



How The Pandemic Has Affected Children's Weight and Height?-A Single Center Experience

Pandemi Çocukların Kilo ve Boylarını Nasıl Etkiledi?-Tek Merkezli Çalışma

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ABSTRACT

Objective: The pandemic lockdown has affected the whole world regarding health, social, and economic aspects. This study aimed to detect the pandemic's effect on children's height and weight.

Methods: The study was a retrospective cohort study. The data were collected from patients aged 48 to 144 months who were followed up for three years between 2020 and 2022 in the pediatric outpatient clinic. Height and weight percentiles, and body mass index values of the patients were recorded.

Results: Eighty children were included in the study. It was determined that the children's annual body weight percentile values increased statistically significantly between 2020-2022. It was determined that there was a significant increase in the weight percentile values of children aged 48-59 months in all three years (p values were 0.00, 0.00, and 0.00, respectively). While there was no change in the height percentile value between 2020-21, an increase was observed in other years (2021 vs. 2022 and 2020 vs. 2022). While there was no increase in body weight percentile values between 2020-2021 in children aged 60-95 months, it was observed to increase in the following two years (p values were 0.00, and 0.00 respectively). In children aged 96-144 months, there was no statistically significant increase in weight and height percentile values over the years.

Conclusion: The pandemic caused weight gain and increased the prevalence of obesity in children. While this increase was more

ÖZ

Amaç: Pandemi döneminde uygulanan karantina tüm dünyayı sağlık açısından ve sosyal ve ekonomik açılardan etkilemiştir. Bu çalışma, pandeminin çocukların boy ve kiloları üzerindeki etkisini tespit etmek için planlanmıştır.

Yöntemler: Çalışma, retrospektif bir kohort çalışmasıdır. 2020-2022 yılları arasında, pediatri polikliniğinde üç yıl boyunca takip edilen 48 ile 144 aylık hastalar çalışmaya dahil edilmiştir. Hastaların boy ve kilo persentilleri ile vücut kitle indeksi değerleri kaydedilmiştir.

Bulgular: Çalışmaya 80 çocuk dahil edilmiştir. Çocukların 2020-2022 yılları arasındaki yıllık vücut ağırlığı persentil değerlerinin yıllara göre istatistiksel olarak anlamlı bir şekilde arttığı belirlendi. Çocukların yaş durumu ile vücut ağırlığı ve boy persentil değerlerinde ise her üç yılda da 48-59 aylık çocukların ağırlık persentil değerlerinde anlamlı bir artış olduğu tespit edildi (p değeri sırasıyla; 0,00, 0,00 ve 0,00). Boy persentil değerinde 2020-2021 yılları arasında bir değişiklik olmazken, 2021 ve 2022 arasında ve 2020 ve 2022 arasında değişiklik gözlemlendi. Altmış-95 aylık çocuklarda 2020-2021 yılları arasında vücut ağırlığı persentil değerlerinde artış görülmezken, takip eden iki yılda artış gözlemlendi (p değeri sırasıyla; 0,00 ve 0,00). Doksan altı-144 aylık çocuklarda ise ağırlık ve boy persentil değerlerinde yıllara göre istatistiksel olarak anlamlı bir artış görülmedi.

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ABSTRACT

pronounced in children aged 48-59 months, no weight gain was observed in children aged 96-144.

Keywords: The pandemics, pediatric obesity, preschool child, body mass index

ÖZ

Sonuç: Pandemi çocuklarda kilo alımına neden olmuş ve obezite prevalansını artırmıştır. Bu artış 48-59 aylık çocuklarda daha belirgin iken, 96-144 ay arası çocuklarda kilo artışı gözlenmemiştir.

Anahtar Sözcükler: Pandemi, pediatrik obezite, okul öncesi çocuk, vücut kitle indeksi

Introduction

The measures taken by countries because of the pandemic have had social, cultural, economic, and health effects worldwide (1). Almost all countries took measures such as travel restrictions, removal of social activities, curfews, and school closures during the pandemic. With the restrictions imposed during the pandemic, children's time at home increased, leading to decreased physical activity, changes in nutrition and sleep patterns, and more time in front of screens (2-4). This situation negatively affected their weight gain (5-7).

Before the pandemic, the prevalence of obesity in children had stagnated in many high-income countries and increased in low and middle-income countries (8). However, with the pandemic, there has been an increase in weight gain among children and adolescents in many countries (9-13). In the early days of the pandemic, while the damage in the health and economic fields was much talked about, the fact that it caused weight gain in children was ignored. However, the increase in obesity in children over time has drawn attention in this direction.

This study aimed to examine the effect of the pandemic on the height and weight of children and the distribution of this increase according to years, genders, and age groups. Also, bringing childhood obesity to the agenda, which always maintains its importance, emphasizes its causes, and offer solutions.

Methods

This study was a retrospective cohort study. The study population consisted of patients aged between 24 and 144 months who were admitted to Batman University Pediatric Department for routine examinations between January 2020 and January 2022. Healthy children attending routine examinations at the pediatric outpatient clinic were included in the study.

The records of the patients were obtained retrospectively by searching the electronic database.

Data Collection

Records were obtained from admissions between January 1st and April 30th, 2020, 2021, and 2022. Data for the same months of the 3 years were recorded for each patient.

The patients lived in the center of Ankara, all in residential compounds and apartments. During routine visits, patients were asked whether they went out and their responses were recorded.

Children who stated that they did not go out were included in the study.

Children aged 24-144 months (2-12 years) who were healthy at the time of admission, had no symptoms, and had no chronic disease were included in the study.

Children with active disease at the time of presentation, with chronic disease, taking medication for any reason, with missing data, and having measurements outside ± 2 standard deviation scores (SDS) were excluded from the study.

A total of 124 files were reviewed, and 80 children who met the study criteria and had complete data were included. The data showed that the children's height and weight percentile values were obtained using the percentile chart modified by Neyzi et al. (10) for Turkish children. Body mass index (BMI) was calculated by dividing the child's weight in kilograms by the square of the child's height in meters. BMI values between the 5th and 84th percentiles were categorized as normal, between the 85th and 95th percentiles as overweight, and $\geq 95^{\text{th}}$ percentile as obese based on Centers for Disease Control and Prevention values. SD scores were calculated. For SDS, standard deviation values of -2 and +2 were considered normal.

Measurement Tools

In the hospital where the study was conducted, a Mesitaş MC 210° height meter was used to measure children's heights. During height measurements, shoulders, hips, and feet were measured against the vertical board at the back, and the line between the external auditory canal and the lower edge of the eyeball was parallel to the ground. Weight was measured without shoes, wearing a single t-shirt and pants, using an Omron® scale sensitive to 100 g. The same person performed the measurements.

Approval for the study was obtained from the Batman University Local Ethics Committee on January 4th, 2023 (no: 38). The subjects' medical records were tracked and reviewed through the electronic pediatric patient data registry.

Data Analysis

The Statistical Package for the Social Sciences (SPSS) 23.0 software (SPSS Inc, Chicago, IL) was used for statistical analysis. Frequency, percentage, arithmetic mean, and standard deviation were used as descriptive statistical methods to evaluate the data obtained from the study. The normality of the distribution of body weight, height, and BMI values was evaluated using the

Kolmogorov-Smirnov test. The test significance value was $p > 0.05$ and it was that the data showed normal distribution characteristics. The study group's body weight, height, and BMI percentile changes according to the years were evaluated using the paired-sample t-test. P values below 0.05 were considered significant.

The G*Power 3.1.9.2 software package was used to evaluate the sample power after the study. As a result of the study, the effect size (effect size: 0.461) was calculated with the percentile values obtained using BMI, and the power of the study was found as 0.98 at an alpha value of 5%.

Results

The study included 80 children, just over half (58.8%) (n=47) of the children were male, and 70% (n=56) were aged 24-59 months. A total of 57.5% (n=46) of mothers and 50% (n=40) of fathers worked in the private sector. A total of 27.5% of mothers worked away from home during the quarantine period. Fifteen percent of children and 58.7% of mothers were ill during the pandemic. Children received online education between March 24th, 2020, and October 5th, 2021. The demographic findings of the patients are shown in Table 1.

It was found that the percentile values obtained from the annual body weight measurements of the children between 2020-2022 increased statistically significantly between the years ($p < 0.001$, $p < 0.001$, and $p < 0.001$, respectively). There was no statistically significant difference between 2020 and 2021 in terms of height percentiles of the children ($p = 0.07$), but the average percentile values obtained in 2022 increased statistically significantly compared with the other years ($p < 0.001$).

The body weight percentile increased from 52% to 68.3%, and the height percentile increased from 54.6% to 60.9%. BMI-SDS values increased from 0.02 to 0.52. The yearly percentile values and BMI-SDS values are given in Table 2.

There was no significant difference in terms of the girls' body weight percentile values between 2020 and 2021 ($p = 0.31$), but

there was a significant increase between 2020-2022 and 2021-2022 ($p < 0.001$ and $p < 0.001$, respectively). The body weight increased in boys significantly in the consecutive years ($p < 0.001$, $p < 0.001$, and $p < 0.001$, respectively).

There was no statistically significant difference in terms of the height percentile values between 2020-2021 in girls ($p = 0.91$), but there was a significant increase in height percentile values between 2020-2022 and 2021-2022 ($p < 0.001$ and $p = 0.01$, respectively). The height percentile values in boys increased

Table 1. Children's descriptive characteristics

| Descriptive characteristics (n=80) | | n | % |
|--|--------------------------|----|------|
| Children's gender | Female | 33 | 41.3 |
| | Male | 47 | 58.8 |
| Children's ages | 24-59 months | 56 | 70.0 |
| | 60-95 months | 12 | 15.0 |
| | 96 months and above | 12 | 15.0 |
| Which school did your child go? | Preschool | 46 | 57.5 |
| | Primary/secondary school | 23 | 28.7 |
| | Kindergarten | 11 | 13.7 |
| Mother's occupation | Housewife | 34 | 42.5 |
| | Officer | 34 | 42.5 |
| | Private, self-employed | 12 | 15.0 |
| Did the mother work remotely from home during the lockdown period? | Yes | 22 | 27.5 |
| | No | 58 | 72.5 |
| Father's occupation | Private, self-employed | 41 | 51.2 |
| | Officer | 38 | 47.6 |
| | Retired/other | 1 | 1.2 |
| Did the child have Covid-19 during pandemic? | Yes | 12 | 15 |
| | No | 68 | 85 |
| Did the mother have Covid-19 during pandemic? | Yes | 47 | 58.7 |
| | No | 33 | 41.3 |

Covid-19: Coronavirus disease-19

Table 2. Assessment of body weight, height and BMI of children by years

| Children's body weight, height and BMI changes | | \bar{X} | SD | Test values | | |
|--|------|-----------|-------|--------------------|--------------------|--------------------|
| | | | | 2020-2021 | 2020-2022 | 2021-2022 |
| Body weight percentile % | 2020 | 54.46 | 29.12 | t=2.855 p=0.00 | t=-7.367 p=0.00 | t=7.674 p=0.00 |
| | 2021 | 57.48 | 28.27 | | | |
| | 2022 | 68.36 | 25.96 | | | |
| Height percentile % | 2020 | 54.69 | 26.54 | t=1.835 p=0.07 | t=-5.186 p=0.00 | t=-4.430 p=0.00 |
| | 2021 | 56.14 | 25.44 | | | |
| | 2022 | 60.95 | 23.32 | | | |
| BMI-SDS | 2020 | 0.02 | 0.82 | t=-2.153 p=0.03 | t=-5.918 p=0.00 | t=5.803 p=0.00 |
| | 2021 | 0.13 | 0.85 | | | |
| | 2022 | 0.52 | 0.84 | | | |

Independent Sample t-test $p < 0.05^*$

BMI: Body mass index, SDS: Standard deviation score

significantly in all 3 years ($p=0.01$, $p<0.001$, and $p<0.001$, respectively).

There was no significant difference in BMI-SDS values between 2020 and 2021 in girls and boys ($p=0.06$ and $p=0.28$, respectively), but there was a significant increase between 2020-2022 and 2021-2022 ($p<0.001$ and $p<0.001$ for girls and $p<0.001$ and $p<0.001$ for boys, respectively). The findings are given in Table 3.

In the evaluation made in the body weight percentile curves with the age status of the children, it was determined that there was a statistically significant increase in all 3 years in children aged 24-59 months ($p<0.001$, $p<0.001$, and $p<0.001$, respectively).

There was no significant difference in body weight percentile values between 2020-2021 in children aged 60-95 months ($p=0.05$), but a significant increase was found between 2020-2022 and 2021-2022 ($p<0.001$ and $p<0.001$, respectively).

In children aged 96-144 months, no statistically significant difference was found between the years ($p=0.14$, $p=0.34$, and $p=0.95$, respectively).

When the height percentile values of the children were analyzed, it was found that there was no statistically significant difference between 2020-2021 in the 24-59-month age range ($p=0.06$), but there was a significant increase between 2020-2022 and 2021-2022 ($p<0.001$ and $p<0.001$, respectively).

A significant difference was found in terms of the height percentile of children aged 60-95 months between 2020 and 2022 ($p=0.02$), but no significant difference was found between 2020-2021 and 2021-2022 ($p=0.17$ and $p=0.18$, respectively).

There was no significant change in terms of the height percentile values of children aged 96-144 months ($p=0.96$, $p=0.63$, and $p=0.43$, respectively).

There was no significant difference in the BMI-SDS change of children aged 24-59 and 60-95 months in 2020-2021 ($p=0.07$ and $p=0.19$, respectively). There was a statistically significant increase between 2020-2022 and 2021-2022 (p -values for 24-59 and 60-95 months of age groups were <0.001 and <0.001 , respectively).

No statistically significant difference was found in terms of the BMI-SDS change in children of 96-144 months of age according to the years ($p=0.96$, $p=0.63$, and $p=0.43$, respectively).

Body weight, height, and BMI assessments of children by age are given in Table 4.

In 2020 and 2021, all children were between -2 and +2 SDS; in 2022, four children reached +2 SDS. After the pandemic, 5% of 80 children reached the obesity limit. Figure 1 shows how far the BMIs obtained from the children's height and body weight measurements moved away from the standard deviation in their age groups.

Table 3. Body weight, height and BMI assessment of children by gender

| Girls (n=33) | | \bar{X} | SD | Test values | | |
|--------------------------|------|-----------|-------|------------------------|------------------------|------------------------|
| | | | | 2020-2021 | 2020-2022 | 2021-2022 |
| Body weight percentile % | 2020 | 58.00 | 25.94 | $t=-1.014$ $p=0.31$ | $t=-4.805$ $p=0.00$ | $t=-5.385$ $p=0.00$ |
| | 2021 | 59.87 | 26.40 | | | |
| | 2022 | 69.87 | 25.14 | | | |
| Height percentile % | 2020 | 61.18 | 29.29 | $t=-0.112$ $p=0.91$ | $t=-2.778$ $p=0.00$ | $t=-2.699$ $p=0.01$ |
| | 2021 | 61.33 | 28.15 | | | |
| | 2022 | 66.54 | 26.19 | | | |
| BMI-SDS | 2020 | -0.02 | 0.69 | $t=-1.907$ $p=0.06$ | $t=-4.012$ $p=0.00$ | $t=-4.059$ $p=0.00$ |
| | 2021 | 0.17 | 0.75 | | | |
| | 2022 | 0.55 | 0.80 | | | |
| Boys (n=47) | | \bar{X} | SD | Test values | | |
| | | | | 2020-2021 | 2020-2022 | 2021-2022 |
| Body weight percentile % | 2020 | 51.97 | 31.20 | $t=-3.056$ $p=0.00$ | $t=-5.665$ $p=0.00$ | $t=-5.630$ $p=0.00$ |
| | 2021 | 55.81 | 29.67 | | | |
| | 2022 | 67.30 | 26.74 | | | |
| Height percentile % | 2020 | 55.81 | 29.67 | $t=-2.504$ $p=0.01$ | $t=-4.430$ $p=0.00$ | $t=-3.559$ $p=0.00$ |
| | 2021 | 67.30 | 26.74 | | | |
| | 2022 | 52.50 | 32.28 | | | |
| BMI-SDS | 2020 | 0.05 | 0.91 | $t=-1.090$ $p=0.28$ | $t=-4.319$ $p=0.00$ | $t=4.196$ $p=0.00$ |
| | 2021 | 0.11 | 0.92 | | | |
| | 2022 | 0.50 | 0.87 | | | |

Paired Sample t-test, $p<0.05^*$
BMI: Body mass index, SD: Standard deviation

Table 4. Body weight, height and BMI Assessment of children by age

| 24-59 months (n=56) | | \bar{X} | SD | Test values | | |
|--------------------------|------|-----------|-------|--------------------|--------------------|--------------------|
| | | | | 2020-2021 | 2020-2022 | 2021-2022 |
| Body weight percentile % | 2020 | 52.07 | 28.04 | t=-2.749 p=0.00 | t=-6.986 p=0.00 | t=-7.213 p=0.00 |
| | 2021 | 55.87 | 27.81 | | | |
| | 2022 | 67.86 | 26.12 | | | |
| Height percentile % | 2020 | 54.46 | 31.21 | t= 1.898 p=0.06 | t=4.723 p=0.00 | t=-3.930 p=0.00 |
| | 2021 | 56.46 | 30.12 | | | |
| | 2022 | 61.76 | 28.50 | | | |
| BMI-SDS | 2020 | -0.06 | 0.74 | t=-1.844 p=0.07 | t=-5.346 p=0.00 | t=5.404 p=0.00 |
| | 2021 | 0.06 | 0.84 | | | |
| | 2022 | 0.53 | 0.83 | | | |
| 60-95 months (n=12) | | \bar{X} | SD | Test values | | |
| | | | | 2020-2021 | 2020-2022 | 2021-2022 |
| Body weight percentile % | 2020 | 47.33 | 32.29 | t=-2.120 p=0.05 | t=-5.171 p=0.00 | t=4.279 p=0.00 |
| | 2021 | 51.83 | 30.15 | | | |
| | 2022 | 68.50 | 24.50 | | | |
| Height percentile % | 2020 | 48.33 | 35.39 | t=1.462 p=0.17 | t=2.545 p=0.02 | t=-1.412 p=0.18 |
| | 2021 | 50.25 | 34.46 | | | |
| | 2022 | 54.83 | 33.46 | | | |
| BMI-SDS | 2020 | -0.16 | 0.92 | t=-1.394 p=0.19 | t=-6.594 p=0.00 | t=-3.713 p=0.00 |
| | 2021 | -0.00 | 0.81 | | | |
| | 2022 | 0.43 | 0.86 | | | |
| 96-144 months (n=12) | | \bar{X} | SD | Test values | | |
| | | | | 2020-2021 | 2020-2022 | 2021-2022 |
| Body weight percentile % | 2020 | 72,75 | 25,88 | t=-1.575 p=0.14 | t=992 p=0.34 | t=-0.057 p=0.95 |
| | 2021 | 70.66 | 26.93 | | | |
| | 2022 | 70.58 | 28.71 | | | |
| Height % percentile | 2020 | 62.08 | 31.25 | t=1.106 p=0.29 | t=-0.539 p=0.60 | t=-1.636 p=0.13 |
| | 2021 | 60.58 | 31.89 | | | |
| | 2022 | 63.25 | 33.46 | | | |
| BMI-SDS | 2020 | 0.61 | 0.91 | t=0.041 p=0.96 | t=0.489 p=0.63 | t=0.803 p=0.43 |
| | 2021 | 0.61 | 0.86 | | | |
| | 2022 | 0.56 | 0.90 | | | |

Paired Sample t-test, p<0.05*
BMI: Body mass index, SD: Standard deviation

Discussion

The increase in the body weight percentiles of the 80 children in our study throughout the pandemic was statistically significant. Some studies showed that weight gain in children was higher, especially in the younger age group (11-13). One study reported that a 2-month school closure alone in a kindergarten caused a 0.64% increase in obesity (14). Our study found that the increase in the body weight percentile values was higher in children aged 24-59 months (2-5 years) compared with the other age groups, consistent with the literature (13,15-18).

Due to the economic damages caused by the pandemic, families' difficulty in accessing healthy, expensive foods, stocking of foods

with long shelf life and high calories, and the ease of access to such foods at home by children may be one of the factors in weight gain (2,7). Children in this age group need support from adults to do physical activity. With the closure of schools and kindergartens, the decrease in their physical activity may affect weight gain in young children. However, we believed that the most important factor was that the psychological stress of mothers caused by the pandemic led them to increase their eating, and they reflected this habit to their children in this age group. Nelson et al. (19) hypothesized that emotions could be transmitted with the same valence within the family. Accordingly, mothers experience this stress by increased eating and passing it on to their children. Studies mention the pandemic's psychological

effects on mothers (20,21). Accordingly, mothers experience this stress by eating more and passing it on to their children.

Another result of our study was that the BMI-SDS value in children aged 96-144 months (8-12 years) showed no statistically significant increase over the 3 years. Children in this age group are more likely to eat unhealthy snacks such as fast food. Difficulty in accessing such foods during quarantine and easier access to healthy home-cooked meals may be a factor in this. In Turkey, children in this age group frequently consume food in school canteens, which mainly sell unhealthy snacks and fast foods. These products are mostly purchased by primary-secondary school students aged 8-14 years (22). School students buy these foods and beverages during lunch breaks and consume them without other alternatives. In some schools, the administration encourages these purchases by placing vending machines in different parts of the school. We thought that the closure of schools during the pandemic and children's difficulty in accessing such foods contributed to this result.

Various studies have examined the relationship between the sex of children and overweight and obesity during the pandemic and reported different results (13-16,23). In the present study, because the increase in BMI-SDS was similar in boys and girls, gender was not identified as a differential variable.

Since the beginning of the pandemic, many studies were published from many countries showing that it caused weight gain in children in their countries (11-15,23-29). The majority of these were cross-sectional studies. In addition, in some studies, weight and height measurements of children were completed with information obtained from families through questionnaires because of difficulties in reaching patients due to the lockdown (13,14,25,29-34).

This study's strength was that the same children's height and weight measurements were followed regularly for 3 consecutive years. Another strength was that these measurements were performed using standardized devices and always by the same healthcare professional.

Study Limitations

Our study had some limitations. Data were obtained from a single center and might not reflect the general population. Also, children's sleep, nutrition, and physical activity status were not asked because it was a retrospective study.

Conclusion

The pandemic has caused weight gain in children and has increased the prevalence of obesity. This increase has been particularly observed in young children. Public health interventions are urgently needed to promote an active lifestyle and physical activity among children and reduce the negative impact of the pandemic on weight gain and childhood obesity. There is also a need to monitor whether this observed weight gain in children will continue and the long-term health consequences. The World Health Organization is also concerned that pandemics will increase in the coming years and that such lockdowns will

affect children the most. Relevant institutions have to strategize on future measures to be taken in this regard.

Ethics

Ethics Committee Approval: Approval for the study was obtained from the Batman University Local Ethics Committee on January 4th, 2023 (no: 38).

Informed Consent: The subjects' medical records were tracked and reviewed through the electronic pediatric patient data registry.

Peer-review: Externally peer reviewed.

Authorship Contributions

Surgical and Medical Practices: N.C.K., T.K.D., Concept: N.C.K., T.K.D., Design: N.C.K., A.S., H.B., H.Ö., Data Collection or Processing: T.K.D., Analysis or Interpretation: A.S., H.B., H.Ö., Literature Search: N.C.K., A.S., H.Ö., Writing: N.C.K., H.Ö.

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