Adult Oral Health Inequalities Described Using Area-based and Household-based Socioeconomic Status Measures

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Abstract

***Objectives**: To describe adult oral health inequalities using an area-based and household-based measure of socioeconomic status (SES). **Methods**: Self-report questionnaires (seeking information on sociodemographic, oral health and oral self-care) were sent to a random sample of adults from the Dunedin South Electorate, New Zealand. Household- and area-based SES measures were collected. The main outcome measures were edentulism prevalence, average-poor self-rated oral health and not having visited a dentist for 2+ years. Data were weighted to produce population-based estimates. **Results**: The response rate was 78.2%; the sample mean age was 47 years (sd, 17; range 18–92 years) and females comprised 54.0%. Edentulism was most prevalent among those from low-SES households who were resident in high-deprivation areas (P<0.0001). Poor self-rated oral health (P<0.0001) and 2+ years since the last dental visit (P<0.0001) were also most prevalent among these same individuals. In contrast, respondents from high-SES households located in the least deprived areas had the lowest prevalence of edentulism, poor self-reported oral health or 2+ years since their last dental visit. Those from the other household/area SES combinations occupied intermediate positions. **Conclusions**: There may be added value to dental public health in using a dual socio-economic measurement approach to population research, with greater oral health gains perhaps being possible by concentrating resources and clinical effort on people living in low-SES households in highly–deprived areas, rather than those living in low-SES households in areas that are not deprived.*

Key Words: Socioeconomic status, oral health, deprivation, edentulism, dental utilization

Introduction

Socioeconomic status (SES) is a central social construct in most societies (1). However, it is only in recent times that rigorous investigation of the association between SES and health has been undertaken (1, 2). Understanding this relationship may help to reveal areas important for health intervention, epidemiological measurement and public policy (3, 4). SES also plays a role in oral health, and is understood to be in a complex interplay with other health determinants such as knowledge and beliefs, behaviors and biomedical factors (5). SES disparities in oral health in New Zealand have been well documented, with low-SES groups being consistently shown to have poorer oral health than their high-SES counterparts (6–8). Most reports have concentrated on the clinical aspects of dental health (such as tooth loss, dental caries or periodontal disease), although self-reported oral health, oral self-care and the use of dental services have also been examined.

As in other industrialized countries, socioeconomic circumstances for some New Zealand groups have changed rapidly in the past two decades (9). Economic inequality has increased, with greater amounts of income and wealth accruing to high-SES groups and a corresponding relative impoverishment of their low-SES counterparts (10). At the time of the 2001 Census, one quarter of households had an annual income of $25,000 or less, 12% of the households had 5 or more permanent residents, and only 10 % owned no motor vehicle (11); these are all indicators of relative poverty in New Zealand.

Data suggest that many New Zealand adults experienced poor oral health during the 1950s, with dental caries being largely managed by the early extraction of teeth (12). Consequently, the prevalence of full dental clearance (having all natural teeth removed) and subsequent denture provision was high, particularly among low-SES groups (12). In the 1960s there was a move towards more conservative dental treatment that resulted in fewer full dental clearances. From the 1970s onwards, there has been an emphasis on more population-based, prevention-oriented oral health strategies, together with the concomitant introduction of fluoride toothpastes (which rapidly dominated the dental self-care market). These factors appear to have contributed to a substantial reduction in caries levels; for example, from 1963 to 1988, the mean DMFT of young adults decreased by 86 % (13). Such reductions were not observed across all population groups, however, with poor oral health increasingly associated with being in an ethnic minority, of low SES, or older, disabled or institutionalized (13,14). While social disparities have played an important role in the occurrence of edentulism in the past, it is unclear whether such a relation still exists (15).

Investigations of socioeconomic disparities in oral health typically use individual (household-level) or area-based measures. The use of the latter has increased in recent years, particularly in the United Kingdom and the United States (16–18). The respective utility of the two measures remains a

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matter of some debate, however, with household-based measures often failing to capture the contextual factors involved in health inequality etiologies, and area-based measures carrying the implicit assumption that individuals within a given location are socioeconomically homogeneous (1). Davey Smith *et al.* asserted that the use of either approach alone carried the potential risk of residual confounding and that application of both measures in combination may be beneficial (19). This was recently confirmed in a study of 9-year-old children in New Zealand, which showed that, while household-based and area-based SES measures each revealed inequalities in oral health, more consistent gradients were uncovered when both measures were used in conjunction (20). It remains unclear whether this approach would also be applicable in the elucidation of adult oral health inequalities.

The aim of this study was to describe social inequalities in edentulism, self-reported oral health and dental health care utilization in a sample of urban-dwelling New Zealand adults by using an area-based and a household-based measure of SES. The hypotheses were: 1) that edentulism and poorer self-reported oral health and less frequent oral care would be more prevalent among low SES groups; 2) that this relationship would become more apparent when the two SES measures were used in combination; and 3) that consistent social gradients would be observed between the high SES/low deprivation and low SES/high deprivation groups in those measures.

Methods

The study was approved by the University of Otago institutional review board and ethical approval obtained from the Otago Ethics Committee. A self-report sociodental questionnaire was sent to 600 people randomly selected from the Dunedin South Electoral Roll (all New Zealanders aged 18+ years must be registered on the Electoral Roll). Prior to contacting those individuals, the sex and age distribution of the sample was checked against that of the Electoral Roll to confirm that the random selection procedure had been successful (in that the age and sex proportions of the sample were within 2–3 % of those registered in the Electoral Roll).

The questionnaire was sent with a cover letter, information sheet and "free post" return envelope. The cover letter requested that the questionnaire be completed by the person in the household over the age of 18 years who was closest to having the next birthday. If that person was unable to complete the questionnaire, the person over the age of 18 who had the last birthday was asked to do so.

Standard follow-up procedures were used: one week after the first mail-out, respondents were sent a reminder postcard; two weeks after the initial mail-out, those yet to respond were sent an additional questionnaire and covering letter; and six weeks after the initial mail-out, the remaining individuals who had not yet responded were sent a third mail-out. Respondent reliability was acceptable; details are reported in a previous publication (21). Late responders did not differ significantly to earlier responders in regards to oral health outcome characteristics.

Respondents were asked about their socio-demographic and dental service-use characteristics, including gender, age, occupation and time since the last dental visit. Respondents' oral health was explored with questions on dentate status ("Do you have any of your own teeth remaining?") and self-rated oral health ("In general, compared with others your age, would you say your dental health is among the nicest, better than average, average, below average or among the worst?")

SES Measures. One area-based and one household-based measure of SES were used. The area-based indicator was the NZDep2001 Index of Deprivation, which combines nine variables from the 2001 New Zealand Census that reflect aspects of material and social deprivation and categorizes each Census meshblock (22). A Census meshblock is the smallest geographic area used by Statistics New Zealand in the collection and analysis of data. The median number of individuals per meshblock in the 2001 Census was 87. In order of decreasing weight within the index, the constituent characteristics are the proportion of people who:

- are aged 18-59 and receiving a means-tested benefit
- are aged 18-59 and are unemployed
- live in households with income below a specific threshold (after controlling for household composition)
- have no access to a telephone
- are younger than 60 and live in a single-parent family
- are aged 18-59 and have no educational qualifications
- live in households below a specific bedroom occupancy threshold (after controlling for household composition)
- are not living in their own home

This results in each Census meshblock receiving a score ranging from "1" (highest deprivation) to "10" (lowest deprivation). For the current analyses, participant address information was geocoded to enable each respondent to be matched to a Census meshblock and thus allocated an NZDep2001 score based on the residence area. Areas with scores 1–3 were classified as "high deprivation"; scores 4–7 were classified as "medium deprivation"; and scores 8–10 were classified as "low deprivation."

The household-based SES indicator was based on standard New Zealand occupationally-based indices (23,24), which employ a 6-interval classification (for example, a doctor scores "1" and a labourer scores "6"). This enabled individuals to be assigned to one of three SES groups: those with a score of "1" or "2" were allocated to the "high SES" group; those with a score of "3" or "4" comprised the "medium SES" group; and the remainder were allocated to the "low SES" group.

A nine-category composite SES measure was created to represent each

TABLE 1
Number of respondents by sex and age group for each approach to measuring SES (data presented as weighted percentages, 95% confidence intervals in brackets).

	Number[a]	Household-based SES[b]			Deprivation category[b]		
		High	Medium	Low	Low	Medium	High
Gender							
Male	46.0 (41.1–50.9)	19.7 (14.0–25.4)	48.3 (41.1–55.5)	31.9 (25.2–38.6)	41.7 (34.6–48.8)	44.4 (37.2–51.6)	13.9 (8.9–18.9)[c]
Female	54.0 (49.1–58.9)	16.2 (11.3–21.1)	39.8 (33.3–46.3)	44.0 (37.4–50.6)	34.7 (28.4–41.0)	40.3 (33.8–46.8)	25.0 (19.2–30.8)
Age group							
18–44 years	45.4 (40.5–50.3)	15.2 (10.0–20.4)	46.1 (38.9–53.3)	38.6 (31.5–45.7)	38.6 (31.5–45.7)	40.3 (33.2–47.4)	21.0 (15.1–26.9)
45+ years	54.6 (49.7–59.5)	20.0 (14.7–25.3)	41.8 (35.2–48.4)	38.3 (31.8–44.8)	37.4 (31.0–43.8)	43.7 (37.1–50.3)	18.9 (13.7–24.1)
Column totals	100.0	17.8 (8.9–26.7)	43.7 (36.4–51.0)	38.4 (30.7–45.6)	37.9 (30.2–45.6)	42.2 (34.8–49.6)	19.9 (11.1–28.7)

[a]Percentages are column percentages
[b]Percentages are row percentages
[c]$P < 0.05$

possible household/area-based SES stratification.

Data analysis. So that estimates might more accurately reflect the Dunedin South Electorate population, data were post-stratified and weighted by age and sex using current Statistics New Zealand estimates for the Dunedin South electorate. Following computation of univariate statistics, bivariate associations were tested for statistical significance ($p< 0.05$) using Chi-square tests. Edentulous persons were excluded from the self-rated oral health and dental service utilization analyses because the oral health outcomes of interest specifically required participants to be dentate.

Each dichotomous dental outcome (edentulism, self-rated oral health and time since last dental visit) was modeled using logistic regression. All variables were checked for multi-collinearity. Dummy variables were created that included: female (female = 1, male = 0), 45+ years (45+ years = 1, 18–44 years = 0), low household SES (low household SES = 1, high and medium household SES = 0), high deprivation (high deprivation = 1, low and medium deprivation = 0). The statistical software package SPSS 13.0 was used to conduct the analyses.

Results

Of the 600 questionnaires originally sent, 14 were returned as "address unknown," and 458 (78.2 %) of the remainder were completed and returned. Complete SES data were available for 431 of those, and subse-

TABLE 2
Concordance between the SES measures (data presented as weighted percentages, 95% confidence intervals in brackets)[a,b]

	Household-based SES		
	High	Medium	Low
Deprivation category			
Low	9.0 (6.2–11.8)	18.2 (14.4–22.0)	10.9 (7.9–13.9)
Medium	7.2 (4.7–9.7)	18.0 (14.2–21.8)	17.0 (13.3–20.7)
High	1.6 (0.4–2.8)	7.6 (5.0–10.2)	10.7 (7.7–13.7)

[a]Kappa = 0.09
[b]'High deprivation' is the area-based equivalent of 'Low household SES'.

TABLE 3
Dental status, self-reported oral health, and dental care utilization by sex, age group and each approach to measuring SES (data presented as weighted percentages, 95% confidence intervals in brackets)

	Percentage edentulous	Percentage who rated their oral health as average or worse than average[a]	Percentage with 2+ years since last dental visit[a,b]
Sex			
Male	12.2 (7.5–16.9)	56.1 (48.5–63.7)	15.3 (9.8–20.8)
Female	20.9 (15.5–26.3)	62.7 (55.5–69.9)	13.6 (8.5–18.7)
Age group			
18–44	2.4 (0.2–4.6)[c]	63.0 (55.9–70.1)	19.2 (13.5–25.0)[c]
45 and over	28.9 (22.9–34.9)	55.4 (47.6–63.2)	9.0 (4.5–13.4)
Household-based SES			
High	8.8 (2.2–15.4)[c]	40.7 (28.8–52.6)[c]	6.5 (0.5–12.5)[c]
Medium	12.1 (7.3–16.9)	60.3 (52.6–68.0)	13.5 (8.1–18.9)
Low	26.1 (19.2–33.0)	69.1 (60.6–77.6)	20.3 (12.9–27.7)
Deprivation category			
Low	8.7 (4.2–13.2)[c]	55.5 (47.2–63.8)	11.6 (6.3–16.9)
Medium	21.5 (15.3–27.7)	57.9 (49.5–66.3)	16.7 (10.4–23.0)
High	22.7 (13.5–31.9)	71.8 (60.6–83.0)	15.9 (6.8–25.0)
All combined	16.9 (8.0–25.8)	59.5 (52.7–66.3)	14.4 (4.5–24.3)

[a]Dentate respondents only
[b]1 missing response for this item
[c]$P<0.05$

TABLE 4
Prevalence of edentulism, average or worse self-rated oral health and 2+ years since last dental visit by a cross-tabulation of area-based and household-based SES measures (data presented as weighted percentages, 95% confidence intervals in brackets)

(a) Prevalence of edentulism

		Deprivation category		
		Low	Medium	High
Household SES category	High	3.3 (2.4–4.6)	4.1 (2.6–5.6)	5.0 (3.4–6.6)
	Medium	6.2 (4.4–8.0)	7.5 (5.5–9.5)	9.2 (7.0–11.4)
	Low	11.1 (8.7–13.5)	13.5 (10.9–16.1)	16.2 (13.4–19.0)

P value for linear trend < 0.0001

(b) Prevalence of average or worse self-rated oral health (dentate only)

		Deprivation category		
		Low	Medium	High
Household SES category	High	42.6 (40.4–44.8)	46.7 (44.5–48.9)	50.8 (48.6–53.0)
	Medium	54.9 (52.7–57.1)	59.0 (56.8–61.2)	62.9 (60.8–65.0)
	Low	66.7 (64.6–68.8)	70.3 (68.3–72.3)	73.6 (71.7–75.5)

P value for linear trend < 0.0001

(c) Prevalence of 2+ years since last dental visit (dentate only)

		Deprivation category		
		Low	Medium	High
Household SES category	High	8.5 (6.0–11.0)	10.8 (8.0–13.6)	13.5 (10.4–16.6)
	Medium	16.9 (13.6–20.2)	20.8 (17.2–24.4)	25.4 (21.5–29.3)
	Low	30.6 (26.5–34.7)	36.3 (32.0–40.6)	42.4 (38.0–46.8)

P value for linear trend < 0.0001

quent analyses are confined to that group (or subsets thereof). The mean age of respondents was 47 years (sd, 17; range 18–92 years), and females predominated, comprising 54.0 % of respondents. All estimates described hereafter are calculated on weighted data. Data on the age and sex distribution of the sample across the SES categories are presented in Table 1. There was a higher percentage of females than males in the "high deprivation" category.

The distribution of respondents across the categories of each SES measure is presented in Table 2. The deprivation and household-based SES ratings coincided for 159 respondents (37.7 %) and differed markedly (for example, an individual rated as "high SES" by one measure but categorized as "high deprivation" by the other) for 55 (12.5 %).

Three hundred and sixty-five respondents (83.1%) were dentate, meaning that 16.9 % were edentulous. Data on dental status, self-care and recency of dental care are presented in Table 3. There were no sex differences with respect to edentulism, self-rated oral health or dental service utilization. Compared with younger respondents, proportionally more of those in the 45+ age group were edentulous and more of those who were dentate had visited a dentist in the previous two years. There were social gradients apparent in edentulism, with proportionally more of those of lower SES (or who were living in an area of high deprivation) being edentulous. Using the household-based SES measure, there were marked social gradients apparent for the percentage rating their oral health as average or worse than average, and for the percentage who had not visited a dentist for at least two years. For the deprivation measure, the most noticeable social gradient was with the percentage who had not visited a dentist for at least two years (although that was not statistically significant; $P = 0.36$).

The variables "edentulous", "average or worse self-rated oral health"' and "2+ years since last dental visit" were selected for further analyses using a combination of the area-based and household-based SES measures. Estimates of the prevalence of edentulism by categories of the composite SES measure are presented in Table 4a. Across the entire sample, there was a distinct social gradient, with the highest percentage of edentulous respondents being observed among those from low-SES households who were resident in areas of high deprivation; the lowest was observed among high-SES individuals living in low-deprivation areas. Estimates for the other combinations fell into a linear gradient. The gradient was even more apparent when the analysis was limited to those aged 45 years or more. Curiously, the opposite gradient was apparent among the younger age group, although this did not reach statistical significance (unpublished observations). Being aged 45+ years accounted for most of the variance (23 %) in the logistic regression model for "edentulism prevalence," while low household SES accounted for 5 % of the variance.

Marked social gradients were apparent in the estimates for the prevalence of average or worse self-rated oral health across the categories of the composite SES measure (Table 4b). Across the entire sample, there was a clear social gradient. The lowest percentage of respondents with average or poorer oral health was observed among those from the high-SES households who were resident in areas of low deprivation; the highest was observed among low-SES individuals living in high-deprivation areas. As with edentulism, the estimates for the other combinations presented a linear gradient which was apparent among both the older and younger respondents (unpublished observations). As indicated by the R^2 change, low household SES accounted for most of the variance (3.5 %) when "average or worse self-rated oral health" was modeled using logistic regression.

Definite social gradients were also apparent in the estimates for the prevalence of 2+ years since the last dental visit across the categories of the composite SES measure (Table 4c). Across the entire sample, there was a marked social gradient whereby the lowest percentage of respondents who had not made a recent dental visit was observed among those from the high-SES households who were resident in areas of low deprivation; the highest was observed among low-SES individuals living in high-deprivation areas. Estimates for the other combinations revealed a linear gradient, and this was even more apparent when the analysis was limited to those aged 45 years or more. The differences were not as marked in the younger age group, but still reached statistical significance (unpublished observations). Low household SES accounted for most of the variance (6.6%) when "2+ years since last dental visit" was modeled using logistic regression and being aged 45+ years accounted for 2%.

Discussion

This cross-sectional investigation of an urban New Zealand adult sample has shown that social inequalities were present with respect to edentulism, self-reported oral health and access to dental care when area-based and household-based measures of SES were used. Consistent gradients were apparent when the SES measures were combined, with the highest edentulism prevalence, poorest oral health and highest prevalence of 2+ years since the last dental visit all being greater among those from low-SES households located in the most deprived areas. Respondents from high-SES households located in the least deprived areas had the lowest prevalence of edentulism, self-reported oral health or 2+ years since their last dental visit, and those from the other household-area SES combinations occupied intermediate positions.

The lack of concordance between the two measures (Table 2) indicates that they are measuring different constructs. This was also reported by Thomson and Mackay (20) and Sin *et al.* (25), and suggests that one measure of SES should not be used as a proxy measure or substitute for the other, but rather to provide supplementary information that lends explanatory power to health inequality models.

Reports from other oral health studies that have used both types of SES measure are rare. However, the consistency of social gradients observed in the current study mirrors those recently reported for children (20). The findings also support those of Borrell *et al.* and Locker and Ford, who found that those living in low-income areas were more likely to rate their oral health as poor than those living in more wealthy areas (26,27). Similar findings with respect to general health support the assertion that the use of both types of measure enables a deeper understanding of the occurrence and etiology of social inequalities in oral health (19,25). It is debatable whether similar findings might have been obtained had clinical as opposed to self-report dental outcomes been assessed. Thomson and Mackay (20) found similar patterns using clinical measures in children, but there are no reports, to date, of the use of adult clinical measures in the assessment of different SES instruments. There may be merit in replicating the current study with clinical measures.

It is important to acknowledge that, while the findings of the study suggest that there is added value for dental public health in using a dual socioeconomic measurement approach to population research, the two types of measure may not always be available. For example, an area-based measure such as NZDep01 relies on census data and a government that supports construction of (and has the capital for) such an index. In a developing world context, lack of expertise or resources may prevent development of such a tool. It is also important to consider that area-based SES measures assume relative homogeneity within a given unit area and only have utility when the area units are sufficiently small to allow accurate comparisons of deprivation among area units (22). The larger the population in a given unit area the less valid area-based SES measures become because of the inherent heterogeneity that occurs with increasing area unit size. Thus area-based SES measures may not be effective in countries such as the United States where the current smallest area unit of analysis (census tracts) may contain more than 1000 people. In contrast, questions pertaining to household-level SES are considered offensive by a number of cultures, meaning such items are not supported by ethics committees reviewing some health surveys (28,29). Household-based SES questions may also not be included in large surveys involving health records or routinely collected data, where the primary focus is monitoring or surveillance.

Each SES measure used in this study has different theoretical and policy implications. Area-based measures relate to the contextual influences on health, so should (in theory) be more amenable to area-based interventions such as community water fluoridation and geographic targeting of resources or services. Household-based measures are more closely linked to the life chances and behaviours of individuals, and are therefore more applicable to policies aimed at people, rather than areas. From a dental public health perspective, there is merit in using both measures in combination, particularly when the purpose of an investigation is to inform policy makers of groups most in need of oral health promotion interventions or community-based oral health strategies. In using both measures, distinctions can be made between people living in low-SES households in highly–deprived areas and those living in low-SES households in areas that are not disadvantaged. The findings provide some insight into the complex SES and oral health relationship, and may be useful in the design of further investigations that aim to explore adult oral health disparities.

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