Research highlights

- Ethnic minority populations have a higher risk of many diseases associated with socioeconomic deprivation.
- Area deprivation measures provide a tool for targeting public health interventions at socioeconomically deprived individuals.
- Area deprivation measures identify higher proportions of deprived individuals from Pakistani and Black Caribbean groups.
- Area deprivation measures do not inappropriately identify higher proportions of non-deprived individuals in ethnic minority groups.
- The pragmatic use of area deprivation measures to target deprived individuals would not disadvantage ethnic minority groups.

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Title:

Cross-sectional study of ethnic differences in the utility of area deprivation measures to target socioeconomically deprived individuals

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Abstract

Area deprivation measures provide a pragmatic tool for targeting public health interventions at socioeconomically deprived individuals. Ethnic minority groups in the UK experience higher levels of socioeconomic deprivation and certain associated diseases than the White population. The aim of this study was to explore ethnic differences in the utility of area deprivation measures as a tool for targeting socioeconomically deprived individuals. We carried out a cross-sectional study using the Health Survey for England 2004. 7,208 participants aged 16-64 years from the four largest ethnic groups in England (White, Indian, Pakistani and Black Caribbean) were included. The main outcome measures were percentage agreement, sensitivity and positive predictive value (PPV) of area deprivation, measured using Index of Multiple Deprivation 2004, in relation to individual socioeconomic position (measured by education, occupation, income, housing tenure and car access). We found that levels of both area and individual deprivation were higher in the Pakistani and Black Caribbean groups compared to the White group. Across all measures, agreement was lower in the Pakistani (50.9-63.4%) and Black Caribbean (61.0-70.1%) groups than the White (67.2-82.4%) group. However, sensitivity was higher in the Pakistani (0.56-0.64) and Black Caribbean (0.59-0.66) groups compared to the White group (0.24-0.38) and PPV was at least as high. The results for the Indian group were intermediate. We conclude that, in spite of lower agreement, area deprivation is better at identifying individual deprivation in ethnic minority groups. There was no evidence that area based targeting of public health interventions will disadvantage ethnic minority groups.

Keywords: UK, ethnicity, deprivation, area, public health, socioeconomic status

Introduction

Socioeconomic status is a well established and an important determinant of health and health inequalities. Lower individual socioeconomic status, measured by factors such as education, income, occupation, housing and car ownership, has been shown to be associated with poorer health (Macintyre, Ellaway, Der, Ford, & Hunt, 1998; Marmot, 2005; Marmot et al., 1991). Therefore, targeting public health interventions at socioeconomically deprived individuals has the potential to reduce health inequalities, as well as improve overall health. In practice, measuring and recording socioeconomic position for every individual in the general population is resource intensive and impractical, so alternative approaches are often used. A commonly used approach is to target individuals who live in socioeconomically deprived geographical areas using accessible area based measures, which incorporate multiple aspects of deprivation (Demissie, Hanley, Menzies, Joseph, & Ernst, 2000; Galobardes, Shaw, Lawlor, Lynch, & Davey Smith, 2006; Tunstall & Lupton, 2003). These measures classify small areas using aggregated data about the characteristics of residents (Noble et al., 2004). However, the use of area deprivation measures to classify the socioeconomic position of residents is subject to the "ecological fallacy"; aggregated information relating to a group of individuals may not reflect the characteristics of all individuals in that group (Macintyre, Ellaway, & Cummins, 2002). An effective tool should accurately capture the target population, whilst minimising the number of people who are targeted in error. Using area deprivation as a proxy for individual deprivation in a targeting process may, nonetheless, be justified if a sufficiently high proportion of deprived individuals live in deprived areas and the number of non-deprived individuals targeted inappropriately is sufficiently small.

Ethnic minority groups in the UK experience higher levels of socioeconomic deprivation (Barnard & Turner, 2011; Nazroo, 1998; Smaje, 1995), and a higher risk of associated diseases than the White population (Bhopal et al., 2002; Davey Smith, Chaturvedi, Harding, Nazroo, & Williams, 2000; Nazroo, 2003). Area measures of deprivation currently in use are driven by a majority White population and may not therefore be equally applicable across other ethnic groups (Davey Smith, 2000). It is unclear whether the pragmatic use of area measures of deprivation as a tool for targeting prevention at deprived individuals works equally well in non-white populations.

This study therefore asked three questions. First, are there ethnic differences in the extent to which area deprivation measures agree with individual socioeconomic measures? Second, are there ethnic differences in the proportion of socioeconomically deprived individuals that are identified by area deprivation measures? Third, are there ethnic differences in the extent to which people without individual socioeconomic deprivation are inappropriately included using area deprivation measures? The findings are discussed in relation to the practical implications for public health programmes.

Method

Data

The Health Survey for England (HSE) is a large, annual, cross-sectional survey that contains self-reported information on health and individual circumstances. The HSE 2004 contained a boosted sample of the ethnic minority population in England (Sproston & Mindell, 2004). Multi-stage stratified probability sampling was used to recruit representative samples of the general and ethnic minority population living in private households (Sproston & Mindell, 2006). Postal addresses were used to select households,

and therefore individuals, to take part in the survey. In the general population sample the postal addresses were selected from randomly identified small geographical areas. The ethnic minority boost sample was recruited separately with postal addresses selected from areas stratified according to the proportion of relevant ethnic minority populations estimated to live there. Focused enumeration was used in areas with the lowest proportions of residents from Black and Asian backgrounds. Weighting variables, which correct for individual non-response and different probabilities of being selected for the survey, were applied in these analyses. Adult participants aged 16-64 years, from the four largest ethnic groups in England – White, Black Caribbean, Indian and Pakistani, were included.

Variables

Ethnicity was self-reported from questions on family and cultural background, using the same categories as the 2001 Census. Area deprivation was measured using Index of Multiple Deprivation (IMD) 2004. IMD is a composite measure of multiple aspects of deprivation widely used in England to identify, and target, deprived areas (Noble et al., 2004). Individual level data on seven domains of deprivation (income; employment; health deprivation and disability; education, skills and training; barriers to housing and services; crime; and living environment) are aggregated for small areas (with approximately 1,500 residents) (Noble et al., 2004). These areas are ranked by increasing area deprivation and grouped into quintiles of the general population. Each household in the HSE 2004 was assigned to an IMD 2004 quintile based on its postcode. The IMD 2004 quintiles were divided into two groups – most deprived (quintile 5) and less deprived (quintiles 1-4).

Individual socio-economic position was measured using self-reported information on income, education, occupation, housing tenure, and car access. Income quintiles were derived from equivalised annual income (a measure of total household income which accounts for the number of people living in the household) based on the whole sample (Sproston & Mindell, 2006). This was divided into a binary variable of lowest income (quintile 5) and higher incomes (quintiles 1-4). Variables with multiple categories – education, occupation, and housing tenure – were dichotomised. Educational level, measured as highest qualification achieved, was divided into higher qualifications (degree level, National Vocational Qualification (NVQ) 2 and 3) and lower or no qualifications (NVQ 1, other and no qualifications). Occupation, categorised using the UK's National Statistics Socio-economic Classification (NSSEC) for the household reference person (the householder with the highest income, or the oldest householder in the case of equal incomes), was divided into higher occupations (managerial, professional, and intermediate) and lower or no occupation (routine, manual, and none, including those who have never worked and the long-term unemployed). Housing tenure category was converted into owner-occupier (own it outright, buying it with a mortgage, pay part rent and part mortgage) and rented or rent free (rent it, live there rent free).

Analyses

Differences between ethnic groups in demographic and socioeconomic characteristics were investigated. Each ethnic minority group was compared with the White group using an independent-samples t-test for age and chi-squared tests for sex, area deprivation, and individual socioeconomic position.

Ethnic differences in the association between area deprivation and individual socioeconomic position were investigated by comparing percentage agreement. The proportion of socioeconomically deprived individuals identified by the area deprivation measure was then investigated by calculating sensitivity; the number of individuals in the most deprived area that also had poorer individual socioeconomic position divided by the total number of those with poorer individual socioeconomic position. Finally, the extent to which the area deprivation measure inappropriately included people without individual socioeconomic deprivation was investigated using positive predictive value (PPV), calculated as the number of individuals in the most deprived area who also had poorer individual socioeconomic position divided by the total number in the most deprived area.

Further analyses determined the effect of different approaches to dichotomising individual socioeconomic position, and therefore the robustness of the conclusions from the main analysis. Narrower and broader definitions of lower individual socioeconomic position were tested. SPSS 19.0 and Microsoft Excel were used for the analyses.

Results

The overall unweighted sample comprised 7,208 participants, of whom 4,377 (60.7%) were White, 1,070 (14.8%) Indian, 874 (12.2%) Pakistani and 887 (12.3%) Black Caribbean (Table 1). Each ethnic minority group had a significantly lower mean age than the White group with the lowest mean age in the Pakistani group. There were significantly fewer males in each ethnic minority group compared to the White group, with the lowest proportion in the Black Caribbean group. In comparison to the White group, the prevalence of area deprivation was higher in all ethnic minority groups (Table 1). The Pakistani group had a higher prevalence of all individual level measures of

deprivation. Higher prevalence of individual level deprivation was also observed in the Indian and Black Caribbean groups, with the exception of education where levels did not differ significantly compared to the White group, and housing tenure where the Indian group was not significantly different to the White group.

Less deprived areas (quintiles 1-4) had higher proportions of individuals with better individual socioeconomic position (Table 2). This was observed for all individual socioeconomic measures and all ethnic groups, although proportions with better individual socioeconomic position tended to be higher in the White group and lower in the Pakistani and Black Caribbean groups. Proportions with poorer individual socioeconomic position and resident in the most deprived areas were more variable and depended on the individual socioeconomic measure used.

Agreement between area deprivation and individual socioeconomic position across all of the individual socioeconomic measures was generally highest in the White group (ranging from 67.2-82.4%) (Table 3). In comparison, agreement was consistently lower in the Pakistani (50.9-63.4%) and Black Caribbean (61.0-70.1%) groups. Intermediate results, closer to those in the White group than the Pakistani and Black Caribbean groups, were observed in the Indian group. Sensitivity was consistently highest in the Pakistani (0.56-0.64) and Black Caribbean (0.59-0.66) groups (Table 3). Values were lowest in the White group (0.24-0.38) for all of the individual socioeconomic measures. In the Indian group (0.30-0.44) sensitivity was lower than the Pakistani and Black Caribbean groups, and slightly higher than the White group. No consistent ethnic differences in PPV were observed across the individual socioeconomic measures (Table

3). Varying the cut off levels of individual socioeconomic position produced similar patterns for the three measures.

Discussion

The study identified differences between the four ethnic groups in how well area deprivation performs as a tool for targeting deprived individuals. In spite of lower agreement between area based and individual measures of socioeconomic position in the Pakistani and Black Caribbean groups, sensitivity was consistently higher compared to the White group and PPV was no worse in the ethnic minority groups. This suggests that if area deprivation is used as a tool for targeting deprived individuals it would correctly identify higher proportions of deprived individuals from Pakistani and Black Caribbean groups, and would perform at least as well at excluding individuals who are not deprived. In the context of an area based intervention this would lead to increased coverage of deprived Pakistani and Black Caribbean populations without compromising the efficiency of the intervention.

Targeting public health interventions at deprived areas can be an efficient way of identifying deprived individuals and focusing limited resources on those with greatest need (Smith, 1999). The geographical clustering of socioeconomic deprivation in the UK and the availability of area based measures make this approach feasible (Noble et al., 2004; Smith, 1999). However, a key criticism of area based targeting is that the majority of deprived people do not live in the most deprived areas (Demissie et al., 2000; Smith, 1999). This “ecological fallacy” is well established and the finding in this study that only 24-38% of individually deprived people from the majority White group would be identified by area deprivation measures is consistent with this and with previous studies

(Smith, 1999; Tunstall & Lupton, 2003). This suggests that interventions that aim to reduce socioeconomic inequalities may need to adopt wider measures beyond area based initiatives. Despite this, area based programmes have been widely adopted in the UK, for example in England's New Deal for Communities initiative and Scotland's Keep Well programme (Mackenzie et al., 2011; Stafford, Nazroo, Popay, & Whitehead, 2008). In addition, it has been shown that targeting interventions, such as cardiovascular disease prevention, at deprived areas may provide an acceptable and cost-effective alternative to mass coverage (Lawson, Fenwick, Pell, & Pell, 2010; Woodward, Brindle, & Tunstall-Pedoe, 2007). However, this evidence is based on analysis of the general population as a whole rather than sub-groups. If it was the case that area deprivation measures were less effective at identifying deprived individuals from specific sub-groups or less efficient because they identified higher numbers of non-deprived individuals then at-risk individuals could be missed and resources wasted. Conversely if area deprivation measures performed more effectively and efficiently this would provide reassurance that their use would not systematically disadvantage these population sub-groups, potentially worsening health inequalities. This study indicates that area deprivation measures perform relatively well in certain ethnic minority groups compared to the White population as a tool for targeting individual deprivation, in that higher proportions of deprived individuals from ethnic minority groups would be identified without higher inappropriate identification of non-deprived individuals. These findings are consistent with Tunstall & Lupton's (2003) conclusion that the spatial patterning of population sub-groups can impact on the ability of area deprivation measures to target deprived populations, as ethnic minority groups are known to cluster in deprived areas in the UK

(Clark & Drinkwater, 2002; Tinsley & Jacobs, 2006). This suggests that area based targeting of public health interventions is unlikely to disadvantage these groups, a key consideration for interventions such as cardiovascular disease prevention where adequate coverage of ethnic minority groups is particularly important because of their high level of risk.

The study used cross-sectional data from a national health survey, which contained a boosted sample of the ethnic minority population in England. This enabled well-validated and robust epidemiological measures to be used on a large sample of the ethnic minority population across a range of socioeconomic measures, including income (an important measure of socioeconomic position not available from data sources such as the Census). The use of binary variables derived from both the area based and individual level socioeconomic measures reflected the design and practical delivery of public health interventions, where populations may be included or excluded from an intervention based on a predetermined threshold (e.g. the most deprived 15% of areas). This study focused on identifying individual level deprivation. However, there is evidence that area itself acts is an independent contributor to health, beyond the impact of individual level characteristics (Macintyre et al., 2002; Macintyre, Maciver, & Sooman, 1993). Therefore, targeting of interventions at deprived areas can potentially address two separate risk factors since it identifies individuals with both area and individual level deprivation. Weaknesses in this study relate to limitations of the data used. The measures of individual socioeconomic status were self-reported which may have affected their accuracy, and there was a high proportion of missing data on income. This proportion varied by ethnic group (ranging form 13.7% in the White group to 26.7% in the Pakistani group) and may

have introduced bias if the non-response was also related to income level. However, the results for income were consistent with those from the other individual socioeconomic measures studied where levels of missing data were much lower.

Ethnic minority populations are known both to cluster in deprived areas in the UK and to experience higher levels of socioeconomic deprivation compared to the White population, differences that are likely to account for the findings observed in this study. The findings indicate that area deprivation is better at identifying individual deprivation in ethnic minority groups, with no evidence that these groups would be disadvantaged compared to the White population.

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Appendix

Results of analyses with narrower and broader definitions of individual socioeconomic position for agreement, sensitivity and positive predictive value by ethnic group

		White			Indian			Pakistani			Black Caribbean		
		Narrower definition[a]	Main analysis	Broader definition[b]	Narrower definition	Main analysis	Broader definition	Narrower definition	Main analysis	Broader definition	Narrower definition	Main analysis	Broader definition
Education	Agreement (%)	75.1	71.2	51.4	73.6	73.1	61.1	56.6	57.2	61.8	60.6	61.0	60.5
	Sensitivity	0.25	0.24	0.18	0.35	0.36	0.29	0.61	0.61	0.62	0.63	0.61	0.55
	PPV[c]	0.33	0.44	0.66	0.37	0.45	0.64	0.47	0.52	0.72	0.29	0.35	0.63
Occupation	Agreement (%)	80.1	67.2	52.4	74.9	63.7	49.7	54.7	57.8	57.3	61.9	63.4	61.9
	Sensitivity	0.30	0.26	0.21	0.35	0.30	0.25	0.62	0.60	0.56	0.67	0.59	0.55
	PPV	0.27	0.63	0.78	0.30	0.64	0.80	0.35	0.61	0.88	0.29	0.60	0.79
Income	Agreement (%)	82.6	78.1	67.0	77.2	71.3	55.1	55.5	63.4	61.6	61.0	63.0	64.9
	Sensitivity	0.36	0.31	0.26	0.38	0.33	0.27	0.63	0.64	0.59	0.60	0.59	0.57
	PPV	0.21	0.38	0.67	0.35	0.52	0.82	0.39	0.70	0.90	0.35	0.49	0.77

[a] Narrower definition of lower socioeconomic position is educational level of no qualifications, occupation of routine or no employment, and income in the lowest decile.

[b] Broader definition of lower socioeconomic position is educational level of NVQ2 level and below, occupation of intermediate, routine, manual or no employment, and income in quintiles 4 and 5.

[c] PPV positive predictive value

Table 1. Characteristics of Health Survey for England 2004 participants for each ethnic group

	White	Indian		Pakistani		Black Caribbean	
Unweighted bases	4,377	1,070		874		887	
Weighted bases	64,771	1,784		858		973	
	mean (SD)[a]	mean (SD)	*p Value*[b]	mean (SD)	*p Value*	mean (SD)	*p Value*
Age (years)	39.9 (13.8)	38.3 (12.7)	*<0.001*	34.6 (12.2)	*<0.001*	38.2 (13.0)	*<0.001*
	n[c] (%)	n (%)		n (%)		n (%)	
Male	32,513 (50.2)	801 (44.9)	*<0.001*	386 (45.0)	*0.002*	391 (40.2)	*<0.001*
Area deprivation							
Quintiles 1-4	55,138 (85.1)	1,428 (80.0)	*<0.001*	410 (47.8)	*<0.001*	534 (54.9)	*<0.001*
Quintile 5[d]	9,633 (14.9)	357 (20.0)		448 (52.2)		438 (45.1)	
Missing	*0*	*0*		*0*		*0*	
Education							
NVQ[e] 2 and above	47,092 (72.9)	1,331 (74.9)	*0.062*	466 (54.8)	*<0.001*	718 (74.7)	*0.221*
NVQ1, other and no qualifications	17,464 (27.1)	445 (25.1)		385 (45.2)		243 (25.3)	
Missing	*215*	*8*		*7*		*11*	
Occupation							
Managerial, professional and intermediate	40,873 (63.3)	1,032 (58.2)	*<0.001*	394 (46.8)	*<0.001*	525 (54.5)	*<0.001*
Routine, manual and none	23,688 (36.7)	742 (41.8)		447 (53.2)		438 (45.5)	
Missing	*210*	*10*		*17*		*10*	
Car access							
Access	57,540 (88.8)	1,500 (84.1)	*<0.001*	704 (82.1)	*<0.001*	591 (60.7)	*<0.001*
No access	7,232 (11.2)	284 (15.9)		154 (17.9)		382 (39.3)	
Missing	*0*	*0*		*0*		*0*	
Income							
Quintiles 1-4	45,650 (81.7)	939 (70.5)	*<0.001*	264 (42.0)	*<0.001*	494 (63.6)	*<0.001*
Quintile 5[f]	10,231 (18.3)	393 (29.5)		365 (58.0)		283 (36.4)	
Missing	*8,891*	*451*		*229*		*197*	
Tenure							
Owner occupier	49,442 (76.5)	1,380 (77.7)	*0.233*	593 (69.7)	*<0.001*	498 (51.6)	*<0.001*

Rent or rent free	15,162 (23.5)	395 (22.3)	258 (30.3)	467 (48.4)
Missing	*168*	*9*	*7*	*8*

[a] SD standard deviation
[b] p Value indicates difference between ethnic group and White group
[c] n weighted base
[d] Quintile 5 for area deprivation represents most deprived areas
[e] NVQ National Vocational Qualification
[f] Quintile 5 for income represents lowest income

Table 2. Individual socioeconomic position for each area deprivation category by ethnic group

		White		Indian		Pakistani		Black Caribbean	
		Quintile 5[a] N (%)	Quintiles 1-4 N (%)	Quintile 5 N (%)	Quintiles 1-4 N (%)	Quintile 5 N (%)	Quintiles 1-4 N (%)	Quintile 5 N (%)	Quintiles 1-4 N (%)
Education	NVQ1[b], other and no qualifications	4,213 (44.0)	13,251 (24.1)	161 (45.4)	284 (20.0)	234 (52.3)	151 (37.4)	150 (34.8)	94 (17.7)
	NVQ 2 and above	5,356 (56.0)	41,735 (75.9)	194 (54.6)	1,138 (80.0)	213 (47.7)	253 (62.6)	281 (65.2)	437 (82.3)
Occupation	Routine, manual and none	6,045 (63.3)	17,643 (32.1)	225 (63.7)	517 (36.4)	267 (60.5)	180 (45.0)	258 (60.0)	179 (33.7)
	Managerial, professional and intermediate	3,505 (36.7)	37,369 (67.9)	128 (36.3)	904 (63.6)	174 (39.5)	220 (55.0)	172 (40.0)	352 (66.3)
Car access	No access	2,738 (28.4)	4,493 (8.1)	124 (34.8)	160 (11.2)	99 (22.1)	55 (13.4)	244 (55.6)	138 (25.8)
	Access	6,894 (71.6)	50,645 (91.9)	232 (65.2)	1,268 (88.8)	349 (77.9)	355 (86.6)	195 (44.4)	396 (74.2)
Income	Quintile 5[c]	3,196 (38.0)	7,035 (14.8)	131 (52.2)	262 (24.2)	235 (70.1)	130 (44.2)	168 (49.4)	115 (26.4)
	Quintiles 1-4	5,219 (62.0)	40,430 (85.2)	120 (47.8)	820 (75.8)	100 (29.9)	164 (55.8)	172 (50.6)	321 (73.6)
Housing tenure	Rented or rent free	4,540 (47.1)	10,622 (19.3)	137 (38.4)	258 (18.2)	144 (32.1)	114 (28.3)	308 (70.5)	159 (30.2)
	Owner occupier	5,093 (52.9)	44,349 (80.7)	220 (61.6)	1,161 (81.8)	304 (67.9)	289 (71.7)	129 (29.5)	368 (69.8)

[a] Quintile 5 for area deprivation represents most deprived areas
[b] NVQ National Vocational Qualification
[c] Quintile 5 for income represents lowest income

Table 3. Results for agreement, sensitivity and positive predictive value calculations for each individual socioeconomic measure by ethnic group

		White	Indian	Pakistani	Black Caribbean
Education	Agreement (%)	71.2	73.1	57.2	61.0
	Sensitivity	0.24	0.36	0.61	0.61
	PPV[a]	0.44	0.45	0.52	0.35
Occupation	Agreement (%)	67.2	63.7	57.8	63.4
	Sensitivity	0.26	0.30	0.60	0.59
	PPV	0.63	0.64	0.61	0.60
Car access	Agreement (%)	82.4	78.0	52.9	65.8
	Sensitivity	0.38	0.44	0.64	0.64
	PPV	0.28	0.35	0.22	0.56
Income	Agreement (%)	78.1	71.3	63.4	63.0
	Sensitivity	0.31	0.33	0.64	0.59
	PPV	0.38	0.52	0.70	0.49
Housing tenure	Agreement (%)	75.7	73.1	50.9	70.1
	Sensitivity	0.30	0.35	0.56	0.66
	PPV	0.47	0.38	0.32	0.70

[a] PPV positive predictive value