

The caries experience of 11 to 12 year-old children in Scotland and Wales and 12 year-olds in England in 2008-2009: Reports of co-ordinated surveys using BASCD methodology

G.M. Davies¹, C.M. Jones², N. Monaghan³, M.Z. Morgan⁴, J.S. Neville¹ and N.B. Pitts⁵

¹The Dental Observatory, Preston, UK; ²NHS Health Scotland, Edinburgh, Scotland; ³Public Health Wales; ⁴Welsh Oral Health Information Unit, Cardiff University, Wales; ⁵Dental Health Services Research Unit, University of Dundee.

Objective: This paper brings together summarised findings on surveys of 106,828 mainstream school pupils aged 11-12 years old undertaken in Scotland, Wales and England in 2008/09. These surveys are the latest in a series using common criteria for measurement and a range of consent arrangements which, for this age group, allow comparison between the three “countries” and over time. **Method:** Representative samples were drawn within the geographies of primary care organisations in the three countries and within English Local Authorities according to BASCD criteria for sampling. Consent was sought from pupils in Wales and England and passive consent was used in Scotland. Children aged twelve were examined in England and children in school year 7 (rising 12) were examined in Wales and Scotland. Examinations were conducted in schools by trained and calibrated examiners using BASCD standard criteria and caries was diagnosed at the dentinal threshold using visual criteria. **Results:** The trend for reducing caries prevalence and severity continues in this age group in all three countries. Unlike data for 5 year old children, the impact of seeking positive consent from pupils does not appear to have introduced bias into the results. Variation in caries levels between and within geographical areas continues. **Conclusion:** Caries prevalence surveys of children aged 11-12 years have been conducted across Great Britain. Those carried out with positive consent appear to produce unbiased results, comparable with previous surveys. Health inequalities in this age group persist, as does the burden of disease for those with end-stage caries.

Key words: epidemiology, dental caries, prevalence, health surveys, England, Scotland, Wales, Great Britain, United Kingdom, informed consent by minors

Introduction

Standardised dental epidemiological surveys of caries among child cohorts have been carried out systematically in the UK since 1987. The UK comprises England, Scotland, Wales and Northern Ireland. Over recent time many areas of UK governmental power has been devolved to Scotland, Wales and Northern Ireland. Each “country” still maintains a universal national health service funded by taxation, but different arrangements have been developed to organise these services in each country. This has resulted in each country running its own dental epidemiological surveys, but these regularly align with regard to the age cohort being examined and they employ common BASCD criteria and standards where possible. During the academic year 2008/09 surveys of children aged 11 to 12 years of age were undertaken in Scotland and Wales while children aged 12 were surveyed in England. In all surveys the BASCD standards for calibration, sampling, examining, recording caries and analysis were used (Pine *et al.*, 1997a, 1997b; Pitts *et al.*, 1997). Following the publication of national guidance (Department of Health, 2006; Welsh Assembly Government, 2006) the consent process for England and Wales has deviated slightly from the published BASCD standard, now using positive consent provided by the

child, while that for Scotland has remained the same – reflecting the different legislation in Scotland.

This paper summarises the process and results of the three countries’ surveys and provides links to sites where the full reports and data tables can be accessed.

Method

National (GB) training and calibration of regional standard examiners took place in September 2008. This covered key areas of the national protocols and any points which had been added in since the previous survey of this age cohort (Pitts *et al.*, 2006). This training was cascaded to fieldwork teams in Scotland, Wales and the ten English Strategic Health Authority Regions.

The population sampling frame was all children of the correct age attending mainstream, state-funded schools. Within each local government or health geography random sampling was carried out such that each child had an equal probability of being selected (Watkins and Pitts, 1994). Sample sizes were chosen to obtain a representative sample of sufficient size to allow meaningful comparisons between local National Health Service and/or local government areas following BASCD guidelines.

Fieldwork teams visited participating schools and examined pupils supine using portable equipment which

comprised a medical inspection lamp of standard brightness and cotton wool rolls for drying. Ball ended probes were used for removal of debris only. Caries was recorded at the dentinal threshold (D_3) level using visual means only. No radiographs were taken.

In the course of the surveys in England and Scotland, 10% of the children in the sample were re-inspected to provide data on the examination decisions of the dentists who were undertaking the inspections and thus check for the diagnostic reliability of the fieldwork.

Consent

In line with Scottish legislation, passive (negative) consent was used in the National Dental Inspection Programme in Scotland. In England and Wales a new consent system was introduced in response to national guidance (Department of Health, 2006; Welsh Assembly Government 2006). This entailed a letter being sent to parents of sampled children giving information of the nature and purpose of the survey. This gave parents the opportunity to withdraw their children at this stage. All remaining pupils were given an explanation of the survey, given an opportunity to ask questions and then asked if they agreed to take part.

Changed consent arrangements for examination of 5 year old children have had a large impact on reported caries levels in England and Wales making cross UK comparisons and historical comparisons within England and Wales inappropriate (Dyer *et al.*, 2008, Davies *et al.*, 2011; Monaghan *et al.*, 2011). In contrast, the changed consent arrangements for 12 year olds have been previously piloted and shown to have very limited impact on both participation (Monaghan and Morgan, 2009) and reported caries rates (Morgan and Monaghan, 2010). Therefore this data is judged to be comparable, both historically and across the various countries of the United Kingdom.

Results

In all three countries there was evidence of a continued reduction in the overall prevalence and severity of obvious caries at population level (Figure 1). Among those children affected by obvious caries the relatively higher mean severity has also continued to decrease over time (Figure 2).

England

In total, 140 out of 152 Primary Care Trusts (PCTs, local commissioners of health care at that time) took part in the survey covering 299 out of 326 local authorities (as configured in April 2009). A total of 89,442 clinical examinations were included in the final analysis. This represented 15% of the population of this age cohort attending mainstream state schools (Rooney *et al.*, 2010a).

The overall response rate of pupils examined as a proportion of those sampled was 74%. Approximately 12% of sampled schools declined to co-operate when asked by fieldwork teams. Only a small proportion of parents (7.3%) actively withdrew their children and only 6.7% of pupils declined the request to take part. Absenteeism on the day of examination accounted for loss of 11.8% of children. There was potential for any or all of these

reasons for non-participation to bias the results. This appeared not to be the case as weighting the results using quintiles of socio-economic deprivation had almost no effect on the unweighted results. This would suggest that withdrawal of co-operation by schools, parents or pupils was not associated with socio-economic circumstances.

At a national level, 33.4% of pupils had experience of obvious caries, having one or more teeth decayed to dentinal level, extracted or filled because of caries, compared with a prevalence of 37.0% previously. The remaining 66.6% were free from visually obvious dental decay. The mean D_3 MFT was 0.74, a reduction of 14% compared with a mean of 0.86 in the previous survey in 2000/01 (Pitts *et al.*, 2002). There was wide variation at PCT level ranging from Southwark PCT where only 12.9% had dentinal caries experience to Knowsley PCT where 56.1% were affected. The overall trend of reducing levels of obvious caries in this age group continues.

PCTs are grouped geographically into ten Strategic Health Authorities (SHAs). As in previous caries surveys among child cohorts severity and prevalence in northern SHAs are higher than those in southern ones, with a gradient moving down the country. Yorkshire and Humber SHA in the north now has the highest mean severity and prevalence in England, while South East Coast SHA has the lowest.

Analysis of the components of the DMFT index over time shows that the care index for permanent teeth, which is the contribution of the filled component of the index (FT/DMFT), reduced in England, Wales and Scotland from around 0.70 in 1988 to between 0.44 and 0.50 from 1992 onwards (Table 1).

The association between disease levels and deprivation was assessed for England and Wales by using the proportion of children who had experienced tooth extraction because of caries for each of five deprivation quintiles (Figure 3). This shows a clear relationship between deprivation and the experience of extractions for caries, with children in the most deprived quintile being three times more likely to have experienced the extraction of one or more teeth than their most affluent peers.

Wider clinical examination and questionnaire data allowed measures other than caries to be reported (Rooney *et al.*, 2010b). These included the demand and need for orthodontic care, the presence of visible plaque and reported brushing frequency, self-reporting of enamel opacities, self-reporting of symptoms and the impact of these on daily activities. These data have been analysed and results are reported on the same site as the caries data.

Full results are available at: www.nwph.net/dental-health

Wales

This was the second survey of year 7 (aged 11 to 12) schoolchildren undertaken in Wales; the first was in 2004-05. Previous surveys in Wales examined children aged 12 in school years 7 and 8. The bars in figure 3 for Wales are shaded differently to reflect this minor change in age group examined. The recent survey took place in the school year 2008/2009. A total of 5,808 children, 17% of the year 7 population, participated and their average age was 11.9 years old (sd 0.33 years - note that for

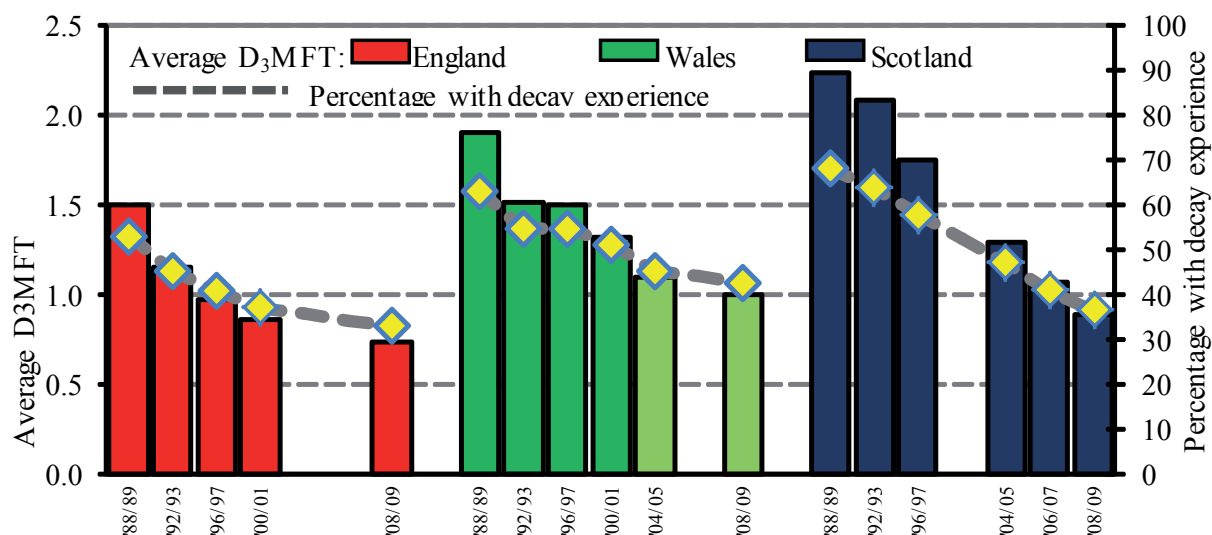


Figure 1. Trends over time in prevalence and severity of caries In England (12 year olds 1988-2009) and Wales (12 year olds 1988-2001 and school year 7 2004-2009) and Scotland (school year 7 1988-2009)

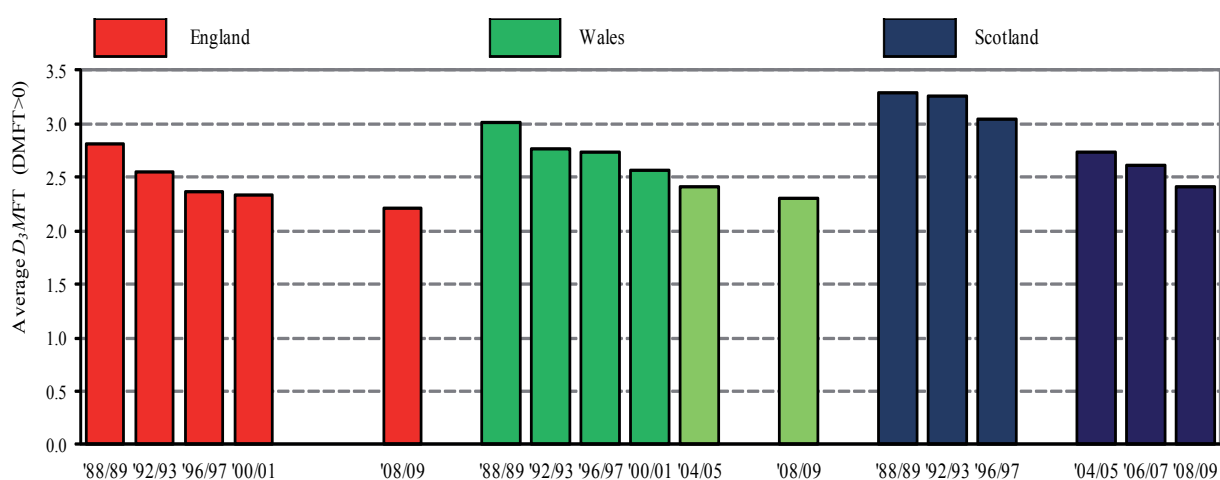


Figure 2. Trends over time in severity of caries among children with any caries experience ($D_3MFT > 0$) in England (12 year olds 1988-2009), Wales (12 year olds 1988-2001 and school year 7 children 2004-2009) and Scotland (school year 7 children, 1988-2009).

Table 1. Components of the DMFT index and care index (FT/DMFT) over time in England, Wales and Scotland among 12-year-olds and 11-12-year-olds.

	England					Wales					Scotland						
	'88 /89	'92 /93	'96 /97	'00 /01	'08 /09	'88 /89	'92 /93	'96 /97	'00 /01	'04 /05	'08 /09	'88 /89	'92 /93	'96 /97	'04 /05	'06 /07	'08 /09
DT	0.26	0.40	0.41	0.39	0.32	0.42	0.49	0.59	0.51	0.48	0.41	0.39	0.87	0.81	0.52	0.4	0.31
MT	0.10	0.09	0.08	0.06	0.07	0.13	0.12	0.17	0.12	0.11	0.12	0.24	0.19	0.17	0.17	0.15	0.13
FT	1.09	0.65	0.47	0.41	0.35	1.35	0.90	0.73	0.68	0.50	0.45	1.60	1.01	0.78	0.60	0.52	0.44
Care index (FT/DMFT)	0.73	0.56	0.48	0.47	0.47	0.71	0.59	0.48	0.52	0.45	0.45	0.71	0.48	0.44	0.46	0.49	0.50

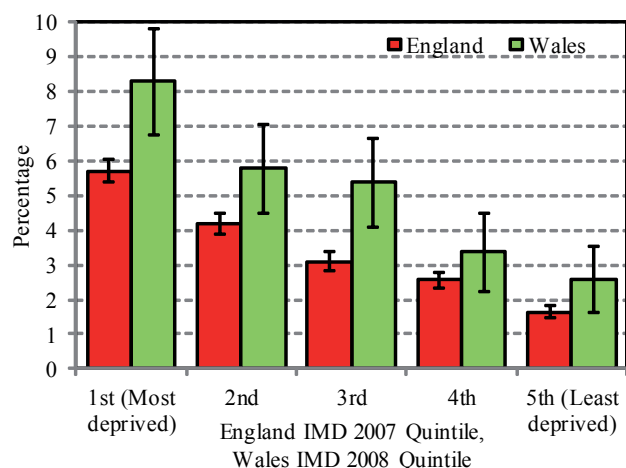


Figure 3. Proportion of children with experience of extraction due to decay ($MT > 0$) in England (12 year-olds) and Wales (11 - 12 year-olds) in 2008/09 by Index of Multiple Deprivation quintiles

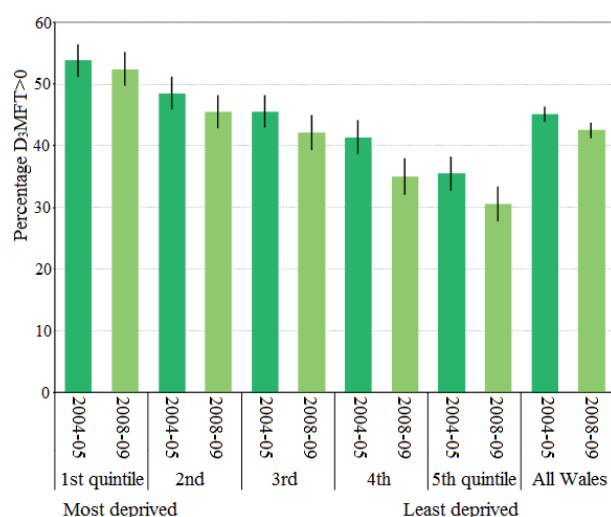


Figure 4. Proportion of children in Wales with experience of obvious caries ($D_3MFT > 0$) presented by Welsh Index of Multiple Deprivation quintiles, surveys of school year 7 children 2004-05 and 2008-09

data protection reasons only month and year of birth are collected in Wales).

The NHS structures in Wales were changing as data were collected. Data were sampled and collected on a local government (Unitary Authority) basis. As each new NHS organisation (Local Health Board) is coterminous with a number (from 2 to 6) of Unitary Authorities these data also allowed reporting on a Local Health Board basis.

The percentage of year 7 children affected by obvious tooth decay in Wales (i.e. % of children with at least one tooth decayed, missing due to decay or filled teeth - $\%D_3MFT > 0$) has fallen from 51% in 2000-01 to 42.5% in this latest survey (Figure 1). Prevalence of decay varied across the seven Welsh health boards, 51% of year 7 children living in Cwm Taf Health Board area (in the South Wales valleys) had experience of obvious decay compared with 36% of those living in Hywel Dda Health Board (in South West Wales). Similarly wide differences in obvious caries prevalence ($\% D_3MFT > 0$) were reported for Unitary Authorities in Wales ranging

from 31% year 7 children being affected in Ceredigion (South West Wales) to 59% being affected in Blaenau Gwent (in the South Wales valleys): almost a two-fold difference.

Those children affected by dentinal tooth decay had, on average, two teeth (2.31) that are either filled, extracted or with obvious lesions in them (Figure 2). Across the whole of the population examined, year 7 children in Wales had an average of 0.98 decayed, missing or filled adult teeth (D_3MFT). Across Health Boards the highest average D_3MFT was seen in Aneurin Bevan Health Board in South East Wales (1.23) and the lowest was seen in Hywel Dda Health Board (0.80). Within each health board area, there were variations in average D_3MFT between unitary authorities and the largest range was seen in Betsi Cadwaladr in North Wales; where the average value of 1.2 for Conwy Unitary Authority was approximately twice the value of 0.66 for Anglesey Unitary Authority.

Each Welsh child's residential postcode was used to allocate them to their home electoral ward so that each anonymised record could be identified with a quintile of the Welsh Index of Multiple Deprivation (WIMD) (Welsh Assembly Government, 2009). Of those children examined for the surveys conducted in 2004-05 and 2008-09, 97% were allocated a WIMD value. In Wales, child poverty targets have been set for 2020, so that the proportion of children with a $D_3MFT > 0$ of year 7 schoolchildren in the most deprived quintile reflects the proportion with caries experience of the middle quintile measured at baseline in 2004-05 (Welsh Assembly Government, 2010). This analysis was intended to assist in reducing inequalities in oral health. In 2008-09 there were reductions in the caries prevalence for both the middle and most deprived fifths when compared with 2004-05 levels. However the improvement for the most deprived fifth was insignificant (Figure 4). Thus overall there has been an increase in the ratio of the caries prevalence for the most deprived fifth to the middle fifth across the two survey years from 1.18 (53.8%/45.5%) in 2004-05 to 1.24 (52.4%/42.1%) in 2008-09. This suggests that there has been a widening of the inequalities gap in Wales.

Full results are available from The Welsh Oral Health Information Unit at: www.cardiff.ac.uk/dentl/research/themes/appliedclinicalresearch/epidemiology/oralhealth/index.html

Scotland

A total of 44 fieldwork dental teams took part in the calibration, one of the dentists failed to calibrate and was excluded from participation in the survey. The remaining teams all displayed satisfactory reliability throughout the survey.

A total of 11,578 children across Scotland were included, representing 19.5% of the state sector school year 7 population of 59,465 (Merrett *et al.*, 2010). Across the fourteen NHS Boards the percentage inspected ranged from 9.2% (423/4,617 in Tayside) to 92.2% (283/307) in Shetland). The mean age of the children examined was 11.5 years, (sd 0.3 years), the same mean as in the 2007 survey (Merrett *et al.*, 2008).

In 2009, the mean D_3MFT in Scotland had decreased to 0.88 (from 1.07 in 2007 and 1.29 in 2005) (Figure 1). Across the 14 Health Boards the range of mean D_3MFT

was from 0.53 in Shetland, to 1.17 teeth in Lanarkshire. The Scottish mean D₃MFT of those with decay experience had declined to 2.41 from 2.61 in 2007 and 2.73 in 2005, illustrating a steady decline over the series of six surveys (Figure 2).

The percentage of school year 7 children across Scotland having obvious decay experience reduced to 36.4%, compared to 40.9% in 2007 and 47.1% in 2005 (Figure 1). The range in prevalence of tooth decay experience was from the lowest of 23.8% in Shetland, to 44.5% in Western Isles.

In 2009 the residential postcode of each child was again used to allocate each to a datazone allowing stratification of the national sample by the Scottish Index of Multiple Deprivation (SIMD) (Scottish Executive, 2006). It was possible to attribute SIMD values to data for 91% of the 11,578 children who were examined. In Figure 5, the bar chart shows the dental decay inequalities gradient across Scotland based on the prevalence of children with obvious decay experience. The best-fit regression line has been added and it shows an almost perfect linear relationship between experience of tooth decay in the permanent dentition and socio-economic deprivation as measured by the SIMD ($R^2 = 0.96$).

The analyses investigating associations between measures of caries and deprivation show findings that are consistent with Sir Donald Acheson's basic premise that "Health inequalities are the outcome of causal chains which run back into and from the basic structure of society" (Acheson *et al.*, 1998).

Full results are available at www.scottishdental.org/index.aspx?o=2153

Overview

Taken together, the results from across England Scotland and Wales show that the trend for reducing caries prevalence and severity continues in this age group in all three countries. Unlike data for 5 year old children, the impact of seeking positive consent from pupils does not appear to have introduced bias into the results. Variation in caries levels between and within geographical areas continues. Caries prevalence surveys of children aged

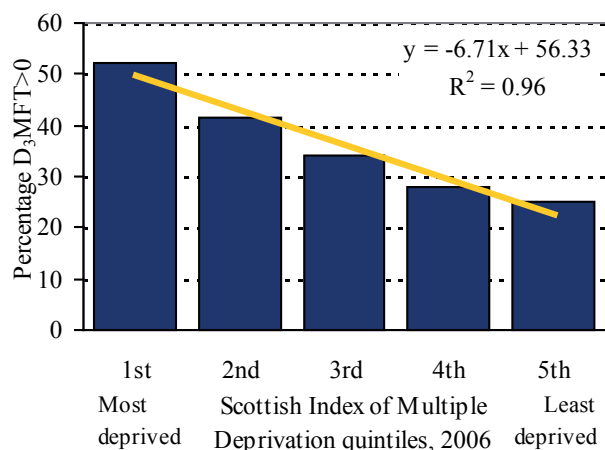


Figure 5. Percentage of Scottish school year 7 children with obvious tooth decay experience 2009 by Scottish Index of Multiple Deprivation quintile with best fit regression line

11-12 years children at the start of secondary education have been conducted across Great Britain, results which should be comparable with previous surveys and between the three countries. Health inequalities in this age group persist, as does the burden of disease for those with end-stage caries.

Acknowledgements

The authors express their thanks to: The Health Departments of England, Scotland and Wales for their continued support of the survey programmes, the many members of the NHS who carry out and facilitate survey activity and the Schools and pupils who allow this activity to take place. Also to M Robinson, T Pickles and A Jones, for assistance with analysis. We are also indebted to BASCD for continuing support of this activity, particularly the following who contributed to the survey: Professor C Pine, BASCD organiser of UK training and calibration; Dr G Burnside, for statistical advice; and J Godson, BASCD Epidemiology R&D Associate.

References

- Acheson, D., Barker, D., Chambers, J., Graham, H. and Marmot, M. (1998): *Independent inquiry into inequalities in health report*. London: Her Majesty's Stationery Office.
- Department of Health (2006): Letter: Consent for School Dental Inspections and Dental Epidemiological surveys, May 2006. London: Department of Health. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4135529
- Davies, G.M., Jones, C.M., Monaghan, N., Morgan, M.Z., Pine, C.M., Pitts, N.B., Neville, J.S. and Rooney, E. (2011) The caries experience of 5 year-old children in Scotland, Wales and England in 2007/08 and the impact of consent arrangements. Reports of co-ordinated surveys using BASCD criteria. *Community Dental Health* **28**, 5-11.
- Dyer, T.A., Marshman, Z., Merrick, D., Wyborn, C. and Godson, J.G. (2008): School-based epidemiological surveys and the impact of positive consent requirements. *British Dental Journal* **205** 589-592.
- Merrett, M.C.W., Goold, S., Jones, C.M., McCall, D.R., Macpherson, L.M.D., Nugent, Z.J. and Topping, G.V.A. (2008) National Dental Inspection Programme of Scotland, 2007 Report of P7 Children. Scotland: Scottish Dental Epidemiological Co-ordinating Committee.
- Merrett, M.C.W., Conway, D.I., Goold, S., Jones, C.M., McCall, D.R., McMahon, A.D., Macpherson, L.M.D. and Pitts, N.B. (2010): National Dental Inspection Programme of Scotland, 2009 Report of P7 Children. Scotland: Scottish Dental Epidemiological Co-ordinating Committee.
- Monaghan, N., and Morgan, M.Z. (2009): Consent of older children participating in BASCD coordinated dental epidemiology surveys in Wales. *Community Dental Health*. **26**, 157-161.
- Monaghan, N.P., Jones, S.J. and Morgan, M.Z. (2011): Do parents of children with caries choose to opt out of positive consent dental surveys in Wales? *British Dental Journal*, **210**, E1 doi:10.1038/sj.bdj.2011.26
- Morgan, M.Z. and Monaghan, N. (2010): Trends in children's ability to consent to a dental examination and the potential impact on reported caries indices. *Community Dental Health* **27**, 200-205.
- Pine, C.M., Pitts, N.B. and Nugent, Z.J. (1997a): British Association for the Study of Community Dentistry (BASCD) guidance on sampling for surveys of child dental health. A BASCD coordinated dental epidemiology programme quality standard. *Community Dental Health* **14** (Supplement 1), 10-17.

- Pine, C.M., Pitts, N.B. and Nugent, Z.J. (1997b): British Association for the Study of Community Dentistry (BASCD) guidance on the statistical aspects of training and calibration of examiners for surveys of child dental health. A BASCD co-ordinated dental epidemiology programme quality standard. *Community Dental Health* **14**, (Supplement 1), 18-29.
- Pitts, N.B., Evans, D.J. and Pine, C.M. (1997): British Association for the Study of Community Dentistry (BASCD) diagnostic criteria for caries prevalence surveys – 1996/97. *Community Dental Health* **14** (Supplement 1), 6-9.
- Pitts, N.B., Evans, D.J., Nugent, Z.J. and Pine, C.M. (2002): The dental caries experience of 12 year old children in England and Wales. Surveys coordinated by the British Association for the Study of Community Dentistry in 2000/2001. *Community Dental Health* **19**, 46-53.
- Pitts N.B., Boyles J., Nugent Z.J., Thomas N., and Pine C.M. (2006). The dental caries experience of 11-year-old children in Great Britain. Surveys coordinated by the British Association for the Study of Community Dentistry in 2004/2005. *Community Dental Health* **23**, 44-57
- Rooney, E., Davies, G., Neville, J., Robinson, M., Perkins, . and Bellis, M. (2010a): NHS Dental Epidemiology Programme for England. *Oral health survey of 12 year old children 2008/09*. Liverpool: North West Public Health Observatory.
- Rooney, E., Davies, G., Neville, J., Robinson, M., Perkins, C. and Bellis, M. (2010b). NHS Dental Epidemiology Programme Survey of 12-year-old children, 2008/09, Supplementary Report. Reporting measures of plaque, self-perception of enamel opacities, self-reporting of symptoms and impact on quality of life. Liverpool: North West Public Health Observatory.
- Scottish Executive (2006). *Scottish Index of Multiple Deprivation: General Report*. Edinburgh: Scottish Executive.
- Watkins, T.R. and Pitts, N.B. (1994): Scottish Health Boards' Dental Epidemiological Programme. Protocol; 1994 version. Stirling: Scottish Health Board.
- Welsh Assembly Government (2006): Welsh Health Circular (2006) 052 Consent for school dental inspections and dental epidemiological surveys. Cardiff: Welsh Assembly Government.
- Welsh Assembly Government (2009): *Welsh Index of Multiple Deprivation*. Cardiff: StatsWales.
- Welsh Assembly Government (2010): Eradicating Child Poverty in Wales: Child Poverty Milestones and Targets Update April 2010. Cardiff: Welsh Assembly Government, Statistical Directorate. <http://wales.gov.uk/docs/statistics/2010/100413sdr572010en.pdf>