RESEARCH NOTE

A longitudinal analysis comparing the proportion of children with excess weight before and during the COVID-19 pandemic

[version 1; peer review: awaiting peer review]

Gillian Santorelli1, John Wright1, Duncan Cooper2, Laura Lennon1, Sarah Muckle2, Jane West1

1Born in Bradford, Bradford Institute for Health Research, Bradford, West Yorkshire, BD9 6RJ, UK
2Department for Public Health, City of Bradford Metropolitan District Council, Bradford, West Yorkshire, BD1 1HX, UK

Abstract

Background: The National Child Measurement Programme (NCMP) reported an increase in the prevalence of children in Reception (4-5 years) and Year 6 (10-11 years) with overweight/obesity during the coronavirus disease 2019 (COVID-19) pandemic compared to the previous year. This prompted us to conduct a longitudinal analysis to compare weight status before and during the pandemic.

Methods: We compared the change in overweight/obesity status of children in Year 1 (Y1) (during the pandemic) who had also been measured as part of the NCMP in Reception (the year before the pandemic), with the change in a sample of children during a two-year ‘pre-pandemic’ period.

Results: Overweight/obesity increased by 1.2% to 24.8% ($p=0.582$) between Reception and Y1 in the pre-pandemic group and by 5.4% to 28.5% ($p=0.002$) in the pandemic group. This was mainly driven by an increase in the proportion of overweight boys in the pandemic group (22% to 30%) compared to the pre-pandemic group rates (~24% at both time-points). Rates in girls increased by 2.0% to 24.8% in the pre-pandemic group and by 3.3% to 27.6% in the pandemic group. A higher proportion of Reception-aged White children in the pre-pandemic group were overweight/obese compared to the pandemic group, but by Y1 the rates were higher in the pandemic group. In children of South Asian (SA) heritage, the proportion with excess weight in Reception was 18.3% in the pre-pandemic group, increasing to 21.6% by Y1. The increase was substantially higher in the pandemic group of SA children, with an increase from 22.9% in Reception to 30.3% by Y1.

Conclusions: We observed a marked increase in the proportion of children with an unhealthy body mass index (BMI) during the first year of the pandemic, suggesting that the societal disruptions caused by lockdown may have adversely affected children’s diet and levels of
physical activity.

**Keywords**
Covid-19, NCMP, overweight/obesity, ethnicity, children

This article is included in the **Born in Bradford** gateway.

This article is included in the **Coronavirus (COVID-19)** collection.

**Corresponding author:** Gillian Santorelli (gillian.santorelli@bthft.nhs.uk)

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Introduction
In early 2020, countries throughout the world introduced societal restrictions in an attempt to contain the spread of coronavirus disease 2019 (COVID-19). Whilst lockdowns have been effective in reducing infections, they have inevitably had adverse consequences on physical health, mental health, behaviours and lifestyle, with increased food intake, poorer diet quality and reduced physical activity all being reported in adults. There is also evidence that the health of children has been impacted. The closure of schools and sporting facilities together with limited opportunities to socialise outdoors has resulted in reduced levels of physical activity (PA): one UK survey found that the percentage of children aged between 9 – 13 years who were sufficiently active reduced from 69% before the pandemic to 29% during the first COVID-19 lockdown, with children from ethnic minorities having lower levels of PA compared to White children. There is sparse data on how children’s diets have changed during the pandemic, but as parents are the primary providers of their children’s food – particularly during lockdown – it is reasonable to assume that the same negative dietary changes reported in adults may have also affected children. A clear consequence of poor diet and reduced PA is weight gain, and because children with excess weight are more likely to be overweight or obese as adults, there are concerns that lockdown will have long-reaching consequences to the health of young people.

As part of the UK government’s strategy to reduce child obesity, the National Child Measurement Programme (NCMP) measures the height and weight of English primary school children in Reception (aged 4–5 years) and Year 6 (aged 10–11 years). Due to the COVID-19 pandemic and related disruption, collection during the school year 2020/21 was restricted to a sample of schools, and statistical weighting applied to estimate the prevalence of excess weight (i.e. overweight or obese, body mass index [BMI] ≥85th centile) at a national level. The programme found that between 2019/20 to 2020/21, the prevalence of overweight/obesity increased from 23.0% to 27.7% in Reception, and from 35.2% to 40.9% in Year 6. Although overweight/obesity rates were similar in boys and girls in Reception, by Year 6 the prevalence was substantially higher in boys compared to girls (44.7% vs 37.0%), and the rates of obesity in the most deprived areas was twice that than in the least deprived areas. The proportion of children with excess weight also differed according to ethnic group: in Reception (Year 6) overweight/obesity accounted for 27.4% (38.8%) of white children, 25.8% (46.7%) of Asian children, and 37.9% (52.4%) of Black children.

These observed increases in the proportion of children who are overweight/obese, based on cross-sectional surveys, are a concern, but interpretation is limited by the ecological inference of cross-cohort comparison. We aimed to replicate these analyses in a longitudinal study of individual children to quantify whether the COVID-19 pandemic and related restrictions had an impact on the weight status of the same cohort of children living in Bradford (UK) by comparing the proportion of children who were overweight/obese prior to the COVID-19 pandemic when they were in their reception year (school year 2019/20), with the proportion during the pandemic when the same children were in Year 1 (school year 2020/21). To examine whether any differences were greater than what might have been ordinarily expected, we compared the differences in proportions with those observed in children over a similar time-period pre-pandemic using a cohort of children resident in the same area.

Methods
Bradford is a city in the North of England with high levels of deprivation and poor health, and a multi-ethnic population including a large Pakistani-heritage community. The city is experiencing rapidly increasing prevalence of diabetes and cardiovascular disease and 41% of children at age 10/11 are overweight/obese.

Data for this study were obtained for children attending one of the 141 primary schools within Bradford who had NCMP height and weight measurements taken when they were in their Reception year in September/October 2019 (aged 4 to 5 years), and who then had repeat measurements between May and July 2021 when they were in Year 1 (aged 5 to 6 years), a mean time difference of 22.3 (SD 0.5) months. These repeat measurements for Year 1 children were taken alongside NCMP Reception and Year 6 measurements for the school year 2020/21 as a local public health initiative supported by City of Bradford Metropolitan District Council to better understand the impact of the pandemic on the health of children growing up in Bradford. As the NCMP programme for school year 2020/21 was restricted to a sample of schools (n=51) due to ongoing COVID-19 restrictions, the data used here represent measurements taken from children attending a sub-sample of Bradford schools selected for the 2020/21 NCMP programme (the ‘pre-pandemic’ sample, n=1,308).

Whilst the repeat measurements taken in Year 1 allow us to observe any change in the rates of overweight/obesity over the course of one school year during the pandemic, the lack of NCMP data at this time point in non-pandemic years limits our opportunity for a comparison group. However, using the Connected Bradford Research database (cBradford), we were able to obtain BMI data from primary care records over a similar time-period after NCMP Reception measurements taken from 731 children before the pandemic, thereby allowing us to provide some form of reference. This ‘pre-pandemic’ group consisted of children for whom NCMP measurements were collected in school years 2016/2017 to 2018/2019, and who had height and weight measurements in their primary care records taken within ±3 months of the time-frame of the measurements of pandemic sample, i.e. between 19 – 26 months apart. Where a child had >1 measurement during this time period, the follow-up measurement closest to 22.5 months (the average time-frame between measurements in the pandemic sample) after the NCMP measurement was chosen. Table 1 presents the number of children included in both samples stratified by sex and ethnicity (White [White British, Irish, any other White background], South Asian [Indian, Pakistani, Bangladeshi] and any other minority ethnic group). Age- and sex-adjusted BMI...
Table 1. Changes in the percentage of children with excess weight (body mass index [BMI] ≥85th centile) between Reception and Year 1 before and during the pandemic.

<table>
<thead>
<tr>
<th></th>
<th>Pre-pandemic sample</th>
<th>Pandemic sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>All children</td>
<td>731</td>
<td>23.5%</td>
</tr>
<tr>
<td>Boys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>388</td>
<td>24.2%</td>
</tr>
<tr>
<td>White</td>
<td>167</td>
<td>28.7%</td>
</tr>
<tr>
<td>South Asian</td>
<td>164</td>
<td>18.9%</td>
</tr>
<tr>
<td>Girls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>343</td>
<td>22.7%</td>
</tr>
<tr>
<td>White</td>
<td>140</td>
<td>29.3%</td>
</tr>
<tr>
<td>South Asian</td>
<td>164</td>
<td>17.7%</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>307</td>
<td>29.0%</td>
</tr>
<tr>
<td>South Asian</td>
<td>328</td>
<td>18.3%</td>
</tr>
<tr>
<td>Other</td>
<td>96</td>
<td>24.0%</td>
</tr>
</tbody>
</table>

* BMI extracted from primary care records at similar ages to those taken in Year 1 in the Pandemic sample.

z-scores were calculated using the UK90 growth reference7, and the proportion of children with excess weight (BMI ≥85th centile) were examined. All analyses were performed using STATA/SE v17.0 (StataCorp LP, College Station, TX, USA, RRID:SCR_012763).

Ethics statement
NCMP measurements are collected on an opt-out basis. As this was a local public health surveillance initiative ethics approval was not required for the additional Year 1 measurements and these were collected in the same way as Reception and Year 6 measurements where parents are provided with information about the measurements and the opportunity to opt their child out of the measurements. Data on the number of opt-outs is not routinely collected for the NCMP and wasn’t for these additional measurements. However, feedback from those taking the measurements suggests that opt-outs were minimal and similar to what would be expected for the usual NCMP measures. Ethical approval for the cBradford research database was granted by the East Midlands-Derby Research Ethics Committee (IRAS ref:227117 and REC ref: 17/EM/0254).

Results
Table 1 and Figure 1 show the proportion of children with overweight and obesity overall and stratified by sex and ethnicity group in Reception and Year 1. In Reception, the proportion of children with overweight/obesity was similar in both the pre-pandemic and pandemic groups (23.5% and 23.1%, respectively). By Year 1 the rates had increased by 1.2% to 24.8% (p=0.582) and by 5.4% to 28.5% (p=0.002) in the pre-pandemic and pandemic groups, respectively. The percentage of boys in the pre-pandemic sample who were overweight/obese was 24.2% in Reception and 24.7% in Year 1. During the pandemic, the rates of overweight/obesity in Reception-aged boys was comparatively lower at 21.9%, but increased to almost 30% by Year 1 (p=0.002). In Year 1, 24.8% of girls in the pre-pandemic...
Figure 1. Percentage of children with excess weight (body mass index [BMI] ≥85th centile) in Reception and Year 1 before and during the pandemic.

group were overweight/obese compared to 27.6% in the pandemic group, representing an increase of 2.0% and 3.3%, respectively, from Reception (both non-significant at the 5% level). When we stratified our samples by ethnic group, the rates of overweight/obesity were almost 11% higher in White compared to SA Reception-aged children in the pre-pandemic sample, though this difference reduced to 5% in Year 1 due to rates falling in White children but increasing in SA children. Conversely, a similar proportion of children in both White and SA ethnic groups were overweight/obese in the pandemic sample in Reception at around 23%, increasing to around 30% by Year 1 (p≤0.02 for both). The increase in the proportion of children of other minority ethnic groups with overweight/obesity in the pre-pandemic group was larger than that observed in White and SA children (+5.2%, p=0.414) but considerably smaller in the pandemic group (+1.3%, p=0.743).

Conclusion/discussion
We have used NCMP and local data to estimate the potential impact of pandemic restrictions on rates of overweight and obesity. We were keen to establish whether any differences identified were greater than what we might expect to see in non-pandemic conditions and used data collected during the three years before the pandemic from children living in the same area. We have shown that there have been greater increases in overweight/obesity in less than two years in the same group of children during the pandemic compared to what we might expect to see in a similar cohort of children growing up in the same city before the pandemic, and this was largely driven by an increase in weight in boys. Current and previous NCMP results show that levels of overweight/obesity increase considerably between Reception and Year 6 even in non-pandemic conditions, and here we have found that the pandemic and related restrictions seem to have driven even greater increases in a short time period in rates of overweight/obesity above and beyond those we might expect to see without pandemic restrictions.

There are some limitations to the data. Due to ongoing pandemic disruption only a sub-sample of schools was included in the NCMP programme for school year 2020/21 both in Bradford and nationally. This means that the Year 1 data for the pandemic group are from a sub-sample of all children in Year 1.
in 2020/21. It also means that comparisons with NCMP England data are limited as the sample of schools providing NCMP data for year 2020/21 is variable and limited in some areas. There were also some differences in the ethnic mix in the two groups (pandemic and pre-pandemic), with less children of SA heritage and more White and other minority ethnic children in the pandemic sample compared to the pre-pandemic sample. There also appears to be a greater proportion of White children in Reception with excess weight in the pre-pandemic group which is not evident in the pandemic group, but unlike the other ethnic groups, the proportion of overweight/obese White children in the pre-pandemic sample decreased between Reception and Year 1. One explanation for this may be that we obtained follow-up measurements from children’s primary care records, and the presence of BMI measurements could represent children for whom there was a concern about their weight, and therefore potentially had been enrolled in a weight management programme. However, it is unlikely that this would have affected White children only, and without being able to explain this inconsistency it is difficult to comment on the impact of the pandemic on children of White ethnicity.

Despite the limitations of the pre-pandemic sample outlined above, it utilises available data and provides some information on what weight changes might be expected in non-pandemic times. Our findings raise concern about the longer term health impacts of the pandemic as we know that weight in childhood tracks into adulthood especially in the poorest families and further increases in overweight and obesity in this population suggest that the least advantaged communities were not only hit hardest by COVID-19 itself but may now also be disproportionately impacted by the wider longer term health impacts of pandemic restrictions. Further surveillance is essential to help inform public health strategies to limit these especially for children and young people and our least advantaged communities.

**Data availability**

**Underlying data**


- Note that in the variable ‘pandemicstatus’, 1=pre-pandemic, 2=during pandemic.

Data are available under the terms of the Creative Commons Zero “No rights reserved” data waiver (CC0 1.0 Public domain dedication).

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**References**


