

Does social deprivation correlate with meningococcal MenACWY, Hib/MenC and 4CMenB/Meningococcal Group B vaccine uptake in Northern Ireland?

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ABSTRACT

Background

Several meningococcal vaccines have been recently introduced into the infant and adolescent vaccination schedules in Northern Ireland to promote immunity to *Neisseria meningitidis*, protecting against meningococcal septicaemia and meningococcal meningitis. Maintained vaccination uptake is vital in securing individual protection as well as herd immunity. Several social factors have been described in influencing vaccine uptake and therefore it was the aim of this study to examine possible correlations between meningococcal vaccine uptake rates and indicators of social deprivation in Northern Ireland.

Methods

Vaccination data was retrieved from the Cover of Vaccination Evaluated Rapidly (COVER) database, for meningococcal vaccines (MenACWY, Hib/MenC & 4CMenB, as well as for MMR vaccine as a non-meningococcal control). Vaccine coverage data assessed included (i). Two doses of MenB by 12 months, (ii). All 3 doses of MenB by 24 months, (iii). Hib/MenC coverage, (iv). MenACWY (Year 12s, for NI) (v). First dose of MMR. Northern Ireland Multiple Deprivation Measures 2017 (NIMDM2017) were examined against 38 indicators in 7 domains. NI HSCT vaccine uptake dataset for each vaccine was correlated with each indicator in the HSCT NIMDM2017 dataset. Regression analysis was performed to determine the relationship between vaccine uptake and deprivation indicators and coefficient of variation (R^2) was calculated for each of the indicators. R^2 values >0.7 were considered significant.

Results

For 4CMenB (all 3 doses by 24 Months), Hib/MenC, MenACWY and for MMR, correlation of variation (R^2) values > 0.7 , were obtained for 17, 16, 0 and 17 social deprivation indicators, respectively. Significant deprivation indicators were (i) the proportion of 18-21 year olds, who have not enrolled in higher education courses at higher or further education establishments, (ii) the proportion of domestic dwellings that are unfit, (iii) the proportion

of domestic dwellings with Local Area Problem Scores, (iv) rate of burglary, (v) rate of vehicle crime, (vi) rate of antisocial behaviour incidents (per 1,000 population), (vii) absenteeism at primary schools and (viii) the proportion of the population aged 65 and over living in households whose equivalised income is below 60% of the NI median.

Conclusions

Within the last two decades, incidence of meningococcal disease has been on the decline. The introduction of meningococcal vaccines has contributed to this decrease and uptake of such vaccines should remain a public health priority to maintain the decline in meningococcal disease. Identifying contributing factors to low vaccine uptake, such as, the association between local deprivation and uptake of meningococcal vaccines, should be of public health importance and acknowledged by local governments and policy makers in their efforts to enhance vaccine uptake, both infant and teenage vaccination. There is a clear correlation with educational deprivation measures such as absenteeism and poor educational attainment and reduced vaccine uptake, perhaps through lack of understanding and willingness to vaccinate. This is where the importance of a clear and coherent public health message surrounding meningococcal vaccination should be prioritised, particularly to establish innovative modalities in a multidisciplinary team approach, to reach out to and increase vaccine uptake rates in socially deprived communities in Northern Ireland.

Keywords: education; meningitis; meningococcal; vaccine uptake; vaccination; social deprivation

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Introduction

The large progressive decline in child mortality globally has largely been due to the introduction of vaccines coupled with improved sanitation and nutrition. Since 1960, the introduction of vaccines has accompanied a 61% decline in infant mortality due to infectious diseases¹. Scientific and pharmaceutical companies have produced countless vaccines that protect against a variety of diseases and governments and health services have sustained the delivery of immunisation programmes to ensure effective distribution². Despite the success of vaccines, in 2019, an estimated 5.2 million children under the age of 5 years died globally, generally from preventable and treatable diseases¹. The value and worthwhile introduction of vaccines needs consistent appreciation by the public to ensure a sustained uptake of such vaccines to maintain health and wellbeing.

Invasive meningococcal disease (IMD) is an infectious disease caused by the widespread human Gram-negative pathogen *Neisseria meningitidis* and is a main cause of life threatening diseases, meningitis and sepsis³. The diverse clinical spectrum of *N. meningitidis* presents varying severity of infection, ranging from mild non-specific flu like symptoms to a sudden onset of sepsis/meningitis. In the most serious incidents, multiorgan failure and death contribute to 10-15% of cases⁴. In addition to mortality, long term sequelae can often be life limiting as hearing loss, neurodevelopmental disabilities and amputations are seen in 11-19% of survivors⁵. This is a serious condition and is viewed as a major public health concern due to the widespread distribution of *N. meningitidis* and associated disease burden in the young population, which has recently reviewed and described in Northern Ireland⁶.

The meningococcus is categorized into twelve serogroups and the most common causative agents of IMD global disease burden is caused by serogroups A, B, C, W-135, and Y³⁻⁶. IMD affects those of all ages however highest incidence is seen in infants, young children, and older adults. Case fatalities are often higher in older adults, often due to underlying comorbidities⁷. The introduction of meningococcal vaccines has led to variations in serogroup incidence and has seen a shift in the age distribution of those at higher risk of IMD.

Societal factors are often influential in vaccine uptake and evidence from a study examining infant vaccine uptake found that most deprived communities were at a significantly greater risk of not receiving the infant measles-mumps-rubella (MMR) vaccine⁸. Other previous studies have shown evidence of the effect of deprivation on vaccine uptake, highlighting an inverse association between deprivation and the uptake of routine vaccines (e.g. HPV, influenza)⁸⁻¹⁰. Social factors such as educational attainment, income and employment can contribute to healthcare outcomes through patient education and understanding. These socioeconomic factors can act as barriers to healthcare however, the effect of socioeconomic deprivation on vaccine uptake is poorly understood and very little attention has been paid to the role of deprivation in effecting uptake of meningococcal

vaccines. Therefore, it was the aim of this study to examine the correlation between meningococcal vaccine (MenACWY, Hib/MenC & 4CMenB) uptake and social deprivation in Northern Ireland.

Methods

Database analysis of meningococcal vaccination uptake rates

The Cover of Vaccination Evaluated Rapidly (COVER) programme provides immunisation data for children within the UK on their first, second and fifth birthday¹¹. For NI, immunisation data was retrieved from the above database. Meningococcal vaccines examined included MenACWY, Hib/MenC and 4CMenB, as well as a non-meningococcal control, namely mumps, measles and rubella vaccine (MMR), was also examined. Vaccine coverage included (i). Two doses of MenB by 12 months, (ii). All 3 doses of MenB by 24 months, (iii). Hib/MenC coverage, (iv). MenACWY (Year 12s, for NI) (v). First dose of MMR.

Vaccine Uptake versus Deprivation Measures

Northern Ireland Multiple Deprivation Measures 2017 (NIMDM2017) provides deprivation measures for NI and utilises 38 indicators in 7 domains (<https://www.nisra.gov.uk/statistics/deprivation/northern-ireland-multiple-deprivation-measure-2017-nimdm2017>). NIMDM2017 provides an aggregated dataset using these domains for Northern Ireland's Health and Social Care Trusts (HSCT), therefore, data displays 6 domains with 37 indicators. The NI HSCT vaccine uptake dataset for each vaccine was correlated with each indicator in the HSCT NIMDM2017 dataset.

Statistics

A regression analysis was performed through Microsoft Excel for Microsoft Office 365 Version 2102 to determine the relationship between vaccine uptake and deprivation indicators and coefficient of variation (R). R squared values (R²) were calculated for each of the indicators. If R² value was 0.5 < R² < 0.7, it was considered a moderate effect size and if the R² value > 0.7 the value was considered a strong effect size. In consideration of that, in this regression analysis, any values which fell within these bounds, particularly > 0.7, were considered significant.

3. Results

Table 1 details the correlation R² between vaccine uptake and social deprivation metric. In relation to the 4CMenB (2 doses by 12 months), 9 indicators produced R² values 0.5 < R² < 0.7 and 18 indicators produced R² values of > 0.7. For 4CMenB (all 3 doses by 24 Months) 9 indicators produced R² values 0.5 < R² < 0.7 and 17 indicators produced R² values of > 0.7. For Hib/MenC, 10 indicators produced R² values 0.5 < R² < 0.7 and 16 indicators produced R² values of > 0.7. For MenACWY, no indicators produced R² values 0.5 < R² < 0.7 or values > 0.7. For MMR, 10 indicators produced R² values 0.5 < R² < 0.7 and 17 indicators produced R² values of > 0.7. Most correlations were seen in the 'Education, Skills and Training' domain and 'Crime and Disorder' domain.



Discussion

Meningococcal disease has an everchanging epidemiology with incidence and serogroups varying widely over time. Over the past two decades, the incidence of meningococcal disease has been declining due to the successful introduction of meningococcal vaccines. The first introduction of meningococcal C vaccine has accompanied rapid declines in IMD incidence however other emerging serogroups such as Men B and W have been increasing in regions of the UK and ROI. Associated with this is the shift in age distribution with those aged over 24 subjected to the highest incidence of IMD. This is not surprising given, the poor uptake of the adolescent MenACWY vaccine in NI and the late introduction of the vaccine in the ROI, perhaps being a contributing factor to the increase among this age-group.

Within NI, the percentage of infants receiving the first two doses of 4CMenB by their first birthday in 2018/19 was 94.3% and 94.5% in 2019/20. In the same years, those receiving their booster dose in NI was 92.4% and 92% respectively^{11,12}. Considering a non-meningococcal comparator, MMR uptake has similar rates, as in 2019/20, 92.2% of infants in NI received their first dose of MMR by their 2nd birthday¹³. MenACWY uptake is much lower compared to infant vaccines. Uptake was initially quite low in 2015/16 as in Northern Ireland only 78% of year 12s received the vaccine. However, there has been an increase in the number receiving this vaccine since then with 84.9% of year 12s receiving their MenACWY vaccine in 2018/19. In comparison to uptake of a similar vaccine, targeted at teenagers, HPV vaccine coverage shows similar uptake rates in Northern Ireland. In 2018-19 only 76.6% of year 9s completed their full course of HPV vaccines and 82.8% of year 10s completed theirs¹³. Uptake of infant meningococcal vaccines has been consistently high since their introduction, however it is apparent that MenACWY uptake is considerably lower when compared with other meningococcal vaccines. In a study of MenACWY uptake and barriers and motivation towards vaccination in Northern Ireland undergraduate students, it was found that amongst 1210 students, 868 first-time freshers and 342 non-freshers, from healthcare-related, non-healthcare-related and engineering/computing faculties, vaccine uptake amongst 18-year-old students was 90.7% and 87.3% in female and male cohorts, respectively, falling to 72.1% and 67.7% (19-year cohort) and 32.7% and 39.6% (20- to 25-year cohort) in males and females, respectively. Students reported that posters, clinics and talks were the preferred methods of communication and not social media. There was general lack of awareness of the signs/symptoms of meningitis and approximately 30% of students falsely believed that administration of the MenACWY vaccine excluded the risk of contracting meningitis¹⁴.

The MenACWY vaccine is aimed at adolescents and those entering university and so motivation to seek information on the seriousness of meningococcal disease and, if not offered in school, the willingness to seek the vaccine themselves may be a barrier to uptake within this age group. In addition, a study analysing school characteristics in uptake of MenACWY found that poorer schools, with high

deprivation, had lower uptake¹⁵ of the vaccine. This finding signifies the importance of socioeconomic factors on vaccine uptake, particularly within the school setting.

Findings in this study regarding meningococcal vaccine uptake and deprivation demonstrated that infant meningococcal vaccines (4CMenB and Hib/MenC) are considerably impacted by local deprivation particularly within Northern Ireland. MenACWY is not affected by deprivation as no correlation was evident in these results. 'Education, Skills and Training' and 'Crime and Disorder' parameters comprised most notable strong effect size correlations, producing R² values > 0.7 (Table 1).

The proportion of pupils attending special schools or attending primary schools with special education needs stages 3-5 produced high R² values of 0.8816, 0.8361, 0.8721 and 0.9159 in this domain for each analysed infant vaccine. It is of interest that poorer vaccine uptake is seen in this subdomain, as the perception of adverse effects from vaccination is a common occurrence amongst parents with children of special needs¹⁶, particularly the notion that childhood vaccines are the cause of Autistic Spectrum Disorder (ASD), in early infancy. The uptake of MMR was significantly impacted by the publication of report (1998), now discredited, linking autism to MMR vaccination¹⁷ leading to an 80% decline of MMR in the following years⁸. Unfortunately, many media platforms can prolong these vaccine 'myths' and information provided through social media can often lead to misrepresentations of vaccine side effects. These assumptions would indeed follow a decline in uptake of any infant vaccine.

Absenteeism in both primary and secondary schools and associated low educational attainment show considerable correlation with poor vaccine uptake (Figures 1a, 1b). The Department of Education published research in 2016 finding that the higher overall absence rate across Key Stage (KS) and KS4, the more likely a lower level of attainment was achieved by the end of KS2 and KS4¹⁸. It is known that level of education is impactful within the vaccination process, as a study evidenced that more educated parents more likely to visit GPs to seek advice about vaccinations¹⁹ than those with a lower educational attainment. Additionally, Forshaw and colleagues identified that maternal education is correlated with increased childhood vaccination and found a significant difference between literate and illiterate women, presenting that increased literacy has a positive impact on vaccine uptake²⁰. In consideration of this, it is evident that education has a critical role in the decision-making process regarding vaccination. Those with higher educational attainment will be more knowledgeable, grasp an easier understanding of health-related information and can make conscious and informed decisions regarding their own healthcare or the healthcare of their children. In addition to educational parameters, many 'Crime and Disorder' parameters highlighted a correlation with poorer vaccine uptake, with four of the most notable indicators seen, including (i) rate of burglary, (ii) rate of theft, (iii) rate of vehicle crime and (iv). rate of anti-social behaviour. These parameters reinforce the deprivation associated with a particular area and within the

Belfast Trust Region these are elevated, compared to other regions of Northern Ireland. There is little research on the impact of crime and disorder on vaccination uptake, however high levels of crime can be associated with lower educational attainment, and reduced social benefits²¹. Crime is a mirror of the quality of the social environment within an area and as an indicator of deprivation, needs to be closely considered in terms of public health so policy makers can be assisted in developing vaccine interventions to target deprived regions to maximise uptake.

Conclusion

Within the last two decades, incidence of meningococcal disease has been on the decline. The introduction of meningococcal vaccines has contributed to this decrease and uptake of such vaccines should remain a public health priority to maintain the decline in meningococcal disease. Identifying contributing factors to low vaccine uptake, such as, the association between local deprivation and uptake of meningococcal vaccines, should be of public health importance and acknowledged by local governments and policy makers in their efforts to enhance vaccine uptake, both infant and teenage vaccination. There is a clear correlation with educational deprivation measures such as absenteeism and poor educational attainment and reduced vaccine uptake, perhaps through lack of understanding and willingness to vaccinate. This is where the importance of a clear and coherent public health message surrounding meningococcal vaccination should be prioritised, particularly to establish innovative modalities in a multidisciplinary team approach, to reach out to and increase vaccine uptake rates in socially deprived communities in Northern Ireland.

CONFLICT OF INTEREST:

Author OCB declares that she has no conflict of interest. Author BCM declares that she has no conflict of interest. Author JEM declares that he has no conflict of interest.

AVAILABILITY OF DATA AND MATERIAL

None available

COMPETING INTEREST

None

Credit authorship contribution statement

Orlaith C. Brennan: Formal Analysis; Investigation; Methodology; Visualization; Roles/Writing - original draft; Writing - review & editing

John E. Moore: Conceptualization; Formal analysis; Investigation; Methodology; Writing - review & editing

Beverly C. Millar: Conceptualization; Formal analysis; Investigation; Methodology; Writing - review & editing

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Figure 1: (a) Effect of absenteeism in primary and (b) post-primary schools on vaccine uptake of three meningococcal vaccines and MMR vaccine.

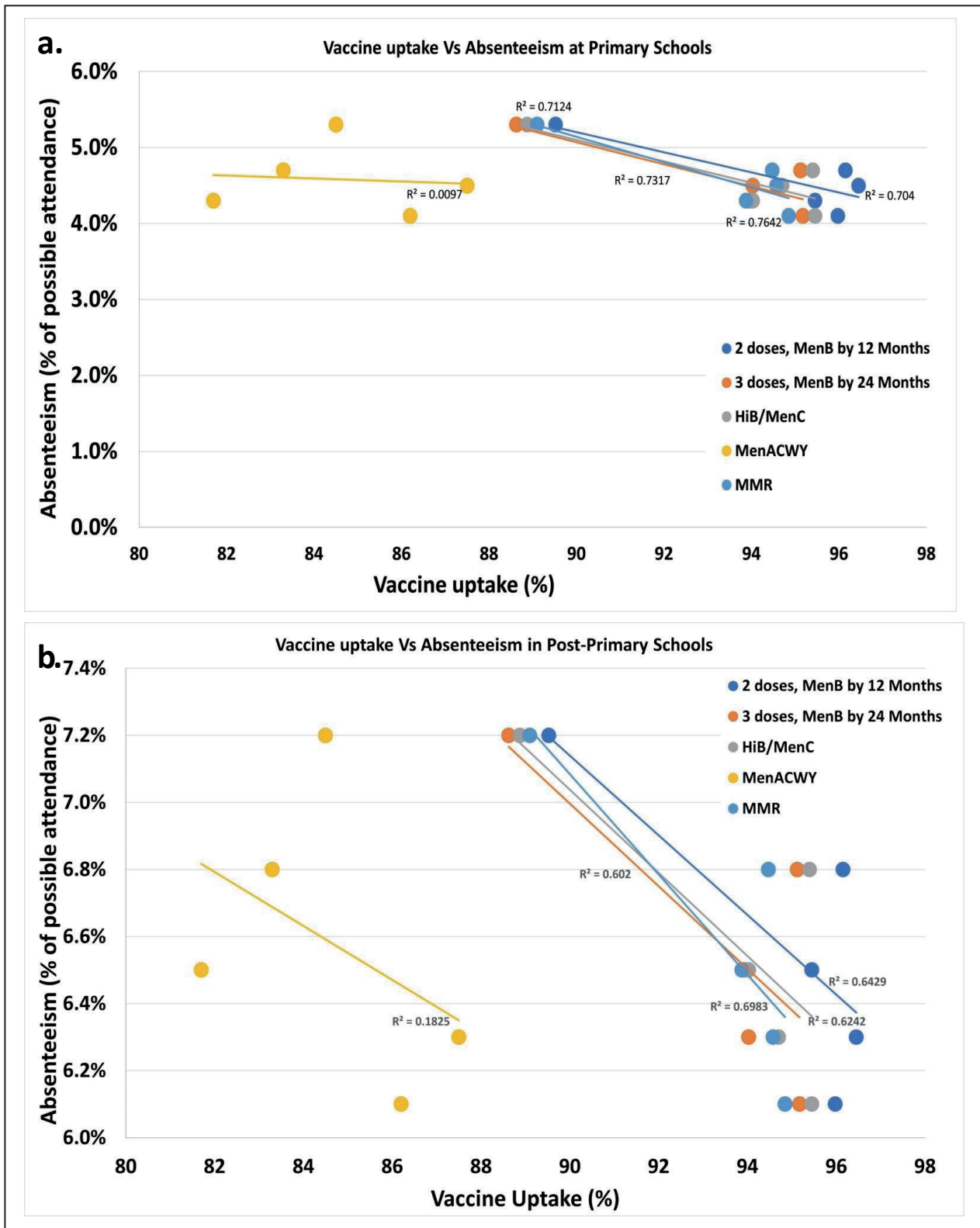


Table 1:

Summary of correlation (R^2 value) between meningococcal vaccine uptake vs deprivation for all deprivation indicators of Northern Ireland

Vaccine	Health & Social Care Trust	Uptake (%)	Income & Employment			
			Proportion of the population living in households whose equivalised income is below 60 per cent of the NI median (%)	Proportion of the population aged 15 and under living in households whose equivalised income is below 60 per cent of the NI median (%)	Proportion of the population aged 65 and over living in households whose equivalised income is below 60 per cent of the NI median (%)	Proportion of the working age population who are employment deprived (%)
4CMenB 12 months 2018	Belfast	89.5	11.8%	17.5%	4.3%	23.1%
	Northern	96.0	12.3%	18.1%	6.5%	18.1%
	South Eastern	95.5	12.1%	17.9%	6.1%	17.9%
	Southern	96.5	14.5%	20.5%	7.2%	19.8%
	Western	96.2	15.3%	20.7%	6.8%	25.8%
	R² Value		0.3261	0.3695	0.9414	0.0904
4CMenB 24 months 2018	Belfast	88.6	11.8%	17.5%	4.3%	23.1%
	Northern	95.2	12.3%	18.1%	6.5%	18.1%
	South Eastern	94.0	12.1%	17.9%	6.1%	17.9%
	Southern HSCT	94.0	14.5%	20.5%	7.2%	19.8%
	Western	95.1	15.3%	20.7%	6.8%	25.8%
	R² Value		0.2664	0.2799	0.8369	0.063
HiB/MenC 2018	Belfast	88.9	11.8%	17.5%	4.3%	23.1%
	Northern	95.5	12.3%	18.1%	6.5%	18.1%
	South Eastern	94.0	12.1%	17.9%	6.1%	17.9%
	Southern	94.7	14.5%	20.5%	7.2%	19.8%
	Western	95.4	15.3%	20.7%	6.8%	25.8%
	R² Value		0.3072	0.3297	0.8871	0.0602
MenACWY 2018-2019 Year 12s	Belfast	84.5	11.8%	17.5%	4.3%	23.1%
	Northern	86.2	12.3%	18.1%	6.5%	18.1%
	South Eastern	81.7	12.1%	17.9%	6.1%	17.9%
	Southern	87.5	14.5%	20.5%	7.2%	19.8%
	Western	83.3	15.3%	20.7%	6.8%	25.8%
	R² Value		0.0404	0.083	0.0891	0.0314
MMR 2018	Belfast	89.1	11.8%	17.5%	4.3%	23.1%
	Northern	94.9	12.3%	18.1%	6.5%	18.1%
	South Eastern	93.9	12.1%	17.9%	6.1%	17.9%
	Southern	94.6	14.5%	20.5%	7.2%	19.8%
	Western	94.5	15.3%	20.7%	6.8%	25.8%
	R² Value		0.2704	0.307	0.9096	0.1098



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Table 1 continued

Vaccine	Health & Social Care Trust	Uptake (%)	Standardised preventable death ratio (excluding Suicides)	Standardised physical health-related benefit ratio	Standardised ratio of people registered as having cancer (excluding non-melanoma skin cancers) (NI = 100)	Standardised emergency admission ratio (NI = 100)	Health & Disability			Standardised ratio of people with a long-term health problem or disability (Excluding Mental Health problems) (NI = 100)
							Standardised ratio of Children's Dental Extractions (NI = 100)	Proportion of Singleton Births with Low Birth Weight (%)	Standardised ratio of multiple prescriptions on a regular basis (NI = 100)	
4CMenB 12 months 2018	Beifast	89.5	128.3	114.7	107.7	116.2	100.3	108.9	107.2	
	Northern	96.0	91.8	89.3	97.8	93.7	84.0	97.0	96.8	
	South Eastern	95.5	86.9	83.9	95.0	101.7	113.1	89.9	97.6	
	Southern	96.5	95.3	101.7	100.7	92.5	111.7	100.1	96.7	
	Western	96.2	104.7	118.7	100.3	97.2	93.9	108.0	103.5	
	R² Value		0.7718	0.1626	0.6575	0.9231	0.00001	0.2438	0.6238	
4CMenB 24 months 2018	Beifast	88.6	128.3	114.7	107.7	116.2	100.3	108.9	107.2	
	Northern	95.2	91.8	89.3	97.8	93.7	84.0	97.0	96.8	
	South Eastern	94.0	86.9	83.9	95.0	101.7	113.1	89.9	97.6	
	Southern HSC	94.0	95.3	101.7	100.7	92.5	111.7	100.1	96.7	
	Western	95.1	104.7	118.7	100.3	97.2	93.9	108.0	103.5	
	R² Value		0.7223	0.1515	0.6812	0.8631	0.0374	0.2091	0.5219	
HIB/MenC 2018	Beifast	88.9	128.3	114.7	107.7	116.2	100.3	108.9	107.2	
	Northern	95.5	91.8	89.3	97.8	93.7	84.0	97.0	96.8	
	South Eastern	94.0	86.9	83.9	95.0	101.7	113.1	89.9	97.6	
	Southern	94.7	95.3	101.7	100.7	92.5	111.7	100.1	96.7	
	Western	95.4	104.7	118.7	100.3	97.2	93.9	108.0	103.5	
	R² Value		0.7071	0.1334	0.633	0.9097	0.0312	0.1869	0.5395	
MenACWY 2018-2019 Year 12s	Beifast	84.5	128.3	114.7	107.7	116.2	100.3	108.9	107.2	
	Northern	86.2	91.8	89.3	97.8	93.7	84.0	97.0	96.8	
	South Eastern	81.7	86.9	83.9	95.0	101.7	113.1	89.9	97.6	
	Southern	87.5	95.3	101.7	100.7	92.5	111.7	100.1	96.7	
	Western	83.3	104.7	118.7	100.3	97.2	93.9	108.0	103.5	
	R² Value		0.0002	0.0036	0.0739	0.1558	0.0379	0.0336	0.0898	
MMR 2018	Beifast	89.1	128.3	114.7	107.7	116.2	100.3	108.9	107.2	
	Northern	94.9	91.8	89.3	97.8	93.7	84.0	97.0	96.8	
	South Eastern	93.9	86.9	83.9	95.0	101.7	113.1	89.9	97.6	
	Southern	94.6	95.3	101.7	100.7	92.5	111.7	100.1	96.7	
	Western	94.5	104.7	118.7	100.3	97.2	93.9	108.0	103.5	
	R² Value		0.7825	0.1893	0.6744	0.936	0.0086	0.2541	0.6424	



Table 1 continued

Vaccine	Health & Social Care Trust	Uptake (%)	Proportion of pupils attending Special Education Stages 3-5 (%)	Absenteeism at Primary Schools (% of possible attendance)	Proportion of school leavers not achieving five or more GCSEs at A*-C (and equivalent) incl. English and maths (%)	Proportion of those leaving school aged 16, 17 and 18 not entering Education, Employment or Training (%)	Education, Skills & Training	Proportion of 18-21 year olds who have not enrolled in Higher Education Courses at Higher or Further Education establishments (%)	Proportion of pupils attending Special Schools or who are attending post-primary schools with Special Education Needs Stages 3-5 (%)	Absenteeism at post-primary schools (% of possible attendance)	Proportions of working age adults (25-64) with no or low levels of qualification (%)
4CMenB 12 months 2018	Belfast	89.5	11.5%	5.3%	39.4%	4.5%	68.5%	10.8%	7.2%	36.1%	
	Northern	96.0	8.1%	4.1%	36.4%	3.3%	64.3%	7.2%	6.1%	35.2%	
	South Eastern	95.5	9.3%	4.3%	32.9%	2.1%	62.6%	9.2%	6.5%	30.3%	
	Southern	96.5	8.3%	4.5%	35.2%	2.1%	62.8%	7.8%	6.3%	36.6%	
	Western	96.2	9.2%	4.7%	34.9%	2.3%	61.4%	9.5%	6.8%	41.0%	
R² Value			0.8816	0.704	0.6417	0.7618	0.8551	0.591	0.6429	0.0031	
4CMenB 24 months 2018	Belfast	88.6	11.5%	5.3%	39.4%	4.5%	68.5%	10.8%	7.2%	36.1%	
	Northern	95.2	8.1%	4.1%	36.4%	3.3%	64.3%	7.2%	6.1%	35.2%	
	South Eastern	94.0	9.3%	4.3%	32.9%	2.1%	62.6%	9.2%	6.5%	30.3%	
	Southern HSCT	94.0	8.3%	4.5%	35.2%	2.1%	62.8%	7.8%	6.3%	36.6%	
	Western	95.1	9.2%	4.7%	34.9%	2.3%	61.4%	9.5%	6.8%	41.0%	
R² Value			0.8361	0.7317	0.5686	0.6158	0.8059	0.5546	0.602	0.009	
HIB/MenC 2018	Belfast	88.9	11.5%	5.3%	39.4%	4.5%	68.5%	10.8%	7.2%	36.1%	
	Northern	95.5	8.1%	4.1%	36.4%	3.3%	64.3%	7.2%	6.1%	35.2%	
	South Eastern	94.0	9.3%	4.3%	32.9%	2.1%	62.6%	9.2%	6.5%	30.3%	
	Southern	94.7	8.3%	4.5%	35.2%	2.1%	62.8%	7.8%	6.3%	36.6%	
	Western	95.4	9.2%	4.7%	34.9%	2.3%	61.4%	9.5%	6.8%	41.0%	
R² Value			0.8721	0.7124	0.5416	0.6275	0.8043	0.5939	0.6242	0.0162	
MenACWY 2018-2019 Year 12s	Belfast	84.5	11.5%	5.3%	39.4%	4.5%	68.5%	10.8%	7.2%	36.1%	
	Northern	86.2	8.1%	4.1%	36.4%	3.3%	64.3%	7.2%	6.1%	35.2%	
	South Eastern	81.7	9.3%	4.3%	32.9%	2.1%	62.6%	9.2%	6.5%	30.3%	
	Southern	87.5	8.3%	4.5%	35.2%	2.1%	62.8%	7.8%	6.3%	36.6%	
	Western	83.3	9.2%	4.7%	34.9%	2.3%	61.4%	9.5%	6.8%	41.0%	
R² Value			0.1567	0.0097	0.148	0.0175	0.025	0.3493	0.1825	0.0898	
MMWR 2018	Belfast	89.1	11.5%	5.3%	39.4%	4.5%	68.5%	10.8%	7.2%	36.1%	
	Northern	94.9	8.1%	4.1%	36.4%	3.3%	64.3%	7.2%	6.1%	35.2%	
	South Eastern	93.9	9.3%	4.3%	32.9%	2.1%	62.6%	9.2%	6.5%	30.3%	
	Southern	94.6	8.3%	4.5%	35.2%	2.1%	62.8%	7.8%	6.3%	36.6%	
	Western	94.5	9.2%	4.7%	34.9%	2.3%	61.4%	9.5%	6.8%	41.0%	
R² Value			0.9159	0.7642	0.5838	0.673	0.7958	0.6513	0.6983	0.0023	



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Table 1 continued

Vaccine	Health & Social Care Trust	Uptake (%)	Proportion of domestic dwellings that are unfit (%)	Proportion of domestic dwellings in a state of disrepair (%)	Proportion of domestic dwellings without (1) modern boiler, or (2) loft insulation and double glazing (%)	Rate of Household overcrowding (%)	Living population with disability without adaptations to dwelling (%)	Proportion of domestic dwellings with Local Area Problem Scores (%)	Standardised ratio of road defects (NI = 100)	Rate of Road Traffic Collisions (per 1,000 population)	Proportion of properties in flood risk area (%)
4CMenB 12 months 2018	Belfast	89.5	1.4%	15.9%	25.0%	4.7%	82.0%	4.7%	180.9	4.6	3.9%
	Northern	96.0	2.5%	15.6%	28.1%	3.1%	84.4%	1.9%	80.8	3.8	2.6%
	South Eastern	95.5	2.3%	15.6%	27.8%	3.0%	84.6%	2.1%	94.6	4.4	1.8%
	Southern	96.5	3.0%	16.1%	27.6%	4.3%	84.0%	1.7%	131.6	4.0	2.4%
	Western	96.2	3.0%	16.2%	25.7%	4.9%	84.1%	1.9%	75.7	4.4	1.4%
	R² Value		0.8637	0.003	0.5007	0.1247	0.8815	0.9991	0.6941	0.4211	0.4084
4CMenB 24 months 2018	Belfast	88.6	1.4%	15.9%	25.0%	4.7%	82.0%	4.7%	180.9	4.6	3.9%
	Northern	95.2	2.5%	15.6%	28.1%	3.1%	84.4%	1.9%	80.8	3.8	2.6%
	South Eastern	94.0	2.3%	15.6%	27.8%	3.0%	84.6%	2.1%	94.6	4.4	1.8%
	Southern HSCT	94.0	3.0%	16.1%	27.6%	4.3%	84.0%	1.7%	131.6	4.0	2.4%
	Western	95.1	3.0%	16.2%	25.7%	4.9%	84.1%	1.9%	75.7	4.4	1.4%
	R² Value		0.7765	0.0004	0.4396	0.1484	0.8923	0.9443	0.8628	0.4084	0.7266
Hib/MenC 2018	Belfast	88.9	1.4%	15.9%	25.0%	4.7%	82.0%	4.7%	180.9	4.6	3.9%
	Northern	95.5	2.5%	15.6%	28.1%	3.1%	84.4%	1.9%	80.8	3.8	2.6%
	South Eastern	94.0	2.3%	15.6%	27.8%	3.0%	84.6%	2.1%	94.6	4.4	1.8%
	Southern	94.7	3.0%	16.1%	27.6%	4.3%	84.0%	1.7%	131.6	4.0	2.4%
	Western	95.4	3.0%	16.2%	25.7%	4.9%	84.1%	1.9%	75.7	4.4	1.4%
	R² Value		0.8264	0.0008	0.4427	0.1224	0.8649	0.9622	0.8068	0.448	0.6968
MenACWY 2018-2019 Year 12s	Belfast	84.5	1.4%	15.9%	25.0%	4.7%	82.0%	4.7%	180.9	4.6	3.9%
	Northern	86.2	2.5%	15.6%	28.1%	3.1%	84.4%	1.9%	80.8	3.8	2.6%
	South Eastern	81.7	2.3%	15.6%	27.8%	3.0%	84.6%	2.1%	94.6	4.4	1.8%
	Southern	87.5	3.0%	16.1%	27.6%	4.3%	84.0%	1.7%	131.6	4.0	2.4%
	Western	83.3	3.0%	16.2%	25.7%	4.9%	84.1%	1.9%	75.7	4.4	1.4%
	R² Value		0.0618	0.0525	0.0588	0.0176	0.0107	0.018	0.0585	0.4881	0.1337
MMR 2018	Belfast	89.1	1.4%	15.9%	25.0%	4.7%	82.0%	4.7%	180.9	4.6	3.9%
	Northern	94.9	2.5%	15.6%	28.1%	3.1%	84.4%	1.9%	80.8	3.8	2.6%
	South Eastern	93.9	2.3%	15.6%	27.8%	3.0%	84.6%	2.1%	94.6	4.4	1.8%
	Southern	94.6	3.0%	16.1%	27.6%	4.3%	84.0%	1.7%	131.6	4.0	2.4%
	Western	94.5	3.0%	16.2%	25.7%	4.9%	84.1%	1.9%	75.7	4.4	1.4%
	R² Value		0.8182	0.0007	0.536	0.1611	0.8942	0.9887	0.7415	0.4886	0.6634



Table 1 continued

Vaccine	Health & Social Care Trust	Uptake (%)	Rate of Violence (including sexual offences), robbery and public order (per 1,000 population)	Rate of Burglary (per 1,000 population)	Rate of Theft (per 1,000 population)	Crime & Disorder				Access to Services	
						Rate of Vehicle Crime (per 1,000 population)	Rate of Criminal Damage and Arson (per 1,000 population)	Rate of Deliberate Primary and Secondary Fires (per 1,000 population)	Rate of Anti-Social Behaviour Incidents (per 1,000 population)	Proportion of properties with broadband speed below 10Mb/s (%)	
4CMenB 12 months 2018	Belfast	89.5	21.2	5.8	11.8	4.0	12.3	4.2	36.6	1.2%	
	Northern	96.0	12.2	3.0	5.4	1.3	7.3	2.4	24.1	11.8%	
	South Eastern	95.5	13.3	3.3	5.2	1.6	7.5	2.7	27.3	7.7%	
	Southern	96.5	13.8	3.8	4.7	1.9	7.4	2.8	22.6	14.2%	
	Western	96.2	18.2	3.5	5.9	2.3	9.7	3.7	28.3	18.1%	
	R² Value		0.5975	0.879	0.9707	0.8289	0.7582	0.5472	0.8596	0.7433	
4CMenB 24 months 2018	Belfast	88.6	21.2	5.8	11.8	4.0	12.3	4.2	36.6	1.2%	
	Northern	95.2	12.2	3.0	5.4	1.3	7.3	2.4	24.1	11.8%	
	South Eastern	94.0	13.3	3.3	5.2	1.6	7.5	2.7	27.3	7.7%	
	Southern HSC	94.0	13.8	3.8	4.7	1.9	7.4	2.8	22.6	14.2%	
	Western	95.1	18.2	3.5	5.9	2.3	9.7	3.7	28.3	18.1%	
	R² Value		0.5464	0.9428	0.8871	0.8313	0.6711	0.5061	0.7474	0.7408	
HIB/MenC 2018	Belfast	88.9	21.2	5.8	11.8	4.0	12.3	4.2	36.6	1.2%	
	Northern	95.5	12.2	3.0	5.4	1.3	7.3	2.4	24.1	11.8%	
	South Eastern	94.0	13.3	3.3	5.2	1.6	7.5	2.7	27.3	7.7%	
	Southern	94.7	13.8	3.8	4.7	1.9	7.4	2.8	22.6	14.2%	
	Western	95.4	18.2	3.5	5.9	2.3	9.7	3.7	28.3	18.1%	
	R² Value		0.5483	0.9148	0.9015	0.8191	0.6821	0.5073	0.7935	0.778	
MenACWY 2018-2019 Year 12s	Belfast	84.5	21.2	5.8	11.8	4.0	12.3	4.2	36.6	1.2%	
	Northern	86.2	12.2	3.0	5.4	1.3	7.3	2.4	24.1	11.8%	
	South Eastern	81.7	13.3	3.3	5.2	1.6	7.5	2.7	27.3	7.7%	
	Southern	87.5	13.8	3.8	4.7	1.9	7.4	2.8	22.6	14.2%	
	Western	83.3	18.2	3.5	5.9	2.3	9.7	3.7	28.3	18.1%	
	R² Value		0.0517	0.0011	0.0122	0.0082	0.0446	0.0621	0.1776	0.0405	
MMWR 2018	Belfast	89.1	21.2	5.8	11.8	4.0	12.3	4.2	36.6	1.2%	
	Northern	94.9	12.2	3.0	5.4	1.3	7.3	2.4	24.1	11.8%	
	South Eastern	93.9	13.3	3.3	5.2	1.6	7.5	2.7	27.3	7.7%	
	Southern	94.6	13.8	3.8	4.7	1.9	7.4	2.8	22.6	14.2%	
	Western	94.5	18.2	3.5	5.9	2.3	9.7	3.7	28.3	18.1%	
	R² Value		0.6372	0.92	0.9548	0.8705	0.7746	0.5933	0.8671	0.7205	

