Short Communication

Widening socio-economic inequalities in oral cancer incidence in Scotland, 1976–2002

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Oral cancer incidence was investigated among 10,857 individuals using Scottish Cancer Registry data. Since 1980 the incidence of oral cancer among males in Scotland has significantly increased, the rise occurring almost entirely in the most deprived areas of residence. British Journal of Cancer (2007) 96, 818–820. doi:10.1038/sj.bjc.6603621 www.bjcancer.com © 2007 Cancer Research UK

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Incidence of oral and oro-pharyngeal cancer continues to rise across the UK in all age groups and in both sexes (Conway et al., 2006). Oral cancer risk appears highly correlated with socio-economic factors, both in Scotland (Macfarlane et al., 1996) and in the UK (Edwards and Jones, 1999), although this was not reflected in a review of incidence studies across the world (Faggiano et al., 2003). Studies of the socio-economic association with oral cancer tend to be cross-sectional and cannot account for temporal changes (Greenwood et al., 2003; Møller and Brewster, 2005). One recent case–control study in Italy, which examined time–trends, found that oral cancer risk associated with poor socio-economic circumstances had disappeared through the 1990s (Bosetti et al., 2001). The aims of this study were to assess the pattern, magnitude, and time trends of socio-economic inequalities in the distribution of oral cancer in Scotland.

MATERIALS AND METHODS

Incident cases of oral cancers (ICD-10 C00-C06) and cancers of the oro-pharynx (C09, C10, and C14) for the period 1976–2002 were obtained from the Scottish Cancer Registry, which has a high level of case ascertainment (Brewster et al., 1997) and accuracy of postcodes, from which the Carstairs scores were derived (see below) (Brewster et al., 2002). Mid-year population estimates were derived from the Annual Reports of the Registrar General for Scotland for corresponding years (General Register Office for Scotland, 1977–2003). Annual and triennial age-standardised incidence rates by sex were calculated for the period 1977–2000 by direct standardisation to the European Standard Population (Waterhouse et al., 1978).

This study utilises the area-based (postcode sector) Carstairs index of deprivation, which comprises four variables from the UK decennial census: social class, unemployment, overcrowding, and car ownership (Carstairs and Morris, 1991). First, 1981, 1991, and 2001 Carstairs deprivation categories were linked with cancer registration data relating to the periods of diagnosis 1976–1985, 1986–1995, and 1996–2002, respectively. Second, to validate this approach, the 1991 census-derived Carstairs deprivation categories were applied to the whole period of diagnosis 1976–2002. There were no substantial differences observed between the two methods; therefore, only data from our first method are reported here.

Poisson regression models were used to assess the magnitude of change and significance of trends in incidence. The independent effects were analysed in a fully adjusted model, and interactions were also examined. Statistical analyses were performed on SAS version 9.1 (SAS Institute Inc.).

RESULTS

Overall incidence of oral cancer for males was 11.1 per 100,000 (95% confidence interval 10.8, 11.3) and for females was 4.1 per 100,000 (3.9, 4.2). Incidence increased significantly in both males (+87%, P<0.001) and females (+65%, P<0.001) over the period of the study. Comparing the 3-year periods at the start and end of the period, incidence in males increased from 10.1 (10.8, 11.3) to 13.3 (12.5, 14.1) per 100,000 and in females from 2.8 (2.5, 3.2) to 5.5 (5.0, 6.0) per 100,000. The median age of diagnosis was 65.1 years.

Between 1976 and 2002, the widening gaps in oral cancer incidence between affluent and deprived socio-economic groups by sex are clearly demonstrated in Figure 1 and Table 1. For males there was a general increase in incidence of oral cancer with increasing severity of deprivation. From an inverse relationship in 1976–1978, the gap between the most and least deprived males appeared in the late 1970s and increased rapidly through to the 1990s. The gap is almost entirely explained by an increase in incidence (+196%, P<0.001) in the most deprived, with a (nonsignificant) reduction in the least deprived group over the period (−74%, P=0.54). A different pattern is seen for females in both magnitude and timing. The incidence increased in those from...
all levels of deprivation, with those women from the most deprived areas having the greatest increase (±163%, \( P<0.001 \)), but a significant increase also apparent in the least deprived (±91%, \( P<0.001 \)). The widening gap between the most and least deprived appeared in the 1980s and continued to increase until the late 1990s. Data from 2000 to 2002 suggest that the gap had closed for women over 65 years.

**DISCUSSION**

Our study shows that oral cancer incidence has increased from the 1970s to present, with corresponding widening socio-economic inequalities, particularly in males. During this period, societal changes have included post-industrial decline bringing unemployment and polarisation of poverty to the parts of Scotland (Devine, 1970s to present, with corresponding widening socio-economic changes have included post-industrial decline bringing unemployment and polarisation of poverty to the parts of Scotland (Devine, 1995). A diet low in fresh fruit and vegetables (Pavia et al, 2006) has also been found to be associated with increased oral cancer risk. The question is to what extent can the trends in oral cancer inequality be explained by socio-economic variation in these risk factors.

Data on smoking prevalence from 1972 show a consistent downward trend in all social classes in both sexes across Britain. Although smoking remained substantially lower in the higher social classes, widening inequalities were not obvious (Goddard and Green, 2005). More recent Scottish data (1995–2003) indicate that the downward trend in smoking prevalence continues with increasing inequalities in its distribution—with those from deprived areas increasingly less likely to give up (Bromley, 2005). Oral cancer risk markedly declines after quitting smoking (La Vecchia et al, 1999). Overall, the patterns in smoking behaviour cannot easily explain the widening socio-economic inequalities in oral cancer incidence.

The association between alcohol drinking in Scotland and socio-economic factors is somewhat mixed. The Scottish Health Survey 1995–2003 (Bromley et al, 2005) consistently shows that more people were drinking alcohol excessively, irrespective of their socio-economic circumstances. Similar findings in Britain from the 1980s were reported (Goddard and Green, 2005). However, between 1998 and 2003 there was a 19% rise in alcohol-related hospital episodes in Scotland with a strong relationship to area deprivation (Bromley et al, 2005). Thus, alcohol may have a role in socio-economic inequalities in oral cancer, although the evidence is incomplete. In our study, we were unable to investigate the well-documented synergistic effects of smoking and heavy drinking.

Daily fruit and vegetable consumption has significantly increased in Scotland (1995–2003), although those from deprived areas were eating less than their affluent counterparts (Bromley et al, 2005). Earlier UK data have highlighted similar trends among unemployed individuals (Braddon et al, 1988). However, owing to the absence of long-term dietary behaviour data, strong conclusions cannot be drawn.

**Figure 1** Males and females European age-standardised incidence rate (EASR) of oral and oro-pharyngeal cancer by Carstairs deprivation quintiles, 1976–2002 in Scotland.

**Table 1** Age-standardised incidence rates of oral and oro-pharyngeal cancer by sex, during nine consecutive triennia in Scotland, by Carstairs deprivation category quintile during consecutive triennia 1976–1985, Carstairs 1991 for 1986–1995 and Carstairs 2001 for 1995–2002.

| Oral cancer cases | 1976–1978 | 1979–1981 | 1982–1984 | 1985–1987 | 1988–1990 | 1991–1993 | 1994–1996 | 1997–1999 | 2000–2002 | Estimated % change | P-value for trend |
|-------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------------|-----------------|
| Males (overall)   | 10.1      | 9.3       | 9.6       | 9.8       | 10.7      | 11.2      | 12.2      | 13.8      | 13.3      | 87               | <0.001          |
| 5 most deprived (n=1944) | 8.9       | 10.6      | 12.2      | 14        | 17.2      | 16.7      | 18.8      | 22.1      | 20.2      | 196              | <0.001          |
| 4 (n=1449)        | 9.2       | 8.9       | 9.0       | 9.6       | 11.9      | 12.2      | 11.7      | 14.3      | 13.9      | 83               | <0.001          |
| 3 (n=1431)        | 9.1       | 10.8      | 9.6       | 9.4       | 9.5       | 10.6      | 12.8      | 13.3      | 13.4      | 78               | <0.001          |
| 2 (n=1322)        | 11.5      | 8.2       | 9.4       | 8.5       | 7.9       | 9.1       | 10.1      | 10.9      | 11.2      | 23               | 0.05            |
| 1 least deprived (n=1089) | 10.8      | 7.7       | 7.8       | 7.6       | 6.6       | 7.5       | 7.9       | 9.2       | 8.2       | 27               | 0.54            |
| Ratio 5:1         | 0.8       | 1.4       | 1.6       | 1.8       | 2.6       | 2.2       | 2.4       | 2.4       | 2.5       | —                | —               |
| Females (overall) | 2.8       | 3         | 3.2       | 3.5       | 3.8       | 4.2       | 5.2       | 5.2       | 5.5       | 65               | <0.001          |
| 5 most deprived (n=813) | 3.1       | 2.8       | 2.8       | 3.8       | 4.3       | 4.8       | 7.3       | 7         | 7.3       | 163              | <0.001          |
| 4 (n=781)         | 2.9       | 3.7       | 3.5       | 3        | 4.2       | 4.1       | 5.8       | 5.6       | 6.5       | 110              | <0.001          |
| 3 (n=660)         | 2.6       | 2.3       | 3.3       | 3.3       | 3.7       | 4        | 4.4       | 4.5       | 4.6       | 105              | <0.001          |
| 2 (n=681)         | 2.2       | 2.8       | 3.3       | 3.4       | 3.7       | 4.4       | 4.4       | 4.5       | 4.1       | 98               | <0.001          |
| 1 least deprived (n=667) | 2.8       | 3.1       | 2.9       | 3.7       | 3.8       | 3.6       | 4.2       | 3.7       | 5.2       | 91               | <0.001          |
| Ratio 5:1         | 1.1       | 0.9       | 1.0       | 1.0       | 1.5       | 1.3       | 1.7       | 1.9       | 1.4       | —                | —               |
The effects of socio-economic circumstances per se are worth considering. Although area measures of socioeconomic status have previously been criticised as ‘ecological fallacy’ – individuals are allocated a status based on their residence – this may in fact help with an explanation. People in the same area sharing many socio-economic circumstances may also experience some additional collective ‘stresses’ (Macintyre et al., 1993). Hypotheses of ‘biological ageing’ effects of poor socio-economic circumstances may be relevant (Adams and White, 2004), perhaps being mediated by telomere shortening (Cawthon et al., 2003). Explanations for the widening inequality trends are complex. More work is required to explain the continuing rise in oral cancer incidence and the increasing socio-economic inequalities. Public health programmes for the early detection and prevention of oral cancer are needed in deprived communities. Although the association with socio-economic factors is well known, little has been done to explicitly address this. To date, ‘high-risk groups’ have primarily been defined by their sex, age, smoking and alcohol behaviours (Speight et al., 2006). Those living in deprived areas should be considered as the key ‘priority risk group’. Policy needs to be directed towards tackling root causes of disadvantage, as efforts to reduce exposure to risk factors are unlikely to succeed unless they are supported by measures designed to improve socio-economic circumstances.

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Deprivation and oral cancer in Scotland (1976 – 2002)
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