

The Role of Area Deprivation in Explaining Ethnic Inequalities in Adult Oral Health in England

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Background: The circumstances of the area where people live may affect their health and ethnic minority groups are often overrepresented in deprived areas. This study explored ethnic inequalities in adult oral health and the contribution of area deprivation to explain such inequalities. **Methods:** Data from 15667 adults across 8 ethnicities (White British, Irish, Black Caribbean, Black African, Indian, Pakistani, Bangladeshi, Chinese) in the Health Survey for England 2010/2011 were analysed. Oral health was indicated by having a non-functional dentition, poor self-rated oral health and oral impacts on daily activities. Survey logistic regression and the Blinder-Oaxaca decomposition method were used. **Results:** There were ethnic inequalities in the non-functional dentition, but not in self-rated oral health or oral impacts. Compared to White British adults (19.7%, 95% CI: 18.9, 20.6), a non-functional dentition was more common in Irish (33.1%, 95% CI: 25.9, 41.2) and less common in Black Caribbean (14.9%, 95% CI: 9.9, 21.7), Black African (6.9%, 95% CI: 3.9, 11.9), Indian (10.5%, 95% CI: 6.3, 17.2), Pakistani (7.2%, 95% CI: 4.5, 11.5), Bangladeshi (12.7%, 95% CI: 4.3, 32.3) and Chinese (2.2%, 95% CI: 0.6, 7.9) adults. In decomposition analysis, observed population characteristics explained over half of the ethnic inequalities in the non-functional dentition. Age, area deprivation and SEP were the main contributors, although results varied by ethnicity. **Conclusion:** Ethnic inequalities in adult oral health varied according to oral health measure and ethnicity. Area deprivation and SEP contributed to, but did not fully, explain such inequalities.

Keywords: Oral health, ethnic groups, health status disparities, tooth loss, social determinants of health

Introduction

In England, ethnic oral health inequalities among adults vary according to the outcome assessed and do not always favour the White population. Data from the 2009 Adult Dental Health Survey showed that Indian and Pakistani/Bangladeshi adults were less likely to have had dental fillings, extractions or a non-functional dentition than White adults, after adjusting for socio demographic and behavioural factors. However, no differences were noted between Black and White adults (Arora *et al.*, 2016). Other national data showed that Indian, Pakistani, Bangladeshi and Chinese adults were less likely to be edentulous than White British adults after adjusting for sociodemographic factors. Also, Irish and Black Caribbean adults were more likely, while Bangladeshi adults were less likely to have toothache (Delgado-Angulo *et al.*, 2019).

Two common explanations for oral health ethnic inequalities are socioeconomic and behavioural factors (Bastos *et al.*, 2018). However, they explain only a small part of the observed differences between ethnic groups (Celeste *et al.*, 2013; Nazer and Sabbah, 2018), suggesting other factors may underlie disparities. Structural factors and systemic racism are now widely debated as perpetuating causes of ethnic health inequalities (Delgado and Stefancic, 2017; Ford and Airhihenbuwa, 2010). Racism is associated with poorer health, mainly through inequalities in power, prestige, freedom, neighbourhood conditions and access to health services (Phelan and Link, 2015). Within that context, the present study focuses on the role of the living area (neighbourhood conditions) to explain ethnic inequalities in adult oral health.

The circumstances of the area where people live may affect their health independently of individual socioeconomic position (SEP) (Diez Roux, 2016; Phelan and Link, 2015). Ethnic minority groups are commonly overrepresented in deprived areas, which are characterised by higher levels of disorder and crime as well as poor physical environment attributes such as low quality and quantity of leisure facilities; transport, housing and food shopping opportunities; and community and health services (Diez Roux and Mair, 2010; Macintyre and Ellaway, 2009). This unequal spatial separation, into deprived areas of ethnic minority people from the majority white population, contributes to and exacerbates existent ethnic health inequalities (White *et al.*, 2012). Whilst a few previous studies have reported associations between area deprivation and poor oral health (Bower *et al.*, 2007; Turrell *et al.*, 2007), none has explored the relationship between area disadvantage and oral health among ethnic minority groups. Given the different features of the physical and social environments where ethnic groups reside, contextual neighbourhood characteristics, including area deprivation, could contribute to ethnic oral health inequalities. The aims of this study were to explore ethnic inequalities in adult oral health and the contribution of area deprivation to explaining such inequalities.

Methods

Study population

This study used data from the Health Survey England (HSE), a series of surveys designed to monitor trends in

the nation's health. Every year, a new nationally representative sample of adults and children living in private households in England is recruited using stratified random probability sampling (Craig and Mindell, 2011). The HSE 2010-2011 surveys were the latest including oral health data. A total of 8420 and 8992 adults were interviewed in 2010 and 2011 (66% response rate in both years), respectively (Craig and Mindell, 2011; 2012). Data were collected through home interviews, followed by a health visit from a trained nurse.

Data from 15697 adults, aged 16 years and over, across 8 ethnic groups (White British, Irish, Black Caribbean, Black African, Indian, Pakistani, Bangladeshi and Chinese) were available. Of those, 33 were excluded for having missing data on oral health outcomes or covariates. The study sample consisted of 15667 adults with complete data on all relevant variables.

Variables

Oral health was indicated via three self-reports. The first asked participants how many natural teeth they still had (no teeth at all, fewer than 10 teeth, 11 to 19 teeth, and 20+ teeth). Those with fewer than 20 natural teeth were classified as having a non-functional dentition. The second asked participants to rate the health of their mouth, teeth and dentures (excellent, very good, good, fair and poor). Those who answered 'fair' or 'poor' were classified as having poor self-rated oral health. The third asked participants if, in the last 6 months, they had any problems with their mouth, teeth or dentures that caused any of the following: difficulty eating food; difficulty speaking clearly; problems with smiling, laughing and showing teeth without embarrassment; or problems enjoying the company of other people such as family, friends or neighbours. Those who reported one or more restrictions in these daily performances were classified as having experienced oral impacts.

Ethnicity was self-assigned using a list of 16 categories under five main ethnic groups (White, Mixed, Black, Asian, and Other). Irish, Black Caribbean, Black African, Indian, Pakistani, Bangladeshi and Chinese were the largest seven non-mixed ethnic minority groups living in England according to the 2001 UK census. The reference group was formed by participants who described themselves as White British. Area deprivation was measured with the Index for Multiple Deprivation (IMD) 2007, a composite indicator based on seven domains (income, employment, health deprivation and disability, education, skills and training, crime, barriers to housing and services, and living environment) collected from various sources at the lower super output area (LSOA). In the HSE, deprivation quintiles are used to reflect broad categories of deprivation while protecting the confidentiality of participants.

Participants' demographic factors (sex, age and residence area) and SEP were included in the analysis as they could confound the association between ethnicity and oral health. Residence area was collected using 3 categories (urban; town and fringes; village, hamlet and isolated dwellings) and dichotomised as urban versus rural. Four SEP indicators were chosen to address concerns about their applicability across different ethnic groups, namely education (highest educational qualification),

national socio-economic classification (NS-SEC) group, equivalised income and current economic activity. A composite SEP measure was derived from fitting a one-factor model in confirmatory factor analysis, where the four individual SEP indicators loaded into a single latent variable representing the individual's SEP (Delgado-Angulo *et al.*, 2019; 2020). Full information maximum likelihood estimation was used to handle missing data in SEP measures. As some SEP measures were categorical, the weighted least square method was used to estimate model parameters. Factor loadings were all significant and ranged from 0.61 to 0.80. The comparative fit index was 0.99, and the root mean square error of approximation was 0.055, suggesting the model had good fit to the data. The SEP latent factor score was categorised into quintiles.

Statistical analysis

All analyses were carried out in Stata 16 (StataCorp LP, College Station, TX) considering sample weights (to adjust for the unequal probability of selection and differential non-response) and the complex survey design (stratification and clustering). The sociodemographic characteristics of the 8 ethnic groups in the study sample were first compared using the Chi-squared test for unordered groups (sex, residence area) and the Wald's test for linear trends for ordered groups (age groups, SEP and area deprivation). The prevalence of non-functional dentition, poor self-rated oral health and oral impacts were then compared by sociodemographic factors using the Chi-squared test for unordered groups and the Wald's test for linear trends for ordered groups.

Ethnic inequalities in each oral health outcome were evaluated using logistic regression. Two models were fitted for each outcome. Model A was adjusted for demographic factors (sex, age and residence area) and SEP quintiles whereas Model B was additionally adjusted for area deprivation. Thereafter, the Blinder-Oaxaca decomposition method was used to determine the extent to which oral health inequalities between White British and each ethnic minority reflected differences in observed population characteristics (sex, age groups, residence area, SEP and area deprivation) and the contribution of each population characteristic to explain such inequalities (Sen, 2014). The method partitions ethnic inequalities in a given health outcome into a part that is explained by differences in observed characteristics included in the model and a part that is attributable to unobserved differences between groups. It must be noted here that a variable can contribute to the ethnic inequality in the health outcome by exacerbating or reducing it (Rahimi and Hashemi Nazari, 2021; Sen, 2014). Although the method was originally proposed to decompose numerical outcomes, extensions for binary outcomes are now available. They can be implemented in Stata using the Oaxaca command. All coefficients were estimated from a pooled regression over both comparison groups and included a group indicator (White British versus ethnic minority group) as an additional covariate, with survey logit models fitted to the data. Categorical explanatory variables were analysed as a set of dummy variables and the deviation contrast transform used to ensure the results of the decomposition were invariant to the choice of the (omitted) reference category (Jann, 2008).

Results

There were major sociodemographic differences among ethnic groups (Table 1). Irish adults were older, whereas all Asian and Black groups were younger than White British adults. Indian and Chinese adults were wealthier, whereas Pakistani and Bangladeshi adults were poorer than White British adults. All minority ethnic groups were overrepresented in urban and deprived areas. There were ethnic inequalities in the non-functional dentition, but not in poor self-rated oral health or oral impacts (Table 2). Having a non-functional dentition was more common in the Irish group but less common in every Black and Asian group than in the White British group. Furthermore, clear gradients in each oral health outcome were noted according to quintiles of SEP and area deprivation.

Ethnic inequalities in the non-functional dentition remained after adjustments, although not for all ethnic groups (Table 3). Irish adults had 1.82 (95% CI: 1.19, 2.77) times greater odds of having non-functional dentition whereas Indian adults had 50% (OR: 0.50, 95% CI: 0.27, 0.92) lower odds than White British after adjustment for demographic factors (sex, age groups and residence area) and SEP quintiles. These differences remained unchanged after further adjustment for area deprivation (OR: 1.71, 95% CI: 1.12, 2.62 and 0.42, 95% CI: 0.22, 0.78, respectively). No differences in the prevalence of

poor self-rated oral health and oral impacts were observed between ethnic groups after adjustments.

The raw ethnic gap in the prevalence of non-functional dentition was negative (indicating higher prevalence in the ethnic minority) for the Irish group (-21%) but positive for the Black African (13%), Indian (9%), Pakistani (10%) and Chinese (13%) groups (Table 4). The 5 covariates in the model collectively accounted for 58% or more of those gaps. For all ethnic minorities, age differences with the White British group were the main contributor to ethnic inequalities in the prevalence of the non-functional dentition. Beyond the contribution of age, SEP and area deprivation were next, but their contribution varied across ethnic groups. Improving deprivation levels, to resemble those found among White British adults, would reduce the proportion of Irish adults with non-functional dentition (closing the gap with White British adults) and reduce even more the proportion of Black African, Indian and Pakistani adults with non-functional dentition (increasing their gaps with White British adults). Adjusting SEP levels to those found among White British adults would increase the proportion with a non-functional dentition among Indian and Chinese adults (closing the gap with White British adults as the two ethnic minorities already have higher SEP levels) but reduce the proportion among Pakistani adults (opening the gap with White British adults even further as Pakistani adults have lower SEP levels).

Table 1. Characteristics of participants, by ethnic group (n=15667)

	<i>White British</i>		<i>Irish</i>		<i>Black Caribbean</i>		<i>Black African</i>		<i>Indian</i>		<i>Pakistani</i>		<i>Bangladeshi</i>		<i>Chinese</i>	
	n ^a	%	n ^a	%	n ^a	%	n ^a	%	n ^a	%	n ^a	%	n ^a	%	n ^a	%
Sex																
Men	6333	48.8	78	52.7	70	44.8	98	53.1	179	53.7	122	52.9	33	51.7	28	51.8
Women	7993	51.2	80	47.3	107	55.2	126	46.9	202	46.3	142	47.1	38	48.3	38	48.2
Mean age (SD), years	48.2 (19.3)		53.0 (18.0)		46.1 (15.6)		36.2 (11.2)		39.1 (13.3)		36.2 (13.3)		39.1 (13.6)		32.8 (10.7)	
Residence area																
Urban	11000	77.3	141	90.5	171	97.1	224	100.0	372	97.5	261	99.0	71	100.0	64	97.9
Rural	3413	22.7	17	9.5	6	2.9	0	0.0	9	2.5	3	1.0	0	0.0	2	2.1
SEP																
Q1 (wealthiest)	2771	19.9	45	29.3	43	23.7	44	19.7	116	29.4	27	10.9	8	9.7	23	33.7
Q2	2895	20.5	24	17.3	38	21.7	42	17.6	80	20.3	34	13.7	5	5.1	16	18.6
Q3	2903	20.8	19	12.0	33	20.0	52	25.8	57	17.5	47	18.8	16	27.7	16	26.5
Q4	2884	20.3	26	16.0	32	18.0	48	22.6	68	17.5	73	28.4	14	19.0	5	14.2
Q5 (poorest)	2873	18.5	44	25.4	31	16.6	38	14.3	60	15.3	83	28.1	28	38.6	6	7.1
Area deprivation																
Q1 (least deprived)	3355	23.1	19	10.8	11	5.7	17	8.0	51	12.2	18	6.4	2	3.0	13	13.8
Q2	3093	21.5	34	21.5	19	10.7	7	3.4	71	17.1	10	4.4	2	3.3	12	16.4
Q3	3028	21.3	31	19.8	15	8.5	34	16.2	82	21.0	21	8.1	10	14.1	11	17.8
Q4	2579	18.2	42	27.5	53	28.9	49	19.4	103	29.8	56	22.3	7	8.0	12	21.8
Q5 (most deprived)	2271	15.8	32	20.4	79	46.2	117	53.1	74	19.8	159	58.9	50	71.5	18	30.1

^a Counts are unweighted.

Table 2. Oral health outcomes among 15667 adults.

	<i>Non-functional dentition</i>		<i>Poor self-rated oral health</i>		<i>Oral impacts</i>	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Sex						
Men	18.4	[17.4, 19.4]	22.4	[21.3, 23.5]	10.5	[9.7, 11.3]
Women	19.4	[18.5, 20.4]	17.4	[16.5, 18.2]	10.7	[10.0, 11.4]
<i>P</i>	0.080		<0.001		0.729	
Age groups						
16-24 years	2.0	[1.3, 2.9]	11.0	[9.2, 13.0]	8.4	[7.0, 10.1]
25-34 years	2.9	[2.1, 3.9]	17.0	[15.3, 18.8]	10.8	[9.4, 12.5]
35-44 years	6.2	[5.2, 7.4]	20.4	[18.8, 22.2]	10.3	[9.1, 11.6]
45-54 years	11.3	[10, 12.7]	24.3	[22.6, 26.2]	11.1	[9.9, 12.6]
55-64 years	23.3	[21.5, 25.3]	24.8	[23.0, 26.6]	11.1	[9.9, 12.4]
65-74 years	46.6	[44.1, 49.0]	20.4	[18.6, 22.3]	11.3	[9.9, 12.8]
75+ years	67.0	[64.6, 69.4]	19.5	[17.7, 21.5]	11.3	[9.9, 12.8]
<i>P value for trend</i>	<0.001		<0.001		0.012	
Ethnicity						
White British	19.7	[18.9, 20.6]	19.8	[19.0, 20.6]	10.6	[10.0, 11.2]
Irish	33.1	[25.9, 41.2]	26.2	[19.4, 34.2]	12.3	[8.0, 18.5]
Black Caribbean	14.9	[9.9, 21.7]	20.7	[15.0, 27.8]	12.8	[8.4, 19.1]
Black African	6.9	[3.9, 11.9]	16.4	[11.4, 22.9]	7.7	[4.9, 12.0]
Indian	10.5	[6.3, 17.2]	19.8	[15.5, 24.8]	10.4	[7.9, 13.6]
Pakistani	7.2	[4.5, 11.5]	21.5	[16.3, 27.7]	13.0	[8.7, 19.0]
Bangladeshi	12.7	[4.3, 32.3]	21.4	[13.1, 33.2]	7.0	[2.3, 19.0]
Chinese	2.2	[0.6, 7.9]	14.2	[7.2, 26.1]	5.7	[2.3, 13.5]
<i>P</i>	<0.001		0.558		0.446	
Residence area						
Urban	19.0	[18.1, 19.9]	20.6	[19.8, 21.5]	11.1	[10.5, 11.8]
Rural	18.5	[16.8, 20.2]	16.6	[15.3, 18.1]	8.6	[7.6, 9.7]
<i>P</i>	0.576		<0.001		<0.001	
SEP						
Q1 (wealthiest)	4.5	[3.8, 5.4]	14.5	[13.3, 15.8]	8.5	[7.5, 9.6]
Q2	10.1	[9.0, 11.2]	17.3	[16.0, 18.7]	9.5	[8.4, 10.7]
Q3	16.6	[15.3, 18.0]	18.8	[17.2, 20.4]	10.0	[8.9, 11.2]
Q4	22.3	[20.8, 23.9]	21.8	[20.3, 23.4]	10.9	[9.9, 12.1]
Q5 (poorest)	42.8	[40.8, 44.9]	27.2	[25.5, 29.0]	14.3	[13.0, 15.7]
<i>P value for trend</i>	<0.001		<0.001		<0.001	
Area deprivation						
Q1 (least)	14.1	[12.8, 15.5]	16.8	[15.4, 18.2]	8.6	[7.6, 9.8]
Q2	18.3	[16.7, 20.0]	16.7	[15.3, 18.3]	9.5	[8.4, 10.7]
Q3	18.6	[17.1, 20.3]	18.9	[17.4, 20.6]	9.5	[8.5, 10.6]
Q4	21.8	[20.0, 23.8]	22.7	[20.8, 24.6]	12.6	[11.3, 14.1]
Q5 (most)	22.6	[20.8, 24.6]	24.9	[23.0, 27.0]	13.2	[11.9, 14.7]
<i>P value for trend</i>	<0.001		<0.001		<0.001	

^a Chi-squared test or Chi-squared test for linear trends

Discussion

In relation to the first objective of this study, we found that ethnic inequalities in adult oral health varied depending on the outcome, but more importantly on the ethnic minority being investigated. Ethnic inequalities were

found in one of three oral health measures. Compared to White British adults, a non-functional dentition was more common in the Irish, and less common in all Asian and Black groups. Differences between the White British group and the Black Caribbean and Bangladeshi groups were negligible though. Conversely, we did not find ethnic

Table 3. Models for the associations of ethnicity, SEP and area deprivation with oral health outcomes

	<i>Non-functional dentition</i>		<i>Poor self-rated oral health</i>		<i>Oral impacts</i>	
	<i>Model 1A</i>	<i>Model 1B</i>	<i>Model 2A</i>	<i>Model 2B</i>	<i>Model 3A</i>	<i>Model 3B</i>
	<i>OR^a [95% CI]</i>	<i>OR^a [95% CI]</i>	<i>OR^a [95% CI]</i>	<i>OR^a [95% CI]</i>	<i>OR^a [95% CI]</i>	<i>OR^a [95% CI]</i>
Ethnicity						
White British	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Irish	1.82 [1.19, 2.77]	1.71 [1.12, 2.62]	1.33 [0.90, 1.97]	1.30 [0.88, 1.91]	1.12 [0.68, 1.82]	1.08 [0.66, 1.76]
Black Caribbean	0.79 [0.45, 1.39]	0.64 [0.36, 1.14]	0.98 [0.67, 1.44]	0.90 [0.61, 1.32]	1.18 [0.73, 1.90]	1.06 [0.66, 1.72]
Black African	0.85 [0.42, 1.73]	0.70 [0.34, 1.46]	0.77 [0.50, 1.21]	0.71 [0.45, 1.12]	0.67 [0.41, 1.10]	0.62 [0.38, 1.03]
Indian	1.02 [0.47, 2.21]	0.99 [0.46, 2.14]	1.01 [0.74, 1.39]	1.00 [0.72, 1.37]	0.96 [0.71, 1.31]	0.94 [0.69, 1.28]
Pakistani	0.50 [0.27, 0.92]	0.42 [0.22, 0.78]	1.00 [0.69, 1.45]	0.92 [0.63, 1.34]	1.11 [0.69, 1.79]	1.02 [0.63, 1.65]
Bangladeshi	0.67 [0.17, 2.62]	0.55 [0.13, 2.25]	0.90 [0.46, 1.74]	0.83 [0.43, 1.60]	0.52 [0.16, 1.67]	0.48 [0.15, 1.53]
Chinese	0.41 [0.09, 1.92]	0.38 [0.08, 1.83]	0.84 [0.40, 1.80]	0.82 [0.37, 1.79]	0.54 [0.21, 1.42]	0.52 [0.20, 1.36]
<i>P</i>	<i>0.027</i>	<i>0.006</i>	<i>0.806</i>	<i>0.667</i>	<i>0.526</i>	<i>0.422</i>
SEP						
Q1 (wealthiest)	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Q2	1.81 [1.46, 2.24]	1.75 [1.41, 2.17]	1.34 [1.17, 1.55]	0.96 [0.82, 1.12]	1.16 [0.97, 1.40]	1.15 [0.95, 1.38]
Q3	3.19 [2.59, 3.93]	2.94 [2.38, 3.62]	1.60 [1.38, 1.87]	1.07 [0.92, 1.25]	1.28 [1.05, 1.56]	1.22 [1.01, 1.48]
Q4	4.29 [3.46, 5.33]	3.75 [3.02, 4.67]	2.06 [1.79, 2.36]	1.25 [1.06, 1.46]	1.43 [1.20, 1.72]	1.34 [1.12, 1.61]
Q5 (poorest)	8.95 [7.22, 11.09]	7.21 [5.77, 9.00]	2.78 [2.39, 3.24]	1.33 [1.14, 1.58]	1.94 [1.60, 2.35]	1.74 [1.43, 2.11]
<i>P value for trend</i>	<i><0.001</i>	<i><0.001</i>	<i><0.001</i>	<i><0.001</i>	<i><0.001</i>	<i><0.001</i>
Area deprivation						
Q1 (least)		1.00 [Reference]		1.00 [Reference]		1.00 [Reference]
Q2		1.14 [0.97, 1.34]		0.96 [0.83, 1.12]		1.09 [0.90, 1.31]
Q3		1.36 [1.15, 1.61]		1.07 [0.92, 1.25]		1.06 [0.88, 1.28]
Q4		1.77 [1.47, 2.14]		1.25 [1.07, 1.46]		1.37 [1.13, 1.65]
Q5 (most)		2.02 [1.67, 2.44]		1.34 [1.14, 1.57]		1.39 [1.14, 1.70]
<i>P value for trend</i>		<i><0.001</i>		<i><0.001</i>		<i><0.001</i>

^a Logistic regression models were fitted to each oral health outcome and odds ratios (OR) were reported.

Model A was adjusted for sex, age groups, ethnicity, residence area and SEP. Model B was additionally adjusted for area deprivation.

inequalities in poor self-rated oral health or oral impacts, either in regression models or decomposition analysis. It is possible that inequalities in the non-functional dentition were easier to identify because incremental tooth loss reflects an individual's cumulative exposure to dental diseases, but even more, access to dental care and the prevailing philosophy of dental care. On the other hand, self-rated oral health and oral impacts on daily life only reflect short-lived circumstances (nowadays and the past 6 months, respectively). Previous studies did not find ethnic inequalities in self-rated oral health (Arora *et al.*, 2016) or the prevalence of oral impacts (measured using the Oral Health Impact Profile) (Abdelrahim *et al.*, 2017). Taken together, these findings suggest that the choice of outcome measure is important as it could mask or make ethnic oral health inequalities visible.

For the second objective of this study, a large portion of the ethnic inequalities in non-functional dentition were explained by differences in observed population characteristics. Age was the main contributor to explain such inequalities, which was expected given the marked age differences between ethnic groups and incremental tooth loss with age. Census data show that ethnic minority groups are younger than the White population, due in part to the decline in fertility after the 'baby boomers'

and immigrants being younger and having higher fertility rates than the host population (Kelly and Nazroo, 2018). Next were the contributions of area deprivation and SEP, with improvements in either measure having different results across ethnic groups. Because all ethnic groups were overrepresented in deprived areas and they all (except the Irish) also had lower prevalence of a non-functional dentition than White British adults, efforts to reduce area deprivation to the levels found among White British adults would decrease the unfavourable gap in non-functional dentition for Irish adults, but widen the favourable gaps for Black African, Indian and Pakistani adults. Similarly, adjusting SEP to the level found among White British adults would decrease the favourable gaps for Indian and Chinese adults (who were on average wealthier than White British adults) but increase it for Pakistani adults (who were poorer). This does not mean we should not advocate policies to reduce area deprivation, but rather monitor closely their impacts on health.

The fact that disadvantaged neighbourhoods were more likely to host ethnic minorities brings ideas of residential segregation and ethnic density. Residential segregation influences the differential location of resources and services, which can in turn affect a neighbourhood's physical and social environments, including funding and

Table 4. Decomposition of inequalities in the prevalence of functional dentition between White British and other ethnic groups.

	<i>Irish</i> Coef. [95% CI]	<i>Black Caribbean</i> Coef. [95% CI]	<i>Black African</i> Coef. [95% CI]	<i>Indian</i> Coef. [95% CI]
Overall effect				
White British	0.20 [0.19, 0.21]	0.20 [0.19, 0.21]	0.20 [0.19, 0.21]	0.20 [0.19, 0.21]
Ethnic group	0.41 [0.33, 0.49]	0.20 [0.14, 0.26]	0.07 [0.03, 0.11]	0.11 [0.06, 0.15]
Total gap	-0.21 [-0.30, -0.13]	-0.004 [-0.07, 0.06]	0.13 [0.09, 0.16]	0.09 [0.04, 0.14]
Explained gap	-0.13 [-0.18, -0.08]	-0.04 [-0.08, 0.001]	0.11 [0.10, 0.13]	0.09 [0.08, 0.10]
Unexplained gap	-0.08 [-0.15, -0.02]	0.04 [-0.02, 0.10]	0.01 [-0.03, 0.05]	0.001 [-0.05, 0.05]
Independent contribution of each variable to ethnic inequalities				
Sex	-0.0001 [-0.003, 0.003]	0.001 [-0.001, 0.001]	-0.002 [-0.004, 0.001]	-0.002 [-0.003, 0.0001]
Residence	-0.002 [-0.004, 0.0002]	-0.002 [-0.004, 0.0002]	-0.005 [-0.01, 0.0003]	-0.003 [-0.006, 0.001]
Age groups	-0.11 [-0.14, -0.08]	-0.03 [-0.06, -0.01]	0.15 [0.13, 0.18]	0.09 [0.07, 0.10]
SEP	-0.01 [-0.03, 0.01]	0.01 [-0.003, 0.02]	0.001 [-0.02, 0.02]	0.02 [0.01, 0.03]
Area deprivation	-0.01 [-0.02, -0.002]	-0.02 [-0.03, -0.01]	-0.04 [-0.06, -0.02]	-0.01 [-0.02, -0.003]
	<i>Pakistani</i> Coef. [95% CI]	<i>Bangladeshi</i> Coef. [95% CI]	<i>Chinese</i> Coef. [95% CI]	
Overall effect				
White British	0.20 [0.19, 0.21]	0.20 [0.19, 0.21]	0.20 [0.19, 0.21]	
Ethnic group	0.10 [0.05, 0.14]	0.17 [0.03, 0.31]	0.07 [-0.05, 0.19]	
Total gap	0.10 [0.06, 0.14]	0.03 [-0.12, 0.17]	0.13 [0.01, 0.25]	
Explained gap	0.06 [0.04, 0.08]	-0.01 [-0.06, 0.03]	0.17 [0.16, 0.18]	
Unexplained gap	0.04 [0.001, 0.08]	0.04 [-0.10, 0.18]	-0.04 [-0.16, 0.09]	
Independent contribution of each variable to ethnic inequalities				
Sex	-0.002 [-0.004, 0.001]	-0.001 [-0.002, 0.001]	-0.001 [-0.003, 0.005]	
Residence	-0.004 [-0.01, 0.001]	-0.002 [-0.004, 0.002]	-0.003 [-0.01, 0.0002]	
Age groups	0.16 [0.12, 0.19]	0.03 [-0.004, 0.07]	0.12 [0.10, 0.14]	
SEP	-0.05 [-0.07, -0.02]	-0.03 [-0.07, 0.02]	0.04 [0.02, 0.06]	
Area deprivation	-0.05 [-0.07, -0.02]	-0.02 [-0.05, 0.01]	0.01 [-0.0002, 0.02]	

^a Estimates derived from Oaxaca-Blinder decomposition analysis with survey logit models. For interpretation, coefficients whose 95% CI contains zero are not significant.

quality of public schools, housing quality, local services (stores, parks and leisure centres, street lights, fire and police protection, and health care), employment opportunities, and hazards (pollution, noise and crime) that are associated with health (Diez Roux, 2016; Phelan and Link, 2015). However, segregation may also confer beneficial health outcomes for minorities by fostering strong social networks, reinforcing social control, and shielding minorities from exposure to prejudice and discrimination (Becares *et al.*, 2012).

Our findings suggest there is no one-size-fit-all policy to address ethnic inequalities in adult health and oral health. It is more likely that a combination of whole population and targeted strategies (i.e., proportionate universalism) could be more effective in improving everybody's health and reducing health gaps between specific ethnic groups. Our findings showed that Irish adults are the ethnic minority at the greatest disadvantage. The important role of the environment needs to be recognised more. Further research is needed to understand how the characteristics and composition of neighbourhoods can contribute to reduce or exacerbate ethnic inequalities in oral health.

Some study limitations must be addressed. First, we used cross-sectional data which limits causal inference. Second, oral health data was based on self-reports, which, although validated and commonly used in epidemiological studies, could be subject to measurement error (such as recall and social desirability bias). That said, the proportion of adults with fewer than 20 teeth in this study was similar to that reported from clinical examinations in the 2009 National Adult Health Survey (18% and 14%, respectively) (Arora *et al.*, 2016). Finally, area deprivation was analysed in broad categories (quintiles) rather than at neighbourhood level, which could have reduced its variability and attenuate associations with oral health outcomes. Therefore, estimates for the contribution of area deprivation to explain ethnic oral health inequalities are conservative.

Conclusion

Consistent with previous literature, this analysis confirms that ethnic inequalities in adult oral health varied according to the outcome and ethnic minority assessed. Irish

adults were more likely, whereas all Black and Asian groups were less likely to have a non-functional dentition than White British adults. Differences in observed population characteristics (age, area deprivation and SEP distributions) between ethnic groups contributed to, but did not fully, explain ethnic inequalities in non-functional dentition. No ethnic differences were observed in terms of self-rated oral health or oral impacts.

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