



## The Immediate Impact of the Novel Coronavirus (COVID-19) Pandemic on Adolescents with Severe Obesity - Another Pandemic

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**Received date:** 30 November 2020; **Accepted date:** 11 January 2021; **Published date:** 19 January 2021

**Citation:** Matheson BE, Herdes RE, Garza D, Shepard WE, Bruzoni M, Pratt JSA, Abu El Haija M. The Immediate Impact of the Novel Coronavirus (COVID-19) Pandemic on Adolescents with Severe Obesity - Another Pandemic. *Asp J Pediatrics Child Health*. 2021 Jan 11;2(3):62-71.

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### Abstract

**Background:** The impact of the novel coronavirus 2019 (COVID-19) on the health and well-being of adolescents with obesity is currently unknown. The shelter-in place (SIP) orders imposed disruptions in everyday routines for all persons, including youth with obesity. Obtaining real-time data could offer important information about how youth with severe obesity are faring in the midst of this global crisis. Hence, this cross-sectional study aims to assess the impact of the COVID-19 pandemic on health-related behavior changes in adolescent patients with severe obesity.

**Methods:** Fifteen adolescents with severe obesity (M ± SD: 16.40 ± 1.67 years; 66.7% female; 40% Hispanic) and 19 parents (45.83 ± 6.98 years; 94.7% female; 47.4% Hispanic) receiving care at an adolescent bariatric surgery clinic at a university medical center participated (20% response). Participants completed an online survey about the impact of COVID-19 and SIP on: eating habits, physical activity, sleep, screen time, mood, and motivation for behavior change. Parents completed similar questions regarding the impact of SIP on their child's health.

**Results:** Descriptive analyses revealed adolescents reported varied sleep quality and quantity, later bedtimes, increased home-cooked and family meals, decreased takeout food consumption, and increased anxiety levels. Almost half reported increased snacking. Changes in physical activity were noted. Parent and adolescent responses were mostly aligned, with the exception of self-reported weight change.

**Conclusions:** Adolescents with severe obesity are facing challenges in maintaining health-related behavioral goals during SIP. Providers should be prepared to discuss and manage the impact of COVID-19 on adolescent patients with obesity.

### Keywords

Severe Obesity, Pandemic, Bariatric Surgery, Coronavirus, COVID-19, Obesity, Child, Adolescent

## Background

In the United States, obesity rates are alarmingly high, with severe obesity (BMI  $\geq 120\%$  of the sex-specific BMI-for-age 95<sup>th</sup> percentile) affecting approximately 6% of children and adolescents [1]. Youth with obesity experience significant medical, psychological, and psychosocial consequences, which often persist into adolescence and adulthood. Factors contributing to overweight and obesity in children and adolescents include genetic, environmental, psychosocial, psychological, and physiological factors which in turn impact eating behaviors, contributing to excess weight gain [2,3]. Behavioral treatments focused on the reduction of food intake and increased physical activity result in long-term weight loss for only about one-third of treatment-seeking children and adolescents [4], whereas bariatric surgery is an effective treatment option for youth with severe obesity [5]. Across behavioral and surgical interventions, youth with obesity are advised to reduce portions, increase fruits and vegetables, exercise 60 minutes/day, and engage in health-related behavioral goals [6]. Thus, consistent access to nutritious foods, physical activity spaces and equipment, and routine medical follow-up care are critical components to promote the health and well-being of patients seeking weight-loss treatment.

The novel coronavirus (COVID-19) has led to a worldwide pandemic with significant medical, economic, and psychological impacts. To limit the spread of the virus and protect the public, governments issued shelter-in-place (SIP) orders resulting in the closure of schools, childcare facilities, recreational facilities and gyms, restaurants, and all non-essential businesses. The impact that COVID-19 and the recent SIP is on the health of adolescents generally is unknown, let alone youth with obesity.

Researchers and clinicians have started to outline the potential effects and impacts that individuals with obesity may face as a result of the COVID-19 pandemic. A recent article highlighted significant consequences that COVID-19 may have for individuals with obesity, including both delayed access to bariatric and metabolic weight-loss surgeries as well as confinement due to public health directives as the first penalty [7].

Obesity is considered an important underlying health condition that increases the risk of severe infection, complications, and mortality associated with COVID-19 [8-11]. In past viral outbreaks such as H1N1, obesity, and severe obesity were categorized as risk factors for hospitalization, mechanical ventilation, and mortality [12-14]. Similarly, the impact of obesity on pulmonary function may also be a risk factor for individuals who contract COVID-19 [12]. Studies have already shown an increased prevalence of obesity in patients with COVID-19 requiring intensive care and mechanical ventilation [15,16]. Lastly, individuals with obesity may experience increased self-isolation and stigmatization in the midst of the COVID-19 public health crisis, which in turn could lead to increased psychological distress and symptoms of anxiety and depression [17,18].

School closures may increase pediatric obesity rates and create further disparities in the risk of obesity among youth [19]. Akin to excess weight gain that occurs during summer months when school is not in session [20-22], the closure of schools in compliance with government-directed public health mandates could have a similar effect. Studies have shown that school-age children maintain the weight gained during summer months throughout the year [21], prolonged school closures to prevent the spread of COVID-19 could similarly lead to excess weight gain in youth. Further, increased screen time, and sedentary activities due to school closures, cancellation of afterschool activities, and stay-at-home mandates may also increase the likelihood of excess weight gain during this time. Food insecurity is also expected to rise during this time [19].

It is likely that children and adolescents will have a difficult time adhering to lifestyle changes known to limit excess weight gain during the pandemic. A longitudinal study conducted in Verona, Italy reported on changes in lifestyle behaviors observed among children and adolescents with obesity during the COVID-19 lockdown compared to several months prior [23], where children (n=41) reported consuming more potato chips, red meat, and sugary beverages, while simultaneously reducing time playing sports and increasing time spent sleeping during the lockdown

period. Although the study has not yet collected weight measurements to compare pre and post-lockdown, the authors speculate that excess weight gain may be seen as a result [23].

The aims of this cross-sectional study were to survey and assess the initial impact of the COVID-19 pandemic on health and behavior change goals in youth with obesity. This work has important implications should SIP public health directives need to be repeated to control future viral outbreaks.

## Materials and Methods

### Participants:

Participants were adolescents receiving on-going medical care at a University Children's Hospital in the Adolescent Bariatric Surgery Clinic. Eligible participants were between 10-21 years old, English proficient, and had attended at least one visit with the Adolescent Bariatric Surgery Program in the last 12 months. All eligible pre and post-operative patients in the Adolescent Bariatric Surgery Program were invited to participate in the study. Exclusion criteria included developmental delay and/or intellectual disability that prohibited understanding and completing survey items. Parents/guardians were invited to participate in the study.

### Procedures:

Participants and their parents/guardians completed an online questionnaire using a HIPAA-compliant survey tool (REDCap). Responses were collected from May 16 - June 11, 2020. Participants and parents/guardians were sent a letter via secure e-mail informing them about the study, with included instructions on how to participate. A research team member called to follow-up if no response within one week of receiving the letter. All participants completed informed consent procedures and provided consent or assent (depending on age), compliant with the institution's Institutional Review Board (IRB).

### Measures:

#### Anthropometrics:

Anthropometric measurements, including Body Mass Index (BMI), were obtained from the most recent

clinic visit via the electronic medical record.

#### Health Domains:

The survey included questions about eating habits, physical activity, sleep, mood, and behavior change motivation over the past month, corresponding to a time during which SIP orders were enacted state-wide. Participants were also asked to report whether their weight had been affected during the SIP timeframe. Parents/guardians were asked to report on their child's functioning in the last month across the same health-related domains. For a full list of questions and response options, please see **Fig-1**.

#### Demographics:

Demographic information including age, ethnicity, race, and sex was obtained from the online questionnaires. Participants indicated whether or not they had received metabolic or bariatric surgery at the time of the survey.

#### Statistical Analysis:

Descriptive analyses were conducted for all survey questions. The limited sample size in this study precluded meaningful significance testing. As such, only descriptive results and percentages are reported. All analyses were conducted using SPSS version 26.

## Results

A total of 95 adolescents and their parents were invited to participate in this study. The response rate for this study was 20% (19 adolescent participants and 19 parent participants). Four of the adolescent responses were excluded prior to data analyses; two participants entered data incorrectly and two participants completed the survey without providing parental consent. Among parent participants, ten respondents also had a child participating in this study whereas the remaining nine did not.

#### Adolescent Participants:

Fifteen adolescent participants ages 13-22 years old (M  $\pm$  SD: 16.40  $\pm$  1.67 years; 66.7% female) were included in this study (**Table-1**). Forty percent (n=6) of the sample identified as Hispanic or Latino and two-thirds identified as Caucasian (n=10). The BMI of

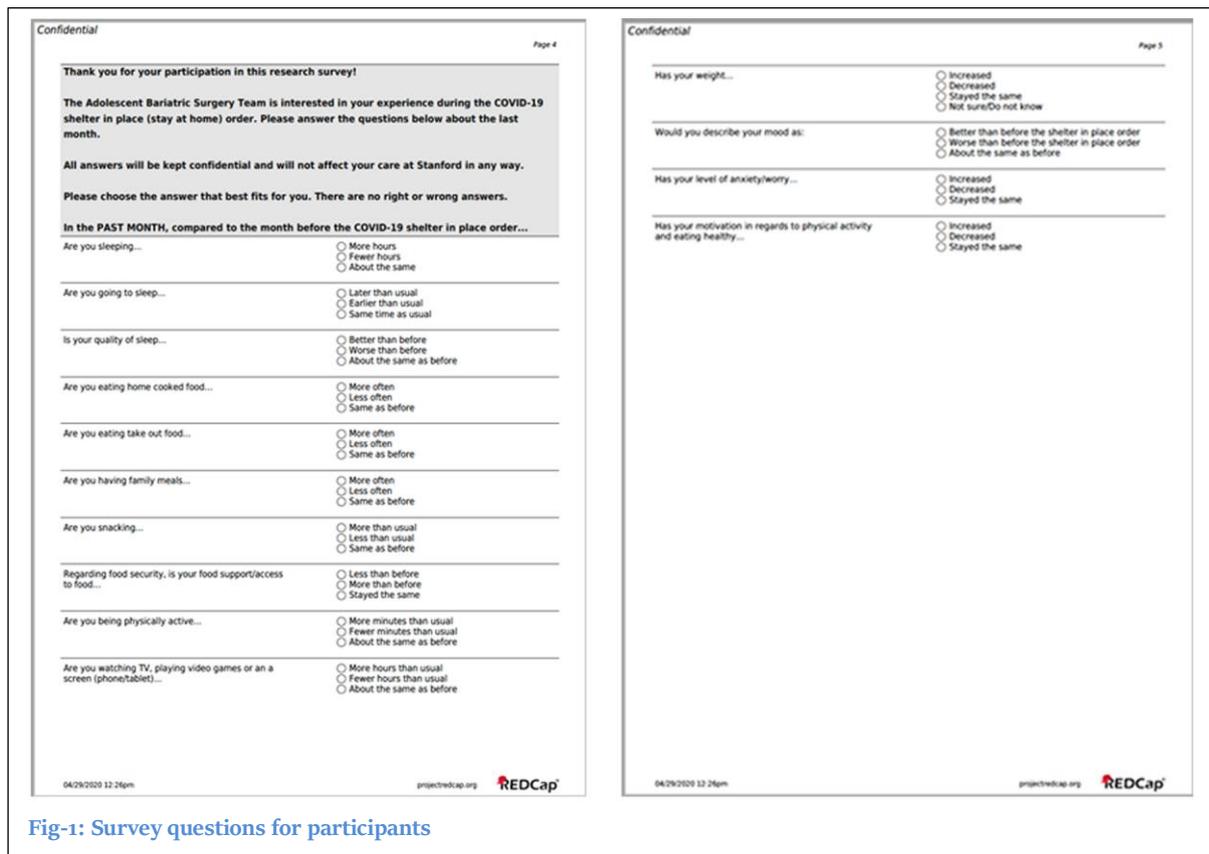


Fig-1: Survey questions for participants

participants in this study ranged from 25.5-55.5 kg/m<sup>2</sup> (M± SD: 42.72 ± 10.49 kg/m<sup>2</sup>); 8 participants had received bariatric surgery (BMI: 38.17 ± 11.4 kg/m<sup>2</sup>), whereas 7 had not (BMI: 47.92 ± 6.74 kg/m<sup>2</sup>).

**Sleep:** Six participants (40%) reported sleeping more hours, five (33.3%) reported sleeping the same number of hours, and four (26.7%) reported sleeping fewer hours. The quality of sleep reported also varied and reported as worse/no change (n=6) or better (n=3). The majority of the adolescents surveyed reported going to sleep later than usual (n=12; 80%) while a limited number reported going to bed at the same time as usual (n= 3; 20%). None of the participants indicated going to bed earlier than usual (**Fig-2**).

**Eating Behaviors:** The majority of adolescents reported consuming more home-cooked meals (n=10; 66.7%), more family meals (n=11; 73.3%), and less take-out food (n=10; 66.7%). Almost half of the sample endorsed snacking more often in the past month (n=7; 46.7%), compared to snacking less than usual (n=5; 33.3%), or at the same rates as before

(n=3; 20%). The majority of adolescents indicated that support and access to food remained unchanged in the past month (n=13; 86.7%); one participant reported that access to food decreased (6.7%).

**Physical Activity and Screen Time:** Adolescents reported that physical activity increased (n=7; 46.7%), decreased (n=5; 33.3%), or stayed the same as the month prior (n=3; 20%). Participants reported screen time either increased (n=8; 53.3%) or stayed the same as before (n=7; 46.7%); no participants noted a decrease in screen time in the past month.

**Weight and Motivation for Behavior Change:** In this study, participants commented on their perception of losing weight (n=6; 40%), maintaining their weight (n=4; 26.7%) or unsure (n=5; 33.3%). Motivation, reflecting on behavioral goals related to physical activity and dietary recommendations, was described as decreased (n=6; 40%), increased (n=5; 33.3%), or no change (n=4; 26.7%). This is the only category where there was a difference between pre and post-operative participants, where more post-operative

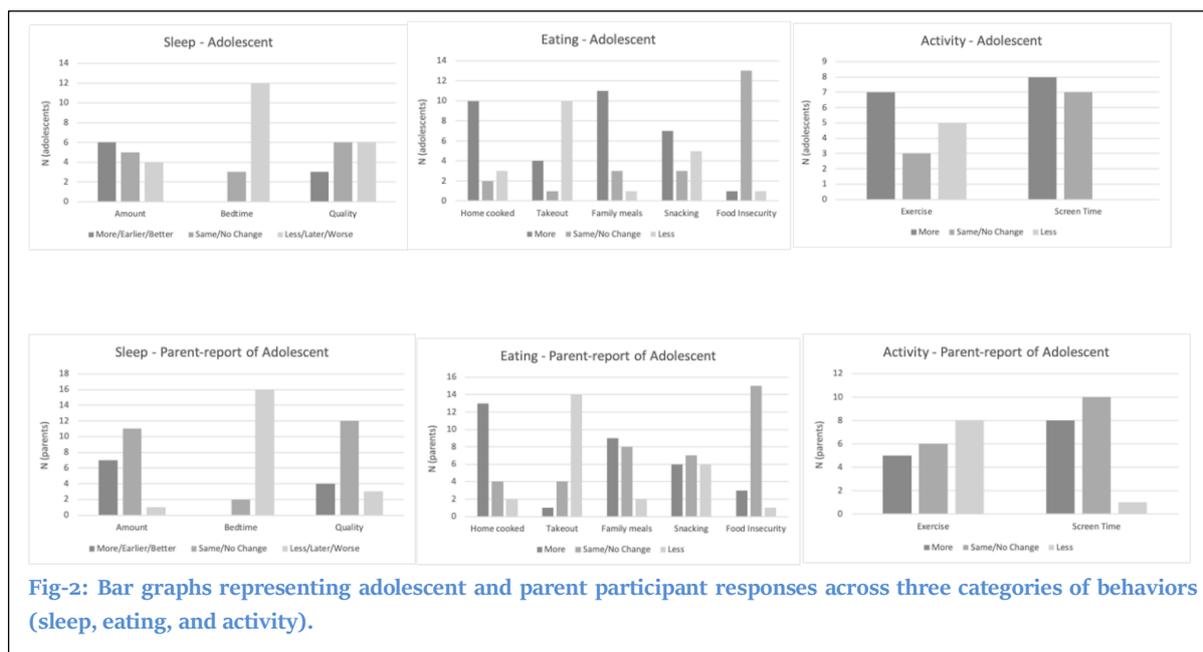


Table-1: Participant Demographics		
	Adolescents	Parents/Guardians
	N = 15	N = 19
Age (y)	16.4 ± 1.67	45.83 ± 6.98
Sex (% female)	66.7	94.7
Ethnicity		
Hispanic	6 (40%)	9 (47.4%)
Non-Hispanic	9 (60%)	10 (52.6%)
Race		
American Indian or Alaska Native	1 (6.7%)	1 (5.3%)
Asian	1 (6.7%)	0 (0%)
Black or African American	0 (0%)	0 (0%)
Caucasian	10 (66.7%)	13 (68.4%)
Multi-racial	2 (13.3%)	2 (10.5%)
Missing	1 (6.7%)	3 (15.8%)
BMI (kg/m <sup>2</sup> )	42.72 ± 10.49	----
Surgery status		
Pre-operative	7 (46.7%)	----
Post-operative	8 (53.3%)	----

participants endorsed increased motivation for behavior change (n=4) compared to pre-operative participants (n=1). Similarly, more pre-operative participants reported decreased levels of motivation (n=5) compared to post-operative participants (n=1). No other noticeable changes were observed between pre and post-operative participants.

**Mood and Anxiety:** The majority of the sample reported either no changes (n=7; 46.7%) or worsened mood (n=6; 40%) in the month following SIP. Similarly, adolescent participants reported increased levels of anxiety and worry (n=9; 60%). In a few cases, self-report of mood improved (n=2; 13.3%) and anxiety decreased (n=3; 20%).

#### *Parent Participants:*

A total of nineteen parents also completed the study. The age range of parent participants was 36-58 years old (n=18; M ± SD: 45.83 ± 6.98 y). One parent did not provide accurate age information. Parent participants were mostly female (94.7%), with almost half of the sample identifying as Hispanic or Latino (47.4%) and two-thirds identifying as Caucasian (68.4%). See **Table-1** for additional demographic information.

**Sleep:** The majority of parents (57.9%) reported that their children were sleeping the same number of hours in the last month, as compared to the month before SIP due to COVID-19. Parents reported that their child's quality of sleep was largely the same as before SIP (63.2%), some reported improvement (21.1%). Few reported worsening sleep quality (15.8%). Most parents said that their child was going to sleep later than usual (84.2%).

**Eating Behaviors:** When asked how their child's eating behaviors during the last month compared to eating habits prior to SIP, most parents indicated that their children were eating less take-out food (73.7%), more food cooked at home (68.4%), or no changes in these behaviors (21.1%). Almost half (n=9; 47.4%) of parents surveyed indicated that their child was having family meals more often or that the frequency remained unchanged (n=8; 42.1%). Only two parents indicating that family meals occurred less often (n=2;

10.5%). The frequency of snacking was split across the sample. Increased and decreased snacking were reported by parents with equal frequency (n=6; 31.6%), with no change reported in the remainder of cases (n=7; 36.8%). Parents reported access to food to largely be the same as before SIP (n=15; 78.9%), with a few parents noting increased (n=3; 15.8%) and decreased (n=1; 5.3%) access to food.

**Physical Activity and Screen Time:** Parents' report of child physical activity varied: fewer minutes than usual (n=8; 42.1%), the same level of activity (n=6; 31.6%), and more minutes than usual (n=5; 26.3%). Screen time (TV, video games, phone, tablet) was reported as same amount of time engaged with these devices (n=10; 52.6%), more hours of screen time (n=8; 42.1%), and fewer hours (n=1; 5.3%) across this sample.

**Weight and Motivation for Behavior Change:** Parents were asked to report on changes in their child's weight over the last month. Responses varied and included decreased weight (n=7; 36.8%), increased weight (n=5; 26.3%), weight stayed the same (n=3; 15.8%), or unsure/do not know (n=4; 21.1%). When asked about their child's parent-perceived motivation for behavior change related to physical activity and eating goals, responses were increased level of motivation (n=7; 36.8%), no change in the level of motivation (n=7; 36.8%), and decreased level of motivation (n=5; 26.3%).

**Mood and Anxiety:** Parents were asked to report on changes in their child's level of mood and anxiety symptoms since SIP. An equal number of parents reported that their child's mood had worsened or stayed the same compared to before SIP (n=8; 42.1%). Few parents reported improvements in their child's mood (n=3; 15.8%). Similarly, most parents reported that their child's level of anxiety and worry had either increased (n=9; 47.4%), stayed the same (n=6; 31.6%), or decreased (n=4; 21.1%).

## Discussion

This study sought to characterize the immediate impact of the SIP orders resulting from COVID-19 on the health and well-being of treatment-seeking youth

with severe obesity. The results of this study indicate mostly negative effects or no change in the few months following SIP directives on various health behaviors. While the snacking increased, take-out meals decreased and family meals increased. Although food insecurity was projected to worsen in the midst of COVID-19 [19], food insecurity was not highlighted as an increased problem in this sample by parents or adolescents. Even though adolescents reported going to bed later than usual, both parents and adolescents reported maintained or increased sleep duration. Furthermore, parent report of child functioning largely mirrored adolescents' responses, with a few notable exceptions.

Interestingly, almost a quarter of the parents surveyed in this study reported that their child had gained weight in the past month, whereas none of the adolescents reported an increase in weight. Self-reported weight is often not accurate, and many patients may not have access to scales at home to verify their weights. Adolescents in particular often underestimate their own body weight [24-26], though these estimations may only be incorrect by a few pounds [27]. However, adolescents' perception that they had either lost weight or maintained is important to note. Adolescents may be surprised if objective markers of weight do not align with their expectations. Similarly, clinical providers may be assuming that weight increased or decreased during this time for a variety of reasons and should be aware that patients may too have their own perceptions and expectations. With many medical appointments offered as TeleHealth rather than in-person visits to limit exposure and spread of COVID-19, patients and providers may not have access to accurate weight data and thus must simply rely on patient perception in the interim. Further, although survey responses were confidential and not shared with the clinical teams, it is possible that some adolescents felt uncomfortable acknowledging weight gain while in a program to manage weight, and thus may not have responded as openly or accurately for this reason.

It is also unknown what long-term impacts SIP and physical distancing protocols may have on the health outcomes for adolescents with severe obesity.

Depending on the length of time that schools remain closed or transitioned to an online-only format, it is possible children and adolescents will gain weight in a similar fashion as to the trend seen over summer breaks [19-22]. However, objective weight information collected by trained providers is needed to compare pre and post-COVID-19 effects before concluding a similar effect. Additionally, there could be differences between pre and post-operative patients. In this study, motivation for behavior change increased more often among post-operative compared to pre-operative participants. Post-operative patients have stayed longer in the program than patients who have yet to undergo surgery, and thus the greater contact time with program providers and recommendations may contribute to this difference. Small group sizes preclude significance testing in this sample, though larger studies should examine differences in health outcomes during COVID-19 and SIP based on treatment-related factors.

The number of adolescents reporting worsened mood and increased anxiety is concerning, though not unexpected. The mental health ramifications resulting from COVID-19 for children and adolescents are thought to be numerous [28-30], including increased isolation, separation from peers, disruptions in routines of everyday life, increased stress, boredom, illness-related fears, and reduced access to routine mental health services. Additionally, adolescence represents a critical time in development in which separation from family and increased time spent with peers and romantic partners are not only expected but also developmentally appropriate. Providers should be mindful of not just the physical but also the psychosocial and mental health impact that COVID-19 and SIP measures have on youth.

This study provides a broad overview of the impact of SIP directives in the context of a global pandemic on the health behaviors among adolescents with severe obesity. Awareness of the multiple ways in which the global pandemic is affecting the health and behaviors of youth with obesity is important for patients, parents, and healthcare providers in order to address specific needs that may arise in response to this unique and unprecedented situation. It is recommended that

clinical providers discuss the challenges with each patient directly. Moreover, given the varying responses collected in this small study, it is imperative for health providers do not assume negative impacts and instead talk openly with patients about their unique experiences. Furthermore, providers may need to help problem-solve challenges in maintaining healthy nutrition and physical activity and be prepared to work alongside patients to meet their individual needs during this time.

This study has strengths and limitations to consider. First, this study was conducted rapidly following SIP directives in an attempt to better understand the impact and challenges that adolescent patients with severe obesity were facing. This study surveyed both adolescents and parents in an attempt to collect data from varying perspectives, and it covered many affected health care behaviors contributing to weight gain. However, this study is not without limitations, and thus the results should be considered with these factors in mind. Given the cross-sectional nature of the study, no casual inferences regarding the changes in health behaviors and weight gain can be made. Additionally, it is possible that the shift observed in reported health behaviors was unrelated to the COVID-19 pandemic. Participants were asked to report on relative differences over the last month only; thus, how compliant patients were with health-behavior goals at baseline (pre-COVID-19) is unknown. Further, the small sample size in this study limits generalizability, and similar studies with larger numbers will be helpful for healthcare providers caring for this patient population. As this research study was optional for the families receiving medical services, there may be something systematically different about families who chose to participate compared to those who did not. It is unknown how many of the families surveyed have access to a scale within the home, and thus questions related to weight change may be limited by self-report. Finally, there are many health-related themes that could not be explored in an effort to reduce participant burden. These topics include but are not limited to illness anxiety, access to on-going medical care, socio-economic status, and COVID-19-related financial changes (e.g., loss of a job, decreased wages), all of which deserve additional exploration. Longitudinal

studies are needed to better understand what lasting effects, if any, the observed changes in lifestyle behaviors may have for adolescents with severe obesity.

## Conclusion

The impact of the novel coronavirus (COVID-19) on health-related behaviors in adolescent patients with severe obesity is not yet fully described. The results of this survey study indicate that COVID-19 and SIP directives present unique challenges in maintaining health-related behavioral goals for a percentage of treatment-seeking patients. Clinicians and medical providers are encouraged to ask their patients about how COVID-19 has impacted their ability to follow through with health-related goals and work collaboratively with their patients in order to problem-solve barriers and challenges resulting from this situation. Additional research is needed to further understand how COVID-19 is impacting adolescents' physical and mental health, and whether these impacts will have lasting consequences. Finally, it will be important to continue monitoring changes in health behaviors as the COVID-19 pandemic continues, both in the short-term and the foreseeable future.

## Acknowledgments

The Stanford REDCap platform (<http://redcap.stanford.edu>) is developed and operated by Stanford Medicine Research IT team. The REDCap platform services at Stanford are subsidized by a) Stanford School of Medicine Research Office, and b) the National Center for Research Resources and the National Center for Advancing Translational Sciences, National Institutes of Health, through grant UL1 TR001085†.

## Funding

This study was funded in part by the Stanford Maternal and Child Health Research Institute (PI: Matheson).

## Author Disclosure Statement

No competing financial interests exist.

## Ethical Approval

All procedures performed in studies involving

human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

### Informed Consent

Informed consent was obtained from all individual participants included in this study.

### Conflict of Interest

All authors have read and approved the final version of the manuscript. The authors have no conflicts of interest to declare.

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