Are children living with obesity more likely to experience musculoskeletal symptoms during childhood? A linked longitudinal cohort study using primary care records

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ABSTRACT

Objective To assess whether there is a higher incidence of musculoskeletal consultations in general practice among children with obesity.

Design Longitudinal

Setting 285 north-east London general practitioners (GPs).

Participants 63 418 (50.9% boys) Reception and 55 364 (50.8% boys) Year 6 National Child Measurement Programme (NCMP) participants, linked to GP electronic health records (EHRs).

Main outcome measure A GP consultation with a recorded musculoskeletal symptom or diagnosis.

Methods We calculated proportions with a musculoskeletal consultation by ethnic-adjusted weight status (underweight <2nd; overweight ≥91st; obese ≥98th centile), sex, ethnicity, and area-level deprivation. We estimated mutually-adjusted hazard ratios (HR) and 95% confidence intervals (95% CI) using Cox's proportional regression models stratified by school year and sex.

Results We identified 1868 (3.0%) Reception and 4477 (8.1%) Year 6 NCMP participants with at least one musculoskeletal consultation. In adjusted analyses, Reception year girls with a body mass index (BMI) classified as overweight (HR 1.24, 95% CI 1.02 to 1.52) or obese (HR 1.67, 95% CI 1.35 to 2.06) were more likely to have at least one musculoskeletal consultation. Year 6 girls with obesity were more likely (HR 1.20, 95% CI 1.07 to 1.35), and boys with a BMI in the underweight range were less likely (HR 0.39, 95% CI 0.21 to 0.73), to have a musculoskeletal consultation.

Conclusions Girls living with obesity at the start or end of primary school are more likely to attend their GP for a musculoskeletal consultation. Routine linkage of NCMP data to EHRs provides useful insights into childhood health conditions related to excess weight in early childhood. Recognition of obesity as a contributing factor for musculoskeletal symptoms may inform clinical management, particularly in girls.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Obesity is considered a contributing factor for some musculoskeletal outcomes. A recent systematic review found that children with obesity at school entry are more likely to experience back pain, slipped capital femoral epiphysis or fractures during childhood; however, the strength of this evidence is low due to the small number of eligible studies included in the review and their overall quality.

WHAT THIS STUDY ADDS

⇒ We found in a large ethnically diverse population of primary school children that girls, but not boys, living with obesity are more likely to have at least one general practice consultation for a musculoskeletal symptom or diagnosis.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This research adds to our understanding of associations between obesity and musculoskeletal outcomes during childhood, and has the potential to inform clinical assessment.

⇒ These analyses demonstrate the value of linking routinely collected National Child Measurement Programme data to general practice electronic health records for research.

INTRODUCTION

Global prevalence estimates suggest one in three adults experience a chronic musculoskeletal condition with associated symptoms of pain, disability, poor mental health and a range of other comorbidities.[1–4] A UK-based primary care study found that one in every three children had a musculoskeletal problem, ranging from self-limiting conditions to serious issues with associated mortality or severe morbidity.[5]

The increasing prevalence of obesity may contribute to the overall burden of poor musculoskeletal health. Obesity increases the likelihood of some musculoskeletal outcomes,[6] particularly back pain,[7] chronic pain[8 9] and slipped capital femoral epiphysis (SCFE).[10] The underpinning pathophysiology suggests that the excess weight carried with obesity places additional stress on the body's joints.

Paulis and co-authors' 2014 systematic review found there was evidence in support of an association between overweight and musculoskeletal pain and injuries and fractures during childhood, although the quality of evidence was considered

moderate to low.[11] This review predominantly summarised cross-sectional studies, leaving the temporal relationship between exposure and outcome difficult to ascertain. Our recent systematic review of longitudinal evidence found that children with obesity at school entry are more likely to experience back pain, SCFE or fractures during childhood, but there were few eligible studies included and they were of moderate quality.[12] We noted that potential confounding variables were inconsistently accounted for in the included studies.

In this study we aim to address this gap in knowledge by investigating whether the incidence of musculoskeletal symptoms is increased during childhood among children living with obesity compared with those of healthy weight.

METHODS

Study population

We included 123 836 of 128 544 (96.3%) National Child Measurement Programme (NCMP) participants from four north-east London (NEL) local authorities (City and Hackney, Newham, Tower Hamlets, and Waltham Forest) whose records were deterministically linked to a primary care registration, using a pseudonymised National Health Service (NHS) number created using OpenPseudonymiser software[13] (online supplemental figures 1,2).

Data sources

Children in the first (Reception) and last (Year 6) years of primary school were invited to participate in the NCMP, which measures the height and weight of 4- to 5-year-olds and 10- to 11-year-olds attfending state-maintained schools in England. We developed data processing agreements, in line with national guidance,[14] with each of the four local authority public health departments for the sharing of NCMP data for the 2013/14 to 2018/19 academic years.

Pseudonymised primary care data were obtained from the Discovery Data Service which receives coded primary care data on a daily basis for 285 general practitioners (GPs) in NEL. Demographic and clinical data recorded up to 1 November 2021 were extracted for NCMP participants successfully linked to the Discovery Data Service. All data were extracted and managed according to UK NHS information governance requirements.[15]

Data processing

Musculoskeletal consultations were identified as events recorded with any of the pre-specified Systemized Nomenclature of Medicine (SNOMED) clinical codes (online supplemental table 1). Only the first record of a musculoskeletal consultation was retained and 5054 children with a musculoskeletal consultation occurring before their NCMP measurement were excluded (online supplemental figure 3).

Primary outcome

For each child, a binary variable was derived indicating those with or without at least one musculoskeletal GP consultation following NCMP measurement. The censor date was the date of the first musculoskeletal consultation. The censor date for children with no musculoskeletal consultation was the earliest of the date at which clinical data were extracted (31 October 2021) or the GP registration end date.

Exposure

Ethnic-specific body mass index (BMI) adjustments[16] were applied to NCMP-recorded BMI, and weight status was determined according to the UK1990 clinical reference standard[17] categorising BMI into one of four mutually exclusive groups: 'underweight' (<2nd centile), 'healthy weight' (≥2nd to <91st centile), 'overweight' (≥91st to <98th centile) or 'obese' (≥98th centile) based on alignment with sex- and age-specific BMI centiles using the LMS growth tool Excel add-in.[18 19]

Confounding factors

NCMP-recorded ethnic group was defined using the NHS classification[20] and grouped into four mutually exclusive groups: White ('White British', 'White Irish', or 'any other White background'); Black ('Black African', 'Black Caribbean', or 'any other Black background'); South Asian ('Indian', 'Pakistani', 'Bangladeshi' or 'Sri Lankan'); and a combination of Mixed and Other ('any other ethnic group', 'mixed ethnicity', 'Chinese' or 'Asian other'). Where ethnic group was missing or reported as 'not stated' in the NCMP (n=11 903), the ethnic group most recently recorded in the electronic health record (EHR) was used (n=10 785). We excluded 1118 children with ethnic group missing in both data sources (0.9% of 126 829).

An area-level measure of relative deprivation—Index of Multiple Deprivation (IMD) score and an associated decile[21]—assigned by Public Health England to each NCMP record based on the postcode of the child's home address was used. IMD decile was concatenated into five quintiles ranging from most to least deprived. In some instances it was necessary to combine the third to fifth least deprived quintiles to minimise the risk of disclosure of individuals.

Statistical analyses

We estimated the proportion with and without at least one musculoskeletal consultation, by sociodemographic characteristics. Follow-up time was derived as the difference in time (years) between NCMP and censor date, and incidence rates (per 1000 person-years) with 95% confidence intervals (95% CI) calculated. Cumulative incidence was plotted using Kaplan-Meier failure functions by weight status. Cox's proportional hazards regression was conducted to estimate hazard ratios (HR) and corresponding 95% CI for a first musculoskeletal consultation, adjusting for confounding factors, academic year of participation in the NCMP and local authority of the school. We tested an interaction between sex and school year of NCMP measurement and stratified subsequent analyses. Proportional hazards assumptions were tested using a log-log plot ($-\ln[-\ln(\text{survival})]$ curves) for each category of weight status, and deemed to be met if the curves were parallel. All analyses were conducted using Stata (MP/15.0).

RESULTS

Sample characteristics

The study sample comprised 63 418 (50.9% boys) 4- to 5-year-olds and 55 364 (50.8% boys) 10- to 11-year-olds in the Reception and Year 6 cohorts, respectively. The majority of children lived in the most deprived areas and were from Black or minority ethnic groups (table 1). Fewer than 1% of children were missing ethnic background and were subsequently excluded from further analyses (n=1118).

Table 1 Sample characteristics by sex and school year of participation in the National Child Measurement Programme

| | | Reception cohort (n=63 418) | | | | | | Year 6 cohort (n=55 364) | | | | | |
| | | Boys (n=32 257) | | | Girls (n=31 161) | | | Boys (n=28 270) | | | Girls (n=27 094) | | |
		N	%	SD*	N	%	SD*	N	%	SD*	N	%	SD*
Local authority†													
	City and Hackney	7368	22.8	0.49	7081	22.7	0.50	6259	22.1	0.52	5930	21.9	0.54
	Newham	10 799	33.5	0.45	10 613	34.1	0.46	9793	34.6	0.48	9438	34.8	0.49
	Tower Hamlets	5848	18.1	0.50	5595	18.0	0.51	5252	18.6	0.54	5118	18.9	0.55
	Waltham Forest	8242	25.6	0.48	7872	25.3	0.49	6966	24.6	0.52	6608	24.4	0.53
Academic year‡													
	2013/14	2832	8.8	0.53	2821	9.1	0.54	2249	8.0	0.57	2146	7.9	0.58
	2014/15	3366	10.4	0.53	3335	10.7	0.54	2779	9.8	0.56	2680	9.9	0.58
	2015/16	6174	19.1	0.50	5979	19.2	0.51	5423	19.2	0.53	5005	18.5	0.55
	2016/17	6804	21.1	0.49	6352	20.4	0.51	5692	20.1	0.53	5560	20.5	0.54
	2017/18	6619	20.5	0.50	6511	20.9	0.50	6002	21.2	0.53	5724	21.1	0.54
	2018/19	6462	20.0	0.50	6163	19.8	0.51	6125	21.7	0.53	5979	22.1	0.54
Ethnic group§													
	White	9151	28.4	0.47	8682	27.9	0.48	6761	23.9	0.52	6478	23.9	0.53
	Mixed and other	6481	20.1	0.50	6171	19.8	0.51	5668	20.0	0.53	5425	20.0	0.54
	South Asian	10 425	32.3	0.46	10 129	32.5	0.47	9550	33.8	0.48	9278	34.2	0.49
	Black	5962	18.5	0.50	5933	19.0	0.51	5983	21.2	0.53	5587	20.6	0.54
	Missing¶	238	0.7	0.55	246	0.8	0.56	308	1.1	0.59	326	1.2	0.60
Index of Multiple Deprivation quintile**													
	Most deprived	17 423	54.0	0.38	17 130	55.0	0.38	15 670	55.4	0.40	15 068	55.6	0.40
	2	12 474	38.7	0.44	11 811	37.9	0.45	10 652	37.7	0.47	10 084	37.2	0.48
	3	1921	6.0	0.54	1818	5.8	0.55	1588	5.6	0.58	1606	5.9	0.59
	4	300	0.9	0.55	279	0.9	0.56	255	0.9	0.59	233	0.9	0.60
	Least deprived	94	0.3	0.56	85	0.3	0.57	57	0.2	0.59	70	0.3	0.61
	Missing	45	0.1	0.56	38	0.1	0.57	48	0.2	0.59	33	0.1	0.61
Weight status††													
	Underweight	599	1.9	0.55	322	1.0	0.56	298	1.1	0.59	377	1.4	0.60
	Healthy weight	25 216	78.2	0.26	25 315	81.2	0.25	17 129	60.6	0.37	17 969	66.3	0.35
	Overweight	3349	10.4	0.53	3081	9.9	0.54	4895	17.3	0.54	4516	16.7	0.55
	Obese	2855	8.9	0.53	2197	7.1	0.55	5639	19.9	0.53	3906	14.4	0.56
	Missing	238	0.7	0.55	246	0.8	0.56	309	1.1	0.59	326	1.2	0.60
At least one musculoskeletal consultation													
	No	31 334	97.1	0.09	30 205	96.9	0.10	25 867	91.5	0.17	24 970	92.2	0.17
	Yes	923	2.9	0.55	956	3.1	0.56	2403	8.5	0.57	2124	7.8	0.58

*Standard deviation.
†Local authority of school where child participated in the National Child Measurement Programme (NCMP).
‡Academic year of participation in the NCMP. Academic years run from September to July.
§As recorded in the NCMP and, where missing, supplemented with ethnic group as recorded in the child's primary care electronic health record.
¶Children with missing ethnic group are excluded from subsequent analyses.
**2015 Index of Multiple Deprivation quintile assigned based on the child's home address postcode as recorded by the school where the child participated in the NCMP.
††NCMP-recorded body mass index (BMI) after application of ethnic-specific BMI adjustments, categorised according to UK1990 clinical reference standard: 'overweight' (≥91st to <98th centile) or 'obese' (≥98th centile).

In the Reception cohort, 8.9% of boys and 7.1% of girls were living with obesity compared with 19.9% and 14.4% in the Year 6 cohort (table 1). Among children in the Reception and Year 6 cohorts, 3.0% and 8.1% had at least one musculoskeletal consultation following NCMP measurement. Just 194 Reception and 875 Year 6 children had more than one musculoskeletal consultation following their NCMP measurement.

Do musculoskeletal consultations vary by weight status?

The proportion of the Reception cohort with a musculoskeletal consultation was higher among girls with obesity compared with girls with a healthy weight, but there were no differences among boys (table 2). In the Year 6 cohort, a greater proportion of girls with obesity, and a smaller proportion of boys with a BMI classified as underweight, had a musculoskeletal consultation, compared with their counterparts with a healthy weight.

Which musculoskeletal symptoms and diagnoses are recorded?

The most commonly recorded musculoskeletal symptoms/diagnoses were related to the knee and back (table 3). Among the Reception cohort with at least one musculoskeletal consultation, 45.6% of boys and 41.4% of girls reported

Table 2 Distribution of those with at least one musculoskeletal consultation following National Child Measurement Programme measurement, by school year of participation and sex

		Reception (n=1868)						Year 6 (n=4477)					
		Boys (n=917)			Girls (n=951)			Boys (n=2374)			Girls (n=2103)		
		N	%	95% CI*	N	%	95% CI*	N	%	95% CI*	N	%	95% CI*
Ethnic group†													
	White	238	2.6	2.3 to 2.9	264	3.0	2.7 to 3.4	562	8.3	7.7 to 9.0	543	8.4	7.7 to 9.1
	Mixed and other	181	2.8	2.4 to 3.2	192	3.1	2.7 to 3.6	497	8.8	8.1 to 9.5	423	7.8	7.1 to 8.5
	South Asian	307	2.9	2.6 to 3.3	285	2.8	2.5 to 3.2	749	7.8	7.3 to 8.4	642	6.9	6.4 to 7.5
	Black	191	3.2	2.8 to 3.7	210	3.5	3.1 to 4.0	566	9.5	8.7 to 10.2	495	8.9	8.1 to 9.6
Index of Multiple Deprivation quintile‡													
	1 (most deprived)	583	3.3	3.1 to 3.7	618	3.6	3.4 to 3.9	1462	9.3	9.0 to 9.9	1349	9.0	8.6 to 9.5
	2	280	2.2	2.0 to 2.5	283	2.4	2.2 to 2.7	760	7.1	6.7 to 7.7	628	6.2	5.8 to 6.8
	3–5 (least deprived)	51	2.2	1.7 to 2.9	47	2.2	1.6 to 2.9	151	7.9	6.9 to 9.4	125	6.5	5.6 to 7.9
Weight status													
	Underweight	20	3.3	2.1 to 5.1	11	3.4	1.9 to 6.1	10	3.4	1.8 to 6.1	28	7.4	5.2 to 10.5
	Healthy weight	701	2.8	2.6 to 3.0	728	2.9	2.7 to 3.1	1485	8.7	8.3 to 9.1	1370	7.6	7.2 to 8.0
	Overweight	102	3.0	2.5 to 3.7	111	3.6	3.0 to 4.3	399	8.2	7.4 to 9.0	343	7.6	6.9 to 8.4
	Obese	94	3.3	2.7 to 4.0	101	4.6	3.8 to 5.6	480	8.5	7.8 to 9.3	362	9.3	8.4 to 10.2

*Confidence interval.
†As recorded in the National Child Measurement Programme (NCMP) and, where missing, supplemented with ethnic group as recorded in the child's primary care electronic health record.
‡2015 Index of Multiple Deprivation quintile assigned based on the child's home address postcode as recorded by the school where the child participated in the NCMP. The third, fourth and fifth least deprived quintiles were combined to minimise disclosive risk.
§NCMP-recorded body mass index (BMI) after application of ethnic-specific BMI adjustments, categorised according to UK1990 clinical reference standard: 'underweight' (<2nd centile), 'healthy weight' (≥2nd to <91st centile), 'overweight' (≥91st to<98th centile) or 'obese' (≥98th centile).

knee pain. Among the Year 6 cohort, equivalent proportions were 40.4% and 35.8%. In the Reception cohort, 21.6% of boys and 32.1% of girls reported back pain, compared with 30.3% of boys and 44.8% of girls in the Year 6 cohort.

Does the incidence of musculoskeletal consultations vary by weight status?

Person-years of follow-up ranged from 2 to 8 years in both cohorts. On average, the first musculoskeletal consultation occurred 2.7 (IQR 1.4–4.3) and 2.1 (1.1–3.3) years after Reception and Year 6 NCMP measurements, respectively.

The incidence of at least one musculoskeletal consultation among boys and girls was 7.5 and 8.0 per 1000 person-years in the Reception cohort, and 21.5 and 19.9 per 1000 person-years in the Year 6 cohort (online supplemental table 2). The incidence of musculoskeletal consultations was higher among girls but not boys living with obesity in the Reception and Year 6 cohorts compared with their counterparts with a healthy weight, and, in the Year 6 cohort, lower in boys with a BMI classified as underweight.

The cumulative incidence of a musculoskeletal consultation in the Reception cohort was higher in girls with obesity than in girls in other weight categories (figure 1), but there was uncertainty around this estimate given the small sample size. Among the Year 6 cohort, the cumulative incidence was similar in all weight status groups, with the exception of boys with a BMI considered underweight, in whom it was lower than in other weight categories (figure 1). The 95% CI surrounding this estimate did not overlap with any other weight status groups despite the small sample size.

Table 3 Distribution of first recorded musculoskeletal symptoms/diagnoses by anatomical region, stratified by school year of National Child Measurement Programme participation and sex

|	Reception				Year 6			
	Boys		Girls		Boys		Girls	
	N	%	N	%	N	%	N	%
At least one foot consultation								
Pes planus (flat foot)	115	12.5	95	10.0	146	6.1	112	5.3
At least one knee consultation								
Osgood-Schlatter's disease (osteochondrosis), genu valgum (knock knee) or genu varum (bow leg)	47	5.1	55	5.8	378	15.9	136	6.5
Arthralgia of knee (knee joint pain)	418	45.6	394	41.4	960	40.4	753	35.8
At least one hip consultation								
Arthralgia of hip (hip joint pain), Legg-Calve-Perthes disease or slipped capital femoral epiphysis	139	15.2	102	10.7	170	7.2	160	7.6
At least one back consultation								
Back pain	198	21.6	305	32.1	720	30.3	942	44.8
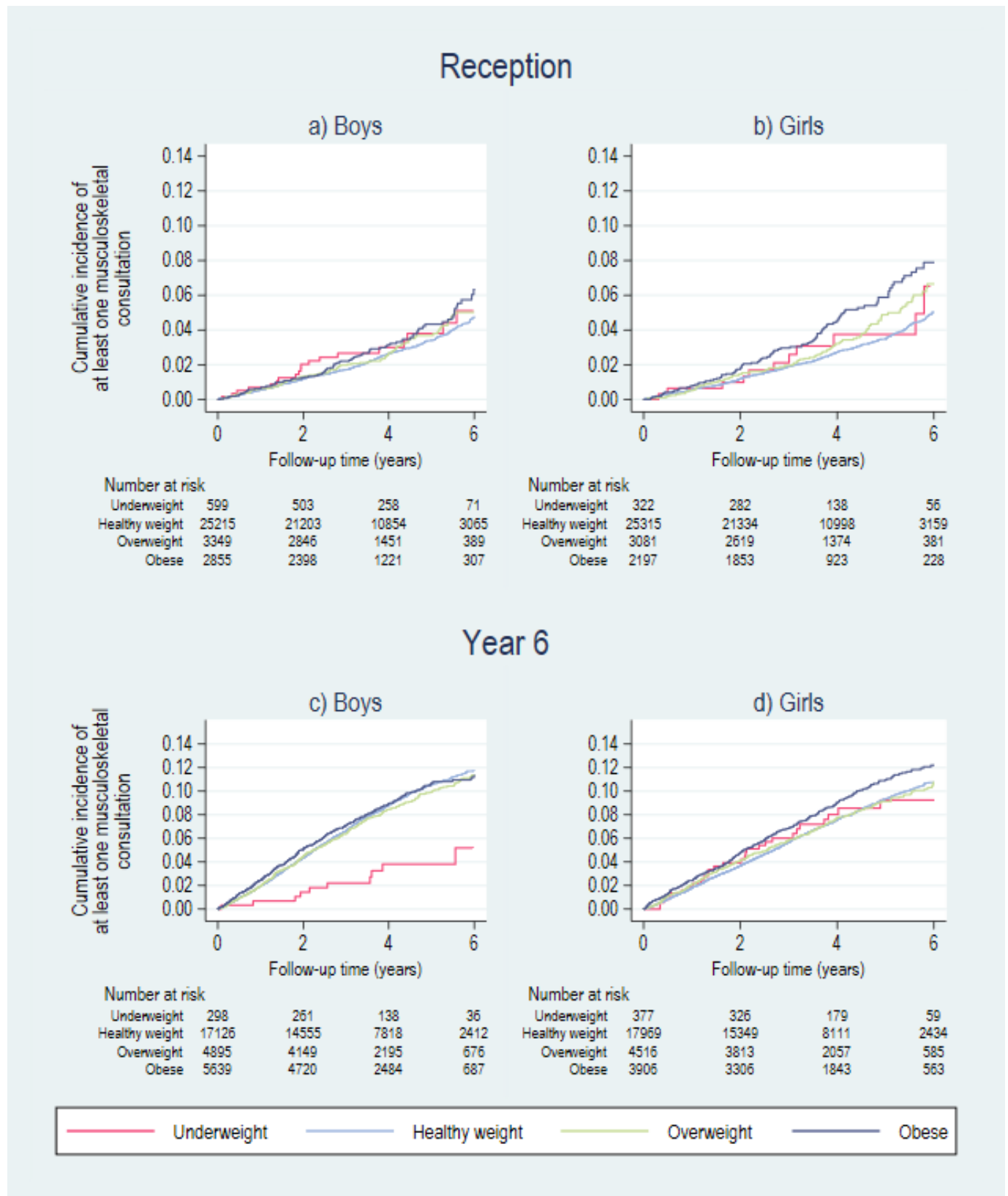
Figure 1 Unadjusted Kaplan-Meier failure function plotted as cumulative incidence of a first musculoskeletal consultation, by weight status, stratified by school year of participation in the National Child Measurement Programme (NCMP), and sex. NCMP-recorded body mass index (BMI) after application of ethnic-specific BMI adjustments, categorised according to UK1990 clinical reference standard: 'underweight' (<2nd centile), 'healthy weight' (≥2nd to <91st centile), 'overweight' (≥91st to <98th centile) or 'obese' (≥98th centile). Graphs truncated after 6 years of follow-up due to small numbers.

Are children living with obesity more likely to have at least one musculoskeletal consultation?

The proportional hazards assumption was met (online supplemental figure 4A,B). In multivariable Cox's proportional hazard regression analyses including all children, an interaction term between sex and school year was statistically significant (HR 0.87, 95%CI 0.78 to 0.97) (online supplemental table 3). Consequently, analyses were stratified by sex and school year. Girls with a BMI in the overweight (HR 1.24, 95%CI 1.02 to 1.52) or obese categories (HR 1.67, 95%CI 1.35 to 2.06) in the Reception cohort had an increased likelihood of at least one musculoskeletal consultation (figure 2A, online supplemental table 4). In the Year 6 cohort, girls living with obesity were more likely (HR 1.20, 95%CI 1.07 to 1.35), and boys with a BMI classified as underweight were less likely (HR 0.39, 95%CI
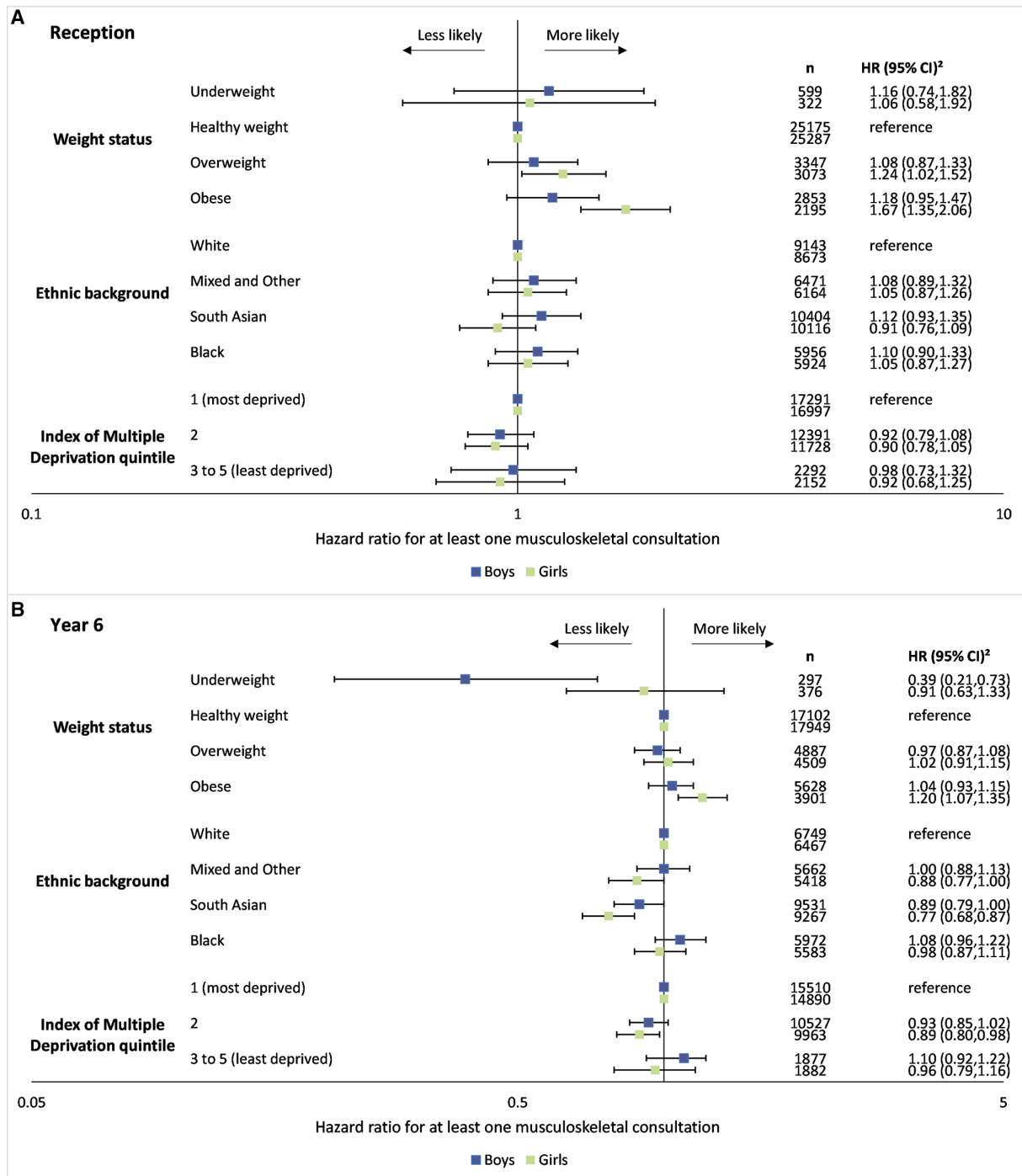
Figure 2 Multivariable* Cox proportional hazard ratios estimating the likelihood of at least one musculoskeletal consultation following National Child Measurement Programme (NCPM) measurement, by sex. *Mutually adjusting for NCMP-recorded body mass index (BMI) after application of ethnic-specific BMI adjustments, categorised according to UK1990 clinical reference standard: 'underweight' (<2nd centile), 'healthy weight' (≥2nd to <91st centile), 'overweight' (≥91st to <98th centile) or 'obese' (≥98th centile); ethnic group as recorded in the NCMP and, where missing, supplemented with ethnic group as recorded in the child's primary care electronic health record; 2015 Index of Multiple Deprivation quintile assigned based on the child's home address postcode as recorded by the school where the child participated in the NCMP; local authority of the school where the child participated in the NCMP; and academic year of participation in the NCMP. Hazard ratios are plotted on a logarithmic scale.

0.21 to 0.73), to have at least one musculoskeletal consultation (figure 2B, online supplemental table 5).

DISCUSSION

Summary of key findings

In this longitudinal study of more than 120 000 children, we examined associations between child weight status and subsequent primary care consultations for musculoskeletal symptoms and diagnoses using novel linkages between school measurement and primary care EHRs. We showed that musculoskeletal primary care consultations were more likely among girls living with obesity and less likely among boys with a BMI classified as underweight.

Strengths and limitations

This study had several strengths. We used real-world linked primary care and school measurement data for a 6-year period in a geographically contiguous urban area with an ethnically diverse population, representative of the wider population in NEL. We have previously shown that school measurement data provide less biased and more accurate information about child weight status than primary care EHRs.[22] We excluded musculoskeletal consultations before the date of school measurement to ensure the musculoskeletal outcomes were reported after the exposure of interest. We employed statistical methods accounting for the longitudinal study design.

However, there were also some limitations. It is possible that GPs may be more likely to diagnose musculoskeletal conditions in children with obesity as compared with children living without obesity. We lacked longitudinal weight and height measurements, and without complete or representative anthropometry measurements in the EHR we used the NCMP measurement date as a proxy date for the onset of obesity. We were unable to determine how long each child had been living with obesity before their NCMP measurement date, and as such our estimates of time to first musculoskeletal consultation are likely to be underestimates.

As most children in our study lived in the most deprived areas, we lacked statistical power to assess inequalities in musculoskeletal consultations. We only had access to an area-level measure of deprivation which may attenuate associations due to misallocating individuals to the average deprivation level of the area.[23] We lacked information about children's participation in physical activity, a potential confounder of the association between obesity and musculoskeletal health. Physical activity is known to reduce the likelihood of obesity but to increase the likelihood of musculoskeletal injuries. Musculoskeletal injuries are more likely following participation in high-impact, vigorous activities, which are more likely to be experienced by boys compared with girls.[24] Future analyses should consider the role of physical activity in confounding the relationship between obesity and musculoskeletal outcomes.

Comparison with existing literature

Our findings are similar to those of Ortiz-Pinto et al who identified an increased incidence of musculoskeletal consultations in Spanish children with obesity.[25] They did not report sex or ethnic differences in incidence in their study.

We found that knee pain was the most common musculoskeletal symptom, although our prevalence estimates are lower than estimates from a survey completed by Finnish children.[26] While there is evidence to suggest obesity during adulthood is a risk factor for knee pain,[27] less is known about this relationship in childhood. Diagnoses of Osgood-Schlatter disease (a condition causing pain and swelling below the knee joint during periods of adolescent growth) are more common among children participating in vigorous, high-impact sport.[28 29]

Very few children consulted for hip-related conditions so we were unable to investigate the relationship between obesity and SCFE. Given that SCFE is the most common hip disorder among adolescence,[30] this may be explained by our relatively limited period of follow-up into adolescence. Perry et al identified an increased risk of SCFE among children with obesity.[31] Additionally, our analyses focused on the first musculoskeletal event, which in the case of SCFE may present as knee pain.[32] Follow-up to ascertain diagnoses following initial consultations may identify more children subsequently diagnosed with SCFE.

Implications for research, policy and practice

Poor musculoskeletal health during childhood has the potential to have a significant impact on quality of life, throughout childhood and continuing into adolescence and adulthood.[33] Participation in some physical activities may be limited by musculoskeletal problems.[34] In turn, increased weight has the potential to contribute to continued musculoskeletal pain, and consequently children may experience a perpetual obesity/musculoskeletal pain cycle as adolescents and adults.[34]

Our longitudinal findings have the potential to inform clinical assessment in primary care. Healthcare professionals, who reportedly have limited awareness of childhood onset musculoskeletal health conditions,[35] may be more aware of the potential contribution of excess weight to these conditions among primary school aged children. This is particularly important because GPs are the first point of contact for children and their families.[36]

Our study demonstrates the value of linking school measurement and primary care EHRs for research. While not designed for research purposes, EHRs are a rich source of health data, are relatively inexpensive, and potentially less biased given the near-universal nature of enrolment into general practice in the NHS.

CONCLUSION

Girls living with obesity are more likely to consult their GP for musculoskeletal symptoms than those with a healthy weight. Routine linkage of school measurement and primary care records enable important insights into the associations between excess weight and subsequent health in childhood and has the potential to inform clinical management. Longer term follow-up is needed to explore whether these symptoms persist.

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