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Low rates of dental attendance by the age of one and inequality between local government administrative areas in England

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Objective: To describe child dental attendance (DA) by 1 year of age in England and its relationship with area deprivation. ***Basic research design:*** Analysis of National Health Service data for the 12 months to June 2017. Deprivation was measured by Index of Multiple Deprivation Rank of Average Score (2015) for upper-tier and unitary local authorities in England (LAs, n=151). DA rates were calculated for children under 1 year (<1yr) and children aged 1 year and under (≤1yr). A Spearman's test assessed strength of association with deprivation. The Slope Index of Inequality (SII) and Relative Index of Inequality (RII) explored equity. ***Clinical setting:*** Upper-tier and unitary LAs in England. ***Main outcome measure:*** Attending an NHS primary care dental service. ***Results:*** DA rates ranged from 0 to 12.3% (Median:2; IQR:1.4,3.9) in children <1yr and from 3.7 to 37.6% (Median:10; IQR:7.4,17) in children ≤1yr. DA rates decreased as deprivation decreased (Spearman=-0.25, p=0.0019 in children <1yr; Spearman=-0.21, p=0.0104 in children ≤1yr). The SII suggested a 2 percentage point difference in DA rate across the deprivation distribution in children <1yr (SII=-0.02, 95% CI=-0.01,-0.04; p=<0.001); and a 5 point difference in children ≤1yr (SII=-0.05, 95% CI=-0.02,-0.09; p=0.003). The DA rate in the most deprived LA was 2.1 higher than the least deprived LA (RII=2.1, 95% CI=1.4,3.2; p=<0.001) in children <1yr and 1.5 higher (RII=1.5, 95% CI=1.2,2; p=0.004) in children ≤1yr. ***Conclusions:*** DA rates were low for all LAs and only partially explained by deprivation. More deprived LAs were, unexpectedly, more likely to report higher DA rates.

Keywords: *Dental Health Services; England; Dental Attendance; Dentistry; Dental Caries*

Introduction

There is broad consensus that children should have a dental examination from a dentist as soon as the first teeth erupt and no later than the child's first birthday (British Society of Paediatric Dentistry, 2016). Early dental visits provide parents with information they require to prevent early childhood caries and it is believed that such dental visits familiarise children with the dental environment and reduce future dental anxiety (Poulsen, 2003).

Poor oral health can cause pain and infection which can affect eating, sleeping, socialising and learning as well as causing economic impacts (Petersen *et al.*, 2015). The National Health Service (NHS) in England, a service primarily funded from general taxation, makes considerable investment in dental services, spending approximately £3.4 billion per annum (NHS England, 2014). In the two years to March 2016, tooth extraction was the main reason for hospital admission in 5 to 9-year olds and the sixth most common procedure in under 5-years old; expenditure on such care in the latter group costing £7.8m in the financial year 2015/16 (Public Health England (PHE), 2017a).

A broad range of interventions, delivered at population and individual level, are advocated to improve the dental health of children, including dental attendance (DA) to receive both treatment of disease and preventive interventions. In 2016, the British Society of Paediatric Dentistry (BSPD) in partnership with the Office of the Chief Dental Officer England, launched a "Dental Check by One" campaign to promote the importance of child attendance by the age of 1 year (British Society of Paediatric Dentistry, 2017). In the same year, NHS England started a new programme, Starting Well, in 13 high priority areas targeting children aged under 5 years who do not currently visit a dentist (NHS England, 2017b). There is, therefore, considerable investment in the model of children attending a dentist for early detection of dental disease and preventive interventions.

Surveys suggest that children from more deprived backgrounds, though at greater risk of disease, are less likely to attend dental services (Holmes *et al.*, 2016). In a 2013 survey of children in England, nine out of ten children aged 5 and 8 were reported by their parents to have visited a dentist for a check-up in the previous 12 months, but only a third of those 5 year olds were reported to have first visited a dentist by the age of 2 (Tsakos *et al.*, 2015); the latter indicator having changed little since the previous survey in 2003 (Holmes *et al.*, 2016). Previous studies of NHS dental access by children in England have shown that this reduces with increasing deprivation (Jones, 2001; Maunder *et al.*, 2006). One study (Jones, 2001) showed a small reduction in more affluent areas, although the author reported that this was unlikely to be statistically significant.

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From April 2013 the Health and Social Care Act 2012 (HM Government, 2012) and associated regulations placed a responsibility upon upper-tier and unitary local authorities (LAs) in England for commissioning oral health promotion programmes. The same Act also requires NHS England to commission dental services appropriate to the needs of the population (PHE, 2018b). This is the first study that investigates variation in DA rate for this age group between English LAs and whether there is an association with deprivation using routinely collected NHS dental activity data.

Methods

Data were obtained from the 2016/17 NHS Dental Statistics for England Annual Report, which is in the public domain (NHS Digital, 2017). The study population included children from 0 to 1 year of age (n=155,308) who attended NHS England dental services for the 12 months to June 2017, irrespective of whether this was for a check-up, treatment or unscheduled care. Data from hospital and private dental services were not included. Individual children were included once only in the dataset, irrespective of the number of courses of treatment reported; age was reported as the child's age at the last day of the 12-month period and residence was based on the location of the dental service. Child population data for upper-tier or unitary LAs (mid-2015 population estimate provided by the Office for National Statistics) were contained in the data set (NHS Digital, 2017).

DA rates were calculated for two age groups:

a) Children under 1 year (less than 12 months), recorded as age 0 in the NHS data and representing children who had attended an NHS dental practice in the year to June 2017 who had not yet reached their first birthday by June 2017. All children in this category could be regarded as having attended a dental practice before the age of 1 year but this indicator will produce a smaller rate than the true rate of children who have visited the dentist before this age as it excludes those who both attended the dentist before their first birthday and subsequently attained this age in the year to June 2017.

b) Children aged 1 year and under (less than 24 months); this group includes children from the previous group plus children recorded as age 1 in the NHS data. The latter represents those who had attended an NHS dental practice in the year to June 2017 who achieved their first birthday but not their second birthday by June 2017. Some of these children, therefore, may have first attended a NHS dental practice only after their first birthday had passed; this indicator is likely to produce a higher rate than the true rate of children who have visited the dentist before that date.

Rates were obtained by dividing the number of those children who attended dental services within a given LA by the child population for that LA in the relevant age group, expressed as a percentage of the population for each LA.

Deprivation level of LAs was measured by the Index of Multiple Deprivation (IMD) Rank of Average Score from the English Indices of Deprivation 2015 (Ministry of Housing, Communities and Local Government, 2015). The IMD is based on 37 indicators grouped as Income Deprivation, Employment Deprivation, Education, Skills and Training Deprivation, Health Deprivation and Disability, Crime, Barriers to Housing and Services and Living Environment. There was a total of 151 LAs; the Isles of Scilly were not included as there were no data in the 2016/17 NHS Dental Statistics for England Annual Report.

A Spearman's (r_s) test was used to assess the strength of the association between DA rate and LA deprivation. Two regression-based summary measures of inequalities: Slope Index of Inequality (SII) and Relative Index of Inequality (RII) were used to examine and estimate the magnitude of inequalities. The SII and RII measures have been commonly used in health research to measure absolute and relative inequalities, respectively (Hosseinpoor *et al.*, 2016). They are methodologically appropriate because they consider the sample size of each socioeconomic group (LA in this study). The values of SII and RII are interpreted as the hypothetical absolute and relative difference between the least deprived and the most deprived. In addition to their methodological appropriateness for this research, these indices are relatively easy to interpret. For example, in this study, the SII of -0.05 indicates 5-percentage point difference in DA between the bottom and top of deprivation distribution. The RII value of 1.5 indicates that DA rate at the top of deprivation distribution is 1.5 times higher than bottom of deprivation distribution. Statistical significance was set at 0.05. The analysis was carried out using Stata 14 (StataCorp., 2015).

Results

The rate of DA in England was 2.8% for children under 1 year and 11.7% for children aged 1 year and under. Rates varied between LAs (Figure 1); for children under 1 year, rates ranged from 0 in City of London to 12.3% in South Tyneside (Median: 2; IQR: 1.4, 3.9). The DA rate was higher than 10% in only two out of 151 LAs. The corresponding range for children aged 1 year and under was 3.7% in Hackney to 37.6% in South Tyneside (Median: 10; IQR: 7.4, 17).

The values of Spearman correlation were statistically significant for both age groups, (r_s = -0.25, p=0.0019 in children under 1 year; and r_s=-0.21, p=0.0104 in children aged 1 year and under). The DA rate decreased as deprivation decreased (Figure 2). The values of SII and RII, suggested that DA rate for children under 1 year was significantly higher in more deprived LAs (p=<0.001). In children under 1 year, the SII was -0.02 (95% CI=-0.01, -0.04) suggesting that the difference in DA rate between the bottom and top of deprivation distribution was 2 percentage points. The RII of 2.1 (95% CI=1.4, 3.2) implies that DA rate in the most deprived LA was 2.1 times higher than the least deprived. Similar findings were obtained for children aged 1 year and under; the SII was -0.05 (95% CI=-0.02, -0.09) suggesting that the difference in DA rate between the bottom and top of deprivation distribution was 5 percentage points. The RII of 1.5 (95% CI=1.2, 2) suggests that DA rate in the most deprived LA was 1.5 times higher than the least deprived LA. Table 1 summarises these results.

Discussion

Rates of DA were generally low with substantial variations between LAs. Unexpectedly, more deprived LAs reported higher DA rates. The SII showed that the difference in DA rate between the bottom and top of deprivation distribution was 2 percentage points in children under 1 year, and 5 points in children aged 1 year and under. In children under 1 year, the rate of DA in the most deprived LA was 2.1 times higher than in the least deprived LA while in children aged 1 year and under, the rate was 1.5 times higher.

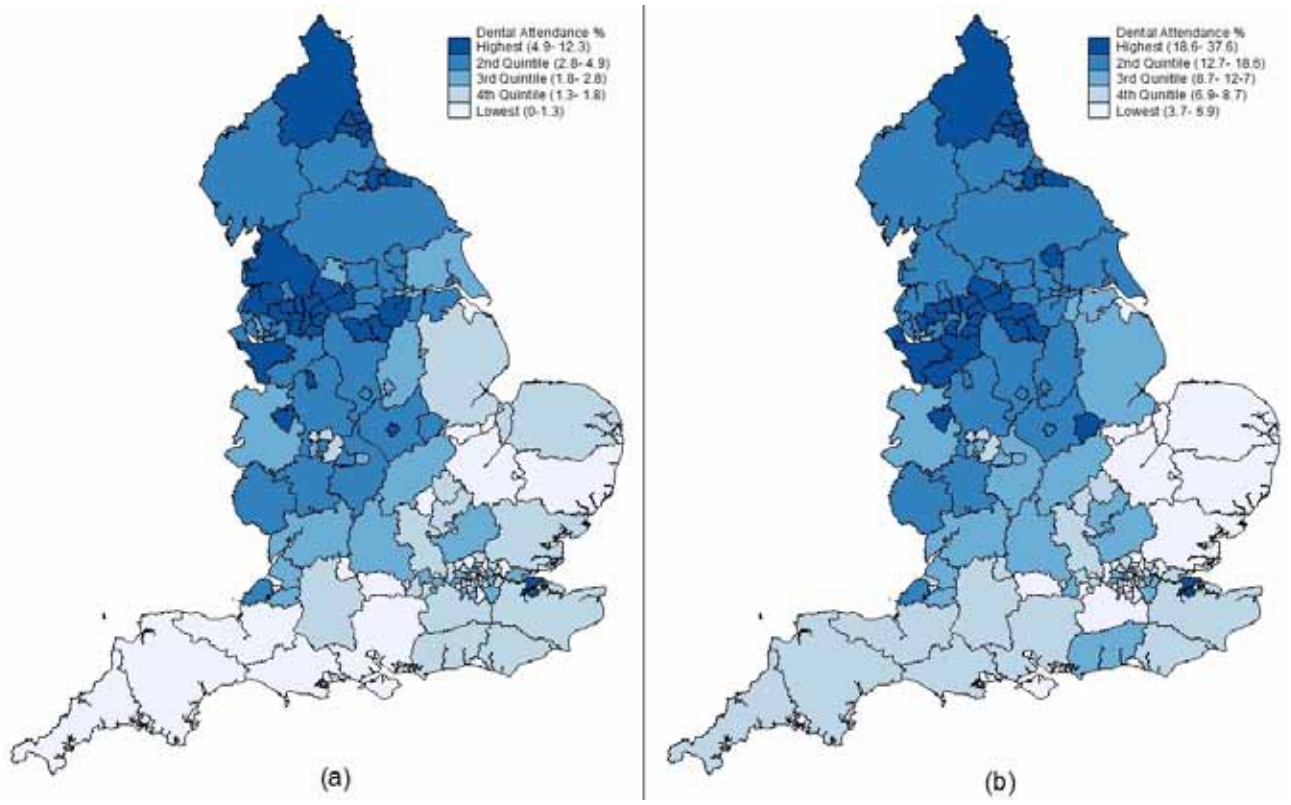

Figure 1: Percentage of dental attendance in: (a) child under 1 year; (b) child aged 1 year and under in England. Source: NHS Digital (2017).

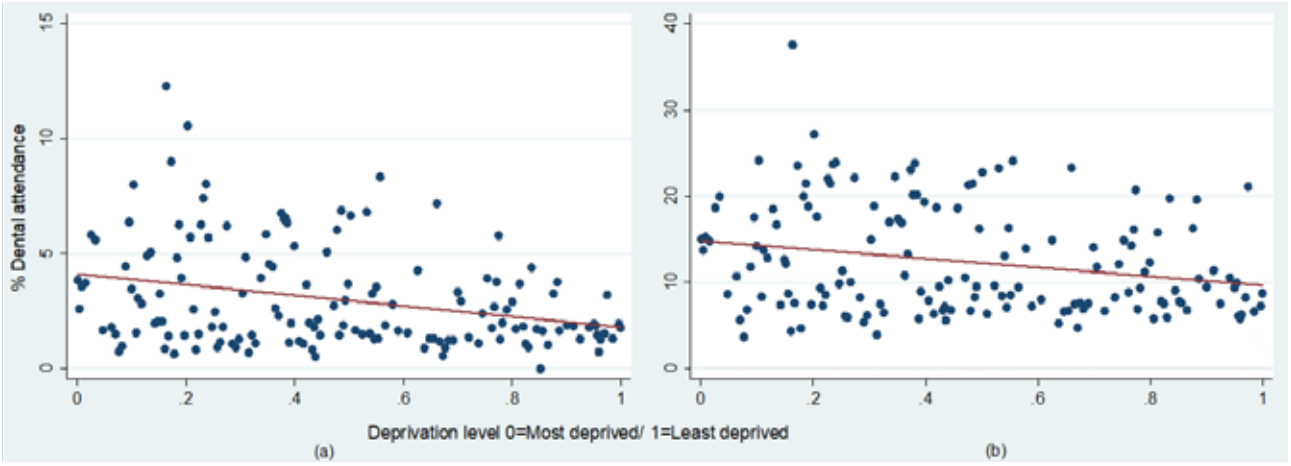

Figure 2: Scatter diagram showing the association between dental attendance in children and deprivation (IMD 2015) in every local authority: (a) children under 1 year; (b) children aged 1 year and under. Source: NHS Digital (2017).

Table 1. Association between children dental attendance and deprivation (IMD 2015).

	Children under 1 year	*Children aged 1 year and under*
	(n=18,359)	(n=155,308)
DA Rate (Range) %	2.8 (0, 12.3)	11.7 (3.7, 37.6)
Median (IQR)[a]	2 (1.4, 3.9)	10 (7.4,17)
r_s	-0.25	-0.21
P value	0.0019	0.0104
SII (CI)[b]	-0.02 (-0.01, -0.04)	-0.05 (-0.02, -0.09)
P value	<0.001	0.003
RII (CI)[b]	2.1 (1.4, 3.2)	1.5 (1.2, 2)
P value	<0.001	0.004

[a] Interquartile Range
[b] 95% Confidence Interval
Source: NHS Digital (2017)

One of the limitations of this analysis is that the dataset allocated children to age groups based on their age at the end of the data collection period and not the date that each child was first seen for examination. There are obvious practical reasons for NHS Digital to have adopted this method and whilst, given the age of the study population, there might be little difference between a child's age when seen for an examination and their age at the end of the collection period, the data are not a precise match for the population of interest and the reference population data used to calculate DA rates..

NHS England reported that for the year to June 2017 only 58.2% of children (under 18 years) were seen by an NHS dentist (NHS Digital, 2017). The present study observed low DA rates among children aged 1 year and under across England, only 3% of children in the under one-year old category attended an NHS dental practice. There were also considerable variations across LAs; a 10-fold variation for children aged 1 year and under and a 12-fold variation in children under 1 year.

Although influenced by socio-economic factors, the DA rate was only partially explained by LA deprivation. DA rates were, surprisingly, higher in more deprived LAs. The LAs with the highest levels of deprivation, such as Blackpool, Knowsley and Hull were not amongst those LAs with the lowest DA rates. Nevertheless, Hackney which had the lowest DA rate was among the ten most deprived LAs. In seeking to interpret the observed pattern of attendance we used The Chartered Institute of Public Finance and Accountancy (CIPFA, 2017) "nearest statistical neighbour" tool to explore whether DA rates were similar between LAs with comparable characteristics such as ethnicity and urban/rural characteristics. This tool is commonly used with other health data sets in England, including oral health data (PHE, 2017b). This also did not explain the variation. For example, the DA rate in children aged 1 year and under in North-East Lincolnshire was 4.3% but its nearest statistical neighbour, Redcar and Cleveland, had a rate of 22%. Nevertheless, it should be considered that LAs are not homogenous and there might be variations in population and deprivation between and within LAs. A LA might be in the middle range of deprivation across its whole population, whereas another with the same IMD might have substantial heterogeneity.

In this study South Tyneside, which had the highest DA rate, has a population dentist-ratio above the England average (NHS Digital, 2017) even though it has a high level of deprivation. It also has a small geographical size, which might make it easier for patients to access services without the need to travel long distances. By contrast, The City of London, who had a very low DA rate in children aged 1 year and under, is a very heterogenous area with a high level of immigration and a likely high population turnover. It has a very small young child population which might partially explain its low rate of DA. Only a small number of children were seen by an NHS dentist but none of those under 1 year. Factors such as the availability and access to NHS dental care and even a pattern of reported inappropriate contact with health services might have an influence (Muirhead *et al.*, 2018). These factors, in addition to the small young child population, might explain the low DA rate.

The rates of DA in this study do not necessarily represent children accessing dental services at an appropriate interval for preventive care, as they will include children who have attended for management of urgent conditions. The incidence of acute dental events is likely to be higher in more deprived communities, matching the observed higher prevalence of dental caries in more deprived groups. The recording of residence by dental provider location rather than child residence might also explain some of the differences between LAs, but it is reasonable to assume that very young children are likely to see a dentist close to where they live.

In explaining dental treatment uptake, it is important to consider those barriers to general access and dental care. First, the unavailability of dental services; in terms of lower population-dentist ratios have been reported in the Midlands, East and North of England compared to the South and London (NHS Digital, 2017). Deprived areas, communities with lower population density and those with relatively high proportions of children (0-14 years) or older people also tend to experience lower dentist to population ratios (Moles, 2001). Furthermore, areas with low population density might present challenges for more deprived groups due to increased transport challenges. There may also be areas with a higher proportion of their population experiencing language barriers. Moreover, ethnicity might have also an impact on dental treatment uptake. Variations in the proportion of dental caries in five-year-olds by ethnicity have been reported, with lower proportion affected in the Black and White groups (PHE, 2017c). In terms of health access, minority ethnic groups are less likely to access primary care services (PHE, 2018a). However, recent studies exploring the association of ethnicity and child DA are limited.

This research reported NHS DA only and has not included children who may have visited dentists under private arrangements. Furthermore, some children may have used hospital dental services exclusively, which are not recorded in NHS primary care dental statistics. Any such use of hospital services for dental care is, however, more likely to be for management of acute conditions or reflect a small number of children with serious health problems who must receive dental care in a hospital environment. Given that dental services are free for children under 18 (NHS Digital, 2017), the reports from surveys state that nearly all children's dental visits are under NHS arrangements (Tsakos *et al*., 2015) and that a high proportion of the adult population in the 2017 GP survey report successful attempts to access NHS dental care (NHS England, 2017a). It might be assumed that NHS dental access figures for children reflect true child access. There may, however, be a higher use of private dental care in more affluent LAs; the 2017 GP survey reported that 38% of adults who reported not having tried to get an NHS appointment mentioned private dentistry as the reason for this (NHS England, 2017a).

Jones and colleagues (2013) observed a lack of association between social deprivation and child (less than 18 years old) NHS dental registration (for contractor and salaried services) in Scotland, though there was a 6% absolute reduction in child registration rates between the least (76%) and most (82%) deprived quintiles. Nonetheless, it is important to consider that these results might not be comparable to our data due to the differences in primary dental care between England and Scotland. Jones and colleagues (2013) discussed the information gap for private dental care, which might affect any assessment of inequalities in dental access related to deprivation, and it is logical to theorise that parents in relatively affluent areas are more likely to see a private dentist and may ask the same

dentist to care for their child's teeth, even if that dentist does not offer NHS dental care, rather than take the child to a different dentist who can. These private dentists might, in turn, offer their regular adult patients free check-ups for their children, or at minimal charge, since they will likely have low dental need.

Progressive restriction of NHS dental contracts that only cater for children (Secretary of State for Health, 2008) may also be a factor in producing this pattern. LAs serving relatively affluent populations with apparent low levels of registration might, therefore, need to assess private DA rates when producing planning estimates. It remains apparent, however, that levels of DA rates for very young children are uniformly low, even in areas where rates are comparatively higher. This is likely to have implications for dental health and provides a challenge for public health initiatives seeking to ensure all children have a dental check-up by their first birthday.

Conclusions

DA rate in children aged 1 year and under was very low. There were substantial variations between LAs. More deprived English LAs were, unexpectedly, more likely to report higher DA rates. However, DA was only partially explained by deprivation at LA level. More studies are needed to explore the reasons of such variations in DA rates such as local initiatives, difficulties accessing NHS care and use of private dental care in those LAs with the lowest rates. The very low baseline and nature of the variation observed creates challenges for policy makers seeking to achieve high rates of DA in younger children as these are low in all areas and the variation observed in this study suggests a complex causality. Further research is needed to understand the underlying drivers for DA and the utility of potential interventions to increase DA rates in this age group.

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