), the Human Subjects Protection Program Office (HSPPO), and other regulatory agencies may inspect these records. In all other respects, however, the data will be held in confidence to the extent

permitted by law. Should the data be published, your child's identity will not be disclosed.

Taking part in this study is voluntary. By completing this survey you agree to allow your child to take part in the research study. Your child does not have to answer any questions that make him/her uncomfortable. He/she may choose not to take part at all. If you decide to allow your child be in this study he/she may stop taking part at any time. If you decide to not allow your child to be in the study or if your child stops taking part at any time, he/she will not lose any benefits for which he/she may qualify. If you have any questions, concerns, or complaints about the research study, please contact me, Dr. Kristi King at 502-852-8843.

If you have any questions about your child's rights as a research subject, you may call the Human Subjects Protection Program Office at 502-852-5188. You can discuss any questions about your child's rights as a research subject, in private, with a member of the Institutional Review Board (IRB). You may also call this number if you have other questions about the research, and you cannot reach the research staff, or you want to talk to someone else. The IRB is an independent committee made up of people from the University community, staff of the institutions, as well as people from the community not connected with these issues. The IRB has reviewed this research study.

If you have concerns or complaints about the research or research staff and you do not wish to give your name, you may call 1-877-852-1167. This is a 24-hour hotline answered by people who do not work at the University of Louisville.

Sincerely,
Kristi King, PhD CHES

Please hand this survey to your child if you agree to let him/her participate in this research study. Yes, I agree to let my child to participate in this research study
No, I do not agree to let my child to participate in this research study

APPENDIX B

Physical Activity and Sport Participation Survey (participant is 18 years old or older)
November 1, 2018
Dear Novak Participant,

You are being invited to participate in a research study by 1). answering a survey about your physical activity and sport participation and 2). allowing us to look at your chart for demographic information and medical history related to diabetes and other autoimmune related conditions. There are no known risks for your participation in this research study. The information collected may not benefit you directly. The information learned in this study may be helpful to others through programming and polices that may support health. This survey will take approximately 5 to 15 minutes to complete.

This study requires the use of protected health information (PHI). Examples of PHI are identifiers such as your name or birthdate together with your health information. The Health Insurance Portability and Accountability Act (HIPAA) provides federal safeguards for your PHI. In this study we will use your medical record number, name, birthdate, height, weight, body mass index (BMI), race, ethnicity, gender, zip code, date of diagnosis, type of insurance, along with your health information relevant to this study such as hemoglobin A1C, diabetes treatment plan, and glucose monitoring. We will keep this data safe by providing the following safeguards: storing it electronically in a secure encrypted server managed by the University and destroying all identifiers when they are no longer needed for the study.

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Taking part in this study is voluntary. By completing this survey you agree to take part in the research study. You do not have to answer any questions that make you uncomfortable. You may choose not to take part at all. If you decide to be in this study you may stop taking part at any time. If you decide not to be in the study or if you stop taking part at any time, you will not lose any benefits for which you may qualify. If you have any questions, concerns, or complaints about the research study, please contact me, Dr. Kristi King at 502-852-8843.

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If you have concerns or complaints about the research or research staff and you do not wish to give your name, you may call 1-877-852-1167. This is a 24-hour hotline answered by people who do not work at the University of Louisville.

Sincerely,
Kristi King, PhD, CHES

Do you want to participate in this research study? Yes, I would like to take this survey
No, I would not like to take this survey

APPENDIX C

Physical Activity and Sport Participation Survey

November 1, 2018
Subject Assent (participant is between 7 and 17 years old)

I am invited to be in a research study being done by a professor named Dr. Kristi King. When a person is in a research study, they are called a "subject". I am invited because I am a child with Type 1 Diabetes.

This means that I get to answer questions about my physical activity and sport participation. There may be some risks with this study. These risks are questions that may make me feel uncomfortable.

This survey will take about 5-15 minutes for me to complete. The information collected may not benefit me directly. The information learned in this study may be helpful to others through programming and polices that may support health.

My family, the doctors, and the research staff will know that I'm in the study. If anyone else is given information about me, they will not know my name. A number and initials will be used instead of my name.

I have been told about this study and know why it is being done and what I have to do. My parent(s) have agreed to let me be in the study. If I have any questions I can ask Dr. King. She will answer my questions. If I do not want to be in this study or I want to quit after I am already in this study, I can tell the researcher and she will discuss this with my parents.

Sincerely,
Kristi King, PhD CHES

Would you like to take this survey?

Yes, I want to take this survey
1, No, I do not want to take this survey

APPENDIX D

Physical Activity And Sport Participation Survey

Please complete the survey below.

Thank you!

What is the medical record number of the participant? _____
(To be filled in by clinic staff)

Are you

- ◯ between 7 and 17 years old
- ◯ 18 years old or older

Physical Activity and Sport Participation Survey
(participant is 18 years old or older)
July 17, 2018

Dear Novak Participant,

You are being invited to participate in a research study by 1). answering a survey about your physical activity and sport participation and 2). allowing us to look at your chart for demographic information and medical history related to diabetes and other autoimmune related conditions. There are no known risks for your participation in this research study. The information collected may not benefit you directly. The information learned in this study may be helpful to others through programming and polices that may support health. This survey will take approximately 5 to 15 minutes to complete.

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○ Yes, I would like to take this survey
○ No, I would not like to take this survey

these issues. The IRB has reviewed this research study.

If you have concerns or complaints about the research or research staff and you do not wish to give your name, you may call 1-877-852-1167. This is a 24-hour hotline answered by people who do not work at the University of Louisville.

Sincerely,
Kristi King, PhD CHES

Do you want to participate in this research study?

Physical Activity and Sport Participation Survey
(participant is between 7 and 17 years old)
July 17, 2018

Dear Parent or Guardian of Novak Participant,

You child is being invited to participate in a research study by 1). answering a survey about his/her physical activity and sport participation and 2). allowing us to look at his/her chart for demographic information and medical history related to diabetes and other autoimmune related conditions. There are no known risks for his/her participation in this research study. The information collected may not benefit him/her directly. The information learned in this study may be helpful to others through programming and polices that may support health. This survey will take approximately 5 to 15 minutes to complete.

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- ◯ Yes, I agree to let my child to participate in this research study
- ◯ No, I do not agree to let my child to participate in this research study

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Sincerely,
Kristi King, PhD CHES

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Physical Activity and Sport Participation Survey
July 17, 2018
Subject Assent (participant is between 7 and 17 years old)

I am invited to be in a research study being done by a professor named Dr. Kristi King. When a person is in a research study, they are called a "subject". I am invited because I am a child with Type 1 Diabetes.

This means that I get to answer questions about my physical activity and sport participation. There may be some risks with this study. These risks are questions that may make me feel uncomfortable.

This survey will take about 5-15 minutes for me to complete. The information collected may not benefit me directly. The information learned in this study may be helpful to others through programming and polices that may support health.

My family, the doctors, and the research staff will know that I'm in the study. If anyone else is given information about me, they will not know my name. A number and initials will be used instead of my name.

I have been told about this study and know why it is being done and what I have to do. My parent(s) have agreed to let me be in the study. If I have any questions I can ask Dr. King. She will answer my questions. If I do not want to be in this study or I want to quit after I am already in this study, I can tell the researcher and she will discuss this with my parents.

Sincerely,
Kristi King, PhD CHES

Would you like to take this survey?

- ◯ Yes, I want to take this survey
- ◯ No, I do not want to take this survey

During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? (Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time.)

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7

During the past 12 months, on how many sports teams did you play? (Include any teams run by your school or community.)

- ◯ 0 teams
- ◯ 1 team
- ◯ 2 teams
- ◯ 3 or more teams

Sport or Physical Activity

Part 1. The following questions are about your participation in sports and physical activities before, during, and after school, on weekends, during the summer, on holidays, and/or vacation. Do not include your participation in camps though; there will be questions later that ask you specifically about sport or physical activity camps.

During the past 12 months, think about all of the sports and physical activities you've participated in.

1. Choose the type(s) of sport and physical activity from the list. (check all that apply)

- ☐ Aerobics
- ☐ Archery
- ☐ Athletics - track and field
- ☐ Badminton
- ☐ Baseball
- ☐ Basketball
- ☐ Boxing
- ☐ Canoeing/kayaking
- ☐ Cross country running
- ☐ Cycling
- ☐ Dance
- ☐ Football
- ☐ Golf
- ☐ Gymnastics
- ☐ Hockey
- ☐ Horse riding
- ☐ Ice hockey
- ☐ Jogging
- ☐ Lacrosse
- ☐ Marching band
- ☐ Martial arts
- ☐ Moto x / motor cycling
- ☐ Paintball
- ☐ Racquetball
- ☐ Rock climbing
- ☐ Rowing
- ☐ Skateboarding
- ☐ Skiing
- ☐ Soccer
- ☐ Softball
- ☐ Swimming (laps)
- ☐ Table tennis
- ☐ Tai Chi
- ☐ Tee-ball
- ☐ Tennis
- ☐ Triathlon
- ☐ Volleyball
- ☐ Walking
- ☐ Weight training
- ☐ Wrestling
- ☐ Yoga/stretching
- ☐ Other
- ☐ General Sports or Physical Activity (a Variety of Sports and/or Physical Activities offered)

1.a. Now select the sport or physical activity that you participate in the most and/or that is the most important to you.

- ◯ Aerobics
- ◯ Archery
- ◯ Athletics - track and field
- ◯ Badminton
- ◯ Baseball
- ◯ Basketball
- ◯ Boxing
- ◯ Canoeing/kayaking
- ◯ Cross country running
- ◯ Cycling
- ◯ Dance
- ◯ Football
- ◯ Golf
- ◯ Gymnastics
- ◯ Hockey
- ◯ Horse riding
- ◯ Ice hockey
- ◯ Jogging
- ◯ Lacrosse
- ◯ Marching band
- ◯ Martial arts
- ◯ Moto x / motor cycling
- ◯ Paintball
- ◯ Racquetball
- ◯ Rock climbing
- ◯ Rowing
- ◯ Skateboarding
- ◯ Skiing
- ◯ Soccer
- ◯ Softball
- ◯ Swimming (laps)
- ◯ Table tennis
- ◯ Tai Chi
- ◯ Tee-ball
- ◯ Tennis
- ◯ Triathlon
- ◯ Volleyball
- ◯ Walking
- ◯ Weight training
- ◯ Wrestling
- ◯ Yoga/stretching
- ◯ Other
- ◯ General Sports or Physical Activity (a Variety of Sports and/or Physical Activities offered)

2. Was this sport or physical activity organized (run by your school or community, a coach, a school, or a league) or non-organized (you play on your own or with friends)?

- ◯ Organized
- ◯ Not organized

3. What season(s) did you do this sport or physical activity? (check all that apply)

- ☐ Fall
- ☐ Winter
- ☐ Spring
- ☐ Summer

4. How many days per week do you do this sport or physical activity? (include practice, games/meets/matches/etc., and training)

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7

5. How much time do you spend doing this sport or physical activity each day you do it?

- ◯ 0-29 minutes
- ◯ 30 minutes (1/2 hour) - 59 minutes
- ◯ 60 minutes (1 hour) - 89 minutes
- ◯ 90 minutes (1 1/2 hours) - 119 minutes
- ◯ 120 minutes (2 hours) or more

Sport or Physical Activity Camp

Part 2. The following questions are about your participation in sports and physical activity camps. A camp may be a day camp or an overnight camp.

Have you participated in a sports or physical activity camp in the last 12 months?

- ◯ Yes
- ◯ No

During the past 12 months, think about all of the sports and physical activity camps you've participated in.

1. Choose the type of sport and physical activity camp(s) from the list (check all that apply)

- ☐ Aerobics
- ☐ Archery
- ☐ Athletics - track and field
- ☐ Badminton
- ☐ Baseball
- ☐ Basketball
- ☐ Boxing
- ☐ Canoeing/kayaking
- ☐ Cross country running
- ☐ Cycling
- ☐ Dance
- ☐ Football
- ☐ Golf
- ☐ Gymnastics
- ☐ Hockey
- ☐ Horse riding
- ☐ Ice hockey
- ☐ Jogging
- ☐ Lacrosse
- ☐ Marching band
- ☐ Martial arts
- ☐ Moto x / motor cycling
- ☐ Paintball
- ☐ Racquetball
- ☐ Rock climbing
- ☐ Rowing
- ☐ Skateboarding
- ☐ Skiing
- ☐ Soccer
- ☐ Softball
- ☐ Swimming (laps)
- ☐ Table tennis
- ☐ Tai Chi
- ☐ Tee-ball
- ☐ Tennis
- ☐ Triathlon
- ☐ Volleyball
- ☐ Walking
- ☐ Weight training
- ☐ Wrestling
- ☐ Yoga/stretching
- ☐ Other
- ☐ General Sports or Physical Activity (a Variety of Sports and/or Physical Activities offered)

1.a Now select the sport of physical activity camp you participate in the most and/or is the most important to you.

- ◯ Aerobics
- ◯ Archery
- ◯ Athletics - track and field
- ◯ Badminton
- ◯ Baseball
- ◯ Basketball
- ◯ Boxing
- ◯ Canoeing/kayaking
- ◯ Cross country running
- ◯ Cycling
- ◯ Dance
- ◯ Football
- ◯ Golf
- ◯ Gymnastics
- ◯ Hockey
- ◯ Horse riding
- ◯ Ice hockey
- ◯ Jogging
- ◯ Lacrosse
- ◯ Marching band
- ◯ Martial arts
- ◯ Moto x / motor cycling
- ◯ Paintball
- ◯ Racquetball
- ◯ Rock climbing
- ◯ Rowing
- ◯ Skateboarding
- ◯ Skiing
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- ◯ Tennis
- ◯ Triathlon
- ◯ Volleyball
- ◯ Walking
- ◯ Weight training
- ◯ Wrestling
- ◯ Yoga/stretching
- ◯ Other
- ◯ General Sports or Physical Activity (a Variety of Sports and/or Physical Activities offered)

2. Who organized your sport or physical activity camp? (check all that apply)

- ☐ School
- ☐ Community
- ☐ University
- ☐ Hospital/Doctor/Clinic
- ☐ Church/Synagogue/Temple/Mosque/Faith Organization
- ☐ Diabetes Organization
- ☐ Business/Private Industry
- ☐ Other

3. What season(s) did you do this sport or physical activity camp? (check all that apply)

- ☐ Fall
- ☐ Winter
- ☐ Spring
- ☐ Summer

4. Was the camp a day camp or an overnight camp?

- ◯ Day camp
- ◯ Overnight camp

5. How many days (and nights) was the camp?

- ◯ 1 day
- ◯ 2 days
- ◯ 3 days
- ◯ 4 days
- ◯ 5 days
- ◯ 6 days
- ◯ 7 days
- ◯ 8 days
- ◯ 9 days
- ◯ 10 days
- ◯ 11 days
- ◯ 12 days
- ◯ 13 days
- ◯ 14 days
- ◯ 15 days or more

6. At camp, how much time did you spend doing this sport or physical activity each day you were at camp?

- ◯ 0 - 29 minutes
- ◯ 30 minutes (1/2 hour) - 59 minutes
- ◯ 60 minutes (1 hour) - 89 minutes
- ◯ 90 minutes (1 1/2 hours) - 119 minutes
- ◯ 120 minutes (2 hours) or more

What is your first name and last name? (optional) _____

What is your birthday? (optional) _____

Thank you! Have a great day!

APPENDIX E

1. STUDY ORGANIZATION

1.1. Title

Physical Activity and Sport Participation for Children with Type 1 Diabetes Study

1.2. Short Title

Physical Activity and Sport Participation Study - T1D

1.3. Principal Investigators

Kristi King, PhD, CHES, University of Louisville, School of Medicine Jason Jaggers, PhD, University of Louisville, School of Medicine

1.4. Participating Institutions, Lead Site Investigators and Co-Investigators

1.4.1. University of Louisville, School of Medicine; University Pediatric Endocrinology, LLC

Lead Site Investigators: Kristi King, PhD, CHES and Jason Jaggers, PhD
Co-Investigator: Kupper Wintergerst, MD

2. INTRODUCTION, BACKGROUND AND RATIONALE

Diabetes Mellitus affects approximately 7% of the population (20.8 million people) of the United States with more than 175,000 being under 20 years of age. With all children encouraged to accumulate at least 60 minutes of play for known health benefits, it is imperative that those with type 1 diabetes mellitus (T1DM) be able to participate with their peers free from fear of diabetes related complications. However, it is unknown just how many children with T1DM engage in routine physical activity or competitive sports. Most become fearful of increased activity due to the unknown glucose response and not knowing the best

way to correct for dramatic highs or lows. There remains a lack of knowledge of how to safely support and promote physical activity in people with type 1 diabetes.

3. OUTCOME MEASURES/OBJECTIVES

The primary aims of this study are to identify the socio-demographic, physical activity and sport participation, and diabetes-related characteristics of the participants; understand the relationships among these variables, to compare physical activity and sport participation behaviors between genders, ages, and diabetes treatment plans, and to compare the health outcomes (e.g. hemoglobin A1C) of those who engage in activity versus those who do not engage in activity.

4. STUDY DESIGN

4.1. General Design/Summary

This study is being conducted to characterize physical activity and sports participation among youth with T1DM cared for at the University of Louisville Pediatric Endocrinology Clinic. The participant will complete an electronic informed consent/assent to participate in this survey study. The survey will be linked to the Pediatric Endocrinology Database Registry through a pre-assigned study Medical ID number. This is a clinical database including all patients cared for in the University of Louisville Pediatric Endocrinology clinic for type 1 diabetes, type 2 diabetes, or prediabetes (please see the methods section for full details of included variables). The primary research activity for this study will be an electronic questionnaire known as the Physical Activity and Sport Participation Survey (PASPS). Participants will complete the PASPS using an iPad.

4.2. Inclusion and Exclusion criteria

The inclusion criteria for the study will be children age 7 years and older with type 1 diabetes cared for in the University of Louisville Pediatric Endocrinology Clinic. Exclusion criteria includes non- English speaking and those who are under 18 without a parent or legal guardian with supporting documentation present.

4.3. Methods/Procedures/Assessments Survey

Patients presenting for diabetes care in the Pediatric Endocrinology clinic or for participation in another activity in the clinic will be invited to participate in the survey during the check-in process. They will be given an iPad to complete the electronic informed consent/assent process described in section 6 below. Those completing this process will be prompted to complete the Physical Activity and Sports Participation Survey (PASPS) on the iPad. The survey will be administered through RedCap which is housed in UofL's secure server. A participant may quit the survey at any time. If the participant is younger than 18 years old, then they

will be accompanied by a parent or legal guardian who can help fill out the survey. See Appendix for survey.

***Physical Activity and Sport Participation Survey (PASPS*)**
The 18-item "Physical Activity and Sport Participation Survey" (PASPS) assesses physical activity and sport participation for children over the past year. Two survey questions were selected from the 2017 Youth Risk Behavior Surveillance System (YRBSS) questionnaire, ten survey questions were adapted from Booth et al. Adolescent Physical Activity Recall Questionnaire which exhibited good reliability and validity for use with children, and the remaining questions were developed by the research team.

Pediatric Endocrinology Database Registry

This clinical database is maintained as part of routine care in the Pediatric Endocrinology Clinic. Variables included are: birthdate, height, weight, body mass index (BMI), ethnicity, race, gender, zip code, diagnosis date, insurance type, hemoglobin A1c (hbA1c) level, hbA1C date, treatment plan, and continuous glucose monitor use. The PASPS survey will be linked to this database utilizing the medical record number, participant name, and date of birth. Once merged, a study ID will be assigned and the full dataset will be de-identified.

Activities Preparatory to Research

To ensure instrument readability and comprehension as well as ease of administration of the Physical Activity and Sport Participation Survey two approaches of instrument and pilot testing will occur – a review by a panel of experts and cognitive pilot testing. These approaches will be used to determine if the survey and/or its administration procedures should be modified before full-fledged administration begins. If significant modifications to the survey or administration process are recommended, an amendment for review will be submitted to the Human Subjects IRB prior to administration to participants for data collection. The data collected during these activities preparatory to research will not be used for data analysis purposes.

Panel of Experts Review

A panel of 3-5 individuals who have expertise in a clinical practice for children will be selected to review the Physical Activity and Sport Participation Survey for readability, clarity, and/or potential administration problems. The researchers will approach experts individually and ask if they are willing to provide a review. If the expert agrees, the researcher will give the expert the "Script for Survey Administration" and then use the iPad to take the survey. The participant will be encouraged to take the survey several times, selecting different answers each time, in order to immerse themselves in the survey content and process. An evaluation sheet, "Physical Activity and Sport Participation Survey Evaluation

Sheet," will be given to the experts to complete regarding their comments, suggestions, concerns regarding the survey or process of completing it. The experts can help uncover questions that might produce multiple interpretations or confusion for the future participants. Once the expert panel evaluations are collected, modifications in the survey or administration process may be made by the research team. It is anticipated by the research team that the review will take approximately 20 minutes of the expert's time.

Cognitive and Process Pretesting

Cognitive pretesting will be conducted face-to-face where the researcher will watch for points of confusion, then probing and follow-up questions to capture what the respondents thought about the questions. Conducting a pretest allows the researcher to make sure that the survey items and the process of taking the survey are fully vetted before implementation to the entire clinic patients begins (i.e., the idea is to try to avoid unanticipated procedural hiccups during administration).

Purposeful and convenience selection of a sampling of participants ages of 6 participants will be sufficient - 3 children age 12 and under (e.g. elementary school age children) and 3 children over 12 years (e.g., middle school or high school). The researchers will ask the care team to identify participants who they feel may be willing to take the pretest on their next regularly scheduled visit. A member of the research team will meet the participant upon "check in" and ask the participant if he/she would be willing to sit with the researcher in a meeting room to complete the survey while the participant waits to see his/her medical care team. The researcher will encourage the participant to take the survey a few times if time allows while participant waits to see his/her medical care team, selecting different answers each time, in order to immerse themselves in the survey content and process. The researcher will have an evaluation sheet, "Physical Activity and Sport Participation Survey Evaluation Sheet," to compete regarding the participant's comments, suggestions, concerns regarding the survey items or process of completing. It is anticipated by the research team that the review will take approximately 10 minutes of the child's time and will not interfere with the child's time with their medical care team.

5. SUBJECT RECRUITMENT METHODS

Participants will be invited to participate during their next scheduled clinical visit. Only established patients of University of Louisville Pediatric Endocrinology will be invited to participate. The PASPS will be administered to each child that presents to the Pediatric Endocrinology clinic with a diagnosis of Type 1 Diabetes and meets inclusion criteria and no exclusion criteria. See attached "Instructions for Administering Survey" in Appendix.

6. INFORMED CONSENT PROCESS

This study will utilize an electronic informed consent/assent document. Children presenting to the University of Louisville Pediatric Endocrinology clinic will be invited to participate. Those expressing interest will be given an iPad to complete an informed consent/assent process. The first question is if they are 18 years of age or older. If they reply yes, they will be presented with an electronic informed consent document. This was developed using the University of Louisville biomedical preamble template. For those who are less than 18 years of age, a prompt for a parental informed consent will present. Patients presenting for care must be accompanied by a parent or a legal guardian. If accompanied by a legal guardian, supporting documentation must be presented and scanned to the medical record as part of the standard check-in process. As per the exclusion criteria, only those who are accompanied by a parent or legal guardian with supporting documentation, will be invited to participate. Once completed by their parent/guardian a prompt for an assent appears. The participant is asked to read and complete the electronic assent that was developed using the University of Louisville biomedical child assent template.

If the participant or parent/legal guardian has questions regarding the electronic informed consent, a member of the research staff will be available to fully answer all questions. When the participant turns the iPad back in after completing the survey, the staff will have available paper copies of the electronic informed consent form and assent form for the participant.

7. RESEARCH PROCEDURES

As described in detail above, the main procedure involved with this research study involves data collection by survey methods to better understand the activity and sport habits of patients in our clinic. This study does not involve any type of intervention, nor will anyone be randomized. Eligible participants are approached in-person by a member of the staff during their clinic visit to determine their interest in participating. If the patient is younger than 18 years old, then the patient will be accompanied by a parent or legal guardian who can help fill out the survey. The survey will be administered on an iPad. If the participant or parent/legal guardian has any questions or concerns regarding the survey, a research staff member can answer any questions.

8. MINIMIZING RISK

8.1. Protection of Human Subjects

This study will be conducted according to Good Clinical Practices, the rules and regulations of the Institutional Review Board at the University of Louisville, and in accordance with state and federal agencies. All participation is strictly voluntary and those involved will not be asked to change any of their daily activities. Protected health information will be collected to allow merging the survey results with the Pediatric Endocrinology Registry data. Once merged, the complete dataset will be de-identified as described above.

8.2. Risks and Benefits

8.2.1. Risks

The primary risk of this study is breach of confidentiality. To help protect against this all data will be stored on pass-word protected computers or in RedCap housed on University of Louisville's secure server. Data protection as described in **8.1** will be utilized.

8.2.2. Benefits

No direct benefit will necessarily be gained by the subjects. From the study, it is hoped that we will learn more about the relationship between diabetes and sports participation that may lead to future benefits for children receiving care in our clinic.

9. PLAN FOR ANALYSIS OF RESULTS

Descriptive statistics will describe socio-demographic, physical activity and sport participation, and diabetes-related characteristics of the participants. Relationships among these variables will be explored using correlation testing. Other inferential statistics such as t-tests or ANOVAs will be used to compare physical activity and sport participation behaviors between genders, ages, and diabetes treatment plans. Lastly, t-test comparing children's health outcomes (e.g. hemoglobin A1c) who engage in activity versus those who do not engage in activity will be investigated.

10. RESEARCH MATERIALS, RECORDS, AND PRIVACY

All computer records utilized for this study will require password access; computer workstations will be locked whenever a staff person leaves his or her desk. Information utilized for study data may be stored in one or more of the following: excel spreadsheets, statistical software databases, RedCap. Access to the study data will be restricted to study personnel. The duration of study record retention will be at least 3 years after the study has ended, with the possibility of indefinite archiving of study data.

APPENDIX F

Physical Activity and Sport Participation for Children with Type 1 Diabetes Study

Instructions for Administering Survey

Why?

This is a research survey that will help us learn more about physical activity and sport participation with our patients with Type 1 Diabetes.

Who?

Inclusion criteria

1. children age 7 years and older
2. diagnosed with type 1 diabetes
3. patient of University of Louisville Pediatric Endocrinology Clinic

Exclusion criteria

1. non-English speaking
2. children who are under 18 without a parent or legal guardian with supporting documentation present

What to say and do?

After checking the patient in...

1. Say "Our sports medicine program is conducting a research study about physical activity and sport participation among children who have Type 1 Diabetes. Would you be willing to complete a short survey on an iPad?"
2. If they are interested, you will
    1. Open the RedCap app on an iPad
    2. Type in the patient's Medical Record ID in the first question of the survey

3. Hand them the iPad and a paper copy of the preamble
4. Say "When you're finished with the survey, bring the iPad back to us. Please let us know if you have any questions or if anything is unclear to you. Thank you."

3. If they are not interested, thank them anyway and direct them to the waiting area.

Check each day...

1. 3 iPads are present
2. 3 iPads are charged
3. Be sure there are 30-40 paper copies each of informed consents in folder
    1. Informed consent (if participant is 18 years old or older)
    2. Parental/Guardian Informed Consent (if participant is 7-17 years old)
    3. Subject assent (if participant is 7-17 years old)

If you have any questions, comments, concerns, please contact

Gwen Pierce – Research – 502-588-3430
Stephany Eubanks – Research – 502-588-0491
Kristi King - Sports Medicine – 502-588-8540
Jason Jaggers - Sports Medicine – 502-588-8540

APPENDIX G

Physical Activity and Sport Participation Survey
Evaluation Sheet

Thank you for helping us review the items in this survey as well as the process of taking the survey on an iPad. Please make comments/suggestions on this 2-page evaluation sheet or the attached PDF. Our goal is for the survey to be clear, understandable, and easy for our participants to complete on the iPad.

Topic/Variable (page number of PDF/iPad)	**Comment/Suggestion**
Medical record number (filled out by the clinic staff) (p. 1)	
Are you…(under 18 or 18 and over) (p. 2)	
Informed Consent (18 or older) (p. 4-5)	
Parent/guardian Informed consent (7-17 years) (p. 7-8)	
Subject assent (p. 9)	
Sport or Physical activity directions (p. 10)	
# days Physical activity/week # sport teams/year (p. 10)	
1. Choose all sports in past year (p. 11)	
1.a. choose 1 most important sport (p. 12)	
2. Organized/not organized (p. 12)	
3. Season (p. 12)	
4. #days per week (p. 13)	
5. Time spent per day (p. 13)	

Topic/Variable (page number of PDF/iPad)	**Comments/Suggestion**
Camp directions (p. 14)	
Camp in the last 12 months? (p. 14)	
1. Choose all sports in past year (p. 15)	
1.a. choose 1 most important sport (p. 16)	
2. Who organized? (p. 16)	
3. Season (p. 16)	
4. Day or overnight camp (p. 16-17)	
5. # days/nights (p. 17)	
6. Time spent per day (p. 17)	
Participant's First and last name (p. 17)	
Participant's birthday (p. 17)	
Thank you (p. 17)	
Please provide additional comments/suggestions	

CURRICULUM VITAE

Amy Kozerski

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Education

Master of Science, Anticipated May 2019
Concentration: Clinical Exercise Physiology
University of Louisville; Louisville, KY

Bachelor of Science, May 2017
Concentration: Health and Human Performance, Exercise Science
University of Louisville; Louisville, KY

Work Experience

Graduate Assistant, August 2017 – Current
University of Louisville, Department of Health and Sport Sciences, Exercise Physiology program, Louisville, KY

- Teaching Assistant - Assist faculty in administering exercise tests and maintaining exercise physiology laboratory
    - HSS 381: Human Anatomy and Physiology 1 Lab, 3 sections
    - HSS 387: Biomechanics, 3 section
    - HSS 388: Principles of Athletic Conditioning, 7 sections
    - HSS 391: Human Anatomy and Physiology 2 Lab, 1 section
    - HSS 394: Foundations of Exercise Physiology, 4 sections
    - HSS 396: Lab Methods in Fitness Evaluation, 4 sections
    - EXP 601: Lab Methods in Exercise Physiology, 2 sections
- Research Assistant - Assist faculty in collecting research data from human subjects, analyzing data, and preparing manuscripts and presentations for university, local, and peer-reviewed audiences
    - Novak Center for Children's Health, Wendy Novak Diabetes Center, Christensen Family Sport and Activity Program, 411 E. Chestnut Street, Louisville, KY, 40202, August 2018 - Current

Community Living Supports, June 2018 – Current
Centerstone, Louisville, KY

- Assist individuals with intellectual disabilities accomplish activities of daily living, setting and achieving personal and socialization goals

Private Family Caregiver, December 2016 – December 2017
LaGrange, KY
- Assist one individual with physical and intellectual disabilities accomplish activities of daily living

Athletic Training Volunteer, August 2014 – Current
St. Elizabeth Sports Medicine, Edgewood, KY
- Collaborate with athletic trainers in the assessment and rehabilitation of injured athletes

Cardiopulmonary Rehabilitation Intern, August 2016 – December 2016
Norton Hospital, Louisville, KY
- Perform resting/exercise blood pressure assessments and stress testing for clinical populations

St. Elizabeth Sports Medicine Volunteer, May 2015 – August 2015
St. Elizabeth Sports Medicine, Edgewood, KY
- Collaborate with physical therapists in the assessment and rehabilitation of clinical and athletic populations

Bluegrass Invitational Wheelchair Basketball Volunteer, February 2015 – 2016
Metro Parks and Recreation, Louisville, KY
- Assist facility staff and athletes with game efficiency and management

National Wheelchair Basketball Tournament Volunteer, March 2015 – 2016
Metro Parks and Recreation, Louisville, KY
- Assist facility staff and athletes with game efficiency and management

Research Projects

1. Sport participation and hemoglobin A1C outcomes for children with Type 1 Diabetes, assist with data collection and analysis, August 2018 – Current
2. Ergogenic, Perceptual and Metabolic Responses to Palm Cooling, assist with data collection, June 2018 - Current
3. Children's Adaptive Physical Activity Program, implement intervention, September 2017 – November 2017
4. The Effects of an Intergenerational Music Therapy Program on Children's Literacy, Older Adults' Physical Function and Self-Worth, and Intergenerational Interactions, assist with data collection, September 2017 – January 2018

Manuscripts in Preparation

1. Kozerski, A., King, K. M., Jaggers, J., & Della, L. Sport participation and hemoglobin A1c outcomes for children with Type 1 Diabetes, Master of Science Thesis

Peer-Review Published Abstracts

1. Vanhoover, A.C., McEnroe, C.B., Gray, W.D., O'Brien, I.T., Kozerski, A.E., Crush, E.G., Selimovic, E.A., Carter, K.A., & Caruso, J.F. (June 2019). The impact of diet on metabolic and exercise performance outcomes to workouts done on gravity-independent hardware. Annual Meeting of The American Society of Nutrition, Baltimore Maryland.

Peer-Reviewed Manuscripts

1. Davison, S., Chen, L., Gray, D., McEnroe, B., O'Brien, I., Kozerski, A., & Caruso, J. (in review). Performance-based correlates to calcaneal osteaogenesis produced by a chronic training intervention. *Scandinavian Journal of Medicine and Science in Sports,* 1-25
2. Chen, L., Selimovic, E.A., Daunis, M., Bayers, T.A., Vargas, L.J., O'Brien, I.T., McEnroe, C.B., Kozerski, A.K., Vanhoover, A.C., Gray, W.D., & Caruso, J.F. (in review). Musculoskeletal outcomes from chronic high-speed high-impact resistive exercise. *Gravitational and Space Research,* 1-28

Peer-Reviewed Research Presentations

1. Gray, W.D., O'Brien, I.T., **Kozerski, A.E.**, Vanhoover, A.C., McEnroe, C.B., & Caruso, J.F. (2019, May). *Electrolyte-based sport drinks: Effect on steady state exercise against progressively higher workloads.* Poster Presentation for American College of Sports Medicine (ACSM) Annual Meeting, Orlando, Florida.
2. **Kozerski, A.**, King, K. M., Jaggers, J.R., McKay, T.E., & Wintergerst, K. (2019, March). *Preliminary analysis of sport participation and hemoglobin A1c outcomes for children with Type 1 Diabetes.* Oral presentation for the Spring Research Conference, Lexington, Kentucky.
3. O'Brien, I.T., Chen, L., Vargas, L.J., Vanhoover, A.C., McEnroe, C.B., **Kozerski, A.E.**, & Caruso, J.F. (2019, March). *Ergogenic, Perceptual and Metabolic Responses to Palm Cooling.* Poster presentation for the Spring Research Conference, Lexington, Kentucky.
4. **Kozerski, A.**, King, K. M., Jaggers, J.R., McKay, T.E., & Wintergerst, K. (2019, February). *Hemoglobin A1c (HbA1c) levels and Sport Participation in Children with Type 1 Diabetes (T1D).* Poster presentation for the Graduate Student Regional Research Conference (GSRRC), Louisville, Kentucky.
5. O'Brien, I.T., Chen, L., Vargas, L.J., Vanhoover, A.C., McEnroe, C.B., **Kozerski, A.E.**, & Caruso, J.F. (2019, February). *Ergogenic, Perceptual and Metabolic Responses to Palm Cooling.* Poster presentation for the Graduate Student Regional Research Conference (GSRRC), Louisville, Kentucky.
6. **Kozerski, A.**, Jaggers, J.R., King, K. M., & Wintergerst, K. (2019, February). *High school softball player with type 1 diabetes 72-hour glucose response: A case*

study. Poster presentation for Southeast American College of Sports Medicine (ACSM) Conference, Greenville, South Carolina.

7. O'Brien, I.T., Chen, L., Vargas, L.J., Vanhoover, A.C., McEnroe, C.B., **Kozerski, A.E.**, & Caruso, J.F. (2019, February). *Ergogenic, Perceptual and Metabolic Responses to Palm Cooling.* Poster presentation for Southeast American College of Sports Medicine (ACSM) Conference, Greenville, South Carolina.
8. Vanhoover, A.C., McEnroe, C.B., **Kozerski, A.E.**, O'Brien, I.T., & Caruso, J.F. (2019, February). *Electrolytes Added to a Carbohydrate-Based Drink: Effect on Exercise Done Against Progressively Higher Workloads.* Poster presentation for Southeast American College of Sports Medicine (ACSM) Conference, Greenville, South Carolina.
9. McEnroe, C.B., Chen, L., Vargas, L.J., O'Brien, I.T., **Kozerski, A.E.**, Vanhoover, A.C., & Caruso, J.F. (2019, February). *Dwell Times from a High-Speed Exercise Intervention as a Correlate to Calcaneal Accretion.* Poster Presentation for Southeast American College of Sports Medicine (ACSM) Conference, Greenville, South Carolina.
10. McEnroe, C.B., Davison, S.W., Bai, L., Vargas, L.J., O'Brien, I.T., **Kozerski, A.E.**, Vanhoover, A.C., Carter, K.A., & Caruso, J.F. (2019, January). *Dwell time as a correlate to calcaneal accretion produced by chronic high-speed resistive exercise.* Poster Presentation for the National Aeronautics and Space Administration's (NASA) Annual Human Research Program Investigators Workshop, Houston, Texas

Invited Presentations

1. Caruso, J.F., O'Brien, I.T., **Kozerski, A.E.**, Vanhoover, A.C., & Gray, W.D. (October 2018). Robotic exoskeletons as exercise countermeasures for manned space flights. Presented to Sandalwood Engineering and Ergonomics, Louisville, Kentucky.
2. **Kozerski, A.E.** (September 2018). Body composition lecture. Presented to University of Louisville graduate students registered for EXP 601: Lab Methods in Exercise Physiology, Louisville, Kentucky.

Internal Funding Sources

1. Kozerski, A.E. (January 2019 – May 2019) *Southeast American College of Sports Medicine Conference Poster Presentation*
    a. Description: Grant for graduate students traveling to conferences to present or participate in the conference.
    b. Role: Presenter
    c. Funding Source: University of Louisville Graduate Student Council
    d. Funding Amount: $350.00

Professional Development and Skills

1. REDCap, August 2018: Secure web application for building and managing online surveys and databases
2. Health Stream KNOW, August 2018: Trains healthcare professionals on functions in Allscripts, patient's medical records
3. Statistical Package for Social Sciences (SPSS), January 2018
4. Kognito Training, August 2016: Online, interactive training simulation designed to educate faculty, staff, and students about best practices in suicide prevention
5. Diversity and Inclusion Training, January 2015
6. Conflict Resolution Training, January 2015
7. Customer Service, Difficult Situations, and Meditation Training, January 2015
8. Delphi Center Training, January 2015: innovative teaching methods
9. Fitness testing: VO2max/submax, lactate threshold, body composition, blood pressure/heart rate, etc.

Professional Memberships

1. American College of Sports Medicine (ACSM) member, September 2017 – Current
2. American Physiological Society (APS) member, January 2019 – Current

Committee Participation

1. University of Louisville, Department of Health and Sport Sciences Student Engagement Committee Student Engagement Committee, July 2018 – Current
2. University of Louisville, Graduate Student Council Representative for Department of Health and Sport Sciences, August 2017-May 2018

Certifications

1. CPR/AED/First Aid Certification, August 2014 – Current
2. BLS Certification, August 2016 – Current