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The Impact of COVID-19 on Pediatric Obesity in Southern Nevada

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ABSTRACT

Background: During March of 2020, schools in Nevada were issued a lockdown mandate. During the same year, 16% of children aged 10 to 17 years were documented as obese in Nevada. The purpose of this study was to evaluate the short term impact of the pandemic on weight change among a clinical subset of pediatric youth residing in Southern Nevada.

Methods: Data were assessed for significant changes in BMI category overall and by race and insurance type. The McNemar-Bowker test was utilized to examine categorical BMI changes from pre to during pandemic timeframes and cross tabulated with the appropriate comparative variable. A two sample test for differences in proportions was used to compare insurance coverage groups.

Results: Overall, 493 (26.2%) patients increased their BMI category. Specifically, of the 654 subjects that were of normal weight during the pre-pandemic period, 168 (26%) became overweight and 12 (1.8%) became obese during the pandemic period of observation. Examination of race indicated that 151 (25.4%) whites, 74 (25.6%) blacks, 148 (29.2%) other race, and 120 (24.3%) of unknown race increased their BMI category; however, these differences were not statistically significant ($\chi 2=3.49$, $p=0.322$). Further, examination by insurance coverage indicated that 113 (22.2%) with commercial insurance and 378 (28.0%) with Medicaid coverage increased their BMI category ($z=2.52$, $p=0.018$).

Conclusion: Overall, a significant BMI increase was observed between the pre and during pandemic period among a clinical youth cohort ($p<0.05$). More studies are needed to determine factors associated with pediatric weight change as well as to identify targeted interventions necessary for Nevada's pediatric population.

Key Words: Childhood; Pediatric; Adolescents; Obesity; Weight gain; COVID-19

INTRODUCTION

The World Health Organization (WHO) declared the outbreak of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), also known as COVID-19, a global pandemic on March 11, 2020 [1]. Several guidelines were developed by the Centers for Disease Control and Prevention (CDC) to address the spread of the pandemic, such as quarantine and isolations [2]. Owing to the public health emergency, governments were responsible for coordinating lockdowns/shutdowns mandates and school closures during the pandemic. Globally, the highest number of school closures due to the pandemic were recorded in November of 2020. This included 148 country wide school closures, representing approximately 738,740,599 students. During this period, while select schools in the United States were partially open, approximately 58,510,836 students were impacted [3]. Additionally, quarantine, global lockdowns, and school closures have been shown to further impact childhood obesity in middle and low income countries [4].

In the United States, childhood obesity was declared as an epidemic crisis due to rising prevalence rates that have tripled since the 1980's [5-8]. The Global Obesity Observatory revealed that US male children (23.29%) ranked 12th and US

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female children (19.47%) ranked 15th for obesity among 200 countries [9]. Furthermore, the Centers for Disease Control and Prevention indicates that 1 out of 5 children are obese in the United States [10]. Children in the United States between the ages 2-5 (13.4%), 6-11 (20.3%), and 12-19 (21.2%) were documented as obese [11]. The detection of poor outcomes such as high blood pressure, impaired glucose tolerance, and depression starting in childhood leads to worsening health conditions and diseases into adulthood [12]. This includes earlier onset of heart disease, diabetes, and cancer, as well as increased risk of mortality, due to the independent risk factor of obesity [13-15]. This has been estimated to increase direct healthcare costs of treating childhood obesity related diseases to $ 14.3 billion in the US [16]. Obesity most often begins in childhood and continues into adulthood [17,18]. Currently, US adult obesity related health costs are estimated at $ 190.2 million [19,20]. Therefore, the impact of the COVID-19 pandemic has raised public health concerns to address childhood obesity as early as possible.

In March of 2020, schools in Nevada were issued a lockdown mandate [21]. During the same year Nevada was ranked 21st nationally for childhood obesity [22]. A study conducted by the Nevada Institute for Children's Research and Policy (NICRP) addressed data from the 2019 Nevada Kindergarten Health Survey. It revealed that among children entering kindergarten for the 2019-2020 school years in Nevada, 11.1% of children were overweight and 21.3% of children were obese. Further, their BMI increased overall by 2.5% from the previous school year. Higher percentages of obese children were seen in rural counties (23.2%) compared to Clark County (21.1%). Further, several published studies indicate increases in weight gain resulting from the pandemic, potentially due to school closures/lockdowns, food insecurity, dietary behaviors or increased food intake and unhealthy foods, reduced movements or physical activity, and increased screen time. No study to our knowledge has been performed in Nevada to understand the impact of the current pandemic on pediatric weight changes among youth. Therefore, the purpose of this study is to evaluate the short term impact of the pandemic on weight change among a clinical subset of pediatric patients residing in Southern Nevada [23-32].

Change in BMI was compared prior to, and during the pandemic among children and adolescents who received pediatric care during both time points. This study addresses a gap in the pandemic literature regarding potential weight change among pediatric patients residing in Southern Nevada.

METHODS

Data Source and Description

This was a longitudinal study of pediatric patients. Patients were identified from adolescent, gastrointestinal, pulmonary, and general pediatric medicine clinics in Southern Nevada between January 1st of 2019 and June 30th of 2021. Data were abstracted from electronic health records from the University of Nevada, Las Vegas Medicine (UNLV) electronic medical record (EMR) database. Data were de-identified by clinical staff prior to data sharing and analyses. The participants in the dataset were identified by a unique patient identification number available in the EMR database.

The official mandate for school closure in Nevada began in March of 2020 [33]. For this study, the 'pre-pandemic period' was defined as January 2019 through February 2020; the 'during-pandemic' period was considered March 2020 through June 2021 at which point the data were extracted for analyses. Patients who were eligible for the study met the following iclusion criteria:

Aged 7-18 years and had at least one visit in both the pre and during pandemic comparison periods.

Since many patients had multiple visits, the single visit yielding the maximum BMI value was utilized for analysis at each time point. We opted to use the maximum value for both pre to during pandemic for each subject, as we based our analyses on the change in BMI category (described below), and use of a mean value for those patients with multiple visits would not allow the inclusion of measurement deviations in a useful way; hence a single value extracted for each time period provided a reasonable value for analysis.

Outliers were defined as a BMI greater than 50 or less than 12.5 and were excluded in the final analyses.

Clinically, values outside of these extremes would be very rare, and practically, values outside of these extremes were well beyond the 1st and 99th percentile of the data set, and hence represent extreme outliers. There were only a total of 11 subjects with values this extreme (<0.4% of the data set), and hence exclusion of these subjects did not impact results.

Initially, data for a total of 4033 unique pediatric patients were abstracted from the EMR, but not all data fields of interest were populated. There were 3019 patients with visits in the pre-pandemic period, and 2850 patients with visits during pandemic period. However, only 1895 were eligible based on having measurements available during both time points for comparison. After removal of outliers, a final 1884 patients were included in this study.

Study Variables

The variables in the extracted dataset included sex age, race, health insurance coverage and type, body mass index and date of each visit. BMI was calculated by physicians from patient weight and height using the age and sex adjusted "BMI Percentile Calculator for Child and Teen"; 9 patient BMI's were placed into categories for analysis defined as: underweight, less than 5th percentile for age; healthy weight, 5th to less than 85th percentile; overweight, 85th to less than 95th percentile and obese greater than 95th percentile. To facilitate analyses of categorical data, race was categorized into four categories (White, Black, Other, and Unknown). The 'Other' category consisted of patients who identified themselves as another race or subgroup such as Chinese, Vietnamese, and Filipino. Some respondents also declined to identify their race. Additionally, insurance types were categorized into two categories (Commercial or Medicaid).

Statistical Analysis

Descriptive statistics and frequencies were calculated for demographic data as either mean (SD) or frequency (%) depending on the variable type. BMI data were assessed for significant

changes in BMI at two time points. Because our interest was in evaluating pre to during pandemic changes, we analyzed patients by BMI category by assessing whether each individual patient changed category (e.g., moving from normal weight to obese or normal weight to underweight) or remained in the same category. We analyzed the data set as a whole and by breakdowns of race and insurance type. The analyses essentially consisted of a set of contingency tables, where rows represented pre-pandemic and columns represented post-pandemic. Because the data represented the same subject at both time periods, the McNemar-Bowker test was utilized to examine categorical BMI changes from pre to during pandemic timeframes. Additionally, a two sample test for differences in proportions was used to compare insurance coverage groups, and tests of multiple proportions across racial groups were accomplished using a chi-square test. All data were analyzed using SPSS (Version 26.0, SPSS, 2019). The statistical significance level was set at $p<0.05$.

Ethics Statement

This study was approved by the Institutional Review Board (IRB) of University of Nevada, Las Vegas Medicine (IRB No. 1745929-1). Informed consent from the study participants and their guardians was waived since data were de-identified for this study.

RESULTS

Slightly more patients were Male (51.9%), White (31.6%), and predominantly with some form of Medicaid coverage (71.1%) (Table 1). Overall, 493 (26.2%) patients increased their BMI category, whereas only 67 (3.6%) decreased BMI category between time points; the remaining 1324 (70.3%) remained stable between time points. Specifically, of the 654 subjects who were of normal weight during the pre-pandemic period, 168 (25.7%) became overweight, and 12 (1.8%) became obese during the pandemic period. Of the 258 patients who were overweight during the pre-pandemic time period 142 (55.0%) remained overweight and 95 (36.87%) became obese. Of the 152 patients who were obese during the pre-pandemic time period, 116 (76.3%) remained obese and 20 (13.2%) became morbidly obese (Table 2). There was a significant BMI change for each variable analyzed; in fact, the McNemar-Bowker statistics were significant for each comparison (all $p<0.05$). Examination of race indicated that 151 (25.4%) whites, 74 (25.6%) blacks, 148 (29.2%) other race, and 120 (24.3%) of unknown race increased their BMI category; however, these differences were not statistically significant ($\chi2=3.49$, $p=0.322$). Further, examination by insurance coverage indicated that 113 (22.2%) with commercial insurance and 378 (28.0%) with Medicaid coverage increased their BMI category ($z=2.52$, $p=0.018$).

Table 1. Baseline demographic characteristics of the pediatric patients included in this study.

Demographic Characteristics	Population (n=1884)
Age, years (Mean ± SD)	12.25 ± 3.4
Gender, n (%)	
Male	977 (51.9)*
Female	883 (46.9)
Race, n (%)	
White	595 (31.6)
Black	289 (15.3)
Other	507 (26.9)
Did not identify	493 (26.2)
Insurance, n (%)	
Commercial	509 (27.0)
Medicaid	1351 (71.1)
Missing	24 (1.3)

Table 2. Cross Tabulation of BMI-change of the Pediatric Patients in Nevada pre- and during- COVID-19. Data are shown as n (%). Bolded numbers highlight a BMI category increase from pre- to during-COVID 19.

			During COVID-19			
Pre COVID-19	**Underweight**	**Normal weight**	**Overweight**	**Obese**	**Morbidly Obese**	**Total**
			Overall			
Underweight	607 (75.4)	194 (24.1)	3 (0.4)	1 (0.1)	0 (0.0)	805
Normal weight	29 (4.4)	445 (68.0)	168 (25.7)	12 (1.8)	0 (0.0)	654
Overweight	2 (0.8)	19 (7.4)	142 (55.0)	95 (36.8)	0 (0.0)	258
Obese	0 (0.0)	4 (2.6)	12 (7.9)	116 (76.3)	20 (13.2)	152
Morbidly Obese	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.7)	14 (93.3)	15
Total	638 (33.9)	662 (35.1)	325 (17.3)	225 (11.9)	34 (1.8)	1884
			Race: White			
Underweight	198 (73.6)	69 (25.7)	1 (0.4)	1 (0.4)	0 (0.0)	269
Normal weight	8 (3.9)	147 (72.4)	44 (21.7)	4 (2.0)	0 (0.0)	203
Overweight	1 (1.5)	5 (7.5)	37 (55.2)	24 (35.8)	0 (0.0)	67

Obese	0 (0.0)	3 (5.7)	3 (5.7)	39 (73.6)	8 (15.1)	53
Morbidly Obese	0 (0.0)	0 (0.0)	0 (0.0)	1 (33.3)	2 (66.7)	3
Total	207 (34.8)	224 (37.6)	85 (14.3)	69 (11.6)	10 (1.7)	595
			Race: Black			
Underweight	106 (78.5)	27 (20.0)	2 (1.5)	0 (0.0)	0 (0.0)	135
Normal weight	5 (5.1)	63 (64.3)	26 (26.5)	4 (4.1)	0 (0.0)	98
Overweight	1 (3.1)	3 (9.4)	16 (50.0)	12 (37.5)	0 (0.0)	32
Obese	0 (0.0)	0 (0.0)	2 (11.1)	13 (72.2)	3 (16.7)	18
Morbidly Obese	0 (0.0)	0 (0.0)	0 (0.0)	0. (0.0)	6 (100.0)	6
Total	112 (38.8)	93 (32.2)	46 (15.9)	29 (10.0)	9 (3.1)	289
			Race: Other			
Underweight	144 (75.8)	46 (24.2)	0 (0.0)	0 (0.0)	0 (0.0)	190
Normal weight	7 (3.9)	114 (63.0)	57 (31.5)	3 (1.7)	0 (0.0)	181
Overweight	0 (0.0)	6 (7.2)	41 (49.4)	36 (43.4)	0 (0.0)	83
Obese	0 (0.0)	1 (2.0)	5 (10.0)	38 (76.0)	6 (12.0)	50
Morbidly Obese	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (100.0)	3
Total	151 (29.8)	167 (32.9)	103 (20.3)	77 (15.2)	9 (1.8)	507
			Race: Unknown			
Underweight	159 (75.4)	52 (24.6)	0 (0.0)	0 (0.0)	0 (0.0)	211
Normal weight	9 (5.2)	121 (70.3)	41 (23.8)	1 (0.6)	0 (0.0)	172
Overweight	0 (0.0)	5 (6.6)	48 (63.2)	23 (30.3)	0 (0.0)	76
Obese	0 (0.0)	0 (0.0)	2 (6.5)	26 (83.9)	3 (9.7)	31
Morbidly Obese	0 (0.0)	0 (0.0)	0 (0.0)	83.9 (0)	3 (100.0)	3
Total	168 (34.1)	178 (36.1)	91 (18.5)	0.0 (50.0)	6 (1.2)	493
			Insurance: Commercial			
Underweight	174 (74.4)	60 (25.6)	0 (0.0)	0 (0.0)	0 (0.0)	234
Normal weight	14 (7.9)	133 (74.7)	29 (16.3)	2 (1.1)	0 (0.0)	178
Overweight	1 (1.7)	6 (10.2)	34 (57.6)	18 (30.5)	0 (0.0)	59
Obese	0 (0.0)	1 (2.8)	4 (11.1)	27 (75.0)	4 (11.1)	36
Morbidly Obese	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	2
Total	189 (37.1)	200 (39.3)	67 (13.2)	47 (9.2)	6 (1.2)	509
			Insurance: Medicaid			
Underweight	422 (75.4)	134 (23.9)	3 (0.5)	1 (0.2)	0 (0.0)	560
Normal weight	15 (3.2)	308 (65.5)	137 (29.1)	10 (2.1)	0 (0.0)	470
Overweight	1 (0.5)	12 (6.1)	107 (54.3)	77 (39.1)	0 (0.0)	197
Obese	0 (0.0)	3 (2.7)	8 (7.2)	84 (75.7)	16 (14.4)	111
Morbidly Obese	0 (0.0)	0 (0.0)	0 (0.0)	1 (7.7)	12 (92.3)	13
Total	438 (32.4)	457 (33.8)	255 (18.9)	173 (12.8)	28 (2.1)	1351

DISCUSSION

Understanding the magnitude of the impact of the COVID-19 pandemic on adolescent health is somewhat premature. The purpose of this study was to evaluate the short term impact of the pandemic on weight change among pediatric youth in Southern Nevada as an indicator of potential health related change. To this end, the study aimed to analyze weight change among children and adolescents overall as well as by race/ethnicity, and health insurance type. Although the true cause of pediatric BMI increase subsequent to the lockdown cannot be determined from this present study, growing evidence reveals adverse behavior changes in diet, physical activity, and mental health have been associated factors for pediatric weight gain. The results of our study suggest an increase in childhood obesity as well as disparities in terms of race/ethnicity and health insurance status.

Our findings revealed weight changes among pediatric youth in Southern Nevada from the pre to during the pandemic period. This finding supports data from other similar published studies that revealed increased weight or obesity prevalence during the COVID-19 pandemic in the United States. For instance, Jessen et al (2021) analyzed over 500,000 pediatric visits to primary care clinics in the United States. The rate of the overall obesity prevalence increased from 13.7% (June to December 2019) to 15.4% (June to December 2020) [34]. In another study, Weaver et al. (2021) recruited 1,883 children (kindergarten 6th grade) across 3 different schools in the same school district in the United States. The study revealed that children who had BMIs in the normal weight percentile before the COVID-19 pandemic experienced a 0.58 (95% CI=0.40, 0.76) acceleration in zBMI change during the pandemic compared with that in the previous years and were 7.50 (95% CI=0.40, 0.76) times more likely to be overweight or obese during the pandemic [35]. Collectively, evidence that has emerged regarding weight gain supports the impact of the Covid-19 pandemic on childhood obesity.

A study in the United States utilizing an interrupted time series design investigated weight change pre and during the pandemic. Authors revealed a z-normalized BMI increase among White

2.79 (95% CI: 1.07, 7.24) and Black 2.57 (95% CI: 1.58, 4.19) children. Another study revealed that children in Philadelphia who were identified as Hispanic (25%) and non-Black Hispanic (21.4%) also experienced weight increase. Local data in Nevada indicated that African American (30.0%) and Hispanic (29.9%) students had higher rates of being obese compared to Caucasians (16.9%) [36]. Thus, it is important to address weight changes across all populations as well as by geographic region.

The last significant finding was the examination of insurance coverage. This study revealed that pediatric patients insured by commercial insurance (22.2%), or Medicaid coverage (28.0%) both increased their BMI category, with Medicaid recipients experiencing the greatest change. The differences in services covered by commercial or Medicaid coverage may have contributed to obesogenic behaviors. A cross sectional study investigated how type of health insurance affects the access to health care services of children. Data from 2009-2013 revealed that parents who had children who were publicly insured were less likely to have an annual well child visit compared to children who were from privately insured families odds ratio=0.82, 95% CI 0.73-0.92 [37]. Another study explored the impact of health insurance on outcomes and costs for previously uninsured children. In a sample of 237 children, those obtaining coverage were significantly (P<.05) less likely than the uninsured to have poor health (27% vs. 46%).

Further, children who remained uninsured were almost twice as likely as those obtaining insurance to have poor health status (46% vs. 27%, respectively; P=.01) [38]. It is plausible that the fear of contracting COVID-19 among parents along with the lock down mandates could have resulted in not having adequate access to health services during this time.

Study Strengths and Limitations

There are multiple strengths when addressing the public health impact of this study. To our knowledge, this is the only study that has investigated the clinical pediatric population in Southern Nevada. This study allows us to understand the short term impact of the pandemic on pediatric obesity changes among a subset of patients across multiple clinics in Southern Nevada. BMI was clinically assessed and not self-reported, yielding a more reliable measurement.

Additionally, data were drawn from a longitudinal sample that allowed for comparisons between the two time periods. The analysis from this study revealed further disparities by race/ethnicity and insurance type, indicating those of non-White race and Medicaid coverage yielded worse outcomes in regards to weight increase.

A limitation of the study is the availability of patients from a limited number of clinics within Southern Nevada; follow up studies are recommended incorporating patients from the entire state in order to increase study power and sample size. Selection bias was another limitation for this study. For instance, patients that attended the clinic may have underlying conditions resulting in weight gain prior to the pandemic. Furthermore, EMR data quality may have been impacted during the pandemic period due to clinic closures and staff shortages. While select patient medication and comorbidities were provided in the database, it was too complex to categorize them for analysis purposes. Future studies are recommended among a larger sample size incorporating a wider geographical region.

CONCLUSION

Our study provided a preliminary understanding of the magnitude of weight change among youth residing in Southern Nevada. It highlights the impact of the pandemic upon the risk of childhood obesity locally and mirrors similar studies in the US. Accordingly, findings from this study may be used to improve resources and services targeting obesity among youth in Southern Nevada. Importantly, this study serves as a call for action for public health and health care professionals to strategize public health interventions and propose policies that will address pediatric health behaviors related to the current pandemic. Further research is needed to monitor the ongoing pandemic including the impact of school re-openings and long term adverse health outcomes. More studies are needed to assess the long term changes involved with managing weight and sedentary behavior. Health inequities by race and insurance coverage warrant further investigation in order to reduce or eliminate health disparities for this population.

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AUTHORSHIP CONFIRMATION/CONTRIBUTION STATEMENT

(Credit format is preferred)

1. Author 1 (JC): Conceptualization (lead); Writing-original draft (lead); formal analysis (lead); writing-review and editing (equal).
2. Author 2 (CC): Methodology (lead); Writing-review and editing (equal).
3. Author 3 (RS): Conceptualization (supporting); Review and editing (equal).
4. Author 4 (SM): Supervision (lead); Software (lead); Resources (lead); Writing-review and editing (equal); Conceptualization (supporting).

AUTHOR'S DISCLOSURE (CONFLICT OF INTEREST) STATEMENT

There are no conflicts of interest. All authors are responsible for the content and writing of this article.

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CONFLICTS OF INTERESTS

None

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