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Equity of the Meningitis B vaccination programme in England, 2016–2018

Karen S. Tiley *, Joanne M. White, Nick Andrews, Elise Tessier, Michael Edelstein [1]

Public Health England (now UK Health Security Agency), 61 Colindale Avenue, London NW9 5EQ, UK

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ABSTRACT

In England, the Meningitis B (MenB) vaccine is scheduled at eight and 16 weeks with a booster dose at one year of age and protects children against invasive bacterial meningococcal disease caused by *Neisseria meningitidis* serogroup B. Coverage of the second dose of MenB vaccine at 12 months was >92% in 2017/18, but this may mask inequalities in coverage in particular population groups.

MenB vaccination records for children aged six, 12 and 18 months of age from December 2016 to May 2018 were routinely extracted from GP patient management systems every month in England via a web-based platform for national monitoring of vaccine coverage. We determined the association between ethnicity, deprivation and area of residence, vaccine coverage and drop-out rates (between dose one and dose two), using binomial regression.

After adjusting for other factors, ethnic groups with lowest dose one coverage (Black or Black British-Caribbean, White-Any other White background, White-Irish) also had lowest dose two coverage, but in addition, these ethnic groups also had the largest drop-out rates between dose one and dose two. The drop-out rate for Black or Black British-Caribbean children was 5.7 percentage points higher than for White-British children. Vaccine coverage decreased with increasing deprivation quintile, and this was most marked for the booster coverage (6.2 percentage points lower in the most deprived compared to least deprived quintile, $p < 0.001$).

To achieve high coverage for completed courses across all ethnic groups and deprivation quintiles both high initiation rates and a reduction in drop-out rates for ethnic groups with lowest coverage is necessary. A qualitative approach to better understand reasons behind lower coverage and higher drop-out rates in the most underserved ethnic groups is required to develop tailored approaches addressing these inequalities.

1. Introduction

The Meningitis B (MenB) vaccination programme was introduced from 1 September 2015 for infants due to receive their primary immunisations starting at two months of age on or after 1 September 2015 (i.e. those babies born on or after 1 July 2015) [1]. The aim was to protect children against invasive bacterial meningococcal disease caused by *Neisseria meningitidis* B [2]. A limited one-off catch-up programme was also delivered targeting infants born in May and June 2015 [1].

For the routine programme, children are scheduled to receive their first dose alongside other infant immunisations at eight weeks of age and a second dose at 16 weeks of age; a further booster dose is then scheduled at one year of age [3]. Meningococcal disease incidence peaks in children under one year of age [2], so it is important that children receive their vaccines on time in order to protect them when they are most at risk. The two-dose MenB priming schedule has been found to be highly effective in preventing MenB disease in infants; a 75% reduction in cases in England was observed in the first three years of the programme in age groups that were fully eligible for vaccination [4].

Preliminary MenB vaccine coverage data up to March 2018 suggested that most children received their first dose by six months of

Abbreviations: MenB, Meningitis B.

* Corresponding author at: Oxford Vaccine Group, Centre for Clinical Vaccinology and Tropical Medicine (CCVTM), Churchill Hospital, Old Road, Headington, Oxford OX3 7LE, United Kingdom.

E-mail addresses: karen.tiley@paediatrics.ox.ac.uk (K.S. Tiley), joannemshivji@gmail.com (J.M. White), Nick.Andrews@ukhsa.gov.uk (N. Andrews), Elise.Tessier@ukhsa.gov.uk (E. Tessier), michael.edelstein@biu.ac.il (M. Edelstein).

[1] Present address: Michael Edelstein has moved to the Azrieli Faculty of Medicine, Bar-Ilan University, Israel.

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age with very little catch-up between six and 12 months of age (coverage of the first dose was around 96% at six months (range 95.5–96.8% between April 2016 and March 2018) and 12 months of age (range 95.2–96.2% between November 2016 and March 2018), with little or no catch up after 12 months of age [5]. Coverage of the second dose however, was lower (around 88% at six months of age, range 86.7–89.2% between April 2016 and March 2018), and around 5% of children received their second dose between six and 12 months of age (coverage of the second dose was 93% at 12 months of age, range 92.4–93.1% between November 2016 and March 2018), again with little or no catch up after 12 months of age [5]. Coverage of the booster dose at 18 months of age was around 87% (range 86.4–88.5% between January 2017 and March 2018) [5].

We wanted to explore the equity of MenB vaccination coverage by ethnicity, gender, deprivation and area of residence with respect to a) vaccine coverage, to assess whether there are variations in vaccine coverage of the first, second and booster dose and in drop-out rates between the first dose and second dose and b) timing of vaccination, to understand which children are receiving their second dose late (between six and 12 months of age).

2. Methods

Monthly data were routinely extracted from ImmForm, a web-based platform based on automated extraction of data from approximately 95% of primary care providers (General Practitioner practices, GP practices) in England [6]. Data from the smallest GP practice IT supplier, supplying practices mainly in South West England (<1% in total), have been excluded from national reporting since the start of the programme because their data have been consistently out of line with the other suppliers and considered unreliable [5].

National data from at least two GP IT suppliers have been available each month from the start of the programme for overall coverage monitoring [5]. Monthly data for the three major GP IT suppliers covered the period December 2016 to May 2018 and are included in the detailed analyses presented here.

Only GP practices that passed the following validation rules were included for a particular month: (i) number of children receiving dose two is equal or lower than the number of children recorded as receiving dose one at six or 12 months (overall or within any gender or ethnic group category); (ii) number of children receiving a booster dose at 18 months is equal or lower than the number receiving dose one at 18 months (sometimes a late second dose may be recorded as a booster dose so the validation at 18 months acts between dose one and booster only).

2.1. Vaccine coverage

The denominator was the number of infants registered with a GP practice who, in the survey month, reached 26 weeks (six months), 52 weeks (12 months) or 78 weeks (18 months) of age. The numerator was the number of infants in the denominator who received (a) first dose (b) second dose of MenB vaccine from eight weeks of age up to 26, 52 or 78 weeks of age, and (c) a booster dose of MenB vaccine up to 78 weeks of age, including vaccinations given by other healthcare providers.

2.2. Ethnicity and gender

For children reaching 12 months of age the vaccine coverage data were available stratified by ethnicity and gender (male, female, not stated, not known). Ethnicity is only captured in ImmForm when coded using the Office for National Statistics (ONS) 2001 census classifications [7]. When ethnicity is not recorded or recorded using another classification, it is coded as not recorded. Ethnicity is only collected at 12 months of age.

To explore coverage data at six and 18 months of age in more detail, in the absence of individual-level ethnicity data for these age groups, a Black, Asian, and Minority Ethnic (BAME) score specific to the population under study was calculated for each GP practice by dividing the number of children from BAME groups (non-White-British ethnic groups) by the total with ethnicity known using the 12 month data denominators for a particular birth cohort as follows:

- To explore coverage of the booster dose at 18 months for children born December 2015 to November 2016 (coverage assessed June 2017 to May 2018) the BAME score for each GP practice was assigned using 12-month data for these children (coverage assessed December 2016 to November 2017).
- To explore coverage of the catch-up in dose two coverage between six and 12 months for children born June 2016 to May 2017 the BAME score for each GP practice was assigned using 12-month data for these children (coverage assessed June 2017 to May 2018).

The BAME scores were then split into four groups: 0–25%, >25–50%, >50–75%, >75–100%.

2.3. Deprivation

GP practices were each assigned a deprivation Fingertip score which is based on a population Index of Multiple Deprivation (IMD) 2015 score (which takes into account seven distinct domains; Income Deprivation, Employment Deprivation, Health Deprivation and Disability, Education, Skills and Training Deprivation, Barriers to Housing and services, Living Environment Deprivation and Crime) [8]. IMD scores for GP practices were re-calculated in 2016 by building the population weighted average over the IMD scores of the Lower Super Output Area (LSOA, small areas designed to be of a similar population size, with an average of approximately 1,500 residents or 650 households [9]) where the practice population lives with 2016 populations [10]. These scores were divided in to quintiles (1:3.2–12.5, 2:12.6–18.3, 3:18.3–25.2, 4:25.2–34.1, 5:34.1–66.5, N.B. scores only presented to 1 decimal place) with 1 being least deprived and 5 being most deprived.

Data were excluded from 121 GP practices that did not record any ethnicity data, and a further 97 GP practices that did not have a deprivation Fingertip score. All practices were assigned to an NHS Local Team (the statutory organisations that planned and provided healthcare services during the period of study). Data from 7,068 GP practices were included in the final dataset.

2.4. Analyses

2.4.1. Dose one and two coverage at 12 months of age

For children born December 2015 to May 2017, becoming 12 months of age in December 2016 to May 2018, we calculated crude coverage of dose one and two by gender, ethnicity (individual level), deprivation (GP practice-level) and Local Team, as well as coverage adjusted for ethnicity, deprivation, and Local Team using binomial regression. We calculated drop-out rates, defined as the difference between the number of children receiving dose one and the number of children receiving dose two, divided by the total number of children receiving dose one. Drop-out rates adjusted for ethnicity, deprivation and Local Team were calculated relative to the baseline of White-British, deprivation quintile 1, London Local Team, using binomial regression.

2.4.2. Booster coverage at 18 months of age

For children born December 2015 to November 2016, becoming 18 months of age June 2017 to May 2018, we calculated coverage of the booster dose at 18 months of age adjusted for the proportion of BAME children born December 2015 to November 2016 within each GP practice, GP practice-level deprivation, and Local Team.

2.4.3. Dose two vaccination coverage at six and 12 months of age

For children born June 2016 to May 2017, becoming six months of age December 2016 to November 2017, and 12 months of age June 2017 to May 2018, we calculated coverage of dose two at six and 12 months of age adjusted for the proportion of BAME children born June 2016 to May 2017 within each GP practice, GP practice-level deprivation, and Local Team.

Analyses were conducted in STATA SE/V.13.1 statistical software.

3. Results

3.1. Dose one and two coverage at 12 months of age

Vaccine coverage for males and females was similar for dose one (96.1% males, 96.2% females) and two (92.5% males, 92.8% females) at 12 months of age.

Dose one coverage ranged from 89.8% (Black-Caribbean) to 97.6% (White-British) i.e. 7.9 percentage points (pp) difference, allowing for rounding. There was wider variation in dose two coverage (range 95.1% White-British to 80.5% Black-Caribbean i.e. 14.6 pp difference) (Fig. 1). There was a 9.3 pp difference between dose one and two coverage for Black-Caribbean children compared to a 2.5 pp difference for White-British children (Fig. 1). Black Caribbean children therefore had lowest coverage of the first dose, and also the largest difference between first and second dose coverage.

After adjusting for deprivation and Local Team, the difference between dose two coverage for White-British and Black-Caribbean children reduced from 14.6 to 11.6 pp (95% CI −12.9 to −10.2 pp, P < 0.001), but was still larger than for any other ethnic group (Table 1). Children of White-Any other White background and White-Irish ethnicity had the next largest adjusted difference in dose two coverage relative to White-British children (8.6 pp and 7.9 pp respectively, P < 0.001) and these ethnic groups also had amongst the lowest coverage overall (Table 1, Fig. 1). There was a trend of decreasing dose two coverage as deprivation quintile increased (Table 1). The most deprived quintile had dose two coverage 3.2 pp (p < 0.001) lower than the least deprived quintile, after adjusting for ethnicity and Local Team (Table 1). Dose two vaccine coverage for Cumbria and North East Local Team was 5.3 pp (p < 0.001) higher than for London Local Team. Adjusted differences in coverage across groups relative to the baseline were more pronounced for dose two than dose one.

The difference in drop-out rate between dose one and dose two for Black-Caribbean children relative to White-British children reduced from 7.8 pp to 5.7 pp after adjusting for deprivation and

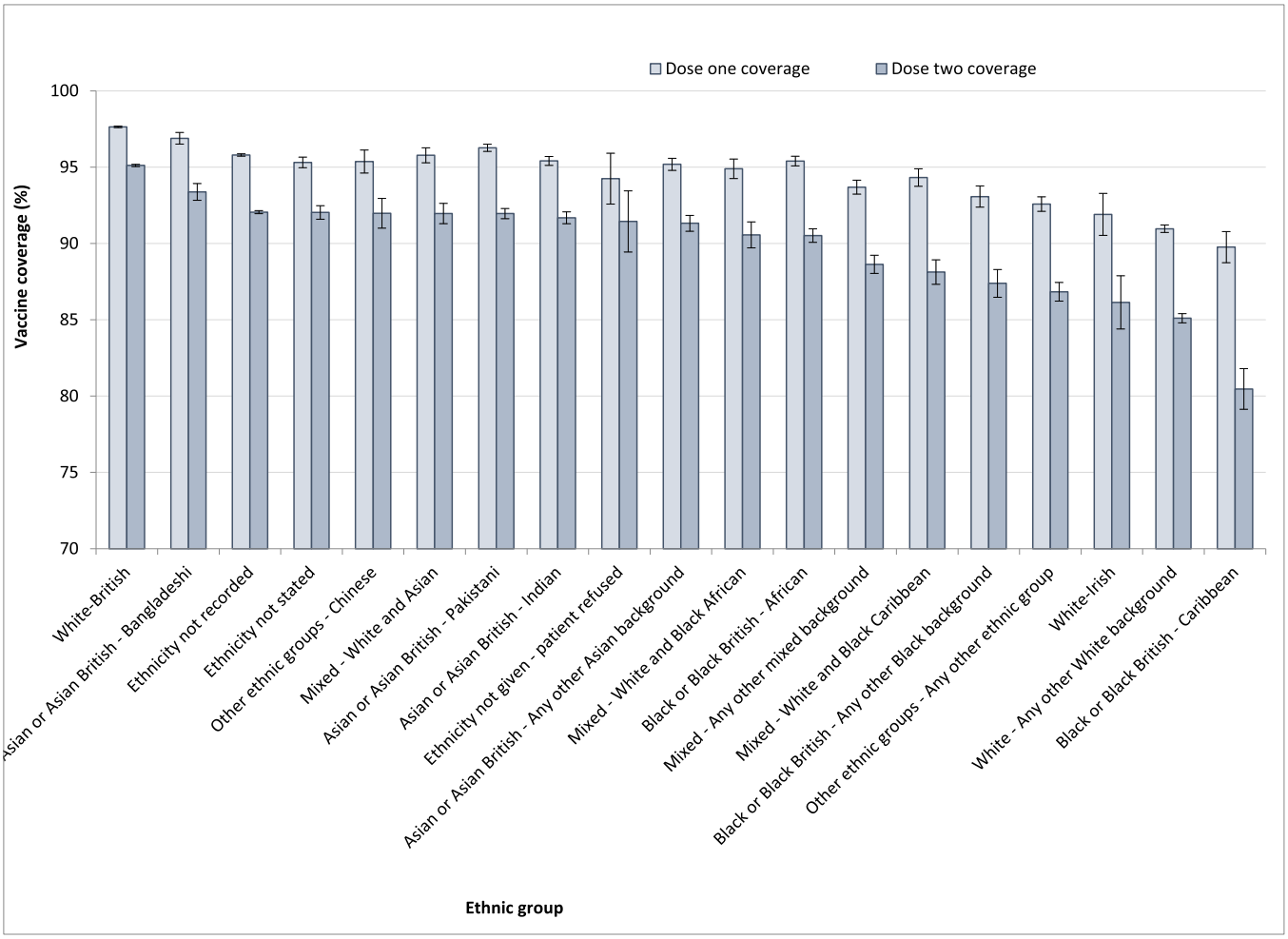

Fig. 1. Unadjusted Meningitis B vaccine dose one and two coverage at 12 months of age by ethnic group for children born December 2015 to May 2017, ordered by dose two coverage, with 95% confidence intervals, England.

Table 1
MenB dose one and two coverage at 12 months of age, differences in coverage from the baseline* group adjusted for ethnicity, deprivation and Local Team, and crude drop-out rates, for children born December 2015 to May 2017, England. *Values where p < 0.001 highlighted in bold.*

	Number of children	Crude dose one coverage (%)	Adjusted difference (%) in dose one coverage from baseline (95% confidence intervals)	Crude dose two coverage (%)	Adjusted difference (%) in dose two coverage from baseline (95% confidence intervals)	Crude drop-out rate dose one to dose two	Crude difference in drop-out rate compared with baseline
Ethnic group							
White-British	367,279	97.6	*Baseline*	95.1	*Baseline*	2.6	*Baseline*
White-Irish	1,508	91.9	**−5.3 (−6.7, −4.0)**	86.1	**−7.9 (−9.6, −6.2)**	6.3	3.7
White - Any other White background	53,630	91.0	**−6.1 (−6.3, −5.8)**	85.1	**−8.6 (−8.9, −8.3)**	6.4	3.9
Asian or Asian British - Indian	19,690	95.4	**−1.7 (−2.0, −1.4)**	91.7	**−2.1 (−2.5, −1.8)**	3.9	1.3
Asian or Asian British - Pakistani	25,112	96.3	**−1.0 (−1.3, −0.8)**	92.0	**−1.7 (−2.1, −1.4)**	4.5	1.9
Asian or Asian British - Bangladeshi	7,929	96.9	0.1 (−0.3, 0.5)	93.4	0.5 (−0.1, 1.0)	3.6	1.0
Asian or Asian British - Any other Asian background	11,330	95.2	**−1.7 (−2.1, −1.3)**	91.3	**−2.1 (−2.6, −1.5)**	4.1	1.5
Black or Black British - African	16,863	95.4	**−1.3 (−1.6, −1.0)**	90.5	**−2.1 (−2.6, −1.7)**	5.1	2.5
Black or Black British - Caribbean	3,400	89.8	**−6.7 (−7.7, −5.6)**	80.5	**−11.6 (−12.9, −10.2)**	10.4	7.8
Black or Black British - Any other Black background	5,114	93.1	**−3.4 (−4.1, −2.7)**	87.4	**−4.9 (−5.8, −4.0)**	6.1	3.5
Mixed - White and Asian	6,473	95.8	**−1.4 (−1.9, −0.9)**	92.0	**−2.2 (−2.9, −1.6)**	4.0	1.4
Mixed - White and Black African	4,526	94.9	**−2.2 (−2.9, −1.6)**	90.6	**−3.2 (−4.0, −2.3)**	4.6	2.0
Mixed - White and Black Caribbean	6,200	94.3	**−2.9 (−3.5, −2.3)**	88.1	**−5.7 (−6.5, −4.9)**	6.6	4.0
Mixed - Any other mixed background	10,913	93.7	**−3.3 (−3.7, −2.8)**	88.6	**−4.9 (−5.5, −4.3)**	5.4	2.8
Other ethnic groups - Chinese	2,980	95.4	**−1.6 (−2.4, −0.9)**	92.0	**−2.0 (−3.0, −1.0)**	3.6	1.0
Other ethnic groups - Any other ethnic group	11,812	92.6	**−4.4 (−4.9, −3.9)**	86.8	**−6.5 (−7.1, −5.9)**	6.2	3.6
Ethnicity not stated	14,264	95.3	**−1.8 (−2.2, −1.5)**	92.0	**−2.3 (−2.8, −1.9)**	3.4	0.9
Ethnicity not recorded	269,738	95.8	**−1.4 (−1.4, −1.3)**	92.1	**−2.0 (−2.2, −1.9)**	3.9	1.3
Ethnicity not given - patient refused	748	94.3	**−3.0 (−4.7, −1.4)**	91.4	−3.1 (−5.1, −1.1)	3.0	0.4
Deprivation quintile							
1 (least deprived)	163,765	96.7	*Baseline*	94.6	*Baseline*	2.2	*Baseline*
2	163,284	96.5	0.0 (−0.2, 0.1)	93.8	**−0.4 (−0.5, −0.2)**	2.8	0.6
3	172,319	96.2	−0.1 (−0.2, 0.0)	92.9	**−0.9 (−1.1, −0.7)**	3.4	1.2
4	178,360	95.8	**−0.3 (−0.4, −0.2)**	91.5	**−2.0 (−2.1, −1.8)**	4.4	2.3
5 (most deprived)	161,781	95.6	**−0.6 (−0.8, −0.5)**	90.5	**−3.2 (−3.4, −3.1)**	5.3	3.1
Local Team							
London	159,195	93.9	*Baseline*	88.4	*Baseline*	5.9	*Baseline*
Wessex	36,502	96.7	**1.7 (1.5, 1.9)**	94.3	**3.7 (3.4, 4.0)**	2.5	−3.4
Yorkshire and Humber	88,815	97.3	**2.5 (2.3, 2.6)**	94.1	**4.6 (4.3, 4.8)**	3.3	−2.6
Lancashire & Greater Manchester	67,779	96.3	**1.7 (1.5, 1.9)**	92.7	**3.6 (3.4, 3.9)**	3.8	−2.1
Cumbria & North East	43,189	98.0	**2.8 (2.6, 3.0)**	95.5	**5.3 (5.1, 5.6)**	2.6	−3.3
Cheshire & Merseyside	36,300	97.0	**2.2 (2.0, 2.4)**	93.9	**4.2 (4.0, 4.5)**	3.2	−2.6
North Midlands	51,018	96.9	**2.1 (1.9, 2.3)**	93.7	**3.9 (3.6, 4.1)**	3.3	−2.5
West Midlands	63,572	95.8	**1.4 (1.3, 1.6)**	91.9	**3.2 (3.0, 3.5)**	4.0	−1.8
Central Midlands	75,980	96.7	**2.0 (1.9, 2.2)**	94.2	**4.0 (3.8, 4.3)**	2.6	−3.3
East	66,516	97.0	**2.1 (1.9, 2.2)**	94.3	**4.0 (3.8, 4.2)**	2.7	−3.2
South West	37,724	96.1	**1.1 (0.9, 1.3)**	93.1	**2.8 (2.5, 3.1)**	3.1	−2.8
South East	60,880	96.1	**1.1 (1.0, 1.3)**	93.3	**2.7 (2.5, 3.0)**	2.9	−3.0
South Central	52,039	96.2	**1.4 (1.2, 1.6)**	93.6	**2.9 (2.7, 3.2)**	2.8	−3.1
Total	839,509	96.2		92.7			

* Baseline (Baseline White-British, deprivation quintile 1, London) dose one coverage 96.0% (95.9 to 96.2%), dose two coverage 92.7% (92.5 to 92.9%).

Local Team, but remained statistically significant and higher than for any other ethnic group (Table 1, Fig. 2). Children in Mixed White and Black-Caribbean, White-Any other White background and White-Irish ethnic groups all had differences in drop-out rates of 2.9 pp after adjustment for deprivation and Local Team. There was a trend of increasing drop-out rates with increasing deprivation; the most deprived quintile had a 2.7 pp higher drop-out rate than the least deprived quintile (Fig. 2). London had the largest drop-out rate; drop-out rates for all other Local Teams were at least 1.8 pp lower (Fig. 2).

3.2. Booster coverage at 18 months of age

Coverage of the booster dose at 18 months (Table 2) was lower for GP practices with a greater proportion of BAME children (4.7 pp lower in practices with the greatest proportion of BAME children compared to those with the smallest), and lower in more deprived GP practices (6.2 pp lower in most deprived compared to least) after adjusting for ethnicity/deprivation quintile and Local Team. Geographical variation ranged up to 11.4 pp higher coverage in Cumbria and the North East compared to London (Table 2).

3.3. Dose two vaccine coverage at six and 12 months of age

Coverage of dose two at six months of age declined as the proportion of BAME children within a GP practice increased (Fig. 3). Although the catch-up (difference between coverage at six and 12 months of age) was slightly larger (3.3 pp) for the >75% BAME group relative to the other groups (range 2.1–2.5 pp), there was still a trend of declining dose two coverage with increasing proportion of BAME children within a GP practice at 12 months (Fig. 3). This aligns with the finding of lower dose two coverage relative to White-British children across most ethnic groups at 12 months of age (Table 1).

A trend of increasing improvement in dose two coverage between six and 12 months was seen by increasing deprivation,

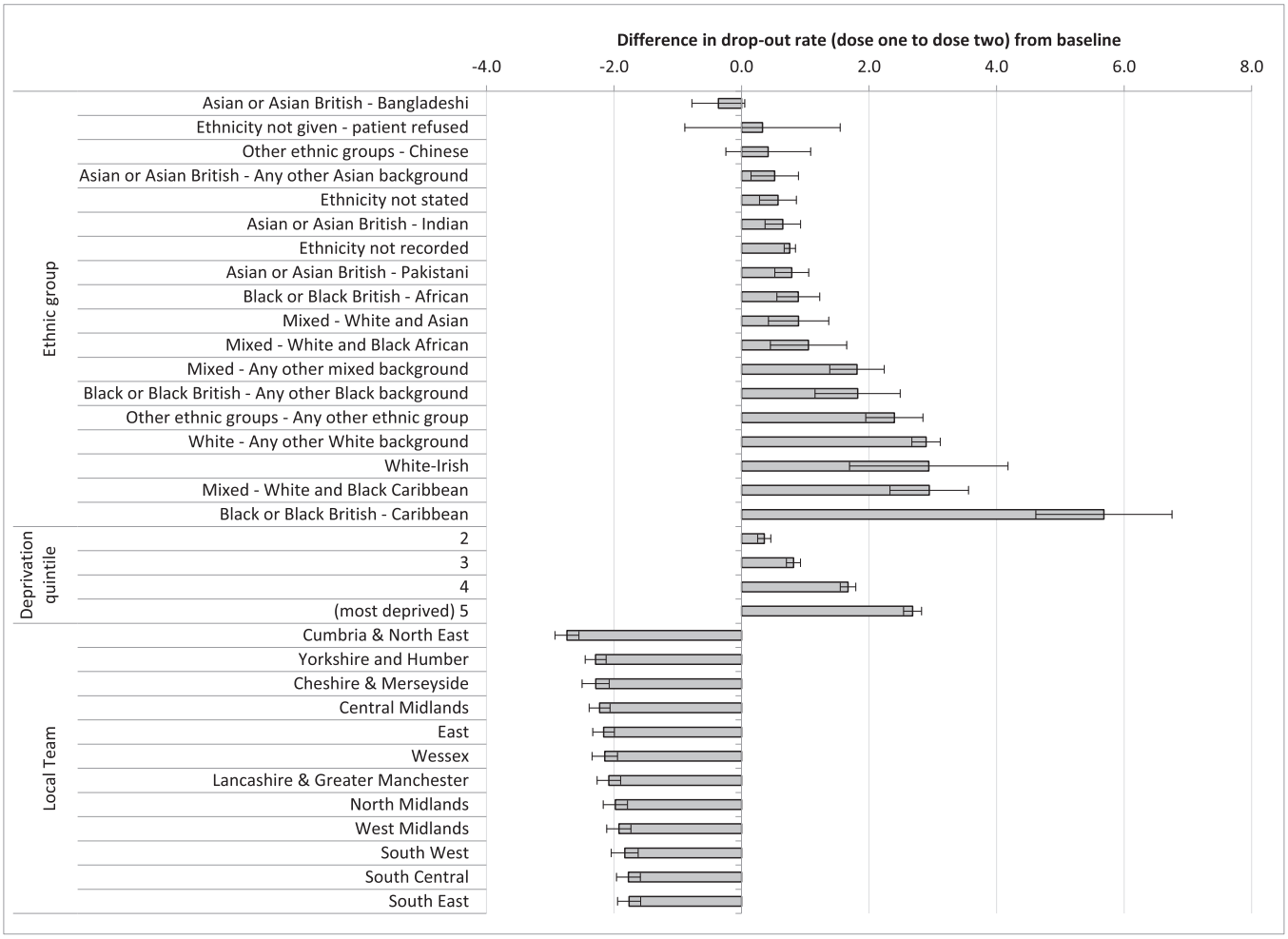

Fig. 2. Meningitis B vaccination differences in drop-out rates (dose one to dose two) at 12 months of age relative to baseline* adjusted for ethnicity, deprivation and Local Team, for children born December 2015 to May 2017, England.*baseline White-British, deprivation quintile 1, London, drop-out rate 3.6% (95% CI 3.5 to 3.8%).

so that the greatest improvement in dose two coverage was seen in the group that had the lowest initial coverage (deprivation quintile 5, most deprived); dose two coverage increased by 7.0 pp between 6 and 12 months of age for the most deprived quintile compared to 2.4 pp for the least deprived quintile. However, although the difference in coverage between least and most deprived quintiles narrowed between six and 12 months of age, the trend of decreasing coverage by deprivation seen at six months remained at 12 months (Fig. 3).

The extent to which dose two coverage increased between six and 12 months in different regions varied with no clear association to coverage at six months of age (Fig. 3).

4. Discussion

This is the first detailed analysis of national MenB vaccine coverage data examining the association between ethnicity, deprivation and area of residence, vaccine coverage and drop-out rates in England and has highlighted some important inequalities.

Although all ethnic groups at 12 months of age had good dose one coverage (between 89.8% and 97.6%), for dose two the range in coverage widened resulting in particularly low coverage for ethnic groups at the lowest end of the range, e.g. Black Caribbean children. The low dose two coverage in these ethnic groups resulted from a combination of lower dose one coverage and higher drop-out rates. This was only partly accounted for by adjusting for deprivation and Local Team.

Children living in a deprived area have lower MenB vaccine coverage for dose one and two and highest drop-out rates between dose one and two, though this was less pronounced than the differences across ethnic groups.

Area of residence was also a key factor suggesting there may be differences in primary care and/or factors affecting healthcare accessibility (such as transport links) across regions, as well as potential opportunities for sharing best practice. The lower coverage and higher drop-out rates in London likely reflect challenges in achieving high vaccine coverage previously identified in London for other vaccine programmes, relating to London's highly mobile population [11].

Differences in coverage by deprivation and Local Team are even more pronounced for the booster than for dose two suggesting that there is further increased drop-out between dose two and booster. This was not assessed directly because in some instances late second doses may be recorded as booster doses which results in higher recorded booster vs dose two coverage in some practices.

It is encouraging that the greatest improvements in dose two coverage between six and 12 months take place in the BAME (%) groups and deprivation quintiles with lowest six month coverage,

Table 2
Meningitis B booster vaccine coverage and differences in coverage from the baseline* group adjusted for ethnicity, deprivation and Local Team at 18 months of age for children born January 2016 to November 2016, England. *Values where p < 0.001 highlighted in bold (all).*

	Number of children	Number of children receiving booster	Crude booster coverage (%)	Adjusted difference (%) in coverage from baseline (95% confidence intervals)*
BAME group (%)				
0–25	309,940	280,047	90.4	*Baseline*
>25 to 50	114,686	99,249	86.5	**−1.7 (−2.0, −1.5)**
>50 to 75	74,713	60,789	81.4	**−3.6 (−3.9, −3.2)**
>75	77,402	61,117	79.0	**−4.7 (−5.1, −4.3)**
Deprivation quintile				
1 (least deprived)	113,951	103,140	90.5	*Baseline*
2	112,620	100,645	89.4	**−0.8 (−1.0, −0.5)**
3	117,468	102,356	87.1	**−2.1 (−2.3, −1.8)**
4	122,162	103,475	84.7	**−3.8 (−4.1, −3.6)**
5 (most deprived)	110,540	91,586	82.9	**−6.2 (−6.5, −5.9)**
Local Team				
London	108,110	84,199	77.9	*Baseline*
Wessex	25,543	23,078	90.3	**8.0 (7.6, 8.5)**
Yorkshire and Humber	60,740	54,925	90.4	**10.6 (10.2, 11.0)**
Lancashire & Greater Manchester	46,762	40,744	87.1	**8.1 (7.7, 8.5)**
Cumbria & North East	29,617	27,267	92.1	**11.4 (10.9, 11.8)**
Cheshire & Merseyside	25,101	22,223	88.5	**8.3 (7.7, 8.8)**
North Midlands	35,227	31,534	89.5	**8.8 (8.4, 9.3)**
West Midlands	43,282	37,226	86.0	**7.4 (6.9, 7.8)**
Central Midlands	52,688	47,060	89.3	**8.3 (7.9, 8.7)**
East	45,817	41,415	90.4	**8.8 (8.4, 9.2)**
South West	25,838	22,838	88.4	**6.7 (6.2, 7.2)**
South East	41,895	36,804	87.8	**5.5 (5.1, 5.9)**
South Central	36,121	31,889	88.3	**6.0 (5.6, 6.4)**
Total	576,741	501,202	86.9	

* Baseline coverage (0–25% BAME, deprivation quintile 1, London): 84.2% (83.9–84.6).

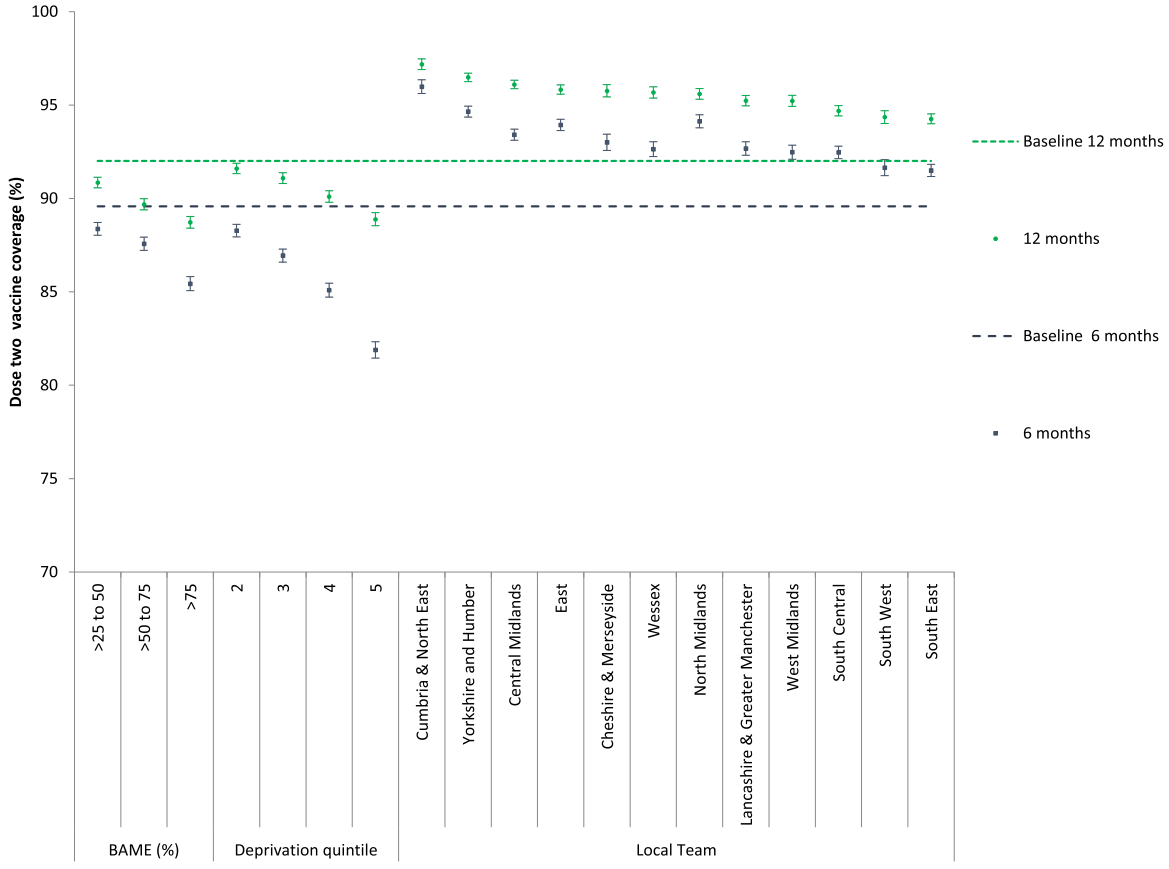

Fig. 3. Coverage of Meningitis B vaccine dose two relative to baseline* at six and 12 months of age adjusted for Black, Asian, and Minority Ethnic groups (BAME) (%), deprivation and Local Team for children born June 2016 to May 2017, England.*baseline: ≤25% BAME, deprivation quintile 1, London.

but there is a need for this to occur to a greater extent to fully eliminate inequalities.

A major strength of this analysis is the size and representativeness of this large national dataset which spans an 18-month time period; even the sub-analyses at six and 18 months include a full 12 months of data. The MenB vaccine coverage data collected through ImmForm is in line with the routine coverage estimated at the first and second birthday reported through the COVER (Cover of Vaccination Evaluated Rapidly) programme from April 2018 (which uses data extracted from Child Health Information Systems) for all three doses [12].

For children aged six and 18 months, where individual ethnicity data were not available, it was only possible to calculate the proportion of BAME children within each GP practice. The advantage of this was that the score for each GP practice applied directly (excepting population movements between six and 12 months or 12 and 18 months of age) to the population under study. However, 'BAME' is a very broad category and encompasses a wide range of ethnic groups with different vaccine coverages and potential health-seeking behaviours, though all except Bangladeshi children had lower coverage than White-British children at 12 months of age in this dataset.

Similar to reported here, in a London study exploring coverage of the three-dose primary course (DTaP/IPV/Hib vaccine) by ethnicity using data extracted from Child Health Information Systems, ethnic groups with lowest dose one coverage also had lowest coverage of the completed course at one year of age [13]. In the London study Black Caribbean children had amongst the largest difference in drop-out rate (2.3%) from dose one to dose three but high dose one coverage (>95%). The adjusted differences in drop-out rates compared to baseline in the London study were generally smaller than in this study.

A national study of rotavirus coverage had previously identified Black-Caribbean, White-Irish and those recorded as 'Other' ethnic group as having the greatest difference in completion (i.e. lower completion) compared with White-British infants [14]; these were also some of the ethnic groups with highest drop-out rates in this study.

This study was undertaken before the start of the COVID-19 pandemic. It is notable that some of the inequalities seen here in the coverage of a routine childhood vaccine were also observed in the uptake of COVID-19 vaccine in adults (black/African/Caribbean ethnic group was least likely of all ethnic groups, in individuals aged 50 years and above, to be vaccinated with COVID-19 vaccine in England [15]).

Overall vaccine coverage for the MenB programme is high (annual national two dose coverage at 12 months ranged 92.0–92.5% between 2018/19 and 2020/21) [16]) and the benefits of this are being seen in its protection of young children from this life-threatening disease [4]. However, the analysis presented here has identified some inequalities common to recent analyses of vaccine coverage and drop-out/completion rates for other vaccine programmes [17]. The reason for the particularly high drop-out rate in the Black-Caribbean ethnic group is not understood and would benefit from further investigation so that tailored approaches can be developed to address these inequalities. Research relating to COVID-19 vaccine hesitancy among ethnic minorities may be helpful in this respect. Strategies such as community engagement via trusted and collaborative community and healthcare networks (particularly community leaders and health care practitioners), as recommended to improve COVID-19 vaccine uptake [18–20], may also improve MenB vaccine coverage. Vaccine coverage for this programme will continue to be monitored nationally so that any further inequalities can continue to be identified, particularly as they may serve as indicators of inequalities across multiple vaccine programmes.

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Authorship

All authors were involved in the design of the study. KT undertook the data analysis in consultation with JW, NA and ME. KT, JW, and ME drafted the article and NA and ET critically revised it. All authors have approved the final version for the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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