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Children's Body Mass Index Before and After COVID-19 Related Childcare Center Closures

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This is to certify that the doctoral study by

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Abstract

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by

Ericka Lynn Peterson

MPH, California State University, Fresno, 2011

BS, California State University, Fresno, 1992

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

Walden University

May 2022

Abstract

Prolonged childcare center closures due to COVID-19 restrictions have changed children's health-related behaviors that may result in an increased risk in childhood obesity. Grounded in the social ecological model, the purpose of this study was to examine the differences in body mass index (BMI), physical activity, consumption of sugar-sweetened beverages (SSBs), and screen time among preschool aged children enrolled in the Merced County Office of Education Head Start program before and after COVID-19 related Head Start center closures. A quantitative, longitudinal study design using secondary data from ChildPlus was used. The paired *t*-test and Wilcoxon signed-rank test was used to measure the differences in BMI and health-related behaviors before and after COVID-19 related Head Start center closures. A *p*-value of <0.05 was used to show statistical significance. Results of the study showed significant differences in BMI ($t(264) = 4.533$, $p = .000$), consumption of SSBs ($Z = 2.046$, $p = .041$), and amount of screen time ($Z = 2.833$, $p = .005$) of participants before and after COVID-19 related Head Start center closures. However, there was no significant difference in the amount of physical activity ($Z = 1.042$, $p = .297$). The results of this study will add to positive social change and enhance understanding of the potential impact of COVID-19 related childcare center closures on childhood obesity and health-related behaviors that will guide public health, early education, and other professionals in the development and implementation of effective physical activity and dietary interventions during future pandemics and prolonged childcare center closures that will mitigate adverse effects on the health and wellbeing of young children from vulnerable communities.

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Dedication

This dissertation is dedicated to my father, Charles E. Peterson Sr., and my late mother, Millie J. Peterson (rest in power and peace, Mommy Dearest). I still hear your voice saying, “Reach for the moon. If you fall short, you will be amongst the stars.” You both have taught me to be the very best version of myself, always striving for excellence. Because of you I AM BLACK EXCELLENCE. The pursuit of this journey may have been delayed; however, never discarded. This has remained my goal. A goal that has now been magnificently accomplished. Thank you so much for all you have given and instilled in me. Words cannot express how much I love you. I am so honored and blessed to be your daughter.

Acknowledgments

First and foremost, I give thanks to God, who is the head of my life. Thank you for your love, for your faithfulness, for your grace. Thank you for giving me strength and perseverance. Without you, this would not have been possible. I would like to thank the MCOE Head Start program for the use of valuable data and my colleagues for your continued support of my educational and academic endeavors. Furthermore, I would like to thank Dr. Namgyal Kyulo, committee chairperson, Dr. Claire Robb, committee member, and Dr. Stacy-Ann Christian, university research reviewer, for your guidance, insight, and mentorship throughout this dissertation process. And lastly, but certainly not least, I would like to thank my wonderful “bubble” family. So much has happened during my pursuit of this doctorate. The rigorous course work, studying, and writing kept me focused and my thoughts occupied; however, there were times when I was disconnected and missed many family events. But make no mistake, it was you, MY FAMILY, that held me up, held me together, and did not let me falter. I so desperately love you all. And Fab 4…you already know what it is. FAB 4 FOR LIFE.

I would like to give a special thanks to my “baby” sister, my “wonder twin,” Dr. Natosha Peterson Speight. Your prime example has challenged me, motivated me, and inspired me. Thank you for your support, inspiration, and encouraging words. I love you beyond measure.

Table of Contents

List of Tables

List of Figures

Section 1: Foundation of the Study and Literature Review

Introduction

In December 2019, a novel beta coronavirus called SARS-CoV-2 (Ruiz-Roso et al., 2020), a severe acute respiratory syndrome (Stavridou et al., 2021), was first reported in Wuhan, China (Pombo et al., 2020; Ruiz-Roso et al., 2020). The pathology was officially classified by the World Health Organization (WHO) in February 2020 as coronavirus disease 2019 (COVID-19; Alhusseini & Alqahtani, 2020; Pombe et al., 2020; Ruiz-Roso et al., 2020). COVID-19 is a multisystem disease that is transmitted from person to person via respiratory droplets with a period of incubation between 2 to 14 days (Alhusseini & Alqahtani, 2020). Symptoms present in individuals as mild to severe and may include fever, shortness of breath, dry cough, sore throat, fatigue, abdominal pain, headache, and diarrhea (Alhusseini & Alqahtani, 2020). COVID-19 spreads rapidly and has caused high rates of morbidity and mortality globally (Alhusseini & Alqahtani, 2020; Stavridou et al., 2021). After reports of over a million confirmed cases and thousands of deaths due to COVID-19, the WHO declared COVID-19 a pandemic on March 11, 2020 (Alhusseini & Alqahtani, 2020; Browne et al., 2020; Dunton et al., 2020; Stavridou et al., 2021).

In response to the COVID-19 pandemic and as a means to mitigate the spread of the virus and relieve stress on health care systems, government officials implemented multinational, nonpharmaceutical measures including confinement, lockdown, quarantine, and stay-at-home orders; closure of nonessential businesses, restaurants, and bars; social or physical distancing guidance; hygiene guidelines; limitations on the size of gatherings; and closure of schools and childcare centers beginning in March 2020 (An, 2020; Auger et al., 2020; Browne et al., 2020; Donohue & Miller, 2020; Pombo et al., 2020; Stavridou et al., 2021). Although the evidence to support the effectiveness of school and childcare center closures is multifarious, these closures are considered an efficacious intervention during a pandemic (Donohue & Miller, 2020) as a means to reduce rates of infection and level the viral curve (Hoffman & Miller, 2020). Many countries implemented school and childcare center closures to mitigate the spread of COVID-19. By the end of March 2020, greater than 150 million children and adolescents (Allabadi et al., 2020; Xiang et al., 2020) in 165 countries were impacted by school closures (Xiang et al., 2020). By mid-April of 2020, the number of countries implementing school and childcare center closures totaled 192, impacting approximately 1.6 billion students globally (Donohue & Miller, 2020).

When children are out of school, the risk of childhood obesity is higher than when children are in school (von Hippel & Workman, 2016). Research by Cuschieri and Grech (2020) found that children and adolescents are more likely to gain weight during summer vacations and holidays due to reduced physical activity, an increase in sedentary behaviors such as screen time, and increased consumption of unhealthy, sugary foods and beverages. Lin et al. (2018) also found that during weekends and summer holidays, children and adolescents are more sedentary and less physically active, consume less healthy diets, and sleep more, which all lead to increased weight gain. Due to potential prolonged school and childcare center closures as a result of the COVID-19 pandemic, attention to the effects of COVID-19 on children and adolescent health and well-being is warranted (Allabadi et al., 2020). Prolonged school and childcare center closures may exacerbate weight gain in children and adolescents (Rundle et al., 2020) much like weight gain seen during summer vacation and holidays.

Due to the unique circumstances of the pandemic, research regarding the impact of COVID-19 on weight gain and the potential increase in childhood obesity prevalence is recommended (Stavridou et al., 2021). Initial research studies on the effects of COVID-19 on obesity and lifestyle behaviors have focused on school-aged children (Stavridou et al., 2021). However, in the United States, 21 million preschool-aged children were impacted by childcare center closures (Donohue & Miller, 2020). The current study examined differences in body mass index (BMI), amount of physical activity, consumption of sugar-sweetened beverages (SSBs), and the amount of screen time among preschool-aged children enrolled in the Merced County Office of Education (MCOE) Head Start program before and after COVID-19 related Head Start center closures. Head Start is a federally funded program the provides comprehensive services, including early care and education, health, nutrition, family, and special services to low-income children aged 3-5 years and their families (Lumeng et al., 2015).

Although researchers have investigated this issue, there is limited literature on the differences between childhood obesity and lifestyle behaviors among preschool-aged children before and after COVID-19 related childcare center closures. Through the end of the 2020-2021 school year, many schools and childcare centers remained closed or on modified or hybrid schedules in various regions of the United States. Schools and childcare centers returned to in-class learning and in-person services beginning Fall of

2021. Further research is needed to examine the long-term impact of COVID-19 related school and childcare center closures on children's health and well-being. This study contributes to the literature by providing information regarding differences in childhood obesity and lifestyle behaviors in the earliest years of childhood and among vulnerable populations before and after COVID-19 related Head Start center closures.

The study also has social implications that may contribute to society in meaningful ways by identifying health behaviors of children from low-income families and addressing the needs of vulnerable communities. School and childcare center closures due to the COVID-19 pandemic will impact subpopulations of children in different ways, some negatively, including compounding existing stressors that contribute to low-income families and BIPOC (Black, Indigenous, and People of Color) communities (Hoffman & Miller, 2020). As the COVID-19 pandemic continues, the information gained from this study will inform key stakeholders (i.e., parents, early educators, primary and secondary educators, school and childcare center administrators, public health and health professionals, and policy makers) of the impact of childcare center closures on obesity and the health-related behaviors of young children. The information gained may assist in the development and implementation of public health interventions, policies, and guidelines to mitigate risk factors associated with childhood obesity during future pandemics, lockdowns, and situations of prolonged school and childcare center closures and address the longer-term effects of COVID-19 related childcare center closures on children's health. In addition, this study may provide information to specifically assist early care and education programs, such as Head Start, in understanding health-related behaviors of young children during prolonged childcare center closures that may result in the development of strategies and organizational policies to address obesity and health-related behaviors during prolonged closures.

Problem Statement

In the United States, the prevalence of childhood obesity remains a serious and complex public health issue impacting about 13.7 million children (Centers for Disease Control and Prevention [CDC], 2019). For children and adolescents aged 2-19 years, "obesity is defined as a BMI at or above the 95th percentile of the CDC sex-specific BMI-for-age growth charts" (CDC, 2019, para. 3). In 2017-2018, results from the National Health and Nutrition Examination Survey (NHANES) showed that the overall prevalence for childhood obesity for children and adolescents aged 2-19 years was 19.3%, and another 6.1% of children were considered severe obese, having a BMI at or above 120% of the 95th percentile (Fryar et al., 2020). Additionally, Fryar et al. found that 16.1% of children and adolescents were overweight. The lowest prevalence of obesity (13.4%) may be found among preschool-aged children (2-5 years old), followed by school-aged children (6-11 years old) with 20.3% (Fryar et al., 2020). Adolescents aged 12-19 years had the highest prevalence of obesity at 21.2% (Fryar et al., 2020). Various physical and psychological health conditions are associated with childhood diabetes including risk of cardiovascular disease, hypertension, type 2 diabetes, stroke, some forms of cancer, anxiety and depression, sleep apnea and asthma, and low self-esteem (An, 2020; CDC, 2020; Sanyaolu, 2019). Children with obesity are at greater risk of becoming adults with obesity (Gordon-Larsen et al., 2010) with more severe obesity and risk factors for disease in adulthood (Bass & Eneli, 2015).

Disparities in childhood obesity exist between racial and ethnic groups, with children from BIPOC communities being impacted the most. The 2017-2018 NHANES indicated that African American children had the highest prevalence of obesity at 29.1% followed by Mexican American children at 24.9% and Hispanic children at 23% (Fryar et al., 2020). The prevalence of obesity was significantly lower for White and Asian children with a prevalence of obesity at 14.8% and 5.1%, respectively (Fryar et al., 2020). There are also differences in the prevalence of childhood obesity by income and educational level of the head of household (Ogden et al., 2018). From 2011-2014, the prevalence of obesity was highest for children in the middle-income group (19.9%), with children in the highest income group having the lowest prevalence of obesity (10.9%) (Ogden et al., 2018). Children in the lowest income group had a prevalence of obesity of 18.9% (Ogden et al., 2018). The prevalence of obesity in children decreased with increased educational levels of the head of household: high school graduate or less (21.6%), some college (18.3%), and college graduate (9.6%; Ogden et al., 2018).

During March 2020, schools and childcare centers were closed around the world as a result of COVID-19 restrictions, impacting over 150 million children and adolescents by the end of March 2020 (Allabadi et al., 2020; Xiang et al., 2020) and 1.6 billion children and adolescents by mid-April 2020 (Donohue & Miller, 2020). In the United States, all 50 states implemented school closures of kindergarten through 12th grades as a mitigation strategy to combat the spread of COVID-19 (Donohue & Miller, 2020). As a result of COVID-19 related school and childcare center closures, 21 million preschool-aged children and 57 million students in kindergarten through 12th grade were impacted (Donohue & Miller, 2020). School and childcare settings provide opportunities for nutritional support and physical activity that can support obesity prevention efforts (Hoffman & Miller, 2020). Prolonged school and childcare center closures have changed children's dietary habits and disrupted children's ability to participate in physical activity (Hoffman & Miller, 2020). During COVID-19 related school and childcare center closures, children have decreased time engaging in physical activity and playing sports; increased screen time and other sedentary behaviors; and increased consumption of unhealthy foods and SSBs (Dunton et al., 2020; Pietrobelli et al., 2020). As a result of these changes in health behaviors, children may be at an increased risk of unhealthy weight gain and obesity (Hoffman & Miller, 2020). It is anticipated that the rate of childhood obesity will increase in proportion to the length of school and childcare center closures (Cuschieri & Grech, 2020). Cuschieri and Grech suggested that the United States would record 1.27 million new cases of obesity among children and adolescents by December 2020 if school and childcare center closures continued. Due to prolonged school and childcare center closures and modified or hybrid schedules, it is imperative that the longer-term effects of COVID-19 on the health and well-being of children be addressed (Allabadi et al., 2020). School and childcare center closures due to the COVID-19 pandemic may amplify the childhood obesity epidemic and further escalate disparities in obesity risk among vulnerable populations (Allabadi et al., 2020). Further research on the differences in childhood obesity and lifestyle behaviors before and after

COVID-19 related school and childcare center closures are necessary to foster social change.

Purpose of the Study

The purpose of this quantitative study is to examine the differences in BMI, amount of physical activity, consumption of SSBs, and amount of screen time of preschool-aged children enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures. The findings from this study are intended to add to the current literature and increase understanding of the impact of COVID-19 related childcare center closures on childhood obesity and health-related behaviors that will guide public health professionals and early care and education programs in the development and implementation of effective physical activity and dietary interventions during future pandemics and prolonged childcare center closures that will mitigate adverse effects on the health of children from vulnerable populations.

Research Questions and Hypotheses

Research Question 1: Is there a difference in the BMI of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

$H_0 1$: There is no difference in the BMI of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a1: There is a difference in the BMI of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Research Question 2: Is there a difference in the amount of daily physical activity of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

H_02: There is no difference in the amount of daily physical activity of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a2: There is a difference in the amount of daily physical activity of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Research Question 3: Is there a difference in the daily consumption of sugar-sweetened beverages of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

H_03: There is no difference in the daily consumption of sugar-sweetened beverages of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a3: There is a difference in the daily consumption of sugar-sweetened beverages of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Research Question 4: Is there a difference in the daily amount of screen time of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

$H_0$4: There is no difference in the daily amount of screen time of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a4: There is a difference in the daily amount of screen time of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Theoretical Framework

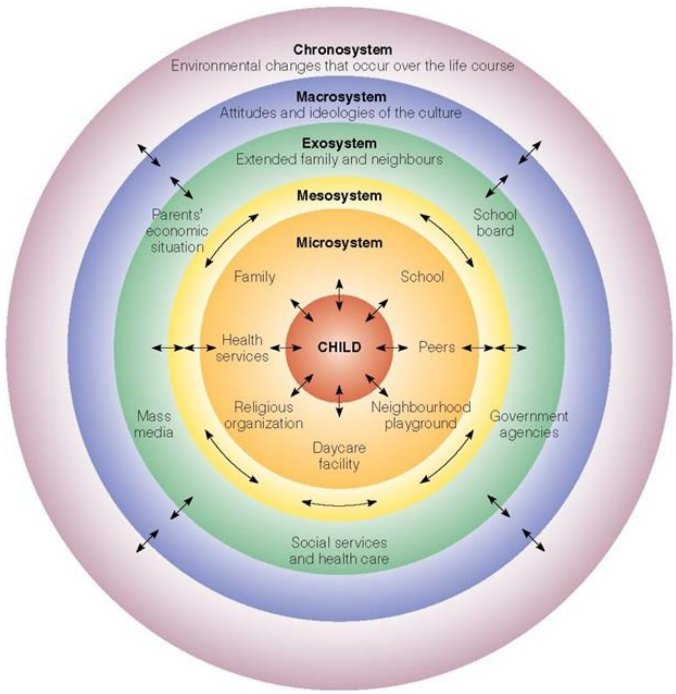
Childhood obesity is complex with outcomes that result from multiple influences including genetics, behaviors, community, and the environment (Browne et al., 2020; Costeira e Pereira et al., 2019). The model that grounds this research study is Urie Bronfenbrenner's social ecological systems theory (also known as the social ecological model [SEM]) proposed in 1977 (Costeira e Pereira et al., 2019). The SEM is a theoretical framework used to understand the determinants that influence health and health behavior (Costeira e Pereira et al., 2019) and can be used to examine the interactions between multiple factors and influences of childhood obesity (Browne et al., 2020). Therefore, the SEM is a useful model for examining the differences in BMI and health-related behaviors among preschool-aged children before and after COVID-19 related Head Start center closures.

Early work of Bronfenbrenner’s ecological systems theory focused on the context of environment; however, the SEM has evolved to included “developmental experiences of continuity and change” through context, personal characteristics, proximal processes, and time, which are dynamic and interrelated (Browne et al., 2020, p. 1). Bronfenbrenner’s ecological systems theory posits that it is necessary to consider environmental aspects beyond an individual’s spere of proximity and immediate context to understand the individual and the individual’s health behavior (Costeira e Pereira et al., 2019). Figure 1 displays the multilevel systems and subsystems of Bronfenbrenner’s ecological systems theory, which includes the following:

- The microsystem includes a child’s immediate connections and relationships within their most proximal environment including family, peers, school, childcare center, and neighborhood (Brown et al., 2020).
- The mesosystem captures the mutual interaction and relationships between individuals and activities of the microsystem (e.g., child and parents, child and childcare center; Browne et al., 2020).
- The exosystem is the social environment and institutions that impact a child’s learning, behavior, and existence including school systems, parental employment, government, and mass media (Browne et al., 2020).
- The macrosystem includes the child’s and family’s cultural influences, values, attitudes, beliefs, and traditions (Browne et al., 2020).
- The chronosystem indicates the concept of time and how time impacts the lifecycle and lifespan development (Browne et al., 2020).

Figure 1

Bronfenbrenner's Ecological Systems Theory



From "Bronfenbrenner's Ecological Systems Theory," by O. Guy-Evans, 2020, *Simply Psychology* (https://www.simplypsychology.org/Bronfenbrenner.html).

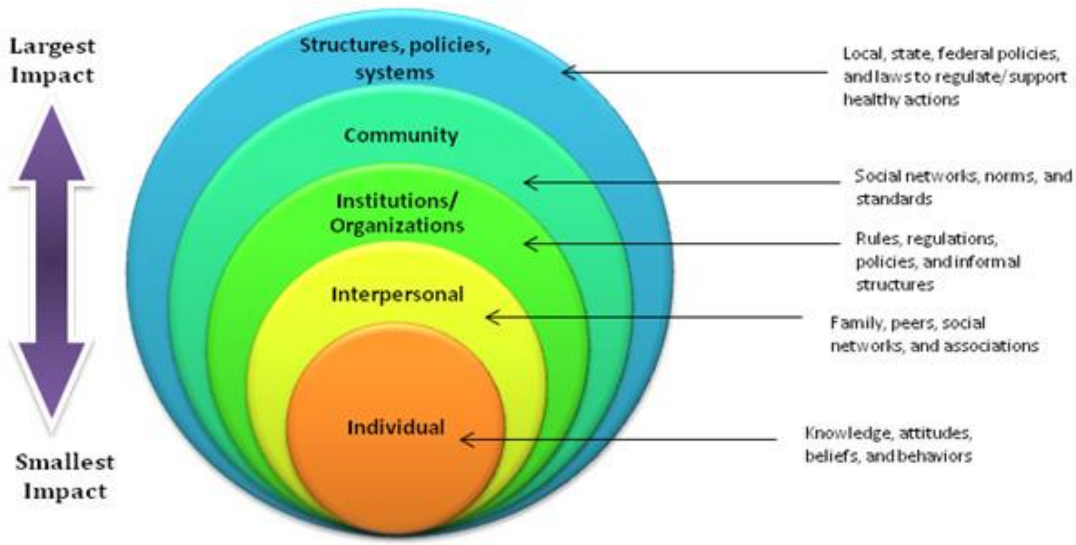
The Centers for Disease Control and Prevention (CDC) has adapted Bronfenbrenner's SEM and categorizes the determinants of childhood obesity into five levels of the SEM including:

> the individual (knowledge, attitudes, beliefs and behaviors), the interpersonal (family, peers, social networks, and associations), the institutional (rules, regulations, policies, and informal structures), the community (social networks, norms, and standards), and the policy level (local, state, federal policies and laws to regulate/support healthy actions; Costeira e Pereira et al., 2019, p. 1884).

The CDC's adaptation of the SEM is displayed in Figure 2.

Figure 2

The Social Ecological Model



From "Health Equity Toolkit for State Practitioner Addressing Obesity Disparities," by Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition, Physical Activity and Obesity, S. James, L. Hawley, R. Kramer, and Y. Wasilewski, 2017 (https://www.cdc.gov/nccdphp/dnpao/state-local-programs/health-equity/pdf/toolkit.pdf). In the public domain.

Grounded by Bronfenbrenner's SEM, examination of the association of COVID-19 and childhood obesity has exposed risks factors and possible consequences and interconnections between biology, psychology, and socio-environmental factors (Brown et al., 2020). Accompanied by social and economic stressors, the pandemic has created increased demands on children and families (Browne et al., 2020). Children and parents have been impacted by school and childcare center closures; distance learning and hybrid models; working from home, lay-offs, and work furloughs; and loss of social networks, sports and extracurricular activities, and other peer group activities (Brown et al., 2020). To reduce the spread of COVID-19, state mandates and executive orders to shelter-in-place required local governments to limit non-essential business and activities. As a result, some businesses were closed resulting in parental loss of jobs, work furloughs, or teleworking that resulted in changes in family financial situations and adjustments to home environments. Parks and playgrounds were closed, and youth sports programs were cancelled that limited children's opportunities for physical activity. Schools and childcare centers were closed while students received education and early education services at home through distance learning. Schools and childcare centers are valuable sources of physical activity and nutritional services that were significantly altered or lost due to school and childcare center closures. With parents and children relegated to the home environment and a change in the home structure, there are potential changes in children's health-related behaviors that can impact the risk of childhood obesity. This research study focused on the differences in BMI, amount of physical activity, consumption of SSBs, and screen time among preschool-aged children before and after COVID-19 related Head Start center closures. The SEM can help to understand how each level of the SEM is connected and interacts in reference to the association of COVID-19 related Head Start center closures on BMI and other health-related behaviors. The SEM can also help to understand how to manage childhood obesity during prolonged school and childcare center closures and its longer-term effects after the COVID-19 pandemic through research, assessment, and the creation of effective public health interventions and policies (Brown et al., 2020).

Nature of the Study

To address the research questions in this quantitative study, the specific research design included a secondary data analysis using data from ChildPlus, the professional Head Start data management system, with a longitudinal study design of data collected before and after COVID-19 related Head Start center closures to examine the differences in BMI, amount of physical activity, consumption of SSBs, and screen time among children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures. Permission to access data from ChildPlus was granted by the MCOE Head Start program director. ChildPlus contains all the variables necessary to conduct the study, which includes BMI, amount of daily physical activity, amount of daily consumption of SSBs, and amount of daily screen time. COVID-19 related Head Start center closures is the independent variable; BMI, physical activity, consumption of SSBs, and screen time are the dependent variables.

Literature Search Strategy

Various databases and other sources available via the Walden University Library were used for the exhaustive literature review for this study. Databases and sources used include Gale In Context, Gale Academic OneFile Select; Complementary Index; Directory of Access Journal; Regional Business News; MEDLINE; PubMed; ProQuest; Sage Premier; Science Direct: Education Source Academic Search Complete; Supplemental Index; and CINAHL Plus. Results were refined to limit the literature search to peer reviewed scholarly journals, full text articles, and publications between the years 2015 and 2021. Keywords of the literature search strategy were *COVID-19, COVID-19 pandemic, childhood obesity, school closures, Head Start, preschool, preschool-aged children, stay-at-home orders, COVID-19 restrictions, COVID-19 confinement, physical activity, sugar-sweetened beverages, dietary/eating habits, sedentary behaviors, screen time,* and *social ecological model*. Keywords were entered into the search engine as single terms or in various combinations of terms to generate search results that were most relevant to the research topic and research questions. Additionally, a snowballing technique using references of relevant articles was used during the literature search.

Literature Review Related to Key Variables

There is minimal debate that school and childcare center closures have been an important and necessary mitigation strategy against the spread of COVID-19 (Hoffman & Miller, 2020). However, it has also been one of the most disruptive mitigation strategies in efforts to reduce the spread (Hoffman & Miller, 2020). The associated effects on children and adolescent health and well-being may be significant (Donohue & Miller, 2020). Schools and childcare centers provide essential nonacademic supports including structured and unstructured physical activity, access to nutritious meals and food assistance, social networks, obesity prevention, and other resources for healthy development (Brown et al., 2020; Donohue & Miller, 2020). When school and childcare center closures were implemented, children and adolescents lost a place of safety, access to nutritious meals, and opportunities for structured and unstructured physical activity

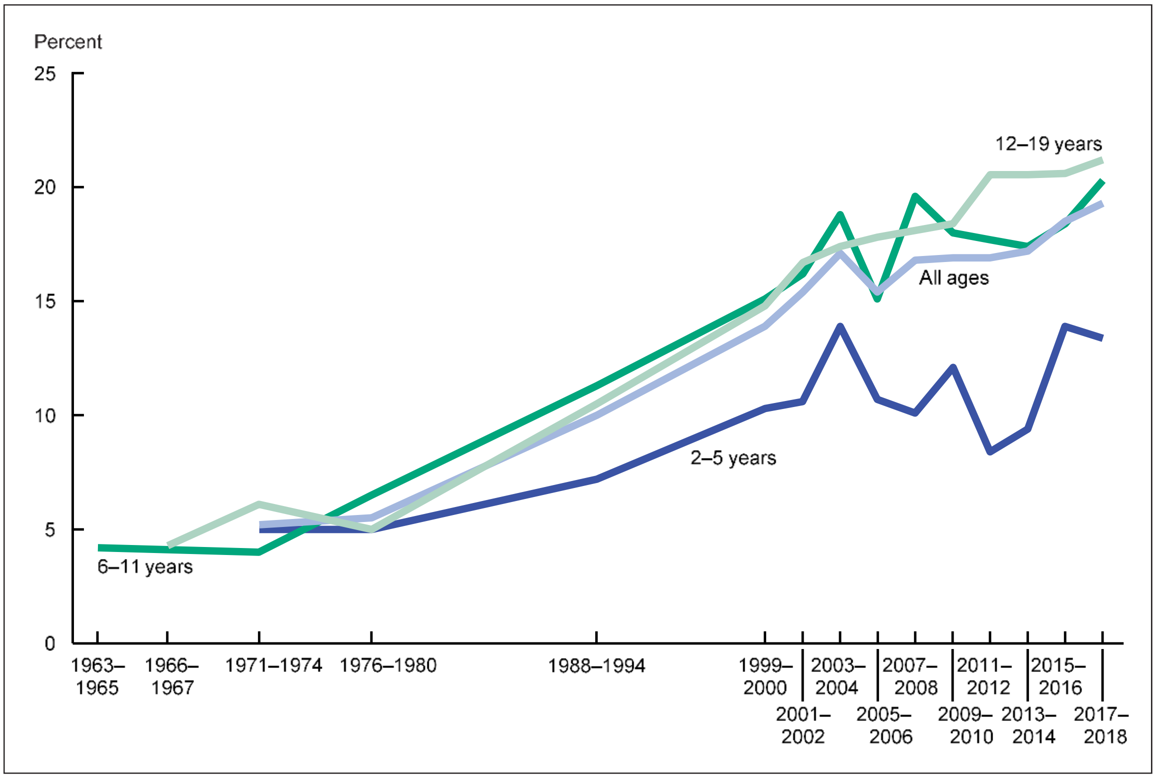
(Brown et al., 2020). Children's and adolescents' level of physical activity, sedentary behaviors (Xiang et al., 2020), and eating behaviors (Allabadi et al., 2020) were impacted. Reduced physical activity, increased sedentary behavior (Xiang et al., 2020), irregular and unhealthy eating, and excessive snacking (Allabadi et al., 2020) are all associate with negative physical health outcomes including loss of cardiorespiratory fitness, unhealthy weight gain (Xiang et al., 2020), and increased risk of childhood obesity (Allabadi et al., 2020).

Trends in Childhood Obesity

In the United States, the prevalence of obesity has doubled and tripled for children and adolescents, respectively, since the early 1960's (Anderson et al., 2019; Sanyaolu et al., 2019). Figure 3 shows trends in childhood obesity by age group since 1963-1965 through 2017-2018 (Fryar et al., 2020).

Figure 3

Trends in Obesity Among Children and Adolescents Aged 2-19 Years, by Age United States, 1963-1965 Through 2017-2018



From "Prevalence of Overweight, Obesity, and Sever Obesity Among Children and Adolescents aged 2-19 years: United States, 1963-1965 through 2017-201," by C. D. Fryar, M. D. Carroll, and J. Afful, 2020, *Health E-Stats*, p. 4 (https://www.cdc.gov/nchs/data/hestat/obesity-child-17-18/obesity-child.htm). In the public domain.

Trends for children aged 2-5 years begin with the years 1971-1974 (Fryar et al., 2020). The prevalence of obesity for children aged 2-5 years steadily increased from 1971-1974 (5.0%) through 2001-2002 (10.6%) and increased sharply in 2003-2004 (13.9%; Fryar et al., 2020). Thereafter, the prevalence declined until 2007-2008 (10.1%)

with another increase seen in 2009-2010 (12.1%; Fryar et al., 2020). Another decrease occurred in 2011-2012 (8.4%) proceeded by a period of increase until 2015-2016 (13.9%; Fryar et al., 2020). The prevalence of obesity declined again in 2017-2018 (13.4%; Fryar et al., 2020). Table 1 shows the prevalence of obesity among children aged 2-5 years by sex in the United States from 1971-1974 through 2017-2018.

Table 1

Prevalence of Obesity Among Children Aged 2-5 Years by Sex: United States 1971-1974 Through 2017-2018

Survey period	All	Boys	Girls
	Percent (standard error)		
1971-1974	5.0 (0.6)	5.0 (0.8)	4.9 (0.8)
1976-1980	5.0 (0.6)	4.7 (0.6)	5.3 (1.0)
1988-1994	7.2 (0.7)	6.2 (0.8)	8.2 (1.0)
1999-2000	10.3 (1.7)	9.5 (2.3)	11.2 (2.5)
2001-2002	10.6 (1.8)	10.7 (2.4)	10.5 (1.8)
2003-2004	13.9 (1.6)	15.1 (1.7)	12.7 (2.5)
2005-2006	10.7 (1.1)	10.4 (1.7)	11.0 (1.2)
2007-2008	10.1 (1.2)	9.3 (1.5)	10.9 (2.1)
2009-2010	12.1 (1.2)	14.4 (1.8)	9.6 (1.7)
2011-2012	8.4 (1.3)	9.5 (1.9)	*7.2 (2.1)
2013-2014	9.4 (1.3)	8.8 (2.0)	10.0 (1.3)
2015-2016	13.9 (1.1)	14.3 (1.2)	13.5 (1.7)
2017-2018	13.4 (1.3)	14.7 (1.8)	12.2 (1.4)

Note: *Estimate has a confidence interval width between 5 and 30 and a relative confidence interval width greater than 130% and does not meet National Center for Health Statistics standards of reliability; see Series Report 2, Number 175 (https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf). Adapted from “Prevalence of Overweight, Obesity, and Severe Obesity Among Children and Adolescents aged 2-19 years: United States, 1963-1965 through 2017-201,” by C. D. Fryar, M. D. Carroll, and J.

Afful, 2020, *Health E-Stats*, p. 6 (https://www.cdc.gov/nchs/data/hestat/obesity-child-17-18/obesity-child.htm). In the public domain.

Studies by Ogden et al. (2016), Pan et al. (2016), and Pan et al. (2019) showed similar trends. Ogden et al. examined trends in the prevalence of obesity in the United States from 1988-1994 through 2013-2014 among 2–19-year-old children and adolescents. For children aged 2-5 years, the authors found that the prevalence of obesity increased until 2003-2004 and began to decline thereafter (Ogden et al., 2016). Using data collected on children 2-4 years of age participating in the Supplemental Nutrition Program for Women, Infant, and Children (WIC) in the United States from 2000-2014, Pan et al. (2016) also examined trends in obesity prevalence. The WIC program provides "supplemental foods, nutrition education, and health care referrals for low-income women who are pregnant, postpartum, or breastfeeding, and infants and children" up to 5 years of age (Pan et al, 2016, p. 1256). Trends in the prevalence of obesity increased from 14.0% in 2000 to 15.5% in 2004 and 15.9% in 2010 (Pan et al., 2016). From 2010 to 2014, the prevalence of obesity decreased from 15.9% to 14.5% (Pan et al., 2016). This decrease was observed across racial and ethnic groups (Pan et al., 2016). Pan et al. (2019) built upon the previous study by Pan et al. (2016) by exploring trends in children of the same age group participating in the WIC program from 2010-2016. The authors found that from 2010-2016 the prevalence of obesity for low-income children participating in the WIC program decreased (Pan et al., 2019). This finding was different from Fryar et al. (2020) that found an increase in the prevalence of obesity for 2–5-year-old children in 2015-2016. Pan et al. (2019) suggested that the difference in the study's findings may have been attributed to a smaller sampling of children from families with diverse levels of income.

Childhood Obesity and BMI

Due to changes in physical activity and other health-related behaviors as a result of school and childcare center closures, it is anticipated that childhood obesity will increase (An, 2020; Cuschieri & Grech, 2020; Stavridou et al., 2021) and that the increase will be in proportion to the length of school closures (Cuschieri & Grech, 2020). An increase of 1.27 million new cases of childhood obesity in the United States were anticipated if schools remained closed through December 2020 (Cuschieri & Grech, 2020). Rundle et al. (2020) also anticipated that COVID-19 related school closures would worsen childhood obesity and increase disparities in risk factors of obesity. The authors posited that the weight gain associated with COVID-19 related school closures would be similar to weight gain associated with summer vacation (Rundle et al., 2020). When children are out of school, children experience weight gain that is unhealthy (Rundle et al., 2020). This weight gain in more apparent in African American and Hispanic children and children who are already overweight (Rundle et al., 2020). Another study by von Hippel and Workman (2016) explored whether the prevalence of overweight and obesity in children and adolescents increased during the school year or summer vacation using the Early Childhood Longitudinal Study, Kindergarten Class of 2010-2011 (ECLS-K:2011). The authors found that between kindergarten and second grade, the prevalence of overweight and obesity only increased during the summer vacation and not during the school year (von Hippel & Workman, 2016). Allabadi et al. (2020) investigated the impact of the COVID-19 related lockdown on weight and various lifestyle behaviors among youth, aged 10-19 years, in West Bank, Palestine between April 24 and April 27, 2020. The results of the study showed that 41.7% of the total sample (*N*=600) experienced an increase in weight (Allabadi et al., 2020).

Using data from the ECLS-K:2011, An (2020) used a microsimulation model to project the impact of COVID-19 on obesity prevalence and BMI *z*-scores from April 2020 to March 2021 under a control scenario (i.e. before the COVID-19 pandemic) and four alternate scenarios. Scenario 1 simulated school closure during April and May 2020 (An, 2020). Scenario 2 included the summer months, June to August 2020, anticipating a 10% decrease in daily physical activity (An, 2020). Scenario 3 assumed continued school closures during the months of September and October 2020 (An, 2020). Lastly, Scenario 4 simulated a closure during November and December 2020 (An, 2020). All alternate scenarios showed increases in BMI z-scores and the prevalence of childhood obesity relative to the control scenario (An, 2020). The microsimulation showed that the impact of COVID-19 on the obesity of African American and Hispanic children and boys were slightly greater than the impact on white and Asian children and girls (An, 2020). Additionally, the microsimulation predicted that the magnitude of the increase in BMI *z*-scores and the prevalence of childhood obesity would be proportional to the length and severity of the COVID-19 pandemic (An, 2020).

Physical Activity

The foundation for a lifetime of health and well-being are established during childhood and adolescence (U.S. Department of Health and Human Services [DHHS], 2018). During these critical periods, children and adolescents develop motor skills, learn and establish healthy behaviors, such as regular physical activity that encourages health and fitness (DHHS, 2018). Children and adolescents who are physically active tend to have lower body fat, stronger muscles and bones, and better cardiorespiratory fitness (DHHS, 2018; Piercy et al., 2018). Additionally, physical activity provides benefits of brain health, including improved cognition, memory, academic performance and reduced risk of depression and depressed disorder, for children and adolescents (DHHS, 2018; Piercy et al., 2018). Due to physical inactivity, obesity, risks factors for chronic diseases, and chronic diseases not usually developed during childhood and adolescence are now observed during these life stages (DHHS, 2018). Engaging in regular physical activity can reduce the likelihood of developing risks factors of disease and chronic diseases in these early years and increase the likelihood of becoming healthy adults (DHHS, 2018).

Children and adolescents should be encouraged to engage in physical activities that are age-appropriate and fun (DHHS, 2018). Physical activity guidelines for children and adolescents, aged 6-17 years, include engaging in 60 minutes or more of physical activity on a daily basis at a moderate-to-vigorous intensity level (DHHS, 2018; Piercy et al., 2018). Aerobic, muscle- and bone-strengthening activities should be incorporated into 60 minutes or more of daily physical activity at least 3 days a week (DHHS, 2018; Piercy et al., 2018). Guidelines for preschool-aged children, aged 3-5 years, include participating in physical activity throughout the day (DHHS, 2018; Piercy et al., 2018). Caregivers should encourage and provide opportunities for physical activities for preschool-aged children that are structured and unstructured including catching, throwing, and kicking games; tricycle or bicycle riding; walking, running, hopping, skipping, and dancing; jumping or jumping rope; tumbling and gymnastics; swimming; and playing on the playground (e.g., tag, follow the leader, tug of war, or climbing on play structures; DHHS, 2018). The specific amount of physical activity to prevent overweight and obesity for preschool-aged children is not clearly defined; however, 3 hours of daily activity of vigorous, moderate, or even light intensity is practical (DHHS, 2018).

School settings promote and encourage regular physical activity by providing recess, activity breaks, physical education classes, sports, extracurricular activities, and programs before and after school (Hoffman & Miller, 2020). School closures challenge the ability of children to be physically active (Rundle et al., 2020) resulting from the lack of structured physical activities that leads to sedentary behavior and weight gain (Cuschieri & Grech, 2020). COVID-19 related school closures decreased structured physical activity for children (Cuschieri & Grech, 2020). In the study by Allabadi et al. (2020) of 600 adolescents, aged 10-19 years, in Palestine, physical activity decreased after the COVID-19 lockdown and school closures. Of the adolescents reporting engaging in physical activity, 21.8% reported an increase while 18.8% reported a decrease and 14.3% reported no change in physical activity (Allabadi et al., 2020). No physical activity during the lockdown was reported by 45% of adolescents (Allabadi et al., 2020). Another study by Xiang et al. (2020) examined the impact of COVID-19 on the lifestyle behaviors of children (*N*=2,426) aged 6-17 years in Shanghai, China. The initial survey was conducted from January 3 to January 21, 2020, prior to activation of the public health emergency in the country on January 24, 2020, and the second was conducted during the pandemic from March 13 to March 23, 2020 (Xiang et al., 2020). Study results revealed that physical activity decreased significantly during the pandemic (105 min/week) in comparison to before the pandemic (540 min/week). The prevalence of physical inactivity increased from 21.3% before the pandemic to 65.6% after the pandemic (Xiang et al., 2020). The most significant finding of a study by Lopez-Bueno et al. (2020) that examined the impact of COVID-19 confinement on Spanish children, aged 3-16 years, in Spain on health-related behaviors (HRB), including physical activity, was that all HRBs worsened in all age groups with the exception of children between the ages of 13-16 years.

School and childcare center closures pose challenges for parents to maintain healthy environments to prevent weight gain among children (Brown et al., 2020). Distance learning options do not include recess, physical education classes, or opportunities for active movement and physical activity and hybrid schedules may offer physical education via virtual sessions (Brown et al., 2020). For some children residing in urban areas, physical activity may be limited due to the lack of green spaces, safe walking areas, and access to opportunities and environments that support physical activity (Brown et al., 2020). Cuschieri and Grech (2020) in their discussion of the potential impact of COVID-19 on the risk of global childhood obesity noted that children living in small apartments and urban areas faced challenges to physical activity due to limited space and opportunities due to closures of playgrounds and other leisure activity centers. In the United States, Dunton et al. (2020) conducted a study with parents of 211 school-aged (5-13 years) children before (February 2020) and after (April and May 2020) the COVID-19 pandemic exploring the effects of the pandemic on physical activity and lifestyle behavior. The authors found that parents perceived a decrease in children's physical activity during the early stages of the pandemic (Dunton et al., 2020). The likelihood of physical activity occurring at home, in a garage, or on neighborhood sidewalks and roads increased while physical activity in parks or on trails decreased (Dunton et al., 2020).

Sugar-Sweetened Beverages (SSBs)

Decreasing consumption of SSBs is an important factor in reducing the prevalence of childhood obesity (Muth et al., 2019). In the Unites States, SSBs are the premier source of added sugars in the American diet (Muth et al., 2019). Over consumption of added sugars is a contributing factor of childhood obesity, especially among children from socioeconomically vulnerable families (Muth et al., 2019). It is also a risk factor for other chronic conditions such as type 2 diabetes, hypertension, cardiovascular disease, and tooth decay (Muth et al., 2019). SSBs are energy dense and provide minimal nutritional value (Muth et al., 2019). In 2011, the American Academy of Pediatrics (AAP) recommended that children and adolescents drink water and avoid consumption of energy and sports drinks (Muth et al., 2019). In 2017, the AAP recommended the support of policies that would limit fruit juice consumption to "no juice in children younger than 1 year, 4 oz. per day in children ages 1-3 years, no more than 4-6 oz. per day in children ages 4-6 years, and no more than 8 oz. per day in children ages 7-18 years" (Muth et al., 2019, p. 2).

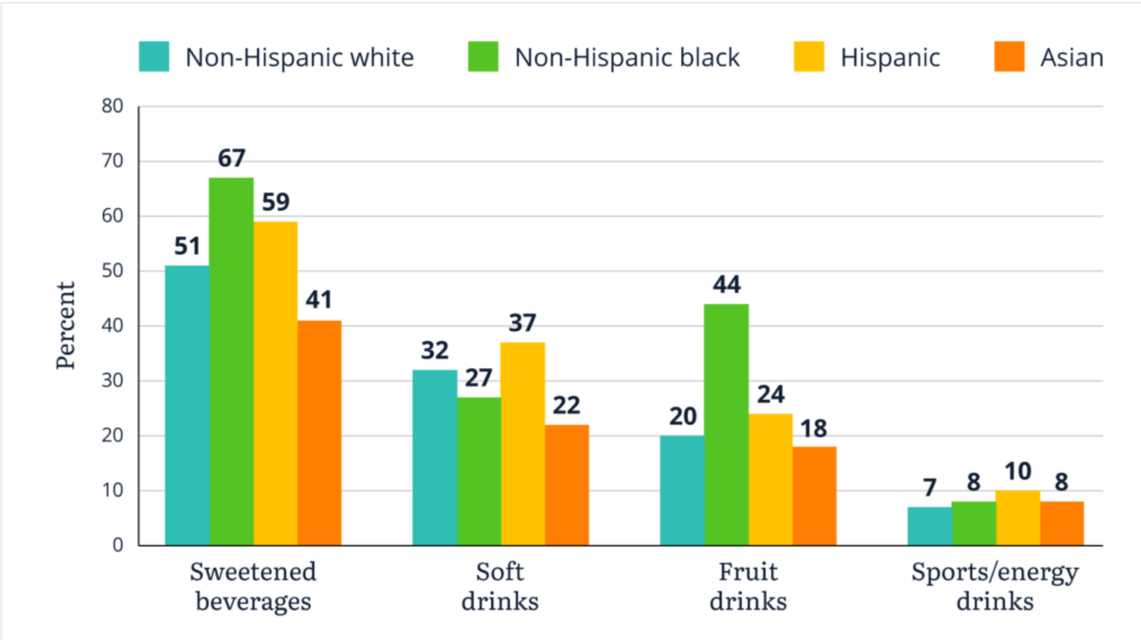
Health organizations have provided recommendations for the consumption of added sugars. The 2015-2020 dietary guidelines for Americans and the World Health Organization (WHO) recommend limiting consumption of added sugar to less than 10% of total daily calories (Muth et al., 2019). Additionally, the WHO recommends limiting added sugar consumption to less than 5% of total daily calories for increased benefits (Muth et al., 2019). According to the 2015-2016 NHANES, only 34.8% of children and adolescents in the United States aged 2-19 years met the recommended guidelines for limiting added sugars to less than 10% of daily calories (Robert Wood Johnson Foundation [RWJF], State of Childhood Obesity, n.d.). About 47.2% of children aged 2-5 years, 31.4% of children aged 6-11 years, and 31.3% of adolescents aged 12-19 years met the recommended guidelines (RWJF, State of Childhood Obesity, n.d.). The American Heart Association (AHA) recommends no more than 25 g (6.25 teaspoons) of added sugar and at most 8 oz. of SSBs per week for children aged 2 years and older (Muth et al., 2019). Despite these recommendations, added sugars make up 17% of total calories consumed by children and adolescents in the United States with approximately half of the added sugars being consumed from SSBs (Muth et al., 2019). Among children aged 2-5 years, 21.3% of added sugar comes from SSBs, for children aged 6-11 years 28.7% of added sugar comes for SSBs, and 36.5% of added sugar comes from SSBs for adolescents aged 12-19 years (RWJF, State of Childhood Obesity, n.d.).

In the United States, 61% of children and adolescent consume SSBs daily (RWJF, State of Childhood Obesity, n.d.). Approximately 45% of children aged 2-5 years, 59% of children aged 6-11 years, and 57% of adolescents aged 12-19 years consume SSBs on any given day (RWJF, State of Childhood Obesity, n.d.). The types of drinks consumed on any given day differ by race and ethnicity as displayed in Figure 4 (RWJF, State of Childhood Obesity, n.d.). Overall, 67% of non-Hispanic black children, 59% of Hispanic children, 51% of non-Hispanic white, and 41% of Asian children consume SSBs on any given day (RWJF, State of Childhood Obesity, n.d.).

Schools promote healthy behaviors through participation in school breakfast and lunch programs limiting high fat foods and SSBs (Hoffman & Miller, 2020). Nutrition standards established by the United States Department of Agriculture (USDA) for elementary and middle schools do not allow SSBs (Muth et al., 2019). The Child and Adult Care Food Program (CACFP) that is administerd by the USDA serves over 3 million children (Muth et al., 2019). CACFP does not allow SSBs as creditable items and encourages child care and early education programs to avoid serving SSBs in their centers in accordance with CACFP best practices (Muth et al., 2019). Additionally, flavored milks are noncreditable for children 2-5 years of age (Muth et al., 2019). A systematic review of literature by Mazarello Paes et al. (2015) regarding the deteminants of SSBs consumption of young children aged 0-6 years showed school policies had a positive impact on reduced consumption of SSBs in the preschool environment.

Figure 4

Children's Daily Consumption of Sugar-Sweetened Beverages by Race and Ethnicity (2015-2016)



From "Sugary Drinks Harm Kid's Health: What is the Impact of Consuming Sugary Drinks?" by RWJF, State of Childhood Obesity, n.d. (https://stateofchildhoodobesity.org/sugary-drinks-harm-kids-health/). Copyright 2004-2020 Robert Wood Johnson Foundation.

The impact of COVID-19 related school and childcare center closures may negatively impact children's food and nutrition security (Pérez-Escamilla et al., 2020). School and childcare center closures have forced children and adolescents to miss school meals that they depend on for food and nutrition security (Pérez-Escamilla et al., 2020). Studies on the impact of COVID-19 related lockdowns and school closures show increases in the consumption of SSBs. In a study of 600 youth (10-19 years old) in

Palestine by Allabadi et al. (2020), 31.5% of youth increased their consumption of SSBs. Another study by Pietrobelli et al. (2020) included a sample of 41 children and adolescents aged 6-18 years with overweight and obesity living in Verona, Italy. The focus of the study was to test the hypothesis that the COVID-19 related lockdown and school closures would increase unfavorable lifestyles behaviors, including intake of SSBs, among children and adolescents with overweight and obesity (Pietrobelli et al, 2020). A survey was conducted with parents at baseline (May-July 2019) and 3 weeks after the COVID-19 related lockdown and school closures (March-April 2020) (Pietrobelli et al., 2020). The result of the study indicated a significant increase in consumption of SSBs from baseline to during lockdown (Pietrobelli et al., 2020). Conversely, in a study with of 820 adolescents aged 10-19 in Spain, Italy, Brazil, Columbia, and Chile, Ruiz-Rosa et al. (2020) found that adolescents reported no changes in consumption of SSBs during the COVID-19 related lockdown and school closure. The authors compared adolescents' nutritional modifications as a result of the COVID-19 related lockdown and school closure with their regular nutritional habits and dietary guidelines.

Screen Time

Due to COVID-19 related lockdowns and school and childcare center closures, physical activity among children and adolescents has decreased and sedentary behaviors have increased (Alonso-Martínez et al., 2021). Research by Dunton et al. (2020) found that children in the United States engaged in less physical activity and more sedentary behavior during the early period of the pandemic than prior to the pandemic. The use of digital media including mobile devices, tablets, desktop, and laptop computers has increased for various purposes (Sultana et al., 2021). Television viewing and the use of digital media for the purpose of entertainment has increased (Sultana et al., 2021). However, digital media has also become essential to allow children and adolescents access to school and educational materials, interaction with others, and to engage in play and recreational use (Wiederhold, 2020).

Even prior to the COVID-19 pandemic, there was an increase in screen time among children and adolescents (Wiederhold, 2020). Chen and Adler (2020) conducted a study with American children under the age of 6 years to examine daily use of screen time using the 1997 and 2014 Child Development Supplement of the Panel Study of Income Dynamics. Due to technological advances, screen time activities in 2014 included "the use of television, videotapes, digital video disc, game devices, computer, cell phone, smartphone, tablet, electronic reader, and children's learning devices" as compared to the 1997 definition of screen time as "time spent on any activity while watching television programs or videotapes, plus time spent on electronic video games and home computer-related activities" (Chen & Adler, 2020; p. 391). In children aged 0-2 years, the average daily screen time increased from 1.32 hours (.56 hours watching television) in 1997 to 3.05 hours (2.62 hours watching television and .37 hours spent on mobile devices) in 2014 (Chen & Adler, 2020). For children aged 3-5 years, there was no significant change in average daily screen time from 1997 to 2014; however, there was an 80% increase in television time and .42 hours were spent on mobile devices (Chen & Adler, 2020). In 2014, watching television accounted for 86% of total screen time for children aged 0-2 years and 78% for children aged 3-5 years (Chen & Adler, 2020). Furthermore, a report by Rideout and Robb (2019) found the average use of screen time for children, aged 8-12 years, was almost 5 hours and almost 7.5 hours for teens. This increase in screen time was due to entertainment purposes and not for school or homework (Rideout & Robb, 2019). The report also showed that there is a gap of 21 percentage points between low-income and high-income children having digital devices in the home (73% vs. 94%; Rideout & Robb, 2019). Children from lower income families (51%) are also less likely to use their digital devices for school and homework compared with children from higher income families (64%; Rideout & Robb, 2019). Among teens that use social media, Hispanic teens spent approximately 2.5 hours daily on digital devices compared to 2.25 hours and 1.5 hours used by African American and white teens, respectively (Rideout & Robb, 2019).

Children's and adolescents' use of digital devices increased even more during COVID-19 related school and childcare center closures (Wiederhold, 2020). Various studies have shown an increase in screen time among children and adolescents after the pandemic compared to before the pandemic. A comparison by Oflu et al. (2021) of digital gaming and screen time by Turkish children aged 3-10 years before and during the pandemic showed a significant increase in the percentage of children with screen time of an hour or more during the pandemic compared to before the pandemic (89% vs 57.7%). A study by Mitra et al. (2020) of Canadian children and adolescents between the ages of 5-17 found that screen time increased for 78.8% of children and adolescents. Furthermore, a study by Moore et al. (2020) to examine the impact of COVID-19 related restriction on movement and play of Canadian children, aged 5-11 years, and adolescents, aged 12-17 years, found that leisure screen time and social media use increased after the pandemic for both age groups with the most significant change in leisure screen time television watching. Children and adolescents watched approximately 6.5 hours of television daily (Moore et al., 2020). In May 2020, Kracht et al. (2021) conducted a study with mothers of preschool-aged children in the United States. Study results showed that 74% of mothers reported increases in their preschool-aged children's screen time after the pandemic (Kracht et al., 2021). Another study with caregivers of children aged 1-5 years in Chile reported an increase of 1.4 hours per day of recreational screen time (Aguilar-Farias et al., 2021). Schmidt et al. (2020) examined physical activity and recreation screen time of children and adolescents aged 4-17 years in Germany and found significant increases in the total amount of recreational screen time, gaming, television watching, and recreational internet use. Total recreational screen time increased 61.2 minutes daily, gaming increased by 21.5 minutes, television watching increased by 21.2 minutes, and recreational internet use increased by 18.5 minutes (Schmidt et al., 2020).

Excessive screen time is associated with non-communicable diseases (Sultana et al., 2021) such as cardiovascular disease risks, diabetes, and obesity due to its association with snacking and increased total sedentary time (Nagata et al., 2020). A systematic review of prevalence studies resulting in a meta-analysis of 16 studies was conducted to examine the association between screen time and overweight and obesity in children and adolescent under the age of 18 years (Fang et al., 2019). The meta-analysis showed an increase in overweight and obesity risk among children who engaged in 2 hours or more of daily screen time compared to children who engaged in less than 2 hours of daily screen time (OR = 1.67; 95% CI [1.48, 1.88], $p < .0001$; Fang et al., 2019). Although excessive screen time may have adverse health effects for children and adolescents, increases in screen time may be an unavoidable reality due to COVID-19 related restrictions (Nagata et al., 2020).

The AAP recommends no screen time, with the exception of video chatting with parental guidance, for infants and toddlers until 18-24 months and an hour or less of daily screen time for children ages 2-5 years (Pappas, 2020). The WHO does not recommend any screen time for infants less than 1 year and recommends no more than 1 hour of screen time for children aged 2-5 years (WHO, 2019). For older children and adolescents, the AAP developed the family media use plan in which screen time usage is negotiated between children and parents (Pappas, 2020). Moderate screen time poses no harm for children and adolescents; however, they may have issues limiting screen time on their own (Sultana, 2021). Screen time does not have to be sedentary and can be used for the purpose of physical activity (Nagata et al., 2020). During the COVID-19 related school and childcare center closures, remote and distance learning necessitates the use of screens; thus, screen time has significant educational benefits (Nagata et al., 2020). Social media is also an ideal platform to connect children and adolescents with family and friends (Nagata et al., 2020). The APP recommended reimagining limits of screen time that would be more appropriate during the pandemic such as concentrating on the type of screen time in which children and adolescents are engaged versus the length of time they are engaged in use of screens (Wiederhold, 2020).

Definitions

Added sugars: Sugars (e.g., sucrose, high fructose corn syrup, glucose) that are added during processing of foods and beverages; does not include naturally present sugars (e.g., fructose and lactose; Muth et al., 2019).

Body Mass Index (BMI): A measure to determine a child's weight status by dividing weight in kilograms by the square of height in meters (CDC, 2018). BMI is sex- and age-specific for children and is frequently referenced as BMI-for-age (CDC, 2018). BMI-for-age weight status categories and percentile ranges are shown in Table 2.

Table 2

Weight Status Categories and Percentile Ranges

Weight Status Category	Percentile Range
Under Weight	Less than the 5^{th} percentile
Normal or Healthy Weight	5^{th} percentile to less than the 85^{th} percentile
Overweight	85^{th} to less than the 95^{th} percentile
Obese	95^{th} percentile or greater

Adapted from "BMI for Children and Teens," by Centers for Disease Control and Prevention, 2018 (https://www.cdc.gov/obesity/childhood/defining.html). In the public domain.

Center-based option: Services provided to children primarily in the classroom setting.

Coronavirus disease (COVID-19): A multisystem disease that is transmitted from person to person via respiratory droplets with a period of incubation between 2 to 14 days (Alhusseini & Alqahtani, 2020).

Dietary habits: Repeated choices of the foods or beverages people want to consume (Preedy & Watson, 2010).

Double session: Option/class in which one teacher provides services for two groups of children in the morning and afternoon four days a week.

Full-day enrollment: Services provided in a center-based setting for more than 6 hours per day.

Head Start: A federally funded program that provides early learning and development, health, and family wellbeing services that promote school readiness for low-income children ages birth to 5 years and their families (U.S. Department of Health and Human Services, Administration for Children and Families, Office of Head Start [DHHS/ACF/OHS], 2020).

Home-based option: Services provided to children, primarily in the child’s home.

Low-Income: In accordance with Head Start program policies, families with incomes at or below the U.S. Department of Health and Human Services federal poverty guidelines. The 2021 poverty guidelines are shown in Table 3.

Table 3

2021 Poverty Guidelines for the 48 Contiguous States and the District of Columbia

Persons in Family/Household	Poverty Guideline
Add $4,540 for each additional person for families/households more than 8 persons.	
1	$12,880
2	$17,420
3	$21,960
4	$26,500
5	$31,040
6	$35,580
7	$40,120
8	$44,660

Adapted from “Poverty Guidelines,” by U.S. Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation, 2021 (https://aspe.hhs.gov/poverty-guidelines). In the public domain.

Part-day enrollment: Services provided in a center-based setting for 6 hours a day or less.

Preschool-age: In accordance with Head Start program guidelines, preschool-age consists of children between the ages of 3-5 years of age.

Physical activity: Bodily movement and activities that require expenditure of energy (World Health Organization [WHO], 2020).

School-day enrollment: Services provided in a center-based setting for 6.5 hours per day.

Screen time: Includes using a computer, watching television, playing video games (Wang et al., 2019), cellular phone, and tablet use.

Sedentary behavior: Activities and behaviors that expend low energy due to minimal body movement (Wang et al., 2019).

Sugar-sweetened beverages or sugary drinks: Terms used for beverages with added sugars (e.g., fruit drinks, regular soda, energy and sports drinks; Muth et al., 2019); any fluid with added sugars (CDC, 2021).

Assumptions

This quantitative study used secondary data to answer the research questions. The following assumptions were considered:

1. Program staff administering the nutrition screening and assessment were culturally and linguistically appropriate for the population.
2. The nutrition screening and assessment was administered to parents/guardians, hereafter referred to as just parents, in their preferred language to maximize comprehension and limit misunderstanding.
3. Program staff were uniformly trained to administer the nutrition screening and assessment questions were asked uniformly with no prompting of parents for responses.
4. Parents responses to the nutrition screening and assessment questions were genuine, honest, and truthful.
5. Nutrition screening and assessment responses were entered into the ChildPlus data management system correctly and accurately.
6. Program staff were uniformly trained on procedures to obtain height and weight measurements for the growth assessment and measurements were obtained accurately, uniformly, and consistently among staff.

7. Height and weight measurements were entered into the ChildPlus data management system consistently, correctly, and accurately.
8. BMI-for-age calculations by the ChildPlus data management system are correct and accurate.

Consideration of these assumptions are necessary in the context of the study due to their significance to the validity and reliability of the research study. In quantitative research, validity and reliability are important in evaluating the quality of the research study and determines how well something is measured (Middleton, 2020). Validity refers to accuracy and reliability refers to the consistency of a measure (Middleton, 2020). To address the research questions, a secondary data analysis with a longitudinal study design was used for this quantitative study. Data from the MCOE Head Start program data management system, ChildPlus, was used for this study. This data was collected from parents at various Head Start centers across Merced County, California, by program staff during the 2019-2020 and 2020-2021 program years before and after COVID-19 related Head Start center closures. Growth assessments (i.e., height and weight measurements) are taken within the first 45 days of each child’s enrollment during each program year. These assumptions are significant to the validity and reliability of the study as such they are significant to the research design and methods of the study and in writing and interpreting the study results (Middleton, 2020).

Scope and Delimitations

The prevalence of childhood obesity remains a global public health issue. It is associated with several chronic conditions and may continue into adulthood (Swyden et al., 2017). Preschool-aged children spend a significant number of hours in childcare settings, including Head Start, and consume as much as two-thirds of their daily caloric intake in childcare settings (Swyden et al., 2017). Childcare settings have been hypothesized to either contribute to childhood obesity or be related to reducing the risk of childhood obesity (Swyden et al., 2017). Childcare settings provide preschool-aged children with opportunities for physical activity and healthy eating (Swyden et al, 2017).

Head Start is the largest, longest operating, federally funded school readiness and early care and education (ECE) program for preschool-aged children in the United States (Byrd-Williams et al., 2017; Copeland & Johnson, 2016). The program provides comprehensive services, including education, health, nutrition, mental, and social services (Bryd-Williams et al., 2017) to over a million low-income children and families annually (Copeland & Johnson, 2016). The prevalence of obesity for children enrolled in the Head Start program is greater than the national prevalence of obesity for preschool-age children (Lumeng et al., 2015). Approximately one-third of children enrolled in Head Start are either overweight or obese (Byrd-Williams et al., 2017; Yin et al., 2019). However, Belfield and Kelly (2013) found that obesity outcomes for children were improved through attendance of Head Start or other preschool programs. Ansar et al. (2015) found decreases in children's BMI over the preschool year with increased outdoor play during Head Start. Additionally, the authors found that children were less likely to be obese (Ansar et al., 2015). Lumeng et al. found an association between Head Start participation and healthier BMIs such that children participating in the Head Start program had significantly healthier BMIs at kindergarten entry than children enrolled or not enrolled in Medicaid. The results of a narrative review of the literature by Swyden et al. (2017) of the association of various childcare settings with overweight and obesity in preschool-age children suggested no consistent association between childcare settings and risk of childhood obesity, with the exception of Head Start that showed either protective or varied effects on childhood obesity risks.

In March 2020, COVID-19 related childcare center closures impacted 21 million preschool-aged children (Donohue & Miller, 2020) and may have increased the risk of childhood obesity (Hoffman & Miller, 2020). This study examined the differences in BMI, amount of physical activity, consumption of SSBs, and amount of screen time before and after COVID-19 related Head Start center closures among preschool-aged children, aged 3-5 years, enrolled in the MCOE Head Start program. Of children aged 3-5 years enrolled in the program during 2018-2019, approximately 16% of children were overweight and 26% of children were obese (Merced County Office of Education Head Start Program [MCOE/HS], 2019). This study included only participants of the MCOE Head Start program; therefore, the study results may not be representative of the general population. Additionally, the research study included only children that were returnees or second- or third-year participants in 2020-2021 to allow for pairing of study participant data before and after COVID-19 related Head Start center closures. MCOE Head Start also provides home-based services; however, children in the home-based program were excluded from the study because they would not be impacted by Head Start center closures due to services being provided in the child’s home environment. New enrollees or first year participants were also excluded from the study due to lack of previous data for pairing of study participant data.

Head Start was selected for this study because of the social change implications that Head Start enrollment and participation may have on the prevalence of childhood obesity for low-income children. As part of President Lyndon B. Johnson's War on Poverty, the Head Start program was established to break the cycle of poverty for low-income families by providing comprehensive program services to low-income, preschool-aged children (Copeland & Johnson, 2016; DHHS/ACF/OHS, n.d.b). Head Start program performance standards require Head Start programs to provide health and nutritional services including time and space for physical activity and gross motor skills development, encouragement of limited screen time, the facilitation of children's access to preventive health care, and adherence to guidelines of the federal Child and Adult Care Food Program (e.g., restriction of SSBs and the serving of fruits and vegetables at mealtimes; Lumeng et al., 2015). With its high level of performance standards and regulations, Head Start may play an integral role in the prevention of childhood obesity, especially for children from low-income families.

Limitations

This study includes limitations that should be considered when reviewing and interpreting study results. Limitations that should be considered are as follows:

1. Data used for this study was secondary data and was not collected for the purpose of this study.

2. Responses to nutrition screening and assessment questions were provided by parents and may be misreported or biased due to a heightened sense of behaviors during the pandemic, the inability to recall information, or misrepresentation of information.
3. Each program staff was responsible for administering the nutrition screening and assessment to parents on their caseloads and bias may have been introduced due to the nature in which questions were asked by each program staff (e.g., prompting and suggesting).
4. Participants of the study included only preschool-aged children enrolled in the MCOE Head Start program, which could lead to selection bias and a threat to external validity (i.e., interaction of causal relationship with settings).
5. Characteristics of children enrolled in the MCOE Head Start program (e.g., low-income) may be different than those not enrolled in the program; therefore, results of the study may not be representative or generalizable to the general population. This may lead to a threat to external validity (i.e., interaction of causal relationship with settings).
6. The study did not examine any other factors besides COVID-19 related Head Start center closures on the dependent variables. This may lead to a threat of internal validity (i.e., history).
7. Differences may be impacted by maturation, a threat to internal validity.

Significance

This study is significant in that research on the differences in BMI, amount of physical activity, consumption of SSBs, and amount of screen time before and after COVID-19 related school and childcare center closures in the United States is limited, especially research related to preschool-aged children. Most studies on the topic occurred during the early months of the pandemic immediately following implementation of lockdowns, stay-at-home orders, and school and childcare center closures in March 2020 (Allabadi et al., 2020). The significance of this study is that it provides a better understanding of the impact of COVID-19 related childcare center closures on childhood obesity approximately 4 months to 9 months after the initial closures of childcare centers. With better understanding of the impact of COVID-19 related childcare center closures, public health and educational professionals, schools, parents, government officials, and policy makers can develop effective, age-appropriate interventions, specifically for prolonged childcare center closures and times of lockdown restrictions that promote engagement in healthy behaviors. Findings from the study could be the foundation for developing state and national policies around healthy diet and lifestyle behaviors during future prolonged childcare center closures and lockdown restrictions during a pandemic. The COVID-19 pandemic has shed light on social inequalities, with the poorest families being most impacted (Ruiz-Roso et al., 2020), and may further exacerbate the disparities of obesity risk factors (Allabadi et al., 2020). Findings from this study will contribute information to the literature regarding the impact of COVID-19 related childcare center closures on low-income, preschool-aged children serving as a basis for public health and educational professionals, schools, parents, government officials, and policy makers to develop and implement effective age-appropriate interventions and policies to promote healthy dietary and lifestyle behaviors for children from vulnerable populations.

Summary and Conclusion

The COVID-19 pandemic required governments all over the world to enact laws and policies that included lockdown and shelter-in-place orders, physical distancing guidelines, hygiene recommendations, mask mandates, and school and childcare center closures (Nagata, 2020). Although these mitigation measures were necessary to combat the spread of the virus, they resulted in changes to daily routines and health-related behaviors. Review of the literature regarding the impact of COVID-19 mitigation strategies, specifically school and childcare centers closures, on childhood obesity, physical activity, SSBs, and screen time revealed an increase in the prevalence of childhood obesity, consumption of SSBs, and screen time, and a decrease in physical activity among children and adolescents in various countries, including the United States, during the early stages of the pandemic compared to before the pandemic. At the time of this study, schools and childcare centers across the United States have returned to in-class learning and in-person services; however, the effects of the COVID-19 pandemic on childhood obesity and other health-related behaviors are still unknown and require further research. Additionally, there may be disparities in the impact of COVID-19 on vulnerable populations that will require further research to understand the true impact. The current study examined the differences in BMI, amount of physical activity, consumption of SSB, and amount of screen time among preschool-aged children, aged 3-5 years, enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures. The study used a secondary data analysis with a longitudinal study design using data from ChildPlus collected by the MCOE Head Start program before and after COVID related Head Start center closures. Most of the current literature on the impact of COVID-19 on childhood obesity and health-related behaviors involve school-aged children. This study fills a gap in the literature by completing research with preschool-aged children, which is a foundational period for establishing healthy behaviors that may prevent future negative health outcomes. This study provides valuable understanding and insight on the impacts of COVID-19 on childhood obesity and health-related behaviors that will assist to inform and guide health policies and interventions that can be used during future pandemics and periods of extended lockdowns and prolonged school and childcare center closures.

Section 2: Research Design and Data Collection

Introduction

The purpose of this study is to examine the differences in BMI, amount of physical activity, consumption of SSBs, and amount of screen time among preschool-aged children, aged 3-5 years, enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures. This section describes the research design and rationale for the study, the methodology including population and sampling procedures, operationalization of variables, the data analysis plan, threats to validity, and ethical procedures and considerations.

Research Design and Rationale

Research designs are specific strategies of inquiry within research approaches that provide guidance for research study procedures (Creswell & Creswell, 2018). This study used a quantitative research approach that explores associations between variables using statistical procedures to analyze numerical data (Creswell & Creswell, 2018). Research designs associated with quantitative research appeal to the postpositivist worldview, which holds a philosophical perspective that probable causes influence outcomes (Creswell & Creswell, 2018). Research problems that are examined reflect those that require identification and assessment of causes that determine effects and are reductionist as with variables that constitute research questions and hypotheses (Creswell & Creswell, 2018). Developing numerical data from observations and studying behavior is important in quantitative research designs (Creswell & Creswell, 2018).

To address the research questions in this study, the specific research design included a longitudinal study that consisted of analysis of secondary data from ChildPlus to examine the differences in BMI, amount of physical activity, consumption of SSBs, and amount of screen time among preschool-aged children, aged 3-5 years, enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures. Using secondary data to answer research questions and test hypotheses has advantages that include the reduction in time and resources, limited risks to study participants, and access to large sets of data and longitudinal data (Dunn et al., 2015). For this study, there were no time or resource constraints to accessing the data. The secondary data from ChildPlus included all necessary variables for this study including children's BMI, minutes/hours of physical activity, cups of SSBs, and minutes/hours of screen time as the dependent variables. MCOE Head Start center closure is the independent variable, which was one of the mitigation strategies implemented to reduce the spread of COVID-19.

Methodology

Population

The study used secondary data collected by the MCOE Head Start program of preschool-aged children enrolled in the MCOE Head Start program during the 2019-2020 and 2020-2021 program years. Data were obtained from the program's data management system, ChildPlus. During 2019-2020, the MCOE Head Start program provided services for 941 preschool-aged children and 713 preschool-aged during 2020-2021. Only preschool-aged children enrolled in the center-based program option during both program years were included in this study to allow for matched pairs. A total of 303 preschool-aged children were enrolled in the MCOE Head Start program during both program years, with 284 children enrolled in the center-based program option.

Sampling Procedures Used for the Original Data Set

The sampling strategy used by the MCOE Head Start program for the collection of data was convenience sampling. Convenience sampling occurs when study participants are selected due to their convenient availability (Creswell & Creswell, 2018). The MCOE Head Start program collects data, including health and nutrition information, on all children enrolled in the program. In accordance with the Head Start program performance standards, all Head Start programs must implement developmentally and culturally appropriate nutrition services that accommodates each child's feeding requirements and nutrition needs (DHHS/ACF/OHS, 2016). Each child's nutritional needs are identified via available health information and health records and parental information (DHHS/ACF/OHS, 2016) via completion of a nutrition screening and assessment. Program staff complete a nutrition screening and assessment with parents of each child during each program year in accordance with program policies and procedures. The nutrition screening and assessment includes questions regarding the minutes of daily physical activity, daily minutes/hours of screen time, and daily cups of SSBs for each enrolled child. Additionally, the MCOE Head Start program conducts a growth assessment for each child within 45 days of program enrollment for each program year. The information is used to discuss the importance of physical activity, healthy eating, limiting screen time, and the negative impact of SSBs (DHHS/ACF/OHS, 2016) with parents and monitor children's physical growth and development.

The data collected by the MCOE Head Start program is non-public. Approval of use of the program data for this study was granted by the MCOE Head Start program director. The MCOE Head Start program has long-standing policies and procedures for the collection of data required by the Head Start program performance standards. Although the data were not collected for the purposes of this study, the data source is appropriate for this study because the data source provides data that was collected before and after MCOE Head Start COVID-19 related center closures in all variables necessary for the population of interest to conduct this study.

Power Analysis

Power analysis is an important aspect of research study design; however, it is often overlooked and underreported (Kyonka, 2019). "The ability of a test to detect an effect of a given size" is statistical power (Kyonka, 2019, p. 136). Statistical power is determined by alpha (α), beta (β), sample size, and effect size (Kyonka, 2019). Alpha (α), a significance level conventionally set at 0.05, is associated with a Type I error which fails "to detect a meaningful effect when one is present" (Kyonka, 2019, p. 136). Beta (β) is associate with a Type II error which falsely detects a meaningful effect when one is not present and is conventionally set at 0.20 (Kyonka, 2019, p. 136). Conversely, power (1-β or 0.80) is the probability of not committing a Type II error or correctly detecting no meaningful effect (Kyonka, 2019). The magnitude or extent of an effect is the effect size with conventional estimates defined by Cohen's *d* as small (0.2), medium (0.5) and large (0.8) for statistical tests (Kyonka, 2019).

Not completing a power analysis during the planning stages of a research study may result in sample sizes that are too small or too large (Kyonka, 2019). Sample sizes that are too small may be underpowered and unable to identify meaningful effects, whereas samples sizes that are too large may be overpowered and identify effects that are small (Kyonka, 2019). Conducting a power analysis can ensure that sample sizes are appropriate for a selected effect size and maximize the test's probative value (Kyonka, 2019).

In an A priori power analysis, the sample size of a research study is estimated by determining acceptable Type I and Type II error values and a minimum meaningful effect size (Kyonka, 2019). The objective is to determine an appropriate sample size that will allow the detection of an effect size that is meaningful given the desired power (Kyonka, 2019). For this study, the conventional significance level for interpreting the *p*-value or α will be 0.05, the statistical power and β will be 0.80 and 0.20, respectively, and Cohen's *d* of at least 0.5 will be used for medium effect size. Using G*Power to conduct a power analysis to calculate an appropriate sample size using the aforementioned values, the computed total for an appropriate sample size was 34 for the paired *t*-test and 35 for the Wilcoxon signed-ranked test (Faul et al., 2007).

Operationalization of Variables

Variables to answer the research questions included COVID-19 related Head Start center closures as the independent variable and BMI, amount of physical activity, consumption of SSBs, and amount of screen time as the dependent variables. MCOE Head Start centers closed and began providing services through distance learning in March of 2020. The MCOE Head Start program began providing a hybrid schedule of in-class learning and distance learning in November 2020. Beginning Summer and Fall 2021, the MCOE Head Start program began the transition to full enrollment and in-person services.

BMI is an interval-level variable and a measure used to determine a child's weight status. BMI is sex- and age-specific for children and is frequently referenced as BMI-for-age (CDC, 2018). In accordance with Head Start program performance standards, height and weight measurements are taken for each child by program staff and entered into ChildPlus, which calculates the child's BMI-for-age (i.e., 18.9 kg/m^2). The three questions related to lifestyle behaviors included on the MCOE Head Start program nutrition screening and assessment and the accompanying responses and codes for analysis are as follows: "How much physical activity does your child get daily (for example playing, walking, running, riding bike, etc.)?" with responses of 0 = "less than 30 minutes", 1 = "30-60 minutes", and 2 = "over 60 minutes"; "How many cups of juice and/or sweetened beverages (for example fruit punch, soft drinks, etc.) does your child drink per day?" with responses of 1 = "0-1 cup", 2 = "2-3 cups" and 3 = "more than 3 cups"; and "How many minutes/hours does your child watch TV (includes computer, cellular phone, tablet, or video games) per day?" with responses of 0 = "0-30 minutes", 1 = "1-2 hours", and 2 = "more than 2 hours." Nutrition screening and assessment questions and responses are written in English and Spanish. Staff who speak other primary languages (i.e. Hmong or Punjabi) are used to administer the nutrition screening and assessment as appropriate. Gender is dichotomized and categorized as male and female. Ethnicity is categorized as follows: White, Black/African American, Hispanic, Asian, and Multi-racial. Primary language is categorized as English, Spanish, Punjabi, Hmong, and American Sign Language. English Proficiency is coded as 0 = None, 1 = Little, 2 = Moderate, and 3 = Proficient.

Data Analysis Plan

Data were analyzed using IBM SPSS Version 27. Data analyzed for this study included data collected by MCOE Head Start program staff before (July 2019 through February 2020) and after (July 2020 through December 2020) COVID-19 related Head Start center closures on March 20, 2020. Only data for children aged 3-5 years enrolled in the center-based option of the MCOE Head Start program during both the 2019-2020 and 2020-2021 program years were used for data analysis to allow for matched pairs. Because collection of data is required for all children enrolled and collected by program staff, no missing data was anticipated. The research questions and hypotheses were as follows:

Research Question 1: Is there a difference in the BMI of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

$H_0 1$: There is no difference in the BMI of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a1: There is a difference in the BMI of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Research Question 2: Is there a difference in the amount of daily physical activity of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

H_02: There is no difference in the amount of daily physical activity of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a2: There is a difference in the amount of daily physical activity of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Research Question 3: Is there a difference in the daily consumption of sugar-sweetened beverages of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

H_03: There is no difference in the daily consumption of sugar-sweetened beverages of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a3: There is a difference in the daily consumption of sugar-sweetened beverages of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Research Question 4: Is there a difference in the daily amount of screen time of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

$H_0$4: There is no difference in the daily amount of screen time of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a4: There is a difference in the daily amount of screen time of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Descriptive statistics for sample characteristics was provided as means and standard deviation for continuous variables and frequencies and percentages for categorical variables. Differences between BMI before and after COVID-19 related MCOE Head Start center closures were measured using the paired *t*-test. Differences between daily amount of physical activity, consumption of SSBs, and amount of screen time before and after COVID-19 related MCOE Head Start center closures were measured using the Wilcoxon signed-rank test for ordinal variables. A *p*-value of <0.05 was used to show statistical significance for all variables and statistical tests.

The paired *t*-test has assumptions as follows: the dependent variable must be numeric and continuous; the independent variable consists of matched pairs with independent observations; the differences in the dependent variable should be close to a normal distribution; and the dependent variable should have no outliers (Laerd Statistics, 2018a; Statistics Solutions, 2021). For this research study, BMI was a continuous, interval-level variable and the independence of observations was assumed since data for the matched pairs were collected in two different program years. Various methods may be used to test the assumption of normal distribution; however, the simplest method may be to visually inspect the data for approximate symmetry or bell-shaped curve using a histogram (Statistics Solutions, 2021). Outliers can be identified by visual observation of a boxplot (Statistics Solutions, 2021). For this study, IBM SPPS version 27 was used to generate a histogram and boxplot to test the assumptions of normal distribution and outliers.

The Wilcoxon signed-rank test is a nonparametric alternative to the paired *t*-test (Laerd Statistics, 2018b). Unlike the paired *t*-test, the Wilcoxon signed-rank test does not assume a normal distribution and has the following assumptions: the dependent variable should be measured at the continuous or ordinal level; the independent variable should consist of matched pairs with independent observations; and the distribution of differences should be symmetrical (Laerd Statistics, 2018b). Amount of physical activity, consumption of SSBs, and amount of screen time are all variables measured at the ordinal level with independent observation collected during two different program years. A boxplot can be used for visual observation to test the assumption of symmetry.

Threats to Validity

Threats to internal and external validity can occur at any time or stage during the process of research (Torre & Picho, 2016). Internal validity reflects the extent to which inferences can be drawn regarding the causal relationship between the independent and dependent variables (Torre & Picho, 2016). Common threats to internal validity include history, maturation, regression, attrition, testing, instrumentation (Shadish et al., 2002; Torre & Picho, 2016), selection, ambiguous temporal precedence, and additive and interactive effects of threats to internal validity (Shadish et al., 2002). External validity refers to the extent to which the outcome of a research study can be generalized across various populations, settings, and outcomes (Torre & Picho, 2016). Common threats to external validity include context dependent mediation and interaction of the causal relationship with the following: units, over treatment variations, outcomes, and settings (Shadish et al., 2002).

Potential threats to internal validity of the current study include history and maturation. History refers to events occurring at the same time as the independent variable that could impact the dependent variable (Shadish et al., 2002; Torre & Picho, 2016). Maturation involves changes occurring naturally over time that can be confused with the impact of the independent variable on the dependent variable (Shadish et al., 2002; Torre & Picho, 2016). Potential threats to external validity include interaction of the causal relationship with settings. This involves differences in an effect depending on the setting used for the research study (Shadish et al., 2002). These potential threats to validity were noted in the limitations of the study and should be considered when interpreting the results of the study.

Ethical Considerations

Fundamental principles of ethical research include respect for persons, beneficence, and justice (Ross et al., 2018). Respect for persons recognizes the autonomy and self-determination of study participants (Ross et al., 2018). Beneficence refers to the protection of the wellbeing of study participants by minimizing risks of harm and maximizing potential benefits (Ross et al., 2018). Justice is the consideration of burdens and benefits of research being equitably distributed among study participants (Ross et al., 2018). Research ethics and institutional review boards (IRBs) are responsible for the oversight of research and are required to ensure that ethical standards and principles of research are met (Ross et al., 2018). Prior to assessing the datasets necessary to complete this study, the process for the ethics review was initiated and ethics approval from Walden's University IRB was granted.

Ethical considerations relevant to secondary data analysis remain the same as data collected for primary research or the original purpose (Ross et al., 2018). However, the principles may be interpreted differently from a practical perspective and may pose different risks of harm and potential benefits for research study participants depending on the nature of the data, unique characteristics of the study sample, and sensitivity of the data (Ross et al., 2018). Generally, secondary data sources without participant identifiers do not present ethical issues (Ross et al., 2018). It important to ensure that data is protected and deidentified and strategies are implemented to restrict data access and to protect and reduce the risk of harm to study participants (Ross et al., 2018).

Parents of children enrolled in the MCOE Head Start program sign a consent for services that provides consent for staff of the MCOE Head Start program to provide and perform services including a nutrition screening and assessment and a growth assessment (i.e. height, weight, and BMI-for-age). Data collected by the MCOE Head Start program is non-public and access to ChildPlus is limited to MCOE Head Start employees and consultants. Levels of security and authorization to access ChildPlus data varies within the MCOE Head Start program depending on position. Permission to use data from the MCOE Head Start program for the purpose of this study was granted by the MCOE Head Start program director. As a program manager for the MCOE Head Start program, appropriate security and authorization to access the datasets necessary for the completion of this study was secured. The datasets that were used for the purpose of this study are not datasets used or reviewed in the employed capacity as a program manager for the MCOE Head Start program and there were no conflicts of interest for use of the data. Datasets were not accessed prior to approval from the Walden University IRB. Datasets for the 2019-2020 and 2020-2021 program years were generated without participants names; however, ChildPlus IDs were included to allow for pairing and matching of participant data and the creation of a combined dataset that included data for all matched pairs for both program years. ChildPlus IDs were excluded from the newly created combined dataset and the original datasets were deleted. The newly created dataset with deidentified data was uploaded into IBM SPSS Version 27 for data analysis. The newly created dataset was stored securely, not shared with any other entities, and only used for the purpose of this study.

Summary

This study used a quantitative, longitudinal study design to examine the differences in BMI, amount of physical activity, consumption of SSBs, and amount of screen time among preschool-aged children, aged 3-5 years, enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures. The statistical analysis included analysis of data collected on children enrolled in the MCOE Head Start program during both the 2019-2020 and 2020-2021 program years. Difference between BMI before and after COVID-19 related Head Start Center closures was measured using the paired *t*-test. Differences between the amount of physical activity, consumption of SSBs, and the amount of screen time was measured using the Wilcoxon signed-rank test. A *p*-value of <0.05 was used to show statistical significance for all tests. Section 3 will provide a presentation of the study results and findings.

Section 3: Presentation of the Results and Findings

Introduction

The purpose of this quantitative study was to examine the differences in BMI, amount of physical activity, consumption of SSBs, and amount of screen time of preschool-aged children enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures. Understanding the impact of COVID-19 related childcare center closure on childhood obesity and health-related behaviors will assist public health professionals and early care and education professionals develop and implement effective physical activity and dietary interventions during future pandemics and prolonged childcare center closures that will mitigate adverse effects on the health and wellbeing of young children. The paired *t*-test was used to examine the difference between BMI before and after COVID-19 related Head Start center closures, and the Wilcoxon signed-rank test was used to evaluate the differences in amount of physical activity, consumption of SSBs, and amount of screen time before and after COVID-19 related Head Start center closures. The research questions and hypotheses for this study were as follows:

Research Question 1: Is there a difference in the BMI of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

$H_0$1: There is no difference in the BMI of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a1: There is a difference in the BMI of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Research Question 2: Is there a difference in the amount of daily physical activity of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

H_02: There is no difference in the amount of daily physical activity of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a2: There is a difference in the amount of daily physical activity of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Research Question 3: Is there a difference in the daily consumption of sugar-sweetened beverages of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

H_03: There is no difference in the daily consumption of sugar-sweetened beverages of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a3: There is a difference in the daily consumption of sugar-sweetened beverages of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Research Question 4: Is there a difference in the daily amount of screen time of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures?

$H_0$4: There is no difference in the daily amount of screen time of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

H_a4: There is a difference in the daily amount of screen time of children aged 3-5 years enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures.

Section 3 will provide an assessment of the data used for this analysis including the timeframe from which the data was collected, the purpose of the original collection of the data, and the baseline descriptive and demographic characteristics of study participants. This section will also review the results of this study including a report of descriptive statistics that characterizes study participants, evaluation of statistical assumptions, and reporting of statistical analysis findings of each research question and hypotheses including tables and figures as appropriate. This section will conclude with a summary of research findings.

Accessing the Data Set for Secondary Analysis

The study used data sets from ChildPlus for children enrolled in the MCOE Head Start program during both the 2019-2020 and 2020-2021 program years. The data were collected by MCOE Head Start program staff between July 2019 – February 2020 and July 2020 – December 2020 in accordance with Head Start program performance standards and MCOE Head Start program policies and procedures. Growth assessment measurements were taken each year within 45-days of program enrollment on each child. Parents completed a nutrition screening and assessment for their child at enrollment. Child data were collected annually to inform the provision of health and nutrition services and the need for parent health education. The data sets used were non-public, and use of the data were approved by the MCOE Head Start program director. During 2019-2020, the MCOE Head Start program had a cumulative enrollment of 941 children. In 2020-2021, cumulative enrollment decreased to 713. The total number of preschool-aged children attending the MCOE Head Start program during both the 2019-2020 and 2020-2021 school year was 303, with 284 children enrolled in the center-based program and 19 children enrolled in the home-based program. Children (19) enrolled in the home-based program were excluded from this study. The MCOE Head Start program provides comprehensive early care and education services to low-income children and families whose characteristics may not be representative of the general preschool-age population. The study used only participants enrolled in the MCOE Head Start program for both the 2019-2020 and 2020-2021 program years.

Univariate Analysis/Descriptive Statistics

In 2019-2020 and 2020-2021, the MCOE Head Start program provided center-based services via 17 Head Start Centers and one childcare partnership (Walnut Child Development Center) across Merced County in four program options (part-day, school-day, full-day, and double session). A total of 284 children were enrolled in the center-based program during both the 2019-2020 and 2020-2021 program years and were included as study participants. Table 4 shows the number and percentage of participants enrolled by MCOE Head Start center and program option. Figure 4 provides of visual of the percentage of participants enrolled by MCOE Head Start center and program option.

Table 4

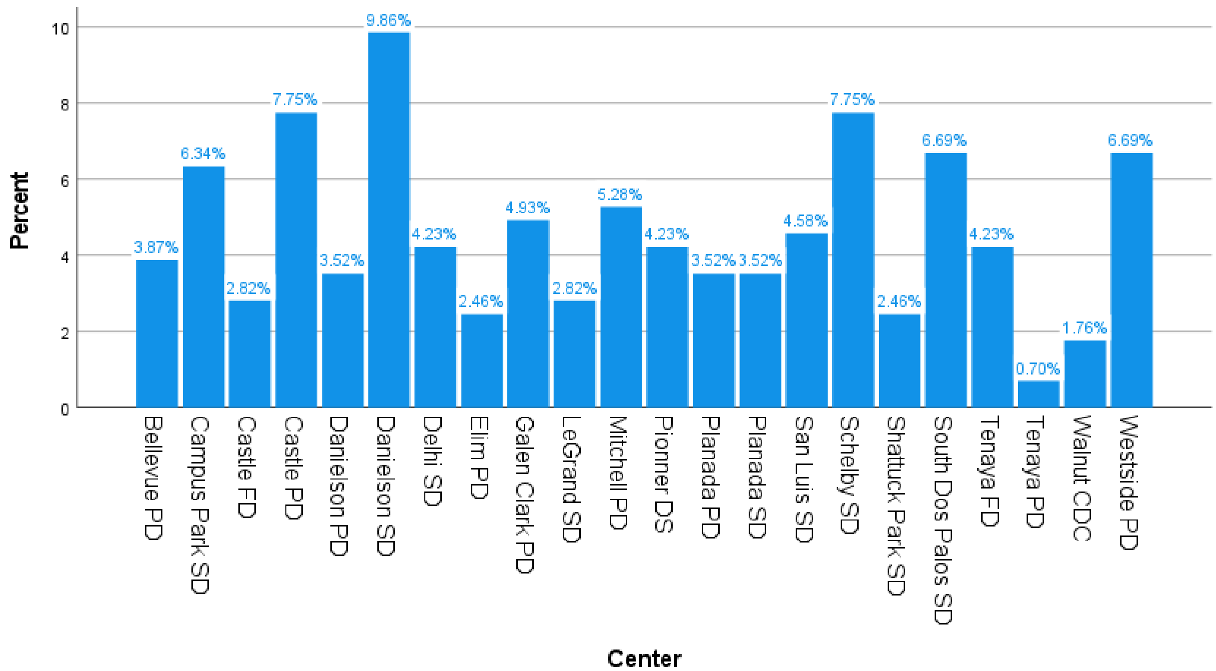
Participants Enrolled by MCOE Head Start Center and Program Option

Center	*N*	%
Bellevue PD	11	3.87
Campus Park SD	18	6.34
Castle FD	8	2.82
Castle PD	22	7.75
Danielson PD	10	3.52
Danielson SD	28	9.86
Delhi SD	12	4.23
Elim PD	7	2.46
Galen Clark PD	14	4.93
LeGrand SD	8	2.82
Mitchell PD	15	5.28
Pioneer DS	12	4.23
Planada PD	10	3.52
Planada SD	10	3.52
San Luis SD	13	4.58
Schelby SD	22	7.75
Shattuck Park SD	7	2.46
South Dos Palos SD	19	6.69
Tenaya FD	12	4.23
Tenaya PD	2	0.70
Walnut CDC	5	1.76
Westside PD	19	6.69
Total	284	100.00

Note: PD = Part-day; SD = School day; FD = Full-day; DS = Double Session; CDC = Child Development Center

Figure 5

Participants by MCOE Head Start Center and Program Option



A total of 134 (47.18%) participants were female and 150 (52.82%) participants were male (see Table 5 and Figure 6). A majority of participants were Hispanic children (*N*=229; 80.63%), which is reflective of the ethnic demographics of Merced county. There were seven (2.46%) children that were Black/African American, 18 (6.34%) children that were White, 13 (4.58%) children that were Asian, and 17 (5.99%) children that were multi-racial (see Table 6 and Figure 7).

Table 5

Participants by Gender

	N	%
Female	134	47.18
Male	150	52.82
Total	284	100.00

Figure 6

Participants by Gender

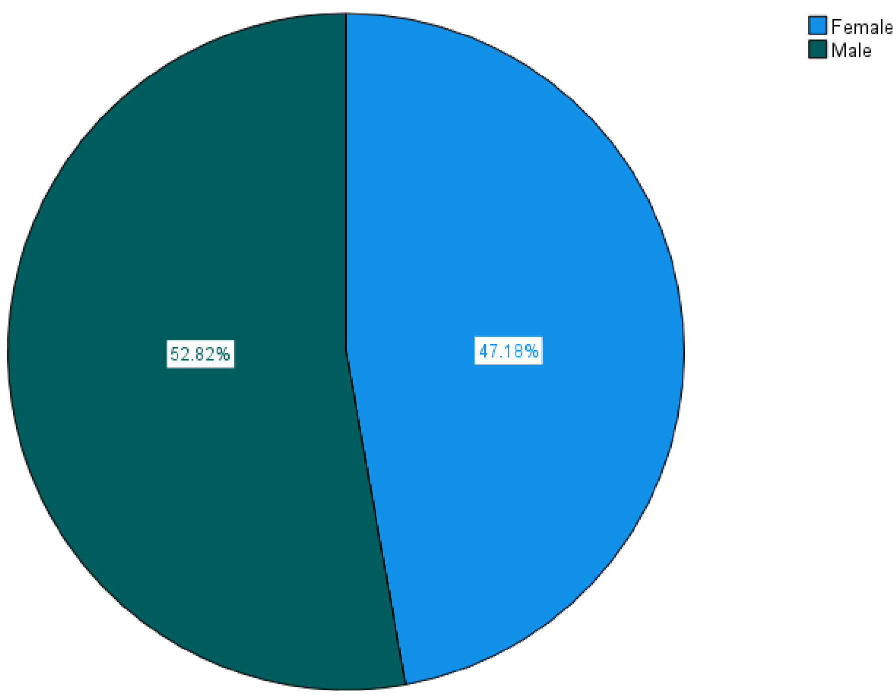


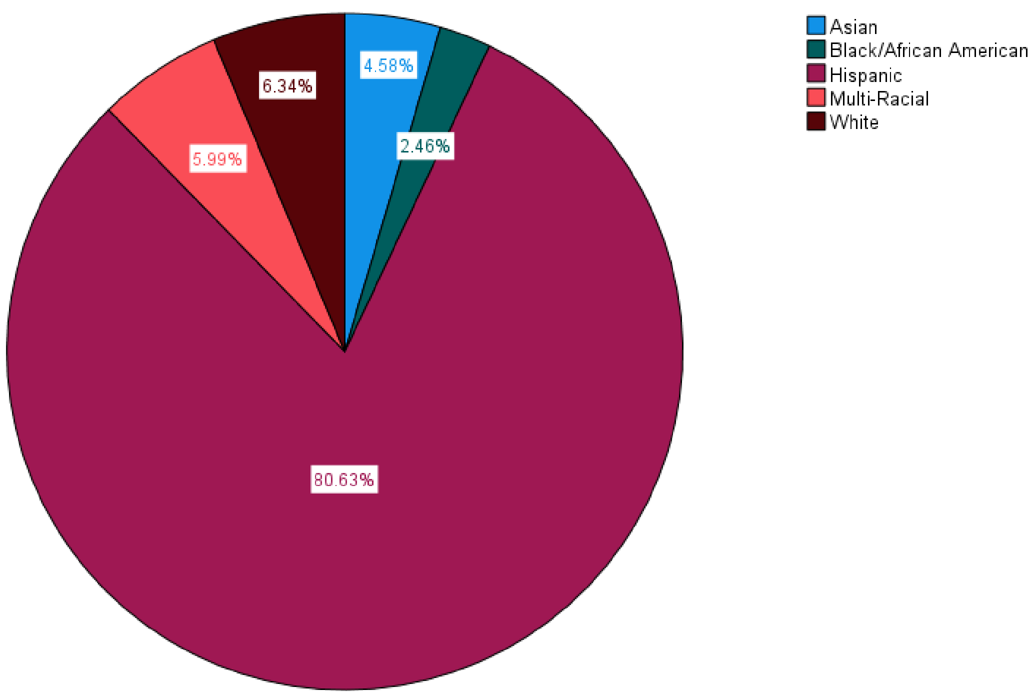
Table 6

Participants by Ethnicity

	N	%
Hispanic	229	80.63
Black/African American	7	2.46
White	18	6.34
Asian	13	4.58
Multi-Racial	17	5.99
Total	284	100.00

Figure 7

Participants by Ethnicity



Primary language of the household is shown in Table 7 and Figure 8. English (*N*=208; 73.4%) was the primary language of most households. Spanish was the primary language for 69 (24.3%) households, Hmong was the primary language for two (0.7%)

households, and Punjabi was the primary language for four (1.41%) households. American Sign Language was indicated as the primary language for one (0.35%) household. Data on English proficiency of parents of participants are shown in Table 8 and Figure 9.

Table 7

Primary Language of Household

	N	%
English	208	73.24
Spanish	69	24.30
Hmong	2	0.70
Punjabi	4	1.41
American Sign Language	1	0.35
Total	284	100.00

Figure 8

Primary Language of Household

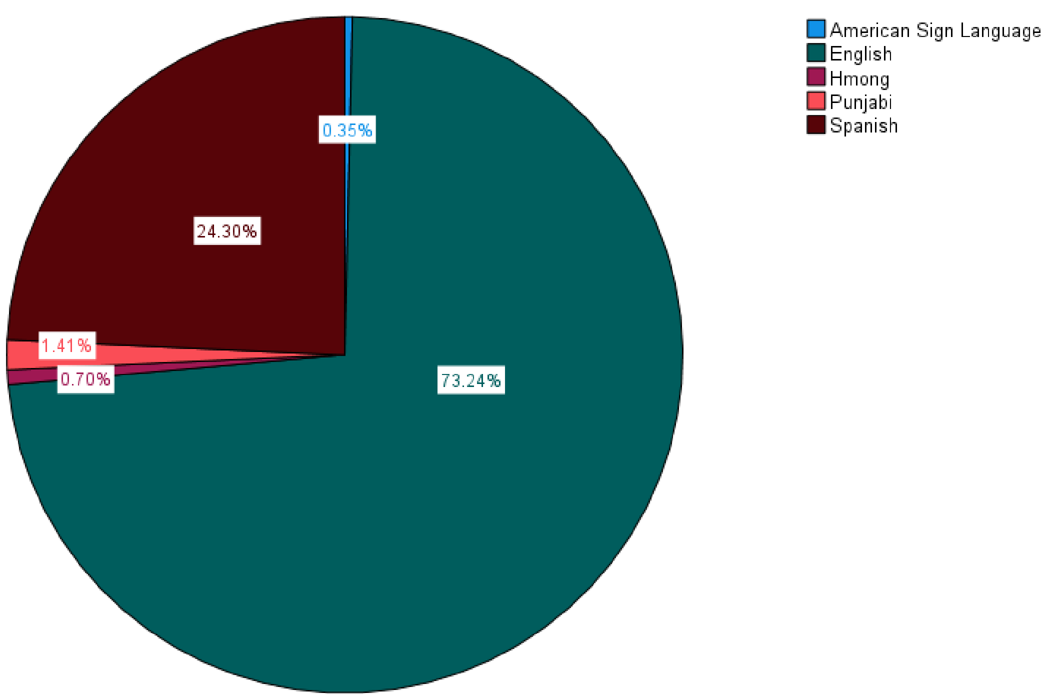


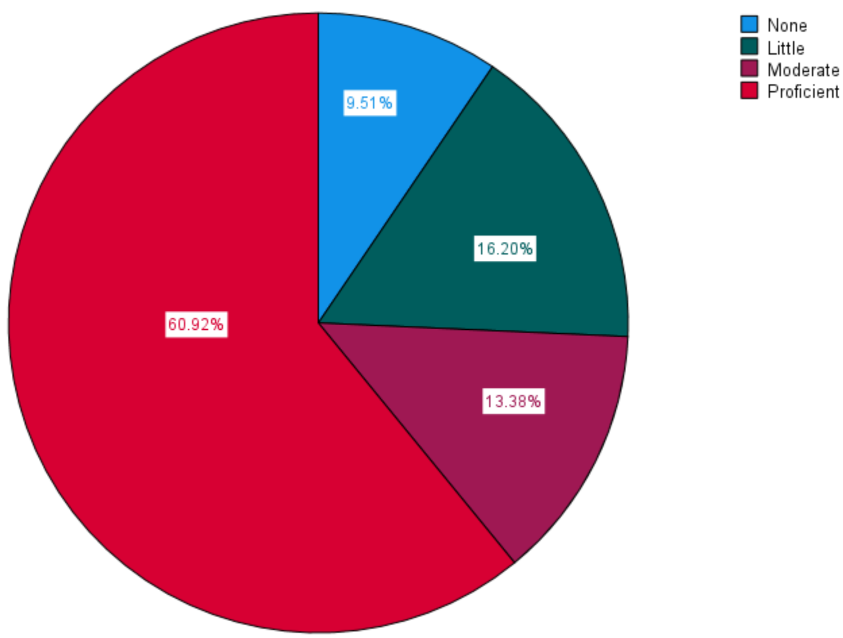
Table 8

English Proficiency of Parents of Participants

	N	%
None	27	9.51
Little	46	16.20
Moderate	38	13.38
Proficient	173	60.92
Total	284	100.00

Figure 9

English Proficiency of Parents of Participants



Results of Statistical Analysis

The paired *t*-test and the Wilcoxon signed-rank test were used for data analysis using IBM SPSS version 27. The paired *t*-test was used to analyze the difference in BMI of participants before and after COVID-19 related Head Start center closures. The

Wilcoxon signed-rank test was used to analyze differences in the amount of physical activity, consumption of SSBs, and amount of screen time of participants before and after COVID-19 related Head Start center closures. The results are presented in the sections that follow.

Difference in BMI

ChildPlus datasets of the BMI of participants enrolled in the MCOE Head Start program during both the 2019-2020 and 2020-2021 program years were used to determine the difference in BMI of participants before and after COVID-19 related Head Start center closures. The null hypothesis was that there is no difference in the BMI of participants before and after COVID-19 related Head Start center closures and the alternative hypothesis is there is a difference. Assumptions of the paired *t*-test include the dependent variable being numeric and continuous, the independent variable consisting of matched pairs with independent observations, the difference in the dependent variable should be normally distributed, and there are no outliers (Laerd Statistics, 2018a; Statistics Solutions, 2021). All assumptions of the paired *t*-tests were met. Of the 284 participants, 265 (93.3%) cases were valid, and 19 (6.7%) cases were missing data (Table 9). Table 10 shows the descriptive statistics for the difference in BMI. The mean (-.2626), 5% trimmed mean (-.2578), and median (-.2000) are close. The skewness was -.053 and kurtosis was -.261. The Shapiro-Wilk test for normality (Table 11) shows a *p*-value of .088; therefore there is no significant difference. Figure 10 shows a histogram with a bell-shaped curve which depicts normality of the distribution. Figure 11 shows a boxplot with no outliers of data for the variable.

Table 9

Difference in BMI Before and After COVID-19 Related Head Start Center Closures – Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	%	*N*	%	*N*	%
Difference in BMI	265	93.3	19	6.7	284	100

Table 10

Difference in BMI Before and After COVID-19 Related Head Start Center Closures – Descriptive Statistics

			Statistic	Std. Error
Difference in BMI	Mean		-.2626	.05794
	95% Confidence Interval for Mean	Lower Bound	-.3767	
		Upper Bound	-.1486	
	5% Trimmed Mean		-.2578	
	Median		-.2000	
	Variance		.890	
	Std. Deviation		.94316	
	Minimum		-2.60	
	Maximum		2.00	
	Range		4.60	
	Interquartile Range		1.25	
	Skewness		-.053	.150
	Kurtosis		-.261	.298

Table 11

Difference in BMI Before and After COVID-19 Related Head Start Center Closures – Test for Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Difference in BMI	.064	265	.012	.991	265	.088

Note: a. Lilliefors Significance Correction

Figure 10

Difference in BMI Before and After COVID-19 Related Head Start Center Closures – Test for Normality

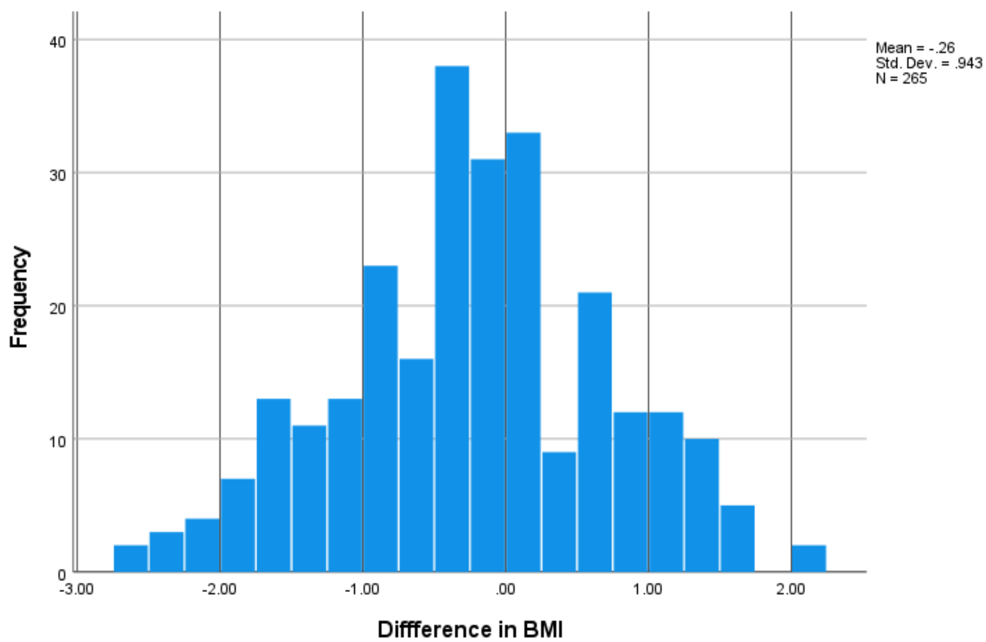
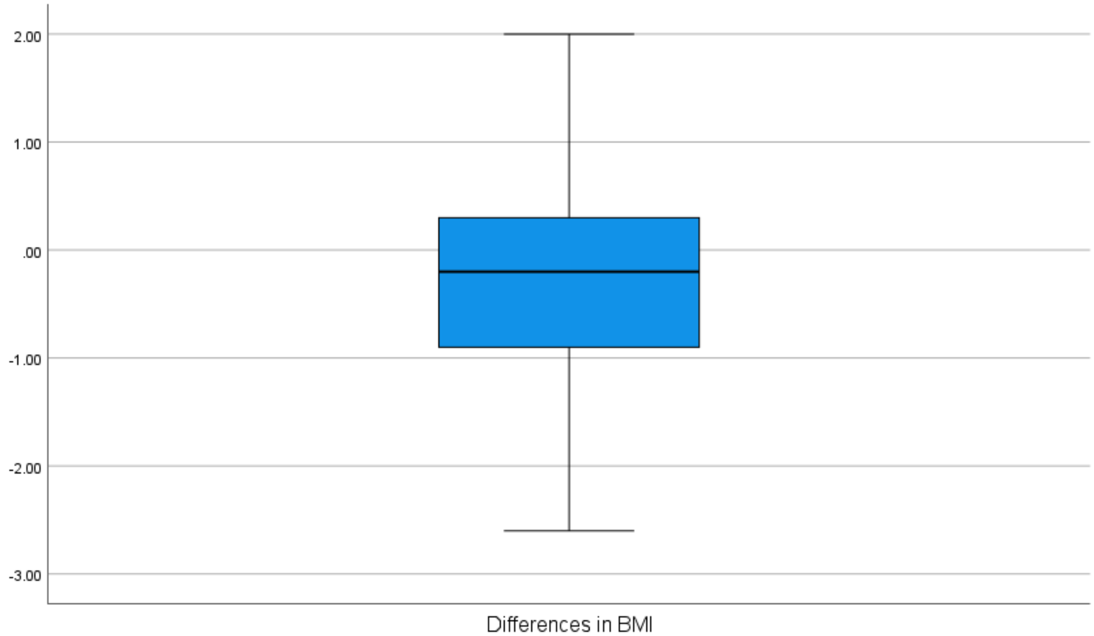


Figure 11

Difference in BMI Before and After COVID-19 Related Head Start Center Closures – Test for Outliers



The paired samples statistics, correlation, test, and effect size for the difference in BMI for participants before and after COVID-19 related Head Start center closures are displayed in Tables 12, 13, 14 and 15.

Table 12

Body Mass Index (BMI) of Participants Before and After COVID-19 Related Head Start Center Closure (Paired Samples Statistics)

	Mean	*N*	Std. Deviation	Std. Error Mean
BMI before	16.673	265	1.9440	.1194
BMI after	16.935	265	2.2229	.1366

Table 13

Body Mass Index (BMI) of Participants Before and After COVID-19 Related Head Start Center Closures (Paired Samples Correlations)

	N	Correlation	Sig.
BMI before and BMI after	265	.906	.000

Table 14

Body Mass Index (BMI) of Participants Before and After COVID-19 Related Head Start Center Closures (Paired Samples Test)

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	*t*	df	Sig. (2-tailed)
BMI before and BMI after	-.2626	.9432	.0579	-.3767	-.1486	-4.533	264	.000

Table 15

Body Mass Index (BMI) of Participants Before and After COVID-19 Related Head Start Center Closures (Paired Samples Effect Sizes)

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
BMI before and BMI after	Cohen's d	.9432	-.278	-.401	-.155
	Hedges' Correction	.9445	-.278	-.400	-.155

Note: a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

The mean for participants' BMI before COVID-19 related Head Start center closures was 16.673 with a standard deviation of 1.9440 and a standard error of the mean of .1194. The mean for participants' BMI after COVID-19 related Head Start center closures was 16.935 with a standard deviation of 2.2229 and a standard error of the mean of .1366. On average, there was a difference of .2626 units in BMI with a standard deviation of .9432 and a standard error of the mean of .0579. The 95% confidence interval of the difference was between .3767 and .1486. The t statistic was $t(264) = 4.533$ with an associated p-value of .000. At the significance level of $p = 0.05$, the results were statistically significant. Therefore, we reject the null hypothesis and conclude that there is a difference in BMI of participants before and after COVID-19 related Head Start center closures. Though statistically significant, the Cohen's d-statistic was .278 which is considered a small effect size.

Differences in Amount of Physical Activity, Consumption of SSBs, and Amount of Screen Time

ChildPlus datasets of the amount of physical activity, consumption of SSBs, and amount of screen time of participants enrolled in the MCOE Head Start program during both the 2019-2020 and 2020-2021 program years were used to determine the differences in these health-related behaviors of participants before and after COVID-19 related Head Start center closures. The null hypothesis was that there is no difference in these health-related behaviors of participants before and after COVID-19 related Head Start center closures and the alternative hypothesis is that there was a difference. Assumptions of the Wilcoxon signed-rank test include the dependent variable being measured at the continuous or ordinal level; the independent variable consisting of matched pairs with independent observations; and the distribution of differences being symmetrical (Laerd Statistics, 2018b). The Wilcoxon signed-rank test does not assume a normal distribution. Table 16 shows a comparison of health-related behaviors of participants before and after COVID-19 related Head Start center closures.

Table 16

Comparison of Health-Related Behaviors of Participants Before and After COVID-19 Related Head Start Center Closures

Health-Related Behaviors		Before COVID-19 Related Head Start Center Closures (N = 284)		After COVID-19 Related Head Start Center Closures (N = 284)		
		N	%	*N*	%	*p*
Amount of Daily Physical Activity						.297
	less than 30 minutes	22	7.7	19	6.7	
	30-59 minutes	36	12.7	52	18.3	
	over 60 minutes	226	79.6	213	75.0	
Cups of Sugar-Sweetened Beverages						.041
	0-1 cup	202	71.1	217	76.4	
	2-3 cups	73	25.7	63	22.2	
	more than 3 cups	9	3.2	4	1.4	
Amount of Daily Screen Time						.005
	0-30 minutes	90	31.7	67	23.6	
	1-2 hours	168	59.2	179	63.0	
	more than 2 hours	26	9.2	38	13.4	

Table 17 and Table 18 shows the ranks and test statistic for the difference in the amount of physical activity of participants before and after COVID-19 related Head Start center closures. As reported by parents, the amount of physical activity was less for 37 participants after COVID-19 related Head Start center closures than before. The amount of physical activity was greater for 27 participants after COVID-19 related Head Start center closures than before. There was no difference in the amount of physical activity after and before COVID-19 related Head Start center closures reported for 220 participants. At the significance level of $p = 0.05$, the Wilcoxon signed-rank test showed that there was no significant difference in the amount of physical activity of participants before and after COVID-19 related Head Start center closures ($Z = 1.042$, $p = .297$). Therefore, we fail to reject the null hypothesis.

Table 17

Difference in the Amount of Physical Activity of Participants Before and After COVID-19 Related Head Start Center Closures – Ranks

		N	Mean Rank	Sum of Ranks
Physical Activity Before and After	Negative Ranks	37[a]	31.96	1182.50
	Positive Ranks	27[b]	33.24	897.50
	Ties	220[c]		
	Total	284		

Note: a. Physical Activity After < Physical Activity Before
b. Physical Activity After > Physical Activity Before
c. Physical Activity After = Physical Activity Before

Table 18

Amount of Physical Activity of Participants Before and After COVID-19 Related Head Start Center Closures – Test Statistic[a]

	Physical Activity Before and After
Z	-1.042[b]
Asymp. Sig. (2-tailed)	.297

Note: a. Wilcoxon signed-rank test
b. Based on positive ranks

Table 19 and Table 20 shows the ranks and test statistic for the difference in the consumption of SSBs of participants before and after COVID-19 related Head Start center closures. As reported by parents, the consumption of SSBs was less for 51 participants after COVID-19 related Head Start center closures than before. The consumption of SSBs was greater for 35 participants after COVID-19 related Head Start center closures than before. There was no difference in the consumption of SSBs after and before COVID-19 related Head Start center closures reported for 198 participants. At the significance level of $p = 0.05$, the Wilcoxon signed-rank test showed that there was a significant difference in the consumption of SSBs of participants before and after COVID-19 related Head Start center closures ($Z = 2.046$, $p = .041$). Therefore, we reject the null hypothesis. The effect size for the difference in the consumption of SSBs of participants before and after COVID-19 related Head Start center closures was 0.08 which is considered a small effect size.

Table 19

Difference in the Consumption of Sugar-Sweetened Beverages (SSBs) of Participants Before and After COVID-19 Related Head Start Center Closures – Ranks

		N	Mean Rank	Sum of Ranks
Consumption of SSBs Before and After	Negative Ranks	51[a]	45.06	2298.00
	Positive Ranks	35[b]	41.23	1443.00
	Ties	198[c]		
	Total	284		

Note: a. Consumption of SSBs After < Consumption of SSBs Before
b. Consumption of SSBs After > Consumption of SSBs Before
c. Consumption of SSBs After = Consumption of SSBs Before

Table 20

Consumption of Sugar-Sweetened Beverages of Participants Before and After COVID-19 Related Head Start Center Closures – Test Statistic[a]

	Consumption of SSBs Before and After
Z	-2.046[b]
Asymp. Sig. (2-tailed)	.041

Note: a. Wilcoxon signed-rank test
b. Based on positive ranks

Table 21 and Table 22 shows the ranks and test statistic for the difference in the amount of screen time of participants before and after COVID-19 related Head Start center closures. As reported by parents, the amount of screen time was less for 44 participants after COVID-19 related Head Start center closures than before. The amount of screen time was greater for 73 participants after COVID-19 related Head Start center closures than before. There was no difference in the amount of screen time after and before COVID-19 related Head Start center closures reported for 167 participants. At the significance level of $p = 0.05$, the Wilcoxon signed-rank test showed that there was a significant difference in the amount of screen time of participants before and after COVID-19 related Head Start center closures ($Z = 2.833$, $p = .005$). Therefore, we reject the null hypothesis. The effect size for the difference in the amount of screen time of participants before and after COVID-19 related Head Start center closures was 0.12 which is considered a small effect size.

Table 21

Difference in the Amount of Screen Time of Participants Before and After COVID-19 Related Head Start Center Closures – Ranks

		N	Mean Rank	Sum of Ranks
Amount of Screen Time Before and After	Negative Ranks	44[a]	56.99	2507.50
	Positive Ranks	73[b]	60.21	4395.50
	Ties	167[c]		
	Total	284		

Note: a. Amount of Screen Time After < Amount of Screen Time Before
b. Amount of Screen Time After > Amount of Screen Time Before
c. Amount of Screen Time After = Amount of Screen Time Before

Table 22

Amount of Screen Time of Participants Before and After COVID-19 Related Head Start Center Closures – Test Statistic[a]

	Amount of Screen Time Before and After
Z	-2.833[b]
Asymp. Sig. (2-tailed)	.005

Note: a. Wilcoxon signed-rank test
b. Based on positive ranks

Summary

This study examined the differences between BMI, amount of physical activity, consumption of SSBs, and amount of screen time of preschool-aged children, ages 3-5 years, enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures. A total of 284 preschool-aged children enrolled in the MCOE Head Start program during both the 2019-2020 and 2020-2021 program years were included in this study. Results of the study showed significant differences in BMI ($t(264) = 4.533$, $p = .000$), consumption of SSBs ($Z = 2.046$, $p = .041$), and amount of screen time ($Z = 2.833$, $p = .005$) of participants before and after COVID-19 related Head Start center closures. Although results showed a significant difference in these health-related behaviors before and after COVID-19 related Head Start center closures, the effect sizes were small. Conversely, results of the study revealed that there was no significant difference in the amount of physical activity ($Z = 1.042$, $p = .297$) of participants before and after COVID-19 related Head Start center closures.

Section 4 will include an interpretation of these results and how the findings contribute to the current literature. A description of the limitations of the study and recommendations for future public health practice and research will also be discussed. Lastly, implications for positive social change at various levels will be described.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

The purpose of this quantitative, longitudinal study was to examine the differences in BMI, amount of physical activity, consumption of SSBs, and amount of screen time of preschool-aged children enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures. To address the research questions, a secondary data analysis of data from ChildPlus collected by MCOE Head Start program staff before and after COVID-19 related Head Start center closures was completed. The study was conducted to enhance understanding of the impact of prolonged childcare center closures on childhood obesity and health-related behaviors of preschool-aged children. Results of the study showed significant differences in BMI ($t(264) = 4.533$, $p = .000$), consumption of SSBs ($Z = 2.046$, $p = .041$), and amount of screen time ($Z = 2.833$, $p = .005$) of participants before and after COVID-19 related Head Start center closures. However, results of the study revealed that there was no significant difference in the amount of physical activity ($Z = 1.042$, $p = .297$) of participants before and after COVID-19 related Head Start center closures. The findings from this study are intended to add to the current literature and increase understanding of the potential impact of COVID-19 related childcare center closures on childhood obesity and health-related behaviors that will assist public health professionals and early care and education programs in the development and implementation of effective physical activity and dietary interventions during future pandemics and prolonged childcare center closures that will mitigate adverse effects on the health of children from vulnerable populations.

Interpretation of Key Findings

It was anticipated that childhood obesity would increase due to changes in health-related behaviors as a result of school and childcare center closures (An, 2020; Cuschieri & Grech, 2020; Stavridou et al., 2021) and that the increase would be proportional to the length of school closures (Cuschieri & Grech, 2020). Cuschieri and Grech anticipated that if schools remained closed through December 2020, there would be an increase of 1.27 million new cases of childhood obesity in the United States. The MCOE Head Start program centers were closed beginning mid-March 2020 through mid-November 2020. The MCOE Head Start program centers reopened providing comprehensive early care and education services via a hybrid option of in-person learning, for up to 10-12 children in each classroom, and distance learning opportunities through the end of the 2020-2021 program year. Results of the study showed a significant difference in the BMI of participants before and after COVID-19 related Head Start center closures ($t(264) = 4.533$, $p = .000$). The mean for participants' BMI was greater ($\bar{X} = 16.935$) after COVID-19 related Head Start center closures than before ($\bar{X} = 16.673$). The results of this study extend knowledge supporting the projections of the microsimulation model used by An to project the impact of COVID-19 and anticipated school closures on obesity prevalence and BMI z-scores from April 2020-March 2021. The results of this study showed an increase in the mean BMI of participants as did all scenarios of the microsimulation showed increases in BMI z-scores relative to the control scenario (An, 2020). Although conducting research with a different age group, Allabadi et al. (2020) found that 41.7% of the children in their study experienced an increase in weight. In the current study, 60.7%

of children experienced an increase in BMI, which was consistent with the increase experienced in the study by Allabadi et al.

Reduced physical activity, increased sedentary behavior (Xiang et al., 2020), irregular and unhealthy eating, and excessive snacking are all associated with negative physical health outcomes and an increased risk of childhood obesity (Allabadi et al., 2020). However, the results of the current study showed no significant difference in the amount of physical activity before and after COVID-19 related Head Start center closures ($Z = 1.042$, $p = .297$). These findings are contrary to the findings by Allabadi et al., who found a decrease in physical activity after the COVID-19 lockdown and school closures. Of the children reporting engaging in physical activity, 21.8% reported an increase in physical activity, 18.8% reported a decrease in physical activity, 14.3% reported no change in physical activity, and 45% reported no physical activity (Allabadi et al., 2020). In the current study, parents reported a decrease in physical activity for 37 (13.0%) participants, an increase in physical activity for 27 (9.5%) participants, and no change in physical activity for 220 (77.5%). These findings were also in contrast with findings by Xiang et al., Lopez-Bueno et al. (2020), and Dunton et al. (2020) that all showed decreases in children’s level of physical activity. In the study by Xiang et al., physical inactivity increased from 21.3% before the pandemic to 65.6% after the pandemic. Lopez-Bueno et al. found that physical activity worsened in all age groups, except in children aged 13-16 years, in a study of Spanish children aged 3-16 years in Spain. Parents of 5–13-year-old children in a study by Dunton et al. reported a decrease in their children’s physical activity after the COVID-19 pandemic.

The results of this study showed a significant difference in the consumption of SSBs before and after COVID-19 related Head Start center closures ($Z = 2.046$, $p = .041$). However, parents reported 51 (17.9%) participants consumed less SSBs after COVID-19 related Head Start center closures, while only 35 (12.3%) participants consumed more SSBs after COVID-19 related Head Start center closures. There was no difference in the consumption of SSBs in 198 (69.7%) participants before and after COVID-19 related Head Start center closures. Contrary to the current study, Allabadi et al. (2020) found an increase in consumption of SSBs in 31.5%, whereas parents reported an increase in consumption of SSBs in only 12.3% of participants in the current study. Pietrobelli et al. (2020) found a significant increase in the consumption of SSBs in children, aged 6-18 years, with overweight and obesity living in Verona, Italy during the COVID-19 lockdown. In children aged 10-19 in Spain, Italy, Brazil, Columbia, and Chile, Ruiz-Rosa et al. (2020) found no changes in consumption of SSBs during the COVID-19 related lockdown and school closures, which is somewhat contrary to findings of this study. In the current study, parents reported no difference in consumption of SSBs in 69.7% of participants in the current study.

Dunton et al. (2020) found that children in the United States engaged in less physical activity and more sedentary behavior during the early period of the pandemic than prior to the pandemic. This study showed a significant difference in the amount of screen time of participants before and after COVID-19 related Head Start center closures (Z = 2.833, p = .005). As reported by parents, more participants showed an increase in the amount of screen time after COVID-19 related Head Start center closure (73; 25.7%).

The results of this study are consistent with findings by Oflu et al. (2021), Mitra et al. (2020), and Moore et al. (2020) that showed significant increases in screen time of children (Mitra et al., 2020; Oflu et al, 2021) in Canada (Mitra et al, 2020) and Turkey (Oflu et al., 2021), and leisure screen time and social media of children in Canada (Moore et al., 2020) after the pandemic than before the pandemic. Additionally, the results of this study support findings by Kracht et al. (2021) that showed 74% of mothers of preschool-aged children reported increases in their children's screen time before than after the pandemic. Aguilar-Farias et al. (2021) also found an increase of 1.4 hours per day of recreational screen time of children aged 1-5 years in Chile reported by their caregivers, which is consistent with the increase in screen time found in this study. The results of this study also aligned with results by Schmidt et al. (2020) that found an increase in recreation screen time, gaming, television watching, and recreational internet use of children aged 4-17 years in Germany.

Health is viewed broadly within the SEM with multiple factors having an impact on health (Agency for Toxic Substances and Disease Registry, 2015). Multilevel influences including individual, interpersonal, institutions/organizations, community, and policies interacting with one another have a profound impact on health behavior and health outcomes. The discovery of a novel beta coronavirus and its impact on the world could not have been predicted. Ensuing national and statewide mandates required people to shelter-in-place and resulted in the closure of non-essential businesses, community facilities and parks, and schools and childcare centers, including Head Start programs. This relegated parents and children to the home environment and a change in the home structure that could potentially alter health-related behaviors that impact childhood obesity.

Head Start programs provide a wealth of health, nutrition, and family support services to children enrolled in Head Start programs and their families. In accordance with Head Start program performance standards, programs are required to provide culturally and developmentally appropriate nutrition services that includes ensuring that children enrolled in programs less than 6 hours a day receive meals and snacks equivalent to one-third to one-half of their daily nutritional needs and children enrolled in programs for 6 hours or more per day receive meals and snacks equivalent to one-half to two-thirds of their daily nutritional needs; adhering to USDA requirements; and serving meals and snacks that are low in sugar, salt, and fat and are high in nutrients (DHHS/ACF/OHS, 2016). Head Start programs are also required to establish relationships with parent that foster, support, and encourage children's health and wellbeing through health and nutrition education and support services (DHHS/ACF/OHS, 2016). This includes staff and parents discussing their child's nutritional needs, selection and preparation of nutritious meals, the importance of healthy eating and physical activity, and the adverse consequences of SSBs (DHHS/ACF/OHS, 2016). Additionally, the Early Childhood Environment Rating Scale® requires children enrolled in the part-day program be provided with a minimum of 35 minutes of physical activity, children enrolled in the school-day program be provided with a minimum of 45 minutes of physical activity, and children enrolled in the full-day program be provided with a minimum of 60 minutes of physical activity (Harms et al., 2015). With the closure of Head Start programs due to state mandates and COVID-19 concerns, the loss of nutrition services and opportunities for physical activity, reduced collaboration between parents and staff, and decreased provision of traditional health and nutrition education support services, there were potential negative impacts on the health and wellbeing of children enrolled in the MCOE Head Start program. The current study did reveal a significant difference in the BMI, consumption of SSBs, and amount of screen time of study participants before and after COVID-19 related Head Start center closures. In reference to the consumption of SSBs, parents reported more children having less consumption of SSBs after COVID-19 related Head Start center closures than before. However, the study did not show any significant difference in the amount of physical activity of study participants before and after COVID-19 related Head Start center closures.

Limitations of the Study

Limitations exist in this current study. The current study used a convenience sample of children enrolled in the MCOE Head Start program. Characteristics of the children and families enrolled in the program (e.g. low-income, majority Hispanic) may differ vastly from other populations; therefore, results of this current study may not be representative or generalizable to the general population. Measurements for growth assessments were obtained by MCOE Head Start program staff as required by Head Start program performance standards. Although staff received training, there are currently no standard anthropometric protocols for collecting measurements to calculate BMI; therefore, errors in measurement may exist. MCOE Head Start staff were tasked with entering measurements into the data management system, ChildPlus, which calculated the

BMI in accordance with the measurements entered. If ChildPlus was not set-up correctly to calculate the BMI or there were errors in data entry of measurements, there may be errors in BMI calculations. Another limitation of this study was self-reported data of health-related behaviors of children by parents that may have introduced bias. Responses to nutrition screening and assessment questions may be misreported or biased due to a heightened sense of children's behaviors during the pandemic, the inability to recall information, or misrepresentation of information. Furthermore, nutrition screenings and assessments were administered by MCOE Head Start program staff who may have introduced bias due to administration errors, including potential prompting or suggestion of responses.

Recommendation for Future Research

There has been limited research on the impact of COVID-19 related Head Start program center closures on the health and wellbeing of preschool-aged children. The purpose of this study was to examine the differences between BMI, amount of physical activity, consumption of SSBs, and amount of screen time of children enrolled in the MCOE Head Start program before and after COVID-19 related Head Start center closures. The current study revealed significant differences in BMI, consumption of SSBs, and amount of physical activity of study participants before and after COVID-19 related Head Start center closures; however, the study showed no significant difference in the amount of physical activity of children before and after COVID-19 related Head Start center closures. Recommendations for future research include conducting research to further understand the changes in health-related behaviors of preschool-aged children during prolonged childcare center closures that includes qualitative research on parents' knowledge and attitudes regarding health-related behaviors including healthy weight, healthy eating, physical activity, SSBs, and screen time. Families, especially parents, play a critical role in the development of health-related behaviors among preschool-aged children that can reduce the risk of childhood obesity (Gentile et al., 2018). It is recommended that future research be conducted using nationally representative datasets to provide for a more robust study on the impact of COVID-19 related childcare center closures on the health of preschool-aged children at all household income levels. However, children from families with low-income have a higher risk of overweight and obesity than children from more affluent families (Weaver et al., 2019). Therefore, further research with this vulnerable population is recommended as well. Considering publicly available Head Start data may lead to a greater understanding of the prevalence of obesity and health-related behaviors among preschool-aged children from low-income families (Imoisili et al., 2021). Most research on the impact of COVID-19 and associated factors have taken place in the early stages of the pandemic. It is recommended that future research examine the longer-term impact of COVID-19 and COVID-19 related childcare center closures on children's health and wellbeing.

Implications for Professional Practice and Social Change

Professional Practice

Health and public health professionals; educational professional including early educators and childcare professional; government officials and policy makers; and parents must understand the impact of COVID-19 related childcare centers closures on the health and wellbeing of young children and develop effective physical activity and dietary interventions and protocols in preparation for future pandemics and prolonged childcare center closures that will mitigate adverse effects on the health of all children, especially children from vulnerable populations. Recommendations for professional practice mirror those offered by Allabadi et al. (2020) that include the development of virtual spaces and programs that encourage physical and nutritional activities in daily routines during childcare center closures. Physical activity programs should incorporate and promote physically distanced outdoor activities of moderate intensity (Allabadi et al., 2020) in accordance with physical activity standards and recommendations for age. Nutrition programs should be developed that increases consumption of fruits and vegetables, increases foods high in nutrients, decreases energy-dense foods, and restricts consumption of SSBs (Allabadi et al., 2020) as recommended for age. Education and early education professionals can incorporate physical activity, music and movement, nutrition education, and healthy practices into daily distance learning lessons and activities (Allabadi et al., 2020).

Health and public health professionals can collaborate with early care and education programs, such as Head Start, and other childcare settings to develop interventions that will promote healthy behaviors. Imoisili et al. (2021) notes that "approximately 73% of U.S. children aged 3-5 years are in nonparental care on a weekly basis" (p. 342). This emphasizes the critical role played by the early care and education and childcare setting in supporting children in the development of healthy behaviors that will promote a healthy weight (Imoisili et al., 2021). Head Start programs provide comprehensive services to over one million children annually through 1,600 locally designed programs (DHHS/ACF/OHS, 2020). Head Start programs are required to implement health and nutrition programs that promote physical activity and healthy eating. Collaborating with Head Start programs may improve health outcomes for enrolled children (Imoisili et al., 2021) and provide a model for health promotion efforts with other childcare settings.

Social Change

Social change can be defined as changes in human relationships and interactions that occur overtime that transforms social and cultural institutions often resulting in long term, profound effects on society (Dunfey, 2019). The prevalence of childhood obesity has steadily increased for decades with children from BIPOC communities being most impacted. Prolonged school and childcare center closures may exacerbate weight gain in children (Rundle et al., 2020). School and childcare center closures due to the COVID-19 pandemic will impact subpopulations of children differently, some negatively (Hoffman & Miller, 2020). When children are out of school, children experience weight gain that is unhealthy, which is more apparent in African American and Hispanic children and children who are already overweight (Rundle et al., 2020).

Head Start programs provide comprehensive services to children from low-income families. In 2018, obesity prevalence for children enrolled in Head Start programs across the country was greater than the prevalence of preschool-aged children, 2-5 years, in the United States at all income levels (Imoisili et al., 2021). The current study provides knowledge and insight on the impact of COVID-19 related Head Start center closures on preschool-aged children's BMI and health-related behaviors. Research suggests that adult behavior is reflective of the environment one lived in as a child and behaviors developed during childhood are continued during adulthood (Fernandez-Jimenez et al., 2018). Developing healthy habits in the early stages of life are important for children to grow and maintain a healthy lifestyle into adulthood (Imoisili et al., 2021). As a framework to understand the determinants that influence health and health behavior, including during pandemics and times of prolonged childcare center closures, application of the SEM can be used to examine the interactions between multiple factors that influence childhood obesity and health-related behaviors. Interventions developed and implemented at various levels of the SEM could have a significant impact on the prevalence of childhood obesity and the promotion and development of healthy behaviors; thus, improving health outcomes over the course of a lifetime.

Conclusion

Childhood obesity remains a serious public health issue with approximately 60% of today's children projected to have obesity at age 35 (Ward et al., 2017). About 50% of the prevalence of obesity will present during childhood (Ward et al., 2017). It was anticipated that the rate of childhood obesity would increase in proportion to the length of school and childcare center closures (Cuschieri & Grech, 2020). Cuschieri and Grech suggested that the United States would record 1.27 million new cases of obesity among children and adolescents by December 2020 if schools and childcare centers remained closed. Many schools and childcare centers were closed well beyond December 2020 and did not reopen until the Fall 2021. Results of the current study showed significant differences in BMI ($t(264) = 4.533$, $p = .000$), consumption of SSBs ($Z = 2.046$, $p = .041$), and amount of screen time ($Z = 2.833$, $p = .005$) of participants before and after COVID-19 related Head Start center closures. However, results of the study revealed that there was no significant difference in the amount of physical activity ($Z = 1.042$, $p = .297$) of participants before and after COVID-19 related Head Start center closures. It is important that stakeholders understand the short and long-term impacts of COVID-19 related school and childcare center closures on the health and wellbeing of children. It is hopeful that the results of this study will provide useful information regarding the impact of COVID-19 related Head Start center closures on the BMI and health-related behaviors of preschool-age children that will serve as a foundation for future research and the development of physical activity and nutrition programs that can be used during future pandemics and prolonged school and childcare center closures that will mitigate the adverse effects on the health of young children.

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