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Are ethnic inequalities in adult oral health-related quality of life modified by immigration status?

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Objective: To explore ethnic inequalities in oral health-related quality of life (OHRQoL) and the role of nativity status on them. ***Methods***: Data from 1868 adults (16-65 years) of 9 ethnic groups participating in a community-based health survey in East London. Participants completed a supervised questionnaire including the Oral Health Impact Profile (OHIP-14) to calculate prevalence, extent and severity of oral impacts. Associations between ethnicity and nativity status (individually and combined) with OHRQoL were assessed in regression models, crude and adjusted for socio-demographic factors and clinical oral health indicators. ***Results***: Black others showed higher prevalence (OR: 1.91; 95%CI 1.05-3.46), severity (IRR: 2.87, 95%CI 1.63-5.06) and extent of oral impacts (IRR: 1.86, 95%CI 1. 35-2.59). Oral impacts were more severe among Black Caribbeans (IRR: 2.85, 95%CI 1.31-6.18) and Bangladeshis (IRR: 3.08, 95%CI .07-8.91); whereas impacts were more extensive among Pakistanis (IRR: 1.54, 95%CI 1.05-2.25) and Bangladeshis (IRR: 1.87, 95%CI 1.16-3.00). Nativity status individually showed no association with OHRQoL, although when combined with ethnicity resulted in many minority groups showing worse OHRQoL than White British participants. ***Conclusion***: Ethnicity and nativity status have a combined and important role in OHRQoL: ethnic minority groups showed worse OHRQoL even when controlling for clinical oral status.

Keywords*: oral health-related quality of life, immigration, ethnicity, inequalities*

There is a large body of research that suggests that new migrants to developed countries have better health than the host population, a phenomenon termed the healthy migrant effect (Roura, 2017). This theory implies that migrants experience lower mortality and better health than their native-born peers despite facing barriers such as language and cultural differences (Jasso *et al.*, 2004). Furthermore, some studies have concluded that the experiences of first-generation migrants, those who left their country of origin to establish themselves somewhere else, will be very different from their offspring (known as second-generation migrants) (Viruell-Fuentes *et al.*, 2012).

Oral health related quality of life (OHRQoL) is a multidimensional concept accounting for the impact of oral health on the self-esteem, comfort and satisfaction when eating, sleeping, and socializing (Bennadi & Reddy, 2013). OHRQoL has been strongly linked to well-being, since poor oral health status may have a negative impact in everyday activities (McGrath, Broder, & Wilson-Genderson, 2004). Ethnicity could play an important role in explaining disparities in quality of life (Huang & Park, 2015) given that individuals belonging to the same ethnic group share features of cultural aspects (Krieger, 2001) that could affect their perception of own oral health. Nonetheless, previous studies on ethnic disparities in OHRQoL report conflicting results (Abdelrahim *et al.*, 2017; Emmanuelli *et al*., 2015; Huang & Park, 2015; Sanders, 2010; Thumboo *et al*., 2003; van Meijeren-van Lunteren *et al.*, 2019).

Furthermore, only a couple of studies have explored the simultaneous effect of immigration status and ethnicity on OHRQoL. In 2010, Sanders found that Latino immigrants reported higher OHRQoL than non-Latino Whites in the USA after controlling for socioeconomic characteristics, oral health-related behaviours and general and oral health indictors, although this difference was limited to the first-generation only (Sanders, 2010). More recently, a study with an ethnically diverse sample in Denmark found that children from the host community had better OHRQoL than South American children; and among them, children of second-generation mothers had higher OHRQoL than those of first-generation mothers (van Meijeren-van Lunteren *et al*., 2019).

Given this gap in the literature, this study aimed to determine whether there are ethnic disparities in OHRQoL among ethnically diverse adults from North East London (England) and the role that immigration status play in that association.

Methods

We analysed data from the East London Oral Health Inequality (ELOHI) Study comprising adults aged between 16 to 65 years old who lived in Dagenham, Waltham Forest, or Redbridge and Barking between 2009 and 2010. These areas were selected due to their ethnically diverse and socially deprived populations, which aids in a better understanding of oral health inequalities. The study protocol for ELOHI was approved by the Outer Northeast London Research Ethics Committee (08/H0701/93).

A multistage stratified random sampling design was used to select a representative sample of the general non-institutionalised population in Outer Northeast London; the sampling frame was a list of all the addresses

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stratified by the number of wards in Barking and Dagenham, Redbridge and Waltham Forest (17, 21 and 20 respectively) and fifty-five addresses were randomly selected from each ward. Residents from the resulting 3193 addresses were contacted via post and invited to participate in the study. Vacant or commercial (457) premises or ineligible addresses (208) were excluded; yielding a final sampling frame of 2528 valid addresses, from which 1437 households gave consent to participate in the study (response rate: 57%).

Participants underwent a clinical examination and answered a supervised questionnaire in their own homes. Clinical examinations were conducted by trained and calibrated dentists following the protocol and clinical diagnostic criteria used for the Adult Dental Health Survey (Kelley *et al*., 2000). These clinical examinations were performed with participants seated in chairs and using mouth mirrors, periodontal probes and artificial light. All teeth, including third molars, were examined for caries experience into dentine and periodontal pockets depth (PPD). The inter-examiner reliability for dental caries and for periodontal disease were strong (Kappa=0.83) and moderate (Kappa=0.57 for PPD), respectively.

The supervised questionnaire was used to gather information on participants' demographic characteristics, socioeconomic position (SEP), migration status and OHRQoL. Each participant was self-allocated into one of the 26 ethnic subgroups using an adaptation of the UK census 2001 categories and later classified into 9 ethnic groups: White British, and White Other; Black African, Black Caribbean and Black Other; Pakistani, Indian, Bangladeshi and Asian Other (Delgado-Angulo *et al*, 2018). Education and the National Statistics Socio-Economic Classification (NS-SEC) were used as SEP indicators. Education was recorded as the participants' highest qualification and classified as no qualification, secondary school, A-levels, and university degree or above. The five NS-SEC groups were derived using the self-coded method based on current (or last) occupation, employment status, size of organisation and supervisor status; participants who were in full-time education, participants who had never work or participants in long-term unemployment were coded as 'never worked/unemployed' (Macmillan, 2002). Immigration status was derived from answers to the question on country of birth, classifying participants as UK-born or foreign-born.

OHRQoL was measured using the short form of oral health impact profile (OHIP-14) which consists of 14 questions on the frequency of adverse impacts on everyday life caused by oral conditions during the last year (Slade, 1997). Questionnaire items are organised into 7 domains: functional limitation (trouble pronouncing words and deteriorated taste), physical pain (aching in mouth and discomfort whilst eating), psychological discomfort (feeling self-conscious or tense), physical disability (interrupted meals and unsatisfactory diet), psychological disability (difficulty relaxing and embarrassment), social disability (irritability and difficulty in doing usual jobs) and handicap (life less satisfying and inability to function). Participants rated the frequency of impacts using 5-point ordinal scales coded 0 for never, 1 for hardly ever, 2 for sometimes, 3 for fairly often and 4 for very often. Three outcome measures, namely prevalence, extent and severity of oral impacts, were derived from participants' responses. The *prevalence* of oral impacts refers to the proportion of people reporting frequent oral impacts and was calculated as those participants reporting one or more items as fairly often or very often (codes 3 or 4). The *extent* of oral impacts was calculated as the number of items reported as fairly often or very often, and ranged from 0 to 14. The *severity* of oral impacts was calculated as the sum of the responses to the 14 OHIP-14 items, thus ranging from 0 to 56 (Slade *et al*., 2005).

Analyses were weighted to account for the survey design and produce representative estimates, in terms of age, gender and ethnicity, based on the UK census 2001. All analysis were conducted in Stata Statistical Software version 18.

The modelling strategy estimated the crude disparities in prevalence, extent and severity of oral impacts according to ethnicity and immigration status, and then gradually adjusted for factors that could explain this association, namely socio-demographic factors and clinical oral health indicators. Logistic regression was used to explore disparities in the prevalence of oral impacts, reported with Odd Ratios (OR). To explore inequalities in extent and severity of oral impacts, count variables with over-dispersion we used negative binomial regression, reporting Rate Ratios (RR). Finally, the combined effect of ethnicity and immigration status on the association between ethnicity and each outcome was examined in the same sequential regression models.

Results

From the initial sample of 2266 adults, 84 participants with mixed/other ethnicities were excluded due to small numbers, 5 because of missing data on their immigration status and 81 because of missing values in one or more items of the OHIP-14. A further 228 had missing data on covariates and were excluded from the analysis, leaving a final sample of 1868 adults; no major differences among those included and excluded was observed (Data available at https://kclpure.kcl.ac.uk/portal/en/publications/are-ethnic-inequalities-in-adult-oral-health-related-quality-of-l).

The distribution of variables according to immigration status is presented in Table 1. There were differences between immigration status groups in terms of age, education, occupational classification, ethnicity, and all clinical oral health indicators ($p<0.05$). In summary, most UK-born participants were White British, whereas the most frequent foreign-born ethnic group was White Other. Foreign born participants were younger and had better SEP indicators, more natural teeth, fewer teeth with dental caries experience but more teeth with periodontal pocketing of 4mm or more. The prevalence of oral impacts among foreign-born participants was 18.0% (95% CI: 14.6-21.8) and the mean OHIP-14 extent and severity scores for this group were 0.7 (95% CI: 0.5-0.8) and 5.7 (95% CI: 4.9-6.6), respectively.

There were no crude disparities by ethnicity in the prevalence of oral impacts; however, Black Africans showed a lower severity and extent of oral impacts when compared to White British. Although these initial associations were completely attenuated when adjusting for

Table 1. Characteristics of the sample according to nativity status.

	UK born		*Foreign born*	
	% / mean	*(95% CI)*	*% / mean*	*(95% CI)*
Gender				
Male	48.8	(44.0-53.8)	47.7	(43.9-53.6)
Female	51.2	(46.3-56.1)	51.3	(46.4-56.1)
Age groups ***				
16-24 years	15.4	(10.5-22.2)	17.4	(12.9-23.2)
25-34 years	20.2	(16.9-23.9)	34.1	(29.3-39.2)
35-44 years	25.9	(22.4-29.9)	22.5	(19.4-26.1)
45-54 years	21.0	(16.9-25.8)	16.6	(13.1-20.8)
54-65 years	17.5	(13.7-22.1)	9.3	(6.8-12.6)
Education level ***				
None	14.5	(10.2-20.1)	10.1	(7.5-13.6)
Secondary	30.5	(25.6-35.8)	19.1	(15.7-23.0)
A-levels	25.0	(21.0-29.4)	27.1	(22.9-31.8)
Degree	30.1	(26.0-34.6)	43.7	(38.7-48.7)
Occupational classification ***				
Managerial	49.4	(44.2-54.6)	30.8	(26.7-35.3)
Intermediate	16.5	(13.5-20.1)	18.2	(14.4-22.7)
Routine	22.0	(17.4-27.4)	24.6	(20.6-29.0)
Never worked	12.1	(8.6-16.8)	26.4	(21.7-31.7)
Ethnicity ***				
White British	85.9	(83.2-88.2)	0	
White others	2.1	(1.2-3.7)	36.9	(31.1-43.1)
Black African	0.9	(0.6-1.3)	12.5	(10.2-15.2)
Black Caribbean	0.7	(0.4-1.1)	3.7	(2.5-5.5)
Black others	2.0	(1.5-2.6)	3.9	(2.8-5.4)
Pakistani	1.6	(1.0-2.6)	13.5	(10.7-17.0)
Indian	0.8	(0.4-1.6)	8.8	(6.7-11.5)
Bangladeshi	0.6	(0.3-1.2)	4.1	(2.8-5.8)
Asian others	5.5	(4.2-7.1)	16.6	(13.6-20.1)
Prevalence of Oral Impacts				
No impacts	80.6	(75.9-84.7)	81.8	(77.9-85.2)
Impact	19.4	(15.3-24.2)	18.2	(14.8-22.1)
Number of teeth **	27.2	(26.8-27.6)	28.3	(27.8-28.8)
Number of teeth with dental caries experience ***	12.6	(11.7-13.4)	9.6	(8.8-10.4)
Number of teeth with PPD>4mm **	10.4	(9.3-11.6)	12.9	(11.8-14.0)
Severity of Oral Impacts	5.7	(4.9-6.5)	5.7	(4.8-6.6)
Extent of Oral Impacts	0.7	(0.5-0.9)	0.7	(0.5-0.8)

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

sociodemographic characteristics, the inclusion of clinical measures in the model highlighted the differences between ethnic groups. Black others showed a higher prevalence (OR: 1.91; 95%CI 1.05-3.46), severity and extent of oral impacts (RR: 2.87, 95%CI 1.63-5.06 and RR: 1.86, 95%CI 1. 35-2.59; respectively). Oral impacts were more severe among Black Caribbean (RR: 2.85, 95%CI 1.31-6.18) and Bangladeshi (RR: 3.08, 95%CI .107-8.91) participants; whereas the extent of oral impacts was greater among Pakistani (RR: 1.54, 95%CI 1.05-2.25) and Bangladeshi (RR: 1.87, 95%CI 1.16-3.00) participants. Conversely, there were no crude or adjusted disparities in OHRQoL indicators by immigration status.

When exploring the simultaneous effect of ethnicity and immigration status on OHRQoL indicators the results were mixed (Table 3). The prevalence of oral impacts was higher among the first-generation of Bangladeshis than among White British participants (OR: 4.01, 95%CI 1.00-16.07) in the unadjusted model, whereas the first-generation of Asian others had lower odds of reporting oral impacts (OR: 0.49, 95%CI 0.25-0.97). Adjusting for socio-demographic characteristics completely explained the initial association among Asian others but increased the chance of first-generation Bangladeshis (OR: 6.22, 95%CI 1.51-25.60) of reporting prevalence of oral impacts when compared to White British participants; this adjustment also triggered statistically higher odds among first-generation Black Caribbeans (OR: 2.82, 95%CI 1.08-7.38) as compared to White British. The fully adjusted model showed that more first-generation

Table 2. Regression models for the association of ethnicity and OHRQoL among 1868 adults in East London.

	Model 1[a]		*Model 2*[a]		*Model 3*[a]	
Prevalence of Oral Impacts	*OR*[b]	*(95% CI)*	*OR*[b]	*(95% CI)*	*OR*[b]	*(95% CI)*
Ethnicity						
White British	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
White others	0.85	(0.47-1.56)	1.00	(0.54-1.86)	0.78	(0.40-1.52)
Black African	0.71	(0.43-1.19)	0.91	(0.54-1.54)	1.42	(0.78-2.56)
Black Caribbean	1.22	(0.59-2.50)	1.41	(0.70-2.84)	1.65	(0.77-3.54)
Black others	1.21	(0.67-2.18)	1.42	(0.79-2.53)	1.91*	(1.05-3.46)
Pakistani	0.79	(0.45-1.40)	0.94	(0.51-1.76)	1.25	(0.60-2.59)
Indian	0.78	(0.39-1.59)	0.91	(0.45-1.83)	1.26	(0.56-2.83)
Bangladeshi	1.54	(0.71-3.32)	1.82	(0.79-4.21)	2.41	(0.91-6.42)
Asian others	0.82	(0.50-1.36)	0.94	(0.56-1.57)	1.19	(0.64-2.19)
Severity of Oral Impacts	*RR*[c]	*(95% CI)*	*RR*[c]	*(95% CI)*	*RR*[c]	*(95% CI)*
Ethnicity						
White British	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
White others	0.87	(0.46-1.64)	1.08	(0.56-2.07)	0.85	(0.41-1.79)
Black African	0.60*	(0.36-1.00)	0.80	(0.44-1.43)	1.77	(0.99-3.14)
Black Caribbean	1.46	(0.81-2.65)	1.74	(0.92-3.27)	2.85**	(1.31-6.18)
Black others	1.37	(0.78-2.41)	1.67	(0.92-3.04)	2.87***	(1.63-5.06)
Pakistani	0.64	(0.37-1.09)	0.76	(0.41-1.39)	1.62	(0.82-3.18)
Indian	0.71	(0.36-1.42)	0.81	(0.38-1.72)	1.92	(0.89-4.11)
Bangladeshi	1.00	(0.49-2.04)	1.47	(0.54-4.00)	3.08*	(1.07-8.91)
Asian others	0.75	(0.46-1.21)	0.93	(0.51-1.69)	1.60	(0.89-2.90)
Extent of Oral Impacts	*RR*[c]	*(95% CI)*	*RR*[c]	*(95% CI)*	*RR*[c]	*(95% CI)*
Ethnicity						
White British	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
White others	1.14	(0.83-1.55)	1.29	(0.92-1.81)	1.19	(0.81-1.73)
Black African	0.62**	(0.45-0.86)	0.75	(0.53-1.06)	1.11	(0.78-1.59)
Black Caribbean	1.13	(0.72-1.78)	1.32	(0.82-2.11)	1.64	(0.96-2.81)
Black others	1.23	(0.87-1.73)	1.36	(0.98-1.89)	1.86***	(1.35-2.59)
Pakistani	0.95	(0.68-1.33)	1.02	(0.72-1.45)	1.54*	(1.05-2.25)
Indian	0.73	(0.48-1.11)	0.75	(0.51-1.11)	1.08	(0.70-1.66)
Bangladeshi	1.07	(0.70-1.64)	1.18	(0.76-1.83)	1.87*	(1.16-3.00)
Asian others	0.87	(0.64-1.18)	0.96	(0.70-1.31)	1.37	(0.97-1.93)

* p<0.05 ** p<0.01 *** p<0.001. [a] Model 1 was unadjusted; Model 2 adjusted for demographic factors (sex, age groups) and SEP (education and socioeconomic classification); Model 3 additionally adjusted for clinical oral health (number of teeth, dental caries experience and number of teeth with PPD>4mm). [b] Logistic regression models were fitted and odds ratios (OR) reported. [c] Negative binomial regression models were fitted and rate ratios (RR) reported.

Black Caribbean, Black others and Bangladeshi reported oral impacts than White British (OR: 3.05, 95% CI 1.10-8.45, OR: 2.14, 95%CI 1.01-4.51, and OR: 7.86, 95%CI 1.59-38.85, respectively).

Oral impacts were less severe among first-generation Pakistani (RR: 0.31, 95%CI 0.10-0.94) and Asian others (RR: 0.44, 95%CI 0.21-0.90) than White British adults in the unadjusted model. These associations were completely attenuated when adjusting for sociodemographic characteristics although new ones came to light. The fully adjusted model showed that first-generation of White others had lower (RR: 0.14, 95%CI 0.03-0.68) severity of oral impacts as compared to White British. On the contrary, other ethnic groups showed higher severity, namely Black Caribbean first and second-generation (RR:3.19, 95%CI 1.37-7.43 and RR: 2.89, 95%CI 1.10-7.60, respectively), Black others first and second-generation (RR:3.37, 95%CI 1.68-6.73 and RR: 2.38, 95%CI 1.03-5.50, respectively), first-generation of Bangladeshis (RR: 10.28; 95%CI 2.20-48.05) and second-generation of Asian others (RR: 2.11, 95%CI 1.05-4.25) (Table 3).

Table 3 also shows the combined effect of ethnicity and immigration status on the extent of oral impacts. Second-generation Black Africans had 41% (RR: 0.59, 95%CI 0.42-0.83) fewer impacts than White British adults in the crude model, although this association was completely explained by sociodemographic characteristics. The fully adjusted model showed that first-generation Black Caribbeans and Black others had 2.13 (95%CI 1.20-3.79) and 2.41 (95%CI 1.65-3.51) times more impacts than White British participants. Second-generation Pakistanis had 62% (RR: 1.62, 95%CI 1.02-2.44) more oral impacts than White British; in addition, Bangladeshis first and second-generation showed 2.29 (95%CI 1.05-5.03) and 1.75 (1.02-2.98) times the extent of oral impacts as White British participants.

Table 3. Regression models for the association of ethnicity and nativity status with OHRQoL among 1868 adults in East London.

	Model 1[a]		*Model 2*[a]		*Model 3*[a]	
Prevalence of Oral Impacts	*ORb*	*(95% CI)*	*ORb*	*(95% CI)*	*ORb*	*(95% CI)*
Ethnicity						
White British	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
White others 1st generation	0.69	(0.16-3.05)	0.76	(0.21-2.77)	0.63	(0.16-2.54)
White others 2nd generation	0.87	(0.46-1.64)	1.04	(0.54-1.99)	0.79	(0.39-1.62)
Black African 1st generation	0.65	(0.21-2.02)	1.03	(0.33-3.22)	1.46	(0.45-4.76)
Black African 2nd generation	0.72	(0.43-1.22)	0.91	(0.53-1.56)	1.42	(0.76-2.64)
Black Caribbean 1st generation	2.34	(0.86-6.34)	2.82*	(1.08-7.38)	3.05*	(1.10-8.45)
Black Caribbean 2nd generation	0.91	(0.39-2.14)	1.04	(0.45-2.44)	1.27	(0.52-3.15)
Black others 1st generation	1.39	(0.72-2.71)	1.71	(0.84-3.50)	2.14*	(1.01-4.51)
Black others 2nd generation	1.05	(0.43-2.55)	1.18	(0.50-2.76)	1.70	(0.73-3.97)
Pakistani 1st generation	0.43	(0.12-1.49)	0.60	(0.16-2.33)	0.71	(0.17-2.91)
Pakistani 2nd generation	0.88	(0.48-1.60)	1.02	(0.53-1.97)	1.39	(0.65-2.96)
Indian 1st generation	0.47	(0.11-2.05)	0.74	(0.16-3.38)	0.96	(0.21-4.39)
Indian 2nd generation	0.84	(0.39-1.80)	0.93	(0.44-1.99)	1.31	(0.55-3.13)
Bangladeshi 1st generation	4.01*	(1.00-16.07)	6.22*	(1.51-25.60)	7.86*	(1.59-38.85)
Bangladeshi 2nd generation	1.12	(0.48-2.64)	1.22	(0.50-2.99)	1.59	(0.55-4.60)
Asian others 1st generation	0.49*	(0.25-0.97)	0.68	(0.34-1.35)	0.74	(0.35-1.60)
Asian others 2nd generation	1.05	(0.58-1.90)	1.10	(0.60-2.00)	1.51	(0.75-3.04)
Severity of Oral Impacts	*RRc*	*(95% CI)*	*RRc*	*(95% CI)*	*RRc*	*(95% CI)*
Ethnicity						
White British	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
White others 1st generation	0.30	(0.09-1.01)	0.28	(0.07-1.15)	0.14*	(0.03-0.68)
White others 2nd generation	0.92	(0.48-1.78)	1.19	(0.61-2.35)	0.95	(0.44-2.06)
Black African 1st generation	0.67	(0.20-2.26)	1.09	(0.26-4.62)	2.29	(0.58-9.04)
Black African 2nd generation	0.59	(0.34-1.01)	0.78	(0.43-1.42)	1.74	(0.96-3.14)
Black Caribbean 1st generation	2.07	(0.10-4.28)	2.57*	(1.12-5.92)	3.19**	(1.37-7.43)
Black Caribbean 2nd generation	1.25	(0.59-2.65)	1.48	(0.69-3.18)	2.89*	(1.10-7.60)
Black others 1st generation	1.15	(0.66-2.01)	1.77	(0.90-3.50)	3.37**	(1.68-6.73)
Black others 2nd generation	1.57	(0.70-3.54)	1.56	(0.64-3.79)	2.38*	(1.03-5.50)
Pakistani 1st generation	0.31*	(0.10-0.94)	0.56	(0.17-1.86)	1.15	(0.27-4.82)
Pakistani 2nd generation	0.71	(0.41-1.24)	0.82	(0.43-1.56)	1.75	(0.85-3.61)
Indian 1st generation	0.80	(0.17-3.78)	1.60	(0.27-9.65)	2.12	(0.44-10.30)
Indian 2nd generation	0.70	(0.33-1.46)	0.70	(0.34-1.42)	1.90	(0.84-4.27)
Bangladeshi 1st generation	1.88	(0.61-5.86)	4.61*	(1.07-19.95)	10.28**	(2.20-48.05)
Bangladeshi 2nd generation	0.77	(0.37-1.58)	0.86	(0.37-2.00)	1.66	(0.75-3.67)
Asian others 1st generation	0.44*	(0.21-0.90)	0.60	(0.28-1.30)	0.95	(0.44-2.08)
Asian others 2nd generation	0.94	(0.55-1.59)	1.17	(0.60-2.27)	2.11*	(1.05-4.25)
Extent of Oral Impacts	*RRc*	*(95% CI)*	*RRc*	*(95% CI)*	*RRc*	*(95% CI)*
Ethnicity						
White British	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
White others 1st generation	0.68	(0.37-1.23)	0.81	(0.39-1.69)	0.98	(0.35-2.73)
White others 2nd generation	1.18	(0.86-1.64)	1.36	(0.96-1.94)	1.22	(0.82-1.80)
Black African 1st generation	0.89	(0.50-1.59)	1.17	(0.62-2.18)	1.47	(0.77-2.78)
Black African 2nd generation	0.59**	(0.42-0.83)	0.71	(0.49-1.02)	1.07	(0.73-1.56)
Black Caribbean 1st generation	1.54	(0.88-2.67)	1.97*	(1.09-3.59)	2.13*	(1.20-3.79)
Black Caribbean 2nd generation	0.99	(0.56-1.74)	1.10	(0.61-1.97)	1.49	(0.76-2.91)
Black others 1st generation	1.30	(0.93-1.80)	1.72**	(1.20-2.46)	2.41***	(1.65-3.51)
Black others 2nd generation	1.16	(0.66-2.06)	1.05	(0.61-1.80)	1.35	(0.80-2.27)
Pakistani 1st generation	0.65	(0.36-1.16)	0.87	(0.47-1.61)	1.16	(0.62-2.16)
Pakistani 2nd generation	1.02	(0.71-1.46)	1.07	(0.74-1.55)	1.62*	(1.07-2.44)
Indian 1st generation	0.99	(0.50-1.94)	1.38	(0.67-2.85)	1.60	(0.82-3.14)
Indian 2nd generation	0.68	(0.42-1.12)	0.65*	(0.42-0.99)	0.98	(0.59-1.60)
Bangladeshi 1st generation	1.26	(0.66-2.41)	1.64	(0.80-3.35)	2.29*	(1.05-5.03)
Bangladeshi 2nd generation	1.02	(0.62-1.70)	1.07	(0.65-1.75)	1.75*	(1.02-2.98)
Asian others 1st generation	0.78	(0.54-1.12)	0.99	(0.67-1.48)	1.28	(0.85-1.93)
Asian others 2nd generation	0.93	(0.64-1.35)	0.94	(0.64-1.39)	1.42	(0.92-2.18)

* $p<0.05$ ** $p<0.01$ *** $p<0.001$. [a] Model 1 was unadjusted; Model 2 adjusted for demographic factors (sex, age groups) and SEP (education and socioeconomic classification); Model 3 additionally adjusted for clinical oral health (number of teeth, dental caries experience and number of teeth with PPD>4mm). [b] Logistic regression models were fitted and odds ratios (OR) reported. [c] Negative binomial regression models were fitted and rate ratios (RR) reported.

Discussion

This study aimed to determine whether the association between ethnicity and OHRQoL was modified by immigration status among adults in East London. OHRQoL was worse among participants of some Black and Asian ethnic groups when controlling for clinical oral health measures. This is similar, to a certain extent, to the results presented in previous studies reporting that ethnic minorities were more likely to report poorer OHRQoL than the host community (Emmanuelli *et al*., 2015; Huang & Park, 2015; Thumboo *et al*., 2003) despite differences in the age and ethnicity of participants and the instruments used to measure OHRQoL. Our results disagree with those of Abdelrahim et al. (2017), who found no difference in the prevalence and severity of oral health impacts between different ethnic groups in addition to a lower extent of oral health impacts among Asian adults when compared to White British participants. These differences could be explained by the grouping of ethnic groups on their study, sub-ethnic groups were merged in broader categories, which might mask finer differences between them.

In our study, the initial ethnic inequalities were magnified when considering the effect of immigration status. First-generation of Black Caribbeans, Black others and Bangladeshis were more likely to have oral impacts, whereas the severity was increased among Black Caribbeans, Black others, first-generation Bangladeshis and second-generation Asian others and oral impacts were more extensive among Bangladeshis, first-generation Black Caribbeans and Black others, and second-generation Pakistanis. Only White others showed lower severity of oral impacts when compared with White British.

The evidence from previous studies is conflicting. van Meijeren-van Lunteren et al. (2019) found better OHRQoL among the host communities and also that, among the disadvantaged group, children of first-generation mothers had better OHRQoL than those of second-generation mothers. Sanders (2010) found, in contrast, that first-generation Latino immigrants reported higher OHRQoL than non-Latino Whites in the USA, reinforcing the Latino paradox.

These mixed results indicate that, although ethnic minorities have similar aspirations as the host community with regards to their quality of life, they also have views and aspirations inherent to their culture and values (Traebert *et al.*, 2010; van Meijeren-van Lunteren *et al*., 2019) besides biologic, socioeconomic, behavioural and psychosocial factors (Thumboo *et al*., 2003) that are not defined by their clinical health status alone (Emmanuelli *et al*., 2015; van Meijeren-van Lunteren *et al*., 2019).

In that sense, the relationship between clinical variables and OHRQoL is mediated by various personal, social and environmental factors, as illustrated by the Wilson and Cleary model (1995). For instance, migrants' social life is altered after migration and these changes play a crucial role in migrants' and ethnic minorities' general and oral health. The availability of social networks in the host country could provide emotional and instrumental support to migrants (Dahlan *et al*., 2019; Viruell-Fuentes *et al*., 2012). Unfortunately, some groups experience greater social exclusion due to racism and discrimination which may explain their predisposition to present the worst health outcomes as compared to their peers (Wilkinson & Marmot, 2003).

With increasing focus of health policy to address health promotion and disease prevention, OHRQoL is important because it incorporates both positive and negative perceptions of oral health outcomes and because of its implications for oral health disparities and access to care. Our results highlight the intersectionality of risk factors for poor OHRQoL, which, in turn, should inform decision-making for policy makers. Sociodemographic characteristics are important factors when explaining differences in OHRQoL indicating that programs that target improving educational status and generating better job opportunities among ethnic minority groups could play a role in narrowing the gaps between groups. Based on these results, guaranteeing accessible and affordable dental treatment for ethnic minority groups could also help reduce inequalities in OHRQoL.

This study's main limitation is the use of cross-sectional data, which prevents the establishment of a temporal order between variables. In addition, future studies would benefit from including information on the socioeconomic status of the participants before migration. On the other hand, the biggest strength of this study is having access to an ethnically diverse sample including the main ethnic groups living in East London and the UK according to the 2001 UK Census and exploring ethnic inequities among sub-ethnic groups. Its second strength is the inclusion of several well-known causes of inequalities such as gender, age, education, occupation, ethnicity and migration status (Harari & Lee, 2021) simultaneously, which allows researching ethnic inequalities through an intersectional lens.

In summary, ethnic inequalities in OHRQoL are the outcome of sociodemographic and community characteristics, the experience of discrimination, and psychological stress. This study yields a better understanding on determinants of OHRQoL among immigrants in the UK which is crucial to specify and address their oral health needs and define effective oral health policies. Future studies should explore the role of cultural factors in explaining oral health inequalities in oral health given that they could be modifiable and, hence, targeted to reduce such inequalities.

Conclusion

In conclusion, ethnicity and immigration status play an important role in the OHRQoL of East London adults; ethnic minority groups show worse OHRQoL even when controlling for their clinical oral health status. Further research is needed to corroborate this results to orientate the design of public health interventions to reduce oral health inequalities.

Ethical Approvals

This study did not require ethics approval since it solely involved secondary data analysis of East London Oral Health Inequality (ELOHI) Study, its study protocol approved by the Outer North-East

London Research Ethics Committee (08/H0701/93).

Conflict of Interest

The authors declare no conflict of interest in relation to this study.

Data Availability Statement

Data not publicly available.

Author contributions

EKDA had solely responsibility for the study conception and design; both EKDA and SN had joint responsibility in the analysis and interpretation of results, and manuscript preparation.

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References

Abdelrahim, R., Delgado-Angulo, E., Gallagher, J. and Bernabé, E. (2017): Ethnic disparities in oral health related quality of life among adults in London, England. *Community Dental Health* **34**, 122-127.

Bennadi, D. and Reddy, C.V. (2013): Oral health related quality of life. *Journal of the International Society for Preventive and Community Dentistry* **3**, 1-6.

Delgado-Angulo, E.K., Marcenes, W., Harding, S. and Bernabé, E. (2018): Ethnicity, migration status and dental caries experience among adults in East London. *Community Dentistry and Oral Epidemiology* **46**, 392-399.

Emmanuelli, B., Kucner, A.A., Ostapiuck, M., Tomazoni, F., Agostini, B.A. and Ardenghi, T.M. (2015): Racial Differences in Oral Health-Related Quality of Life: A Multilevel Analysis in Brazilian Children. *Brazilian Dental Journal* **26**, 689-694.

Harari, L. and Lee, C. (2021): Intersectionality in quantitative health disparities research: A systematic review of challenges and limitations in empirical studies. *Social Science & Medicine* **277,** 113876.

Huang, D.L. and Park, M. (2015): Socioeconomic and racial/ethnic oral health disparities among US older adults: oral health quality of life and dentition. *Journal of Public Health Dentistry* **75**, 85-92.

Jasso, G., Massey, D.S., Rosenzweig, M.R. and Smith, J.P. (2004): Immigrant health: selectivity and acculturation. In N. B. Anderson, R. A. Bulatao and B. Cohen (Eds.), *Critical Perspectives on Racial and Ethnic Differences in Health in Late Life*. Washington, DC: National Academy Press.

Kelley, M., Steele, J., Nuttall, N. M., Bradnock, G., Morris, J., Nunn, J. and Cooper, I. (2000): *Adult Dental Health Survey. Oral Health in the United Kingdom.* Retrieved from London:

Krieger, N. (2001): A glossary for social epidemiology. *Journal of Epidemiology and Community Health* **55**, 693-700.

Macmillan, P. (2002): *The National Statistics Socio-economic Classification User Manual*.

McGrath, C., Broder, H. and Wilson-Genderson, M. (2004): Assessing the impact of oral health on the life quality of children: implications for research and practice. *Community Dentistry and Oral Epidemiology* **32**, 81-85.

Roura, M. (2017): Unravelling migrants' health paradoxes: a transdisciplinary research agenda. *Journal of Epidemiology and Community Health* **71,** 1136.

Sanders, A.E. (2010): A Latino advantage in oral health-related quality of life is modified by nativity status. *Social Science & Medicine* **71**, 205-211.

Slade, G.D. (1997): Derivation and validation of a short-form oral health impact profile. *Community Dentistry and Oral Epidemiology* **25**, 284-290.

Slade, G.D., Nuttall, N., Sanders, A.E., Steele, J.G., Allen, P. F. and Lahti, S. (2005): Impacts of oral disorders in the United Kingdom and Australia. *British Dental Journal* **198,** 489-493.

Thumboo, J., Fong, K.Y., Machin, D., Chan, S.P., Soh, C.H., Leong, K.H. and Boey, M.L. (2003): Quality of life in an urban Asian population: the impact of ethnicity and socioeconomic status. *Social Science & Medicine* **56**, 1761-1772.

Traebert, J., Foster Page, L.A., Thomson, W.M. and Locker, D. (2010): Differential item functioning related to ethnicity in an oral health-related quality of life measure. *International Journal of Paediatric Dentistry* **20**, 435-441.

van Meijeren-van Lunteren, A.W., Wolvius, E.B., Raat, H., Jaddoe, V.W.V. and Kragt, L. (2019): Ethnic background and children's oral health-related quality of life. *Quality of Life Research* **28**, 1783-1791.

Viruell-Fuentes, E.A., Miranda, P.Y. and Abdulrahim, S. (2012): More than culture: structural racism, intersectionality theory, and immigrant health. *Social Science & Medicine* **75**, 2099-2106.

Wilkinson, R. and Marmot, M. (2003): The solid facts : Social Determinants of Health. In (2nd ed.). Copenhagen :: Centre for Urban Health, World Health Organization.

Wilson, I.B. and Cleary, P.D. (1995): Linking clinical variables with health-related quality of life. A conceptual model of patient outcomes. *Journal of the American Medical Association,* **273**, 59-65.