Obesity Facts

Research Article

Obes Facts
DOI: 10.1159/000546217

Received: January 7, 2025
Accepted: April 25, 2025
Published online: May 2, 2025

From Childhood to Adolescence: Long-Term Trends in Severe Obesity in German Youth (2002–2023)

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Keywords
Adolescent · BMI · Childhood obesity · Children · COVID-19 · Epidemiology · Extreme obesity · Obesity · Obesity management · Overweight · Pediatric obesity · Severe obesity · Weight gain · Weight loss · Weight maintenance · Weight status · *Z*-score

Abstract

Introduction: Research on severe obesity (SO) is scarce and often contradictory. As higher weight status persists into adulthood, we aimed to analyze long-term trends in the prevalence of SO in children and adolescents in Germany using a large real-world data set. Furthermore, we analyzed subgroup differences and assessed how the COVID-19 pandemic affected weight status. ***Methods:*** We analyzed data from the CrescNet auxological network, including 1,495,401 clinical visits by 4- to 16-year-old children (2002–2023). Weight trends were examined with a focus on SO using logistic regression, stratified by sex and age. Effects are reported as odds ratio per 5 years (OR_5) pre-pandemic and as OR for consecutive years during the pandemic. Quantile regression assessed trends of the 50th, 90th, 97th, and 99th percentiles of excess weight. ***Results:*** Pre-pandemic, SO remained stable or declined in children under 12 until 2010: OR_5: 0.8–1, $p < 0.001$) but rose significantly afterward (OR_5: 1.1–1.2, $p < 0.001$). Children between 12 and 16 years of age showed a continuous increase, especially boys ($boys_{12–16}$: OR_5: 1.3, $girls_{12–16}$: OR_5: 1.1, $p < 0.001$). During the pandemic, SO peaked in 2021 across all groups ($OR_{21\ vs.\ 19}$: 1.3–1.7, $p < 0.001$). By 2023, younger children had returned to pre-pandemic levels, while older children, particularly 8- to 16-year-old girls, remained at higher weights ($OR_{23\ vs.\ 19}$: 1.2–1.5, $p <$ 0.001–0.002). Weight gain was most prominent in SO groups but could also be seen in pre-pandemic and pandemic overweight and obesity subgroups, generally decreasing toward the end of the pandemic. ***Conclusion:*** SO has increased over the last 2 decades, with the COVID-19 pandemic accelerating this trend, particularly in

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adolescents. While younger children recovered by 2023, excess weight in older children, especially girls, continues to escalate.

Plain Language Summary

Many national and international studies have shown that the prevalence of severe obesity (SO) (defined as BMI-SDS >2.58) has increased, especially in adolescents. Understanding SO is crucial, as the risk of severe comorbidities (such as cardiovascular and metabolic diseases) increases with weight status, leading to higher mortality risk and increased healthcare costs. Additionally, childhood obesity often persists into adulthood. Still, research on SO remains limited and often contradictory. Therefore, we utilized data from 1.4 million clinical visits over a two-decade period to examine long-term weight trends. Our analyses also include the COVID-19 pandemic, which, due to social distancing measures and changing lifestyles, has accelerated weight trends in many countries. Our findings show that SO has increased over the years. Adolescents remain the most strongly affected group, showing continuous increases from 2002 to 2023, while younger children only began exhibiting increasing prevalence rates from 2010 onward. Pre-pandemic, boys were more affected by SO; however, post-pandemic, girls' weight status has increased at a more rapid pace. Generally, only younger age groups have managed to return to pre-pandemic levels, while adolescents have not returned to their pre-pandemic weight status. The strength of our study lies in the large set of real-world data from daily medical practice, ensuring high representativeness. Furthermore, we used different methods and found consistent results, indicating a need for preventive measures to curb the increasing prevalence of SO.

Introduction

In recent years, national and international studies have shown that the prevalence of obesity (OB) and overweight (OVW) has stabilized or are even decreasing in younger age groups [1, 2]. However, research concerning severe obesity (SO) is scarce, with contradictory results. Furthermore, childhood OB tends to continue into adulthood [3], and the persistence increases with the severity of OB [4]. Even in young children, SO leads to alarming health issues typically seen only in older people, such as cardiovascular and metabolic diseases, contributing to higher mortality in adult years [5–8].

Despite the reported stability or decline in the prevalence of OB and OVW, several countries have indicated that the increase in the prevalence of SO is an emerging problem [9–14]. For the USA, Skinner et al. [10] found an increase in the prevalence of SO in youth between 1999 and 2016. In Germany, long-term analyses of the prevalence of SO are lacking. The YES study estimated that around 200,000 young people in Germany are affected by SO [15]. Separately, the KiGGS study reported that the prevalence of SO was stable between the 2003–2006 and the 2014–2017 periods of data collection (~1.2%) [16]. However, contradictory data from the CrescNet pediatrician network showed that the prevalence of SO increased significantly between 2007 and 2017, particularly in adolescents [17]. The COVID-19 pandemic contributed further to weight gain in youth on a global level [13, 18–21]. The WHO declared the start of the pandemic in March 2020 and ended its status as a public health emergency in May 2023 [22]. Few studies have covered weight trends during this period, particularly during the later phase when governments began lifting restrictions.

Given the lack of literature on the prevalence of SO and the contradictory results from the few long-term analyses that are available, there is a strong need for a comprehensive long-term analysis using real-world data. Our study utilized a large, representative data set from daily medical practice to provide valuable insights into current weight trends. We aimed to analyze whether SO rates have increased over the past 2 decades, which groups are most affected, and how the pandemic impacted children's and adolescents' weight status.

Methods

All data were extracted from CrescNet, an evidence-based auxological network connected to pediatricians nationwide [23]. CrescNet collects standardized body measurements from check-ups and additional visits, such as height and weight, from participating pediatric outpatient clinics (n = 505). These are pseudonymously transferred on a quarterly basis and stored at the university hospital [24]. Parents must provide consent, with the option to revoke it later. CrescNet's primary goal is the early detection of growth and developmental disorders. CrescNet is described in detail elsewhere [23, 24].

Measures

Height and weight were assessed by trained staff using standardized procedures during routine exams, check-ups, or other pediatric consultations. Weight was recorded with

calibrated scales, and height was measured with stadiometers provided to CrescNet partners. Subjects wore only light underwear and no shoes. Subsequently, BMI was calculated and transformed into sex- and age-adjusted standard deviation scores (SDS) using the German reference values [25] in accordance with the guidelines of the German workgroup on childhood OB and the German Obesity Society [25, 26]. In accordance with the same guidelines, we defined the following weight groups: severe underweight: BMI-SDS ≤ −1.88; underweight: −1.88 < BMI-SDS ≤ −1.28; normal weight: −1.28 < BMI-SDS ≤1.28; OVW: 1.28 < BMI-SDS ≤1.88; OB: 1.88 < BMI-SDS ≤2.58; SO: BMI-SDS >2.58. The significance level was set to $\alpha = 0.001$. Furthermore, we adopted the methodology of Freedman et al. [27], employing "excess weight" relative to the 50th weight percentile (W-E) and "excess BMI" based on the 90th BMI percentile (BMI-E) as our outcome measures. W-E has been shown to be a useful tool for children and adolescents on a higher weight spectrum [28]. We divided the study population into three age groups: 4–8 years, 8–12 years, and 12–16 years. We used the statistical language R, version 4.2.1. (R Core Team, 2024), to compute our analyses and create our figures.

Statistical Analysis

Descriptive statistics are given as means and standard deviations for continuous variables and counts and percentages for categorical variables. We accounted for multiple measurements per child by weighting the data appropriately.

Logistic Regressions

We assessed the trends in SUW, UW, OVW, OB, and SO by applying logistic regression models with time as the only predictor stratified by sex and age group. For the years before the pandemic (2002–2019), we included the examination date as a continuous variable and checked for non-linear trends up to degree 3. If non-linear trends were present, the entire time interval was divided into intervals of linear trends to enable easier interpretation of the results. Effects are reported as OR per 5 years (OR5). For the time during the COVID-19 pandemic, we included time as the discrete variable "year" because we expected higher variability between years (due to anti-pandemic measures). Effects are reported as ORs between each two consecutive years, compared with 2019 as the reference period.

Quantile Regressions

As we were especially interested in the trends at the tails of the distributions (i.e., OB and SOB), we additionally applied quantile regression with W-E and BMI-E as an outcome to inspect the 50th, 97th, and 99th empirical percentiles, stratified by sex and age groups. All analyses were applied to the time periods before and after 2011 (until 2019), with time as a continuous predictor, and with year as a discrete predictor for trends during the COVID-19 pandemic (2019–2023). Pre-pandemic results are presented as the change rate per year and as differences between years during the pandemic.

Study Population

For this study, a total of 1,495,401 visits from 591,330 children were included in the analyses, representing 777,792 measurements from boys and 717,609 from girls aged 4–16 years. The age groups comprised $n = 727{,}785$ (4–8 years), $n = 433{,}872$ (8–12 years), and $n = 334{,}069$ (12–16 years) participants.

Inclusion and exclusion criteria were adopted from Blüher et al. [1] and Kess et al. [2]. We included data collected by pediatricians between January 1, 2002, and December 31, 2023. To reduce bias, we excluded data from children with chronic diseases (C, E20–E27, Q65–Q99), which includes patients diagnosed with malignant neoplasms, endocrine disorders related to the adrenal glands, congenital musculoskeletal malformations, and other congenital malformations or chromosomal abnormalities. Further, we excluded data from patients with long-term medication that can affect height/weight, such as somatropin, hydrocortisone, leuprorelin, levothyroxine, fludrocortisone, carbamizole, metamizole, mecasermin, octreotide, diazoxide, estradiol, glucocorticoid, and oxandrolone.

Results

Baseline characteristics of the study population are summarized in Table 1.

Logistic Regressions

Generally, all age and weight groups above the 90th percentile exhibited increases in weight status. The group most affected by OVW, OB, and SO was that of 12- to 16-year-olds. The existing pre-pandemic trend toward higher weight status accelerated during the COVID-19 pandemic from 2020 to 2023 and affected all age and weight groups. Only 4- to 8-year-olds returned to pre-pandemic levels (Fig. 1; detailed effects in online suppl. Tables 1–3; for all online suppl. material, see https://doi.org/10.1159/000546217). If not stated otherwise, the respective p values were all ≤0.001.

Table 1. Characteristics of our cohort stratified by sex, age groups, and timeframe (before [2002–2019] and during the pandemic [2020–2023])

Pre-pandemic (2002–2019)	4- to 8-year-olds		8- to 12-year-olds		12- to 16-year-olds	
Characteristics	male, *N* = 300,605	female, *N* = 278,435	male, *N* = 173,735	female, *N* = 160,064	male, *N* = 129,950	female, *N* = 120,255
Age, years	5.61 (1.14)	5.60 (1.15)	9.90 (1.14)	9.88 (1.14)	13.78 (1.10)	13.82 (1.12)
Height-SDS	−0.01 (1.04)	−0.04 (1.04)	0.06 (1.05)	0.05 (1.08)	0.03 (1.09)	−0.02 (1.04)
Weight-SDS	0.04 (1.08)	0.05 (1.07)	0.19 (1.18)	0.19 (1.16)	0.22 (1.18)	0.24 (1.21)
BMI-SDS	0.09 (1.02)	0.11 (1.02)	0.23 (1.15)	0.22 (1.14)	0.26 (1.19)	0.31 (1.18)
Weight groups						
Severe underweight	7,267 (2.4%)	5,996 (2.2%)	4,645 (2.7%)	4,366 (2.7%)	4,487 (3.5%)	3,518 (2.9%)
Underweight	16,252 (5.4%)	14,663 (5.3%)	10,418 (6.0%)	9,895 (6.2%)	7,856 (6.0%)	6,563 (5.5%)
Normal weight	242,788 (81%)	223,362 (80%)	123,744 (71%)	115,213 (72%)	90,045 (69%)	85,219 (71%)
Overweight	19,410 (6.5%)	20,079 (7.2%)	19,525 (11%)	17,834 (11%)	14,918 (11%)	13,112 (11%)
Obesity	10,421 (3.5%)	10,296 (3.7%)	12,823 (7.4%)	10,435 (6.5%)	10,237 (7.9%)	8,339 (6.9%)
Severe obesity	4,467 (1.5%)	4,039 (1.5%)	2,580 (1.5%)	2,321 (1.5%)	2,407 (1.9%)	3,504 (2.9%)
Pandemic [2020–2023]						
Characteristics	male, *N* = 53,279	female, *N* = 48,288	male, *N* = 35,746	female, *N* = 31,898	male, *N* = 27,716	female, *N* = 24,520
Age, years	5.57 (1.18)	5.56 (1.18)	9.85 (1.11)	9.84 (1.10)	13.84 (1.08)	13.88 (1.10)
Height-SDS	−0.01 (1.09)	−0.05 (1.08)	0.11 (1.11)	0.14 (1.14)	0.12 (1.15)	0.01 (1.06)
Weight-SDS	0.04 (1.15)	0.04 (1.12)	0.27 (1.26)	0.27 (1.24)	0.36 (1.31)	0.30 (1.30)
BMI-SDS	0.09 (1.07)	0.12 (1.05)	0.29 (1.22)	0.26 (1.20)	0.35 (1.32)	0.35 (1.28)
Weight groups						
Severe underweight	1,426 (2.7%)	1,053 (2.2%)	1,057 (3.0%)	953 (3.0%)	1,195 (4.3%)	926 (3.8%)
Underweight	3,036 (5.7%)	2,716 (5.6%)	2,247 (6.3%)	2,133 (6.7%)	1,809 (6.5%)	1,416 (5.8%)
Normal weight	42,299 (79%)	38,306 (79%)	24,108 (67%)	21,911 (69%)	17,387 (63%)	16,428 (67%)
Overweight	3,431 (6.4%)	3,395 (7.0%)	3,992 (11%)	3,563 (11%)	3,252 (12%)	2,707 (11%)
Obesity	1,960 (3.7%)	1,881 (3.9%)	3,440 (9.6%)	2,559 (8.0%)	2,942 (11%)	1,946 (7.9%)
Severe obesity	1,127 (2.1%)	937 (1.9%)	902 (2.5%)	779 (2.4%)	1,131 (4.1%)	1,097 (4.5%)

In children younger than 12, the SO prevalence was stable or even decreased until approximately 2010 (OR_5: 0.8–1). Afterward, until 2019, we found an increase for both sexes (OR_5: 1.1–1.2). For children older than 12, the proportion increased between 2002 and 2019, with the most pronounced rise in boys ($boys_{12–16}$: OR_5: 1.3, $girls_{12–16}$: OR_5: 1.1). During the COVID-19 pandemic, we found the highest proportions of SO in 2021 for all age groups ($OR_{21\ vs.\ 19}$: 1.3–1.7), followed by a significant decrease from 2021 to 2022 for all subgroups except for girls older than 12, where no statistically significant trend was found. For the youngest age group, the values had returned to pre-pandemic levels in 2023, whereas in children older than 8, the levels were still significantly higher ($OR_{23\ vs.\ 19}$: 1.2–1.5, $p < 0.002$). From 2022 to 2023, we found stable or even decreasing rates in the youngest age group ($boys_{4–8}$: $OR_{23\ vs.\ 22}$: 0.9, $p = 0.111$; $girls_{4–8}$: $OR_{23\ vs.\ 22}$: 0.9). Girls older than 8 experienced a substantial increase between 2022 and 2023 ($girls_{12–16\ y}$ $OR_{23\ vs.\ 22}$: 1.2; $girls_{8–12\ y}$ $OR_{23\ vs.\ 22}$: 1.5), reaching even higher rates after the end of the pandemic ($girls_{8–16\ y}$ $OR_{23\ vs.\ 19}$: 1.5). Boys who are of 8–16 years of age also showed higher

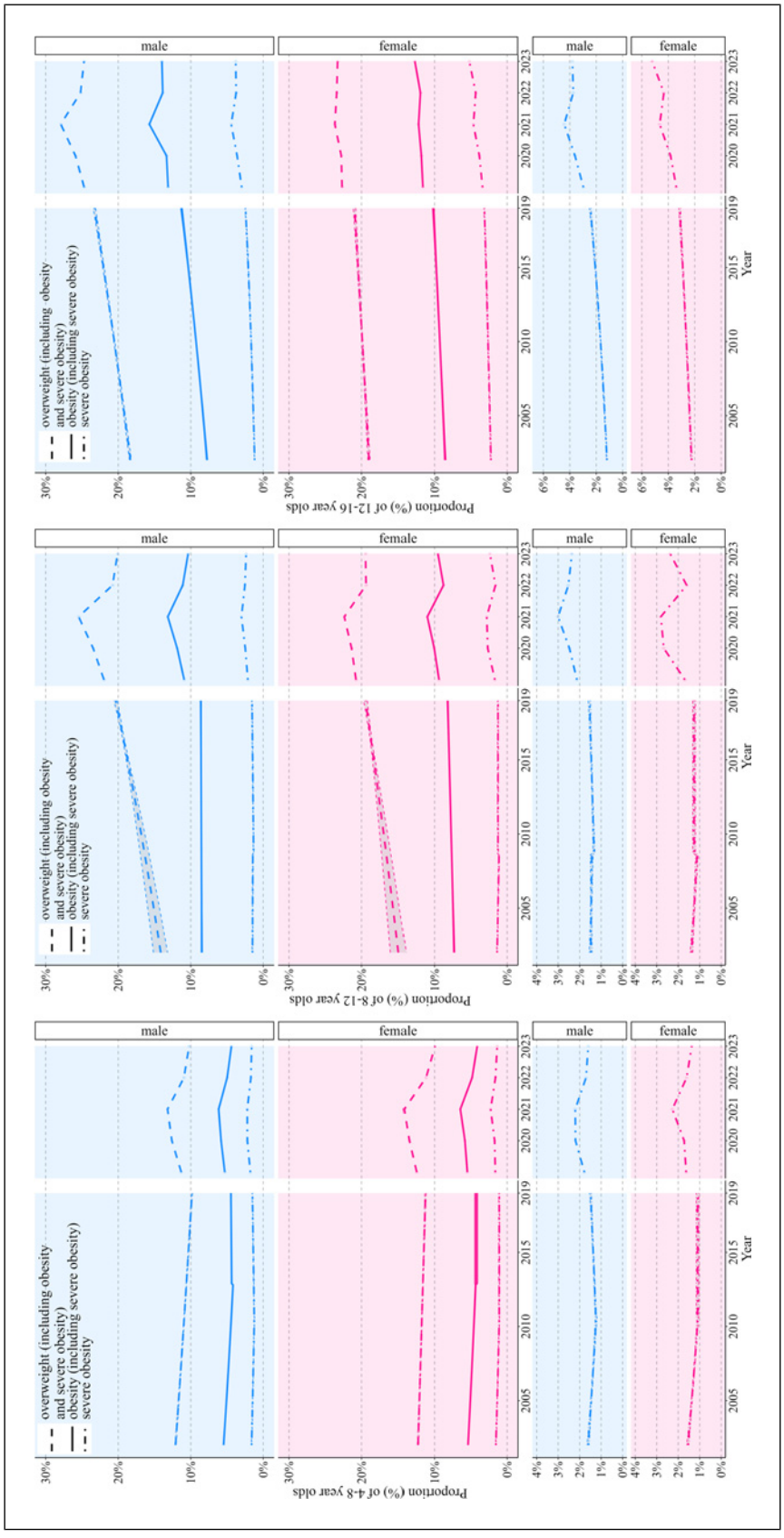

Fig. 1. Prevalence of OVW, OB, and SO between 2002 and 2023 stratified by sex, age, and weight groups. The group most affected was that of 12- to 16-year-olds. The existing pre-pandemic trend toward a higher weight status accelerated during the COVID-19 pandemic between 2020 and 2023. Only 4- to 8-year-old children returned to pre-pandemic levels.

proportions of SO in 2023 ($boys_{12–16\ y}$ $OR_{23\ vs.\ 19}$: 1.4; $boys_{8–12\ y}$ $OR_{23\ vs.\ 19}$: 1.2, $p = 0.002$).

Furthermore, we found stable or decreasing OB prevalences (OR_5: 0.9–1) for children younger than 12 years between 2002 and 2019, except for 4- to 8-year-old girls. From 2012, this age group exhibited a slightly increasing trend along with children older than 12 (OR_5: 1.1). For children older than 12, there was an increase between 2002 and 2019 for both sexes.

For OVW, we observed stable or decreasing prevalences for all children younger than 8 years and girls older than 12 years (OR_5: 0.9–1.0). For 8- to 12-year-olds and boys older than 12 years, the OVW prevalence increased between 2002 and 2019 (OR_5: 1.1–1.2) with 8- to 12-year-old boys affected the most.

During the COVID-19 pandemic, the prevalences of OB and OVW increased to their highest levels in 2021 for all children ($OR_{19\ vs.\ 21}$: 1.1–1.3). For OVW, 8- to 12-year-old boys were particularly affected ($OR_{19\ vs.\ 21}$: 1.3). Afterward, all groups returned to pre-pandemic levels or even to lower levels than had existed in 2019 ($OR_{19\ vs.\ 23}$: 0.7–1) except for girls older than 12 who demonstrated even higher prevalences of OB and OVW in 2023 ($OR_{19\ vs.\ 23}$: 1.1–1.2).

Underweight and severe underweight prevalences remained mostly stable or even decreased between 2002 and 2019, with one exception: the group of 12- to 16-year-olds, who showed a slight upward trend. During the pandemic, underweight prevalence increased, while severe underweight remained stable for 8- to 12-year-olds. Children under 8 were most affected by the increasing prevalence of underweight and severe underweight (online suppl. Fig. 1; detailed effects in online suppl. Tables 1–3).

Quantile Regressions

Empirical W-E percentiles were relatively stable for 4- to 8-year-olds and increased for children older than 8. During the COVID-19 pandemic, the percentiles for all children increased; only 4- to 8-year-olds returned to pre-pandemic levels. The percentiles for 12- to 16-year-olds continued to increase drastically in 2023 (Fig. 2; detailed effects in online suppl. Tables 4–5).

2002–2019

For children younger than 12, we found that the 99th and 97th empirical percentiles remained stable or even decreased slightly before 2011 for both sexes. From 2011–2019, the 99th percentile increased by approximately 10%, whereas the 97th remained mostly stable. For children older than 12, we observed an increase in the 97th and 99th percentiles across the entire time span. The group that exhibited the most pronounced effects consisted of boys older than 12. For this group, the 99th percentile increased from 1.9 (2002) to 2.1 times the expected weight (2019). The empirical 50th percentiles remained stable and persisted at the expected value of 1 for both sexes and across all age groups until 2019.

COVID-19

We found that the empirical 97th and 99th percentiles increased during the COVID-19 pandemic until 2021 for children younger than 8 years of age but returned thereafter to pre-pandemic levels. For children older than 8, we also found that the 97th and 99th percentiles had increased; However, most of them did not return to pre-pandemic levels until 2023. The highest values were found in 2021.

For 8- to 12-year-old boys, the W-E at the 99th percentile increased from 2.0 times the expected weight in 2019 to 2.2 times the expected weight in 2021 and decreased slightly to 2.1 (in 2023). For boys older than 12, the 99th percentile of excess weight started at 2.1 times the expected weight (2019), increased to 2.2 (2021), and remained at this level until 2023. For girls older than 12, the 99th percentile increased from 1.9 times the expected weight (2019) to 2.1 (2021), followed by a slight decrease of 10% in 2022. In 2023, it was again 2.1 times the expected weight. For children older than 12, we even found that the 50th percentiles had increased by 10% between 2019 and 2023. Similar patterns were observed for empirical BMI-E percentiles (detailed effects in online suppl. Tables 6–7).

Discussion

With our analyses, we investigated weight trends in children and adolescents for a time span of more than 2 decades. Although BMI-SDS is commonly computed in epidemiologic studies of weight trends in children, other metrics have recently been identified as potentially more suitable for evaluating changes in BMI, especially in the outer percentiles. Freedman et al. [27] found that it is better to represent changes in OB prevalences as percentages of the 50th or 95th percentiles. Thus, we used BMI-SDS, W-E, and BMI-E simultaneously. The results were generally consistent across all the methods.

In our study, in younger children (12 or younger), the prevalence of SO was stable or decreased until 2011 and

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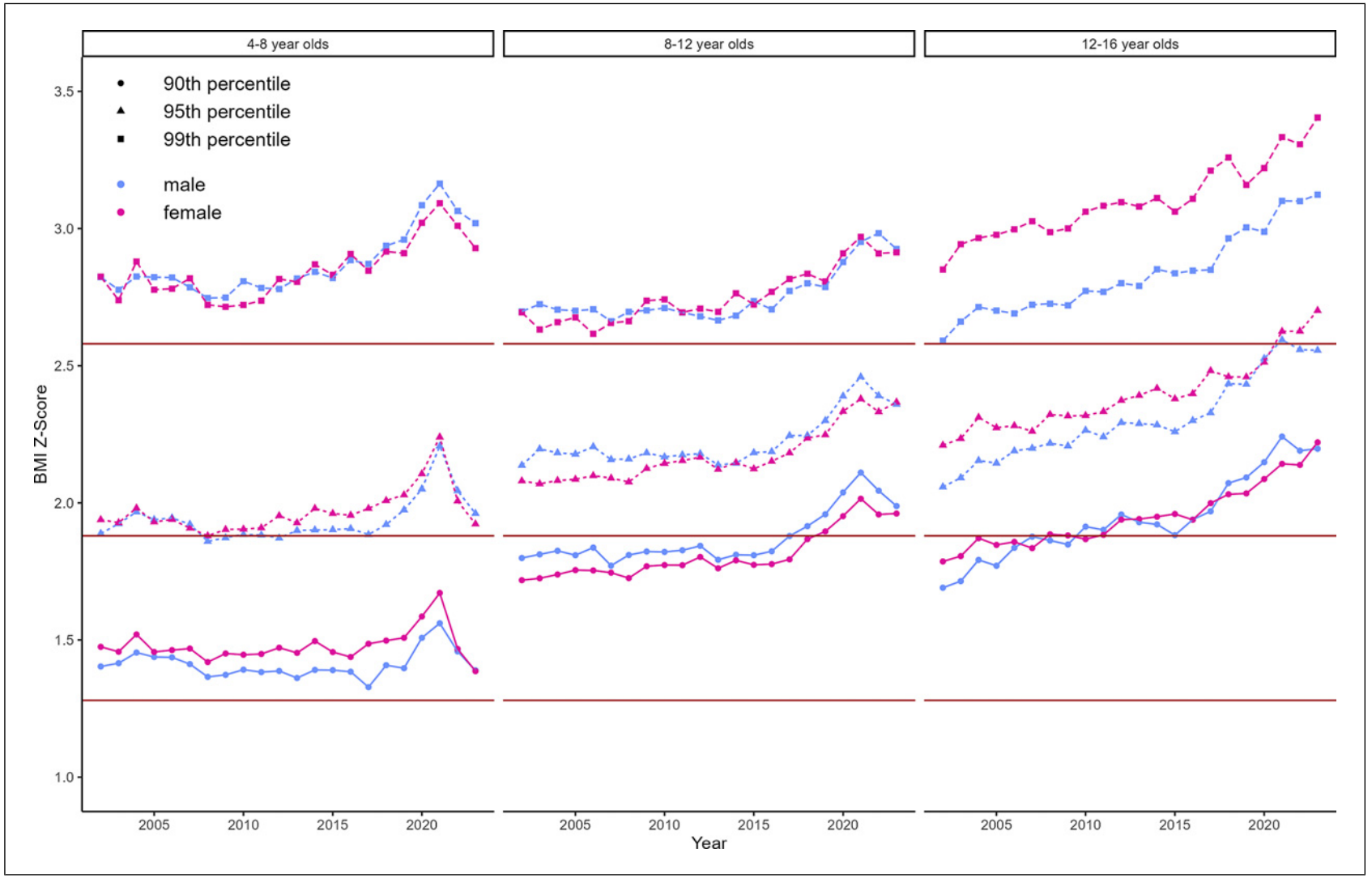

Fig. 2. Changing 90th, 95th, and 99th percentiles between 2002 and 2023 stratified by sex, age, and weight groups: Only 4- to 8-year-olds returned to pre-pandemic levels. The percentiles for 12- to 16-year-olds continued to increase drastically in 2023.

increased afterward. Children older than 12 experienced a consistent increase, which was more pronounced in boys. During the pandemic, SO became more prevalent in all age groups and both sexes, impacting 8- to 16-year-olds the most. After the pandemic, younger children returned to pre-pandemic levels, but children older than 8 did not. In 2023, the increase in SO was stronger for 8- to 16-year-old girls than for boys of the same age. Our finding that the prevalence of SO was increasing before the pandemic is in line with many other studies. A country that is particularly affected by the rising prevalence of SO is the USA [9, 10, 14]. For example, Skinner et al. [10] showed that the prevalence increased between 1996 and 2016. Furthermore, our study supports current research that identified adolescent boys as a group that is particularly vulnerable to developing a higher weight status [13, 14, 29, 30]. High or even increasing prevalences of SO were found in European [29, 31], Asian [12, 13, 32], and Oceanian [11, 33] studies as well, indicating a global problem [34]. For Germany, in contrast to our findings, Schienkiewitz et al. [16] did not find an increasing prevalence of SO or sex-related differences. This difference might be due to the smaller number of cases in the KiGGs study compared with the CrescNet database. Additionally, as reported by Mauz et al. [35], the participation of families with low socioeconomic status decreased in the second wave of the KiGGs study, which is another factor associated with a higher weight status [14, 29].

The often-cited plateau [1, 2] in the prevalences of OVW and OB for younger children was somewhat evident in our study. We found an increase in the pre-pandemic prevalence of OB in 12- to 16-year-old boys and 4- to 8-year-old girls (from 2012 onwards), while OVW rose in 12- to 16-year-old boys and all 8- to 12-year-olds. For the other groups, pre-pandemic prevalence rates remained stable or even decreased. In line with previous research, older age groups continued to be affected by increasing OB and OVW prevalences [10, 13, 14]. Also in line with our findings, Ogden et al. [14] found stability or decreases in the prevalences for younger children and increases for 12- to 19-year-olds.

With the onset of the COVID-19 pandemic, we found drastically increasing proportions of OVW, OB, and SO across all age groups and both sexes. The increase was strongest for SO, highlighting what other studies [18, 20] have shown: Children already greatly affected by excess weight were most likely to experience weight gain during the pandemic. A study by Vogel et al. [18] also indicated increasing weight status in German children and adolescents during the pandemic, continuing pre-pandemic trends. This trend is not unique to Germany as many other countries have also reported that the prevalences of OVW, OB, and SO increased during the pandemic [13, 19–21, 36, 37]. For example, a study by Lange et al. [21] found rates of BMI changes approximately twice as high during the pandemic than pre-pandemic in a US cohort of 2- to 19-year-olds. Again, the largest increase was found in children with a higher pre-pandemic weight status. Similar weight trends have been observed in Asian countries. A South Korean study [38] showed the strongest increase in 12- to 15-year-old male adolescents, a finding that is similar to the trend we found. However, in our study, the increase measured in BMI-SDS was slightly stronger in 8- to 12-year-old girls, even though the W-E of the 99th percentile for 12- to 16-year-old boys was higher.

In general, all OB and OVW groups returned to pre-pandemic levels in 2023 except 12- to 16-year-old girls. For SO, only the youngest age group returned to pre-pandemic levels. Children older than 8 remained at higher levels than before the pandemic. Moreover, while OVW and OB prevalences stabilized post-pandemic, boys older than 12 and girls older than 8 showed another drastic increase in SO in 2023. Girls affected by SO seem to struggle more to return to pre-pandemic levels. The reason remains unclear; however, according to research claiming girls suffered more than boys during the pandemic [39, 40], girls may also find it more challenging to re-adapt to a post-pandemic lifestyle. To date, research on post-pandemic weight trends is lacking. However, our findings support the hypothesis that many children who achieved weight loss post-pandemic returned to pre-pandemic levels [41]. Furthermore, Irschik et al. [36] showed that children with OB are an exception to this pattern and instead continue to gain weight. We observed the respective trend exclusively in 12- to 16-year-old girls, likely because Irschik et al. [36] did not distinguish between different degrees of OB. Indeed, we found that such patterns were predominant only in the SO groups.

Many factors contributed to pandemic weight gain: social restrictions, a more sedentary lifestyle, an increased consumption of unhealthy foods, and unhealthy eating habits [42–44]. Such factors were particularly likely to affect families with lower household income who were already more affected by higher prevalences of OVW and OB [44]. Furthermore, in Germany, routine check-ups for children, where weight issues are typically addressed, were disrupted [45], and fewer medical appointments took place during the pandemic [46]. In addition, school closings and reduced social

activities led to more screen-based leisure activities, which affected weight [47] and worsened mental health issues [47, 48].

The rising prevalence of SO is not just a pandemic issue; it highlights the urgent need for intervention due to the severe physical and mental effects of OB. OB is linked to comorbidities such as cardiovascular [5, 7, 49–53] and metabolic diseases [54], non-alcoholic fatty liver disease [6], sleep apnea, and dyslipidemia [7]. In addition, SO leads to reduced mobility [55], social isolation [56], and even unemployment [57]. Isolation, combined with OB-related comorbidities, significantly decreases income and increases healthcare costs for individuals and society [58], underscoring the need for early intervention.

Our findings have limitations: The COVID-19 pandemic led to a decline in data entry into the CrescNet database during 2020–2023, likely due to fewer medical consultations. Additionally, 4- to 8-year-olds were overrepresented in our cohort due to frequent early childhood check-ups. Lastly, CrescNet does not collect data on socioeconomic status, parental weight, or degree of deprivation, all factors linked to higher weight.

Conclusion

Our study highlights the growing concern about SO in youth, especially as the COVID-19 pandemic exacerbated the already increasing pre-pandemic trends. As the prevalence of SO in adolescents did not return to pre-pandemic levels and has even continued to rise, there is a pressing need for interventions and preventive strategies.

Acknowledgments

We thank all participating pediatricians, their patients, and the patients' families. The authors also thank Jane Zagorski for her excellent language editing and editorial support (as always).

Statement of Ethics

The registry (CrescNet) was approved by the Federal Saxonian Data Protection Authority and is registered in the clinical trial database (NCT03072537). The register was reviewed and approved by the Ethics Committee of the University of Leipzig (Ethikkommission der Universität Leipzig), Approval/reference No. 121/22-ek. Primary and specialist care pediatricians are cooperation partners of Leipzig University. They and their patients were fully informed and agreed that the data could be used for scientific purposes. Written informed consent was obtained from the parent/legal guardian of participants prior to the study.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Funding Sources

In line with its charitable aims, the CrescNet Register is supported by the following companies: BioMarin Deutschland GmbH, Sandoz Pharmaceuticals Hexal AG, Novo Nordisk Pharma GmbH, Merck Serono GmbH, Lilly Deutschland GmbH, Ipsen Pharma GmbH, and Ferring Arzneimittel GmbH. This publication has been written as part of the MD program of the LIFE Child Study, which is supported by the Free State of Saxony as per budget approved by the State Parliament and Leipzig University's Medical Faculty. Robert Stein is supported by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG); project number 493646873 – MD-LEICS and acknowledges financial support by the German Diabetes Association (DDG, "Allgemeine Projektförderung") and the Faculty of Medicine, University Leipzig ("Nachwuchsförderprogramm"). All supporters of the register played no role in the design or implementation of the study.

Author Contributions

W.K. conceptualized and designed the study, provided methodologic expertise, discussed the results, and critically reviewed and revised the manuscript. M.V. conceptualized and designed the study, supervised the analyses, discussed the results, and critically reviewed and revised the manuscript. A.B. conceptualized the manuscript, carried out the data analysis, discussed the results, and drafted the initial and final manuscript. R.G. and C.B. were responsible for data collection, discussed the results, and critically reviewed and revised the manuscript. R.P., A.K., U.S., R.S., and A.K. discussed the results, critically reviewed, and revised the manuscript. All authors contributed significantly to the intellectual content and provided valuable feedback on the manuscript. The final manuscript was approved by all authors.

Data Availability Statement

The data set presented in this article cannot be shared publicly due to ethical and legal restrictions. CrescNet collects potentially sensitive information. Publishing the data is not covered by the informed consent provided by the study participants. Additionally, the CrescNet Data Protection Concept requires all (external and internal) researchers who want to access the data to sign a project agreement. Researchers interested in accessing data may contact the study by writing to forschungsdaten@medizin.uni-leipzig.de. Information on the measurement metrics and the standard operation procedures are available on https://crescnet.org.

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