



Interventions to reduce socio-economic inequalities in dental service utilisation – a systematic review

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Objective: A gradient exists where people with lower socio-economic status (SES) use dental services less regularly than others. Evidence suggests these SES differences may contribute to inequalities in oral health. A variety of approaches have been tried to increase regular dental service use, although it is possible that some are ineffective or may even widen SES inequalities. We aimed to undertake a systematic review of interventions to reduce SES differences in dental visiting. **Basic research design:** Interventions limited to those influencing dental service use by adults. Any type of experimental design, investigating interventions aiming to reduce SES inequalities in dental service use, was included. Primary outcome was a measure of dental utilisation. **Results:** Electronic search of 8 databases, with citation snowballing, identified 14,396 titles and abstracts. Paper eligibility screening identified 63 full papers, of which 6 met the inclusion criteria. All included studies were conducted in the United States. Of these, three were targeted to parents, and two towards pregnant women. Two studies incorporated mailing postcards as (at least) one component of the intervention, although results were mixed. Another three studies included scheduling dental appointments as part of a multi-component approach, again with mixed results. The remaining study, involving community health advisors undertaking activities aimed at raising community awareness, found no significant intervention effect. **Conclusions:** Evidence in this area is limited and results are mixed. More work is needed to investigate the effectiveness of interventions to reduce SES inequalities, especially in different healthcare systems and involving a wider participant range.

Keywords: Dental visiting, inequalities, dental practice, systematic review, socio-economic status

Introduction

Expenditure on dental services represents a significant contribution to overall health expenditure in many countries. In the United Kingdom, for instance, government expenditure on dental preventive healthcare totalled £897 million in 2013 (Office for National Statistics, 2016). Nevertheless, in many of these countries, people of low socio-economic status (SES) are much less likely to make use of dental services than others (Reda *et al.*, 2017; Hill *et al.*, 2013; Office of National Statistics, 2012; Sisson, 2007; Sanders *et al.*, 2006). Since there is evidence that inequalities in dental service use contributes at least in part to inequalities in oral health (Sgan-Cohen *et al.*, 2013; McGrath & Bedi, 2011; Sisson, 2007; Sheiham *et al.*, 1985), this offends the principle of health equity which implies that everyone should have a fair opportunity to attain their full health potential (Whitehead, 1992). In the United States, for example, 13.8% of people at or above the poverty level (aged 20–64 years) report experiencing dental pain compared to 22.6% below the poverty line (Vargas *et al.*, 2000). Set beside statistics that also show that 64.3% of US citizens are reported to have visited a dentist in the preceding year, compared to 35.9% of those below poverty level (Department of Health and Human Services, 2000), it is clear that interventions that reduce the inequality in dental service use are needed as part of a global drive to address inequalities in oral health (Sgan-Cohen, 2013).

While there has been extensive research outlining barriers and facilitators to the regular use of dental services that involve individuals, communities and structural factors (Harris *et al.*, 2017), the literature on interventions addressing the problem is surprisingly weak. A systematic review in this area is especially important because some effective public health interventions may increase inequalities by disproportionately benefiting less disadvantaged groups (Lorenc *et al.*, 2013; Watt, 2007; Victoria *et al.*, 2000; Schou & Wight, 1994). This has shown to be the case for some interventions attempting to improve access in the wider healthcare context. People who take up new initiatives are often those who already make ready use of services (Chapman *et al.*, 2004). This study therefore aimed to undertake a systematic review of interventions to reduce socio-economic inequalities in dental service utilisation in adults.

Method

Inclusion / Exclusion criteria

The review was limited to interventions influencing the dental service utilisation behaviour of adults to reduce socio-economic inequalities (although we included service use by children where the intervention aimed at influencing the behaviour of adults arranging care for their children). Interventions, of any experimental design (including natural experiments), targeted at the individual, community or macro-level were included, provided there was a focus on socio-economic differences in dental service use. Measures of SES were either based on in-

dividual characteristics (composite: e.g. occupation, education and income) or contextual measures (e.g. neighbours and other geographical areas) (Shavers, 2007). Study designs included randomised controlled clinical trials (RCTs), non-randomised controlled trials (NRCTs), controlled before and after studies, interrupted time series studies and repeated measures studies. The primary outcome was a measure of dental service use such as either a proportion visiting the dentist in the last 12 or 24 months; or the reason given for the last visit to the dentist (i.e. visiting the dentist for a check-up / routine care / emergency treatment). Comparisons included interventions versus no interventions; or interventions versus an alternative intervention. Any length of follow up was accepted. Interventions where the reported outcome measure was secondary care utilisation were excluded. Studies were limited to OECD countries and those published in the English language. Abstracts were included, but not unpublished studies.

Search strategy

‘Seminal’ papers on healthcare seeking were used to develop electronic search terms. Databases (MEDLINE, Social Science Citation Index (SSCI), Conference Proceedings Citation Index-Science (CPCI-S), Conference Proceedings Citation Index – Social Science & Humanities (CPCI-SSH), Cochrane Database of Systematic Reviews, ProQuest, OpenGrey, ESCO Dentistry and Oral Science) were electronically searched from 1970 to October 2018. An example electronic search strategy in MEDLINE is given in Appendix 1. Backward and forward citation as well as contact with other experts within the field was used to identify additional records. All titles and abstracts identified were double screened by two reviewers. Full articles were retrieved for those meeting criteria and were then screened by three reviewers, with any inconsistencies resolved by discussion.

Data extraction and synthesis

Data extraction into structured data extraction tables was independently duplicated by two authors. Interventions were grouped by type (i.e. individual or community-based intervention). Due to the heterogeneity of studies, a narrative synthesis of data was undertaken (Arai *et al.*, 2007).

Quality assessment

The Cochrane Collaboration tool for assessing risk of bias was used to assess RCTs, NRCTs and cluster RCTs. Each study was graded as high risk, low risk or unclear risk for the following domains: sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting, and other potential biases (Higgins & Green, 2011). In addition, the cluster RCT was assessed for recruitment bias, baseline imbalance, loss of cluster, incorrect analysis and comparability with individually randomised trials (Higgins & Green, 2011). For the repeated cross-sectional study; selection, performance, detection, attrition and reporting bias were assessed, as per the Cochrane Handbook recommendations (Higgins & Green, 2011).

Results

Study Identification

Initial searching, including forward and backward citation and contact with experts, identified 14,396 studies for title and abstract screening. Eligibility screening identified 63 papers for full paper screening, of which 6 met full inclusion criteria (Figure 1). Reasons for paper exclusion included studies not of intervention design (27 studies) or studies of dental service use in children only, but not involving adults directly (such as the use of mobile dental clinics) (30 studies).

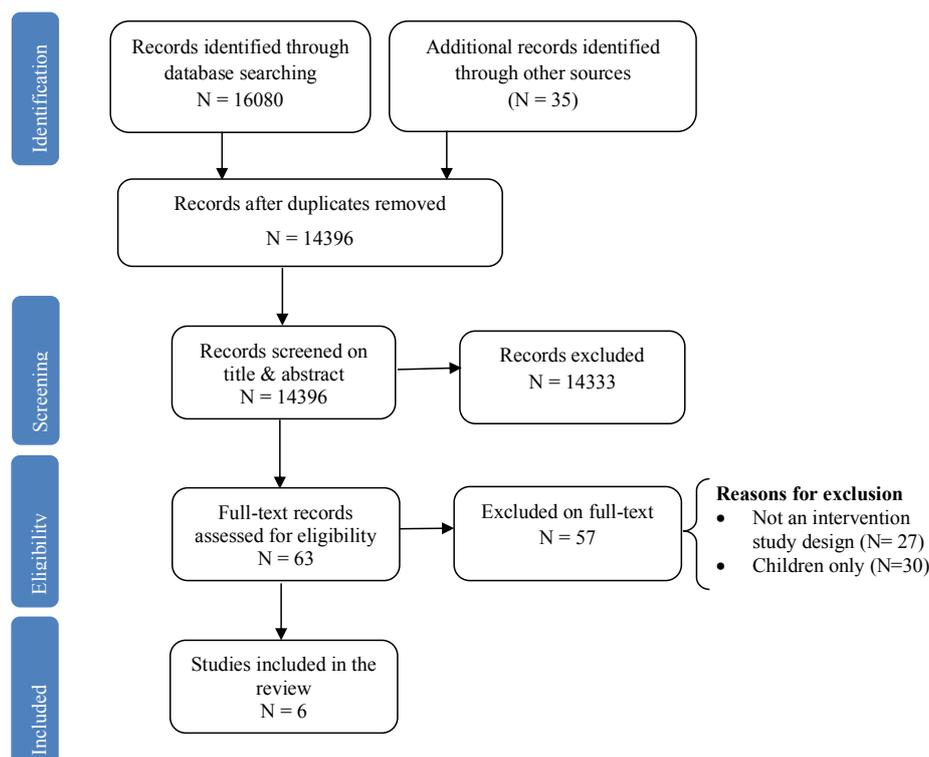


Figure 1. Flow diagram of study inclusion

Population characteristics: setting and participants

All 6 included studies were conducted in the United States between 1976 and 2014. Participants were recruited mainly from either child or low income pregnant women populations (Table 1). For example, Cibulka *et al.* (2011) recruited 170 pregnant, low-income, predominantly African American (82%) women from ante-natal clinics, while Riedy *et al.* (2015) recruited 400 rural Oregonian low-income, mainly White (79%) pregnant women from public health departments. Reiss *et al.* (1976) recruited 51 children (35 low-income, predominantly black families) from a rural elementary school; Binkley (2007) enrolled 202 predominantly female (99%), African American (80%) parents/caregivers of Medicaid insured children, and Dela Cruz *et al.* (2012) recruited 5807 low-income, predominantly Hispanic (67%) children enrolled in Yakima County Medicaid or 'Basic Health plus' schemes. The remaining study took a community level approach, training and supporting 13 community advisors (low-income, rural, African American Adults) to disseminate oral health education to their communities in Uniontown, Alabama (2007).

Of the 6 included studies, 3 were RCTs (Reidy *et al.*, 2015; Dela Cruz *et al.*, 2012; Binkley, 2007), one a cluster RCT (Reiss *et al.*, 1976), one an NRCT (Cibulka *et al.*, 2011) and one a repeated cross-sectional study (Clarke, 2007). Five studies used a composite measure of SES (income) (Reidy *et al.*, 2015; Dela Cruz, 2012; Cibulka *et al.*, 2011; Binkley, 2007; Reiss *et al.*, 1976), while the remaining study used a contextual measure (geographical area) (Clarke, 2007).

Intervention characteristics and summary of outcome

All 6 included studies were complex interventions involving more than one component (Table 1). The following section describes each of these interventions in turn, along with outcomes reported (Table 2), subdivided into summaries of interventions targeted to: 1) pregnant women; 2) parents and 3) communities.

Interventions targeting pregnant women

Cibulka *et al.* (2011) delivered their intervention to mothers before their 24th week of pregnancy. It consisted of completing a pre- and post- intervention questionnaire, watching a 5 min DVD presentation about periodontal disease and techniques for efficient toothbrushing and flossing. Participants were also scheduled to receive a dental check-up, along with a reminder postcard sent 1-2 weeks prior to this appointment. The intervention also included the use of Advance Practice Nurses (APN) in ante-natal clinics to discuss oral health with participants, and to distribute oral hygiene supplies such as a toothbrush, toothpaste and dental floss. The control group only completed the pre- and post- questionnaires. The primary outcome measure was dental attendance during pregnancy (up to the 36 week ante-natal visit). Results indicated a significant increase in dental service use by the experimental group compared to control ($p=0.006$, unadjusted OR 2.7; 95% CI 1.37 to 5.3). In addition, the intervention group showed an increase in oral health perception, daily toothbrushing and flossing frequencies and reduced their consumption of cariogenic drinks.

Riedy *et al.* (2015) used counsellors to deliver motivational interviewing (MI) to ante-natal mothers, focusing on individual dental needs, dental risks and barriers to care. This included

written protocols and video-recorded 'real life' examples to guide discussion and assure fidelity. Participants also received written oral health education information. Follow-up calls were made after 4 and 6 weeks to check on participants' plans. The control group received the same educational information as the intervention group. A patient navigator function was incorporated into counsellors' roles, but this was available to both intervention and control groups. Results showed that the MI intervention did not significantly increase dental attendance when compared to health education control alone (adjusted OR = 0.34; 95% CI = 0.16 – 0.74), with authors suggesting that inclusion of the patient navigator role in both groups may have lessened the difference between the intervention and control. Moreover, MI intervention cost \$108.62 more per participant to deliver.

Interventions targeting parents

Reiss *et al.* (1976) issued all participants (intervention and control) with a 'note' (prompt) containing information on the results of their child's dental screen. In addition, one intervention group (termed the three-prompt) received a phone call by school staff to reinforce the note (dental screening results), and a home visit by a dental hygienist to repeat recommendations on the note. The other intervention group (termed the one-prompt plus \$5 incentive) received a \$5 dental coupon after their child completed a dental examination. Attendance at an initial dental visit (up to 17 weeks post intervention) was used as the primary outcome measure. While both interventions were effective at increasing the number of initial dental visits, the one-prompt plus \$5 dental coupon generated the most immediate uptake, more participants completed courses of dental treatment and it was the most cost effective (Table 2).

The intervention reported by Binkley (2007) involved a case manager or home visitor visiting both participants and dental practices. For participants, they assisted in the scheduling of dental appointments, distributing of oral hygiene supplies (toothbrush, toothpaste and mouth rinse), transport, helping with Medicaid eligibility and discussed oral hygiene with participants. The case managers assisted dental practices in billing and collecting of Medicaid charges and also increased the number and quality of scheduled appointments for participants. The primary outcome was dental service use two-years post intervention. Similar levels of utilisation were noted across the groups ($p=0.39$, unadjusted OR 1.29; 95% CI 0.73 to 2.27). However, participants in the intervention who completed all study activities were almost three times more likely to see the dentist than similar families in the control group (Table 2).

A large study by Dela Cruz *et al.* (2012) incorporated postcards aimed at enhancing enrolment for a Baby and Child Dentistry programme among low income families. One intervention postcard contained enrolment information (intervention 1), while the other also included oral hygiene information as well (intervention 2). The control group did not receive a postcard. The primary outcome measure was 'utilisation rates' in the following 18 months. No significant difference was demonstrated between intervention 1 and control (unadjusted OR 1.06 95% CI 0.93 to 1.21) and between intervention 2 and control (unadjusted OR 1.10; 95% CI 0.97 to 1.26), perhaps due to the ceiling effect of high attendance in the control group (Table 2).

Table 1. Summary of interventions

<i>Study, setting & participants</i>	<i>Intervention</i>	<i>Intervention including a postal reminder (P) or scheduling of appointments (S)</i>	<i>Control</i>	<i>Primary outcome dental utilisation</i>	<i>Effect on utilisation</i>
Individual Intervention					
<i>Pregnant women</i>					
Cibulka <i>et al.</i> , 2011 170 pregnant, low - income women	Multi component intervention 5 min DVD presentation on periodontal disease and techniques for efficient toothbrushing and flossing Advanced Nurse Practitioners (ANP) discussed oral health and gave participants toothbrush, toothpaste and floss Scheduling of dental appointment Reminder postcard 1-2 weeks before the appointment	P S	No intervention	Dental attendance during pregnancy up to 36 week visit	↑
Riedy <i>et al.</i> , 2015 400 pregnant low -income women	Motivational Interviewing centred on participant dental needs, dental risks and barriers to care. Written information on oral hygiene and dental coverage (OHE) Follow-up call 4 and 6 weeks post interview. Counsellor as service navigator		OHE Counsellor as service navigator	Dental attendance during pregnancy for the mother	↔
<i>Parents</i>					
Reiss <i>et al.</i> , 1976 51 low-income children	<u>Intervention 1</u> 3 prompts Note (containing information of the outcome of the dental screen by dentist & hygienist) Telephone contact Home visit	P	1 prompt (note)	Initial dental visits and follow up (frequency) visits up to 17 weeks post study	↑
	<u>Intervention 2</u> 1 prompt (note) plus \$5 incentive	P			↑
Binkley, 2007 202 parents or caregivers of Medicaid insured children	Case Manager / Home visitor visit included: Participants Assistance obtaining dental care OH discussion Given OH supplies Dental practices Assistance in billing & collecting Medicaid charges Increase no. & quality of scheduled appointments for intervention subjects	S	No intervention	Dental utilisation (utilisers or non-utilisers)	↔
Dela Cruz <i>et al.</i> , 2012 5807 low income children	<u>Intervention 1</u> Mailing of postcard with enrolment information	P	No post card mailing	'Utilisation rates' in the following 18 months	↔
	<u>Intervention 2</u> Mailing of postcard with enrolment information and oral hygiene information	P			↔
Community Intervention					
Clarke, 2007 5306 adults and children living in Uniontown or Union Springs, Alabama	Community Health Advisor (CHA) Model of Intervention CHA assigned to disseminate OH education within their community including: Regular presentations at community gatherings (e.g. church) Discussed oral health with friends, family and neighbours Constructing and distributing holiday cards with oral health information In addition, 1 CHA discussed oral health via the local radio.	P	No intervention	Visit frequency (regular or not) and last visit (<yr preventive) following intervention lasting 1 year	↔

↑ significantly increased utilisation, ↔ no significant increase in utilisation ($p < 0.05$)

Table 2. Utilisation of dental services in intervention and control groups

Study		Intervention 1 (n)	Intervention 2 (n)	Control (n)	OR (95% CI)*
Individual Intervention					
<i>Pregnant women</i>					
Cibulka <i>et al.</i> , 2011	Utilised	41		24	2.7 (1.37-5.30)
	Did not utilise	31		49	
Riedy <i>et al.</i> , 2015	Utilised	146		168	0.34 (0.16-0.74)
	Did not utilise	25		10	
<i>Parents</i>					
Reiss <i>et al.</i> , 1976	Utilised	6		3	5.00 (0.82-30.46)
	Did not utilise	4		10	
	Utilised		8	3	6.67 (1.12-38.83)
	Did not utilise		4	10	
Binkley, 2007	Utilised	42		36	1.29 (0.73-2.27)
	Did not utilise	59		65	
Dela Cruz <i>et al.</i> , 2012	Utilised	1258		1085	1.06 (0.93-1.21)
	Did not utilise	756		694	
	Utilised		1274	1085	1.10 (0.97-1.26)
	Did not utilise		740	694	
Community Intervention					
Clarke, 2007	Utilised	538		1361	0.83 (0.73-0.94)
	Did not utilise	1098		2308	

* Primary outcome see Table 1

Interventions targeted at the community level

Clarke (2007) recruited 13 Community Health Advisors to disseminate oral health education within their community. This included distributing oral hygiene products and educating their community through presentations, one-to-one conversations, messages delivered via the local radio station and holiday cards with oral health messages. The primary outcome measure was visit frequency and reason for last visit one-year post intervention. There was a greater

pre-post increase in regular attendance for the intervention community relative to the comparison community (+5.45% for intervention vs. +2.5% for comparison (Table 2). However, the significant intervention effect disappeared after an intention-to-treat analysis was carried out.

Quality Assessment

Apart from a lack from blinding, many of the RCTs were found to have a low risk of bias. Table 3 gives the risk of bias by domain for each included study, grouped by study design.

Table 3. Risk of bias in included studies

RCTs & CCT

Study	Sequence generation	Allocation concealment	Blinding	Incomplete outcome data	Selective Reporting	Other potential biases
Binkley, 2007	Low	Low	Unclear	Unclear	Low	None
Cibulka <i>et al.</i> , 2011	High	High	High	Low	Low	None
Dela Cruz <i>et al.</i> , 2012	Low	Low	High	Low	Low	None
Riedy <i>et al.</i> , 2015	Low	Low	High	Low	Low	None

Cluster RCT

Study	Sequence generation	Allocation concealment	Blinding	Incomplete outcome data	Selective Reporting	Other potential biases
Reiss <i>et al.</i> , 1976	Unclear	Unclear	Low	High	Low	<ul style="list-style-type: none"> • Recruitment bias: unclear • Baseline imbalance: unclear • Loss of cluster: low • Incorrect analysis: low • Comparability with individually randomised trials: unclear

Repeated cross-sectional

Study	Selection	Performance	Detection	Attrition	Reporting Bias
Clarke, 2007	Unclear risk	Unclear risk	Low risk	Low risk	Unclear risk

Discussion

Although the focus of the review was to summarise and synthesise evidence of interventions aimed at improving the SES gradient in dental service use, we found that even in such an important area, studies are mainly limited to those involving parents organising care for their children and pregnant women. Almost all intervention studies have been targeted at individual behaviour, rather than addressing community or structural factors. Moreover, all included studies involved participants at the lower end of the SES spectrum, with none involving participants across the whole gradient. This represents a considerable research gap, given that policy now dictates that we should adopt intervention efforts with 'a scale and intensity that is proportionate to the level of disadvantage' (proportionate universalism) (Carey *et al.*, 2015; Marmot & Bell, 2012).

Although a common approach to intervention design was the use of postal reminders and/or help in scheduling appointments (Table 1), the heterogeneity of studies meant that meta-analysis was not advised. All included studies were complex interventions, which is perhaps not surprising given the multi-faceted nature of dental service utilisation, where inequalities are known to from several points in the care seeking process (Harris *et al.*, 2017). However, a downside of complex interventions, is that it is often hard to determine a) which component(s) of the complex interventions promote positive behavioural action (Campbell *et al.*, 2007; Blackwood, 2006) and b) which component(s) maybe of less importance than others but result in increased costs and participant burden. In trying to tease apart the effective ingredients of complex interventions, the study by Riedy may guide us, in that the lack of difference found between motivational interviewing and health education, might be attributable to the presence of someone to assist the participant in navigating services (Reidy *et al.*, 2015). Certainly more studies are warranted to investigate whether a navigator function is especially needed.

On the other hand, interventions which decrease the necessity of the individual to use their own self-regulatory capability (i.e. motivation or self-control) for activities such as scheduling appointments appear to have had mixed results. Cibulka *et al.* (2011) showed that when low income pregnant women were scheduled a dental check-up appointment and sent a reminder 1-2 weeks before this appointment, attendance increased 29.5% from baseline compared to 2.8% within the control group. Yet, when case managers scheduled participants a dental appointment without a reminder, no increase in service use was found (Binkley, 2007). Differences in the type of participant, local service availability and ceiling effects in service use, mean that this is an area where more studies are needed, especially in different health systems, before we can draw conclusions.

Perhaps the key to increasing service use is to target both the individual and service levels by combining appointment scheduling systems for individuals with subsequent reminder 'prompts', as has been shown in other healthcare settings (Gurol-Urganci *et al.*, 2013). For example, a recent systematic review demonstrated a consistent significant increase in health care attendance

(30 of 31 RCTs) when a simple reminder (i.e. date, time and location of appointment) was used (McLean *et al.*, 2016). Reminders included using letters, personalised telephone calls, mobile / SMS, email, automated telephone and voice messaging. This would support Cibulka and colleague's (2011) study of postal reminders for dental appointments, which resulted in an intervention effect.

Finally, it is important to draw attention to a couple of methodological issues. First, we included two primary outcome measures (a measure of dental service use such as the proportion visiting the dentist in the last 12 or 24 months; and the reason given for the last visit (e.g. for a check-up / routine care / emergency treatment), in order to increase the sensitivity of the search, given that the literature appeared to be so sparse in this area. These two measures were identified as the most frequently used in the international literature, which are indicative of preventive dental visiting (Harris, 2013). Secondly, it should be noted that though the review was limited to interventions influencing the dental service utilisation of adults, we included studies involving the visiting behaviour of children, where the intervention targeted adults arranging their care. This has implications since interventions targeted at parents may have different effects than those addressing the visiting behaviour of adults themselves (since the dental visit for children may be free whereas for adults it may not; and there may be a gender bias since interventions involving children may generally involve more women than men). However, there were insufficient included papers to undertake a sub-group analysis to explore this further.

Conclusion

This systematic review has shown that evidence in this area is limited, with mixed results. There is a lack of research into interventions which aim to reduce socio-economic inequalities in adult dental visiting, and interventions that target community or structural causes of these inequalities. More work is needed to be done to investigate the effectiveness of interventions to reduce SES inequalities in dental visiting in a wider range of healthcare systems and populations.

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Appendix 1. Example electronic search undertaken in MEDLINE

Searched via OVID 01/10/18. Restricted to English language, 1970 to Current.

1	((SES or socio-economic* or socioeconomic* or social* or economic* or material* or structural* or income or educat* or occupation* or insurance) adj3 (disparit* or unequal* or inequit* or equit* or equalit* or exclude* or exclusion or include* or inclusion or gradient or hierarchy or class or determinant* or variation* or status or advantage* or disadvantage* or factors or depriv*))ti,ab.	193879
2	(inner city or innercity or inner-city or deprived areas or low\$ income or receiving welfare or in receipt of welfare or on welfare or receiving benefits or in receipt of benefits or on benefits or public assistance).ti,ab.	44047
3	(disparit* or unequal* or inequit* or equit* or equalit* or gradient or hierarchy or determinant* or variation* or advantage* or disadvantage* or depriv*) adj3 (access* or inaccess* or utilis* or utiliz* or attend* or demand or visit* or treatment or care or healthcare or seek* or uptake or take?up or attend* or non-attend* or obtain* or unobtain*).ti,ab.	39051
4	(disparit* or unequal* or inequit* or equit* or equalit* or gradient or hierarchy or determinant* or variation* or advantage* or disadvantage* or depriv*) adj3 (enable* or enabling or facilitat* or enhanc* or increas* or improv* or maximis* or promot* or permit* or allow* or ability to pay or inability to pay or cost or afford* or unafford* or financial* or barrier* or prevent* or limit* or reduc* or inhibit* or fear or afraid or anxiety* or anxious* or phobia or phobic or discourag* or perception of need or perceived need or perception of treatment need or perceived treatment need or lifestyle commitment* or time commitment* or work commitment* or leisure commitment* or employment commitment* or care commitment* or caring commitment* or other commitment* or work obligation* or employment obligation* or care obligation* or caring obligation* or other obligation* or work responsibilit* or employment responsibilit* or care responsibilit* or caring responsibilit* or other responsibilit* or work duties or employment duties or care duties or caring duties or other duties or work duty or employment duty or care duty or caring duty or other duty).ti,ab.	78276
5	(dental* or dentist* or oral health or oral care or oral hygiene).ti,ab.	251425
6	1 and 5	5318
7	2 and 5	1206
8	3 and 5	949
9	4 and 5	1035
10	6 or 7 or 8 or 9	7475
11	limit 10 to (english language and humans and yr="1970 -Current")	5804
12	remove duplicates from 11 (within database)	5781