

The prevalence of dental caries and fissure sealants in 12 year old children by disadvantaged status in Dublin (Ireland).

D. Sagheri, J. McLoughlin and J.J. Clarkson

Department of Public and Child Dental Health, Dublin Dental School and Hospital, Trinity College, Ireland

Objective The aim was to record dental caries levels and the presence of fissure sealants in 12-year old schoolchildren whose domestic water supply had been fluoridated since birth in Dublin (Ireland). **Research design** Cross-sectional study. **Participants** A representative, random sample of 12-year old schoolchildren in north-west Dublin. **Outcome measures** Dental caries levels were recorded using WHO criteria and fissure sealant was recorded when sealant was detectable on a permanent molar tooth. Medical card ownership, as a surrogate for disadvantage, was recorded by use of a questionnaire. **Results** Three-hundred and thirty-two (332) children were examined. The mean DMFT was 0.80 (SD 1.24). Analysis (Mann-Whitney *U* test) based on stratification of the sample according to medical-card status revealed no statistically significant difference between DMFT median scores of children of medical-card holders (i.e. social disadvantage background) and non medical-card holders (p -value=0.23). However, the data revealed a social gradient in the presence of at least one fissure sealant. Approximately 10% more children in the group of medical-card holders had no fissure sealants present. Fisher's exact test was used to examine the association between the absence of fissure sealants and at least one fissure sealant between the two groups and was considered to be statistically significant (p -value=0.04). **Conclusion** This study demonstrated a social gradient in the presence of fissure sealants, but no such gradient in dental caries levels. This demonstrates the importance of population-based measures in the prevention of dental caries, such as water fluoridation, in reducing oral health inequalities.

Key words: Children, dental caries, deprivation, Dublin, fissure sealant, inequalities, Ireland

Introduction

There is agreement that the reported dental caries decline in the last decades in industrialized countries is mostly connected with widespread use of fluorides (Marthaler 2004). In addition the effectiveness of fissure sealants when properly placed to prevent pit and fissure caries is well established (Locker *et al.*, 2003; Llodra *et al.*, 1993). Weintraub (2001) found good evidence that fissure sealants are effective in high-caries risk children. The Health Service Executive (HSE) is responsible for the management and delivery of health and social services in the Republic of Ireland. The HSE dental services have statutory responsibility for the dental care of all children (up to the age of 16). After the publication of a HSE funded survey of children's dental health in the Dublin region in 1993 (Eastern Health Board, 1993) guidelines for the application of fissure sealants were developed and implemented by the HSE dental services in the Dublin area. The HSE dental service in north-west Dublin operates a school dental programme which targets all children in second (age 7-8 years), fourth (age 9-10 years) and sixth (age 11-12 years) classes for dental examination and treatment. Parents of children in the target classes receive information and consent documentation and an appointment for a dental examination in one of the local dental clinics by post. One important aim of this programme is the prevention of dental caries and the placement of fissure sealants plays an important role in achieving this aim. During the dental examination dentists assess

the children for the application of fissure sealants on permanent molar teeth. Guidelines for selection of teeth and the application of fissure sealants are available to each member of staff in a folder on clinical procedures in each HSE dental surgery. The following criteria are applied for selection of children and teeth for fissure sealants: 1. children with dental caries in their primary teeth ($dmfs \geq 2$). 2. Children with occlusal caries in one of their permanent teeth 3. Children with impairments, in particular if the development of dental disease and dental treatment would endanger their general health. 4. Children from a disadvantaged social background. However, no training and evaluation strategy was introduced with the publication of these guidelines and no follow-up procedures are in place to monitor adherence with the guidelines. The aim of this study was to record the dental caries levels and the presence of fissure sealants on permanent molar teeth in 12-year old school-children living in north-west Dublin who had lifetime exposure to fluoridated water.

Method

Children aged 12 years were selected as the study population because up to then the HSE school dental programme in north-west Dublin targeted this cohort and therefore the selection of these children provided important information on the level of "dental fitness" before these children leave primary school and are not in one of the target groups under the current HSE school

dental programme. Furthermore, this age group is comparable with earlier Irish studies and this age group was recommended for study by WHO.

The HSE North-West in Dublin (total population of approximately 179,000) had a population of 12-year olds of approximately 2,200 (Johnson *et al.*, 2001) attending 52 schools) provided information on numbers of children in the classes and schools. The demographic data permitted determination of the sample size and the random selection of schools for inclusion in the study. The total target sample size required, based on a confidence level of 95%, margin of error of 5%, was 328 children. The primary sampling unit was the school. The second stage of the sampling process was then the selection of a cohort of students in this age group in one class. If a school had more than one class available, each class has an equal probability of being randomly selected. All children within a class were included in the sample.

Training and calibration of the examiner

The examiner (DS) and recorder were trained and calibrated prior to the commencement of the fieldwork to ensure reliability on the measurement index used. The teeth were examined visually for dental caries, recorded at the level of cavitation into dentine, following criteria and methods suggested by the World Health Organization (WHO, 1997). The teeth were examined wet and a CPITN probe was only used to confirm a diagnosis of cavitation or to remove food debris. Fissure sealant was recorded as present when either a complete or incomplete sealant was detectable on a permanent molar tooth. The trainer (JMcL), with extensive experience in oral health surveys, provided the standard against which the examiner (DS) was calibrated. The level of agreement between the examiner and the gold standard in the measurement index was assessed by use of the Kappa statistic, as described by Fleiss and Chilton (Fleiss and Chilton, 1983). A validation exercise was conducted during the fieldwork (re-examination of 10% of the subjects) to monitor examiner agreement and consistency during the course of the survey.

Ethical approval and consent

The Hospitals Joint Research Ethics Committee (JREC) approved the study in December 2001. All parents of participating children were fully informed regarding the nature of the study and the benefits of participating. Consent documentation was sent to parents along with questionnaires for completion by the parents one week before the examination. The consent form required the parents to state the child's current address and all previous addresses and if they were connected to the public water supply. This ensured that only children with lifetime exposure to fluoridated water participated in the study.

Two short questionnaires, one for the parents and one for the children, which could be completed in less than 10 minutes, were designed. Questionnaire items were adapted from previous Irish surveys in order to ensure their validity. The questionnaires included items regarding the child's dental care provider, the frequency of visits to the dentist and provided treatments. In addition, the parents' questionnaire included one item regarding the

family's medical card status. Clinical examinations were only carried out of the children with completed consent forms ('Positive Consent') and questionnaires.

Social Stratification

Medical card ownership is a regularly used surrogate for disadvantage in epidemiological studies and quality of life research in the Republic of Ireland. For the general population in the Republic of Ireland under the age of 70 and without a disability, serious medical condition or recipients of certain allowances, a medical card is issued based on a means test and is available to low income individuals and families to provide them with a range of health and social services free of charge.

Fieldwork and data processing

All children were examined in their schools under the same standardised conditions after completion of the children's questionnaire. A transportable halogen lamp (Daray Versatile Medical Light with halogen bulb, 12 volts, 20 watts) was used to illuminate the mouth. Dental caries was considered to be present when any lesion had a detectably softened floor, undermined enamel, or softened wall. On an approximal surface, the lesion had to be visible and the probe point had to enter a lesion with certainty. A fissure sealant was recorded present when either a complete or incomplete sealant was detectable on a surface of a permanent molar tooth and when there was no decay on the same tooth. The teeth were examined wet and a CPITN probe was only used to confirm a diagnosis or to remove food debris. A strict cross infection protocol was followed. Data were processed using the Statistical Package for the Social Sciences, SPSS 14.

Results

In all, 431 consent forms and questionnaires were issued. Three-hundred and thirty-two (332) children (77% response) were examined. The difference between the number of consent forms issued and participants in the study was mostly made up of children who were not present at the second visit or who forgot to return the consent forms. One hundred and seventy-one (171) females and 161 males were examined. The gender balance was representative of the national population, with 48.5 percent male and 51.5 percent female. The mean age of the children on the day of examination was 11.98 years. Examiner and recorder were calibrated to ensure reliability on dental caries levels prior to the commencement of the fieldwork. The level of agreement between the examiner and the gold standard showed an agreement of Kappa 0.87. A validation exercise was conducted during the fieldwork to monitor examiner consistency during the course of the survey (intra-examiner Kappa 0.89).

The data are presented as the mean values of decayed, missing and filled permanent teeth (DMFT). The mean DMFT for the sample was 0.80 (1.24 standard deviation) and the proportion of children with caries-free dentition (DMFT=0) was 59.9%. Three hundred and twenty-one (321) parents of the 332 children examined returned the questionnaire and answered questions concerning their medical card status. Table 1 demonstrates the differences

in dental caries levels between the group of medical card holders (“Disadvantaged”) and non-medical card holders (“Non disadvantaged”). The mean DMFT in the group of medical card holders was 0.80 and in the group of non-medical card holders it was 0.74. The non-parametric Mann-Whitney U-test showed no statistically significant difference between median DMFT scores of children of medical card holders and non-medical card holders (p-value = 0.37).

Furthermore, this study recorded the presence of fissure sealants on permanent teeth. The overall presence of at least one fissure sealant in the sample was 43.7%. It can be seen from Table 1 that approximately 12.7% more children in the group of medical card holders have no fissure sealants present on their permanent molar teeth compared with the group of non-medical card holders. This reveals a social gradient in the absence of fissure sealants on the permanent molars teeth in the sample in favour of the group of non-medical card holders. The data also showed (Table 2 & Figure 1) that there was a higher proportion of children with four or more fissure sealants in the group of non-medical card holders (19.3%) when compared with the group of medical card holders (10.7%). The non-parametric Mann-Whitney U-test showed a statistically significant difference between median fissure sealant scores of children in the group of medical card holders and non-medical card holders (p-value = 0.024). Fisher’s exact test was then used to examine the association between children with no fissure sealant and children with at least one fissure sealant according to their parents’ medical card status, the difference between the two groups was considered to be statistically significant (two-tailed p-value = 0.0402).

The results of the questionnaires (Table 2) revealed that the vast majority of parents (85.7%) reported that their child attended the HSE dental service for oral care (Q1: What kind of clinic usually provides your child’s dental treatment?). The data showed a social gradient in the reported attendance with the different oral care providers. It can be seen that the vast majority (95.1%) of children in the group of medical card holders attended the HSE dental service compared with 81.2% in the group of non-medical card holders. A considerable proportion of children (17.0%) in the group of non-medical card

holders usually attend a private dentist for oral care. Pearson’s chi-square was used to test the hypothesis of no association between chosen dental care provider and medical card status. The calculated chi-square ($\chi^2 = 13.303$) showed a statistically significant value (p-value = 0.004) which lead to rejection of the null hypothesis that medical card status is unrelated to the chosen dental care provider.

Parents were then asked about the frequency of visits to the dentist (Q2: How many times over the past three years has your child been to the dentist? and Q3: When was the last time your child visited a dentist?). Table 2 shows that for both items the group of non-medical card holders reported more frequent visits to the dentist than their peers in the group of medical card holders. The calculated chi-square (Q2: $\chi^2 = 20.995$; Q3: $\chi^2 = 20.200$) showed a statistically significant value (Q2: P-value = 0.002; Q3: P-value = 0.001) which lead to rejection of the null hypothesis that medical card status is unrelated to frequency of visits to the dentist.

The next item (Q4: Do you only go to the dentist, if you are in pain or having trouble, or do you also sometimes go to the dentist for a check-up?) investigated the reasons for visits to the dentist. The results demonstrate that medical card holders are less likely to visit the dentist for check-ups (63.1% compared with 77.9% of non-medical card holders) and are more likely to attend the dentist when they have dental problems (24.3% compared with 14.2% of non-medical card holders). The calculated chi-square ($\chi^2 = 8.908$) showed a statistically significant value (p-value = 0.031) which lead to rejection of the null hypothesis that medical card status is unrelated to the reason of visit to the dentist.

The parents were then asked to report on the treatment provided at the last appointment (Q5: What kind of treatment did your child have during his/her last visit to the dentist?). A considerably higher number of non-medical card holders reported that their child received fissure sealants (23.8% compared with 17.9% of medical card holders), but more medical card holders reported that their child got his/her teeth cleaned (19.2%) when compared with non- medical card holders (15.3%).

Table 3 gives the frequency distribution of 12-year-olds with no fissure sealant and with at least one fissure

Table 1. The distribution of dental caries and number of children with at least one fissure sealed and with no fissure sealed permanent molar teeth according to medical card status in north-west Dublin.

n	332	
Mean DMFT (SD)	0.80 (1.24)	
Caries free (%)	59.9%	
Number of children with fissure sealants present	145 (43.7%)	
Number of children with no fissure sealants present	187 (56.3%)	
<i>Medical Card (MC) status*</i>	<i>MC status ‘NO’</i>	<i>MC status ‘YES’</i>
n	218	103
Mean DMFT (SD)	0.74 (1.24)	0.80 (1.14)
Caries free (%)	63.3	57.3
Number of children with fissure sealants present	104 (47.7%)	36 (35.0%)
Number of children with no fissure sealants present	114 (52.3%)	67 (65.0%)

*11 parents did not report their child’s medical card status

Table 2. Frequency of visits to the dentist, reasons for visits to the dentist and provided treatment during the last visit to the dentist according to medical card status in north-west Dublin.

Q1: What kind of clinic usually provides your child's dental treatment?			
	MC YES (%)	MC NO (%)	Total (%)
Private Dentist	2.9	17.0	12.5
Health Board (school dentist) dental clinic	95.1	81.2	85.7
Dental Hospital	0.0	0.5	0.3
No answer	1.9	1.4	1.6
Q2: How many times over the past three years has your child been to the dentist?			
	MC YES (%)	MC NO (%)	Total (%)
9 times or more	3.9	4.6	4.4
6 times or more	8.7	16.5	14.0
3 times or more	29.1	36.7	34.3
Once or twice	40.8	37.6	38.6
None	12.6	1.8	5.3
Don't know	3.9	1.8	2.5
No answer	1.0	0.9	0.9
Q3: When was the last time your child visited a dentist?			
	MC YES (%)	MC NO (%)	Total (%)
Within the past 12 months	71.8	86.7	81.9
Within the past 2 years	14.6	11.0	12.1
Within the past 5 years	7.8	0.5	2.8
More than 5 years ago	1.0	0.5	0.6
Never	2.9	0.5	1.2
No answer	1.9	0.9	1.2
Q4: Do you only go to the dentist, if you are in pain or having trouble, or do you also sometimes go to the dentist for a check-up?			
	MC YES (%)	MC NO (%)	Total (%)
I go for a check-up	63.1	77.9	73.2
I go only if I'm in pain or have some trouble	24.3	14.2	17.4
I don't go to the dentist	5.8	2.3	3.4
No answer	6.8	5.5	5.9
Q5: What kind of treatment did your child have during his/her last visit to the dentist?			
	MC YES (%)	MC NO (%)	Total (%)
Teeth filled	34.6	34.4	34.5
Teeth taken out	19.2	15.3	16.5
Treatment to prevent teeth decaying / fissure sealants	17.9	23.8	22.1
Teeth cleaned and polished	19.2	15.3	16.5
Other treatment	6.4	9.5	8.6
No answer	2.6	1.6	1.9

Table 3. Frequencies and percentages of 12-year-olds with no fissure sealant and with at least one fissure sealant on their permanent molar teeth according to medical card status and dental care provider.

	<i>Medical card status 'NO'</i>						<i>Medical card status 'YES'</i>					
	<i>Fissure sealant = 0</i>		<i>Fissure sealant > 0</i>		<i>Total</i>		<i>Fissure sealant = 0</i>		<i>Fissure sealant > 0</i>		<i>Total</i>	
	<i>Number</i>	<i>Percent</i>	<i>Number</i>	<i>Percent</i>	<i>Number</i>	<i>Percent</i>	<i>Number</i>	<i>Percent</i>	<i>Number</i>	<i>Percent</i>	<i>Number</i>	<i>Percent</i>
HSE	93	52.5	84	47.5	177	100	65	66.3	33	33.7	98	100
Private dentist	17	45.9	20	54.1	37	100	0	0.0	3	100.0	3	100
Dental Hospital	1	100.0	0	0.0	1	100	0	0.0	0	0.0	0	0.0
No answer	3	100.0	0	0.0	3	100	2	100.0	0	0.0	2	100

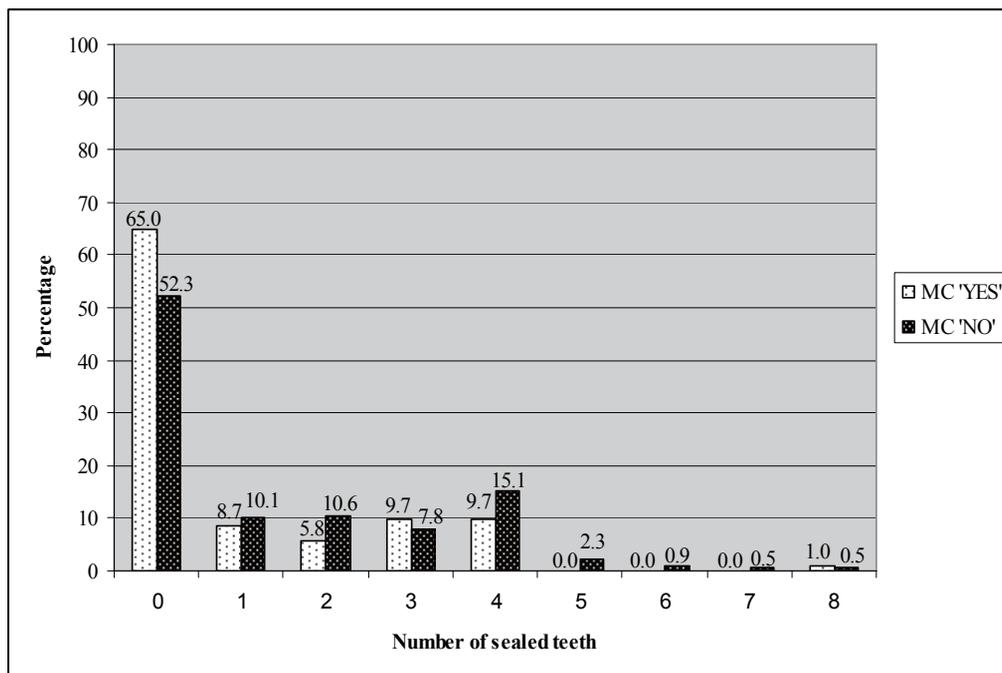


Figure 1. Frequencies of fissure sealed permanent molar teeth according their parents' ownership of a medical card (MC 'YES' / MC 'NO') in north-west Dublin.

sealant on of their permanent molar teeth according to medical status and oral care provider. The data demonstrates that a higher percentage of children in the group of non-medical card holders who attended HSE dental clinics had at least one of their permanent molar teeth sealed (47.5%) when compared with the medical card holders (33.7%).

Discussion

The findings of this study show similar dental caries levels in 12 year olds who had lifelong exposure to fluoridated water regardless their social background (i.e. disadvantaged or not disadvantaged background) in north-west Dublin. The reported dental caries levels in this study are very similar to the published mean DMFT of 0.9 in 12 year-olds in the greater Dublin area who had lifelong exposure to fluoridated water (Whelton at al. 2006). McDonagh and co-workers (2000) in their systematic review of water fluoridation confirmed that water fluoridation significantly narrows the gap between caries levels of young children in lower and those in higher socio-economic groups. The findings of the current study suggests that water fluoridation led to a reduced gap in dental caries experience between the group of medical card holders and non-medical card holders in north-west Dublin. Riley and co-workers (1999) stated in their study on water fluoridation and social inequalities that the ability of water fluoridation to reduce health inequalities may be a function of its passive mode delivery and that most other strategies in contrast rely upon the compliance of the individual.

Targeting fissure sealants to children at risk of developing dental caries is a key element of the school-based fissure sealant programme in Ireland. The present study recorded the presence of fissure sealants on permanent

molar teeth. The data were analysed to determine whether there was equity in the delivery of fissure sealant, because current guidelines aim to target children with an increased risk of developing dental caries and one group identified in these guidelines are children from a disadvantaged social background. Therefore one would not expect a statistically significant gradient in favour of non-medical card holders in the presence of at least one fissure sealant and also in the absence of fissure sealants on permanent molar teeth. It could be argued that the reported gradient was due to a higher attendance by children of non-medical card holders at private dentists when compared with their peers in the medical card holder group. However excluding data collected on children attending private dentists did not demonstrate a shift in values that would suggest a targeted approach towards children from a disadvantaged social background. The present study showed different patterns in the frequency of visits to the dentist and treatments provided between the group of medical card holders and non-medical card holders with less frequent visits among the less well off. A number of reasons for these different patterns have been suggested. Factors such as lack of transport, disability or illness of legal guardians may limit access to services, lack of financial resources and lack of awareness of oral health, all may result in lower uptake of dental healthcare services (Siegrist and Marmot, 2006).

The findings of the current study suggest that dentists may have difficulties in identifying those children who would benefit most from fissure sealants or they might experience problems in implementing current guidelines concerning the application of fissure sealants, because no systematic training, evaluation and follow-up procedures are in place to monitor sealed surfaces and adherence with the guidelines. Kumar and Wadhawan

(2002) found in their evaluation of a school-based fissure sealant programme several reasons for not adhering to the guidelines such as; difficulty in assuring parents that some children were not at risk for caries, lack of confidence in the risk-assessment method, uncertainty regarding what constitutes deep pits and fissures, fear of misclassifying children and requests by third parties that all children should benefit from preventive measures. Therefore, adequate training in the implementation of the guidelines through lectures, written protocols and site visits might be beneficial. These guidelines could be based on recommendations on the application of fissure sealants (Nunn *et al.*, 2000) and on recall intervals between routine dental examinations (NHS National Institute for Health and Clinical Excellence, 2004) and should be adapted to local needs. However, this high-risk approach has to be complemented by population-based preventive measures (Rose, 1985). Hausen and colleagues (2000) reported that only targeting high-risk children with intensive preventive measures (including fissure sealants) did not yield favourable results. They concluded that only basic prevention has almost the same preventive effect than high preventive care programmes, but with substantially less effort and lower costs. In this context, Seppa (2001) questioned the value of such an 'at-risk group strategy' in countries where dental caries has polarized. For that reason, the high-risk approach needs to be complemented by a population-based prevention measure. The findings of the present study demonstrate that water fluoridation is still an indispensable cornerstone in the prevention of dental caries which lead to similar dental caries levels in the surveyed population regardless their social background.

In conclusion this study demonstrated the existence of a social gradient in the presence of fissure sealants, the frequency of visits to the dentist and dental treatment provided to 12-year old schoolchildren living in north-west Dublin. However, no such gradient was found in their dental caries levels. These findings underpin the important role of water fluoridation in reducing oral health inequalities as long as these social gradients in uptake of dental services are not noticeably reduced.

References

- Eastern Health Board. (1993): *Children's Dental Health in the Eastern Health Board region, 1993*. Dublin: Eastern Health Board.
- Fleiss, J.L. and Chilton, N.W. (1983): The Measurement of Interexaminer Agreement on Periodontal Disease. *Journal of Periodont Research* **18**, 601-606.
- Hausen, H., Karkkainen, S. and Seppa, L. (2000): Application of the high-risk strategy to control dental caries. *Community Dentistry and Oral Epidemiology* **28**, 26-34.
- Johnson H, Dack P, Boyle E, Doyle D. (2001): *Census 1996 by District Electoral Division for the Northern Area Health Board*. Dublin: Eastern Regional Health Authority.
- Kumar, J.V. and Wadhawan, S. (2002): Targeting dental sealants in school-based programs: evaluation of an approach. *Community Dentistry and Oral Epidemiology* **30**, 210-5.
- Llodra, J.C., Bravo, M., Delgado-Rodriguez, M., Baca, P. and Galvez, R. (1993): Factors influencing the effectiveness of sealants--a meta-analysis. *Community Dentistry and Oral Epidemiology* **21**, 261-8.
- Locker, D., Jokovic, A. and Kay, E.J. (2003): Prevention. Part 8: The use of pit and fissure sealants in preventing caries in the permanent dentition of children. *British Dental Journal* **195**, 375-8.
- McDonagh, M., Whiting, P., Bradley, M., Cooper, J., Sutton, A., Chestnutt, I., Misso, K., Wilson, P., Treasure, E., Kleijnen, J. *A Systematic Review of Public Water Fluoridation*. York: NHS Centre for Reviews and Dissemination, University of York, 2000.
- Marthaler, T.M. (2004): Changes in dental caries 1953-2003. *Caries Research*, **38**, 173-81.
- NHS National Institute for Health and Clinical Excellence (NICE). *Dental Recall: Recall intervals between routine dental examinations, Clinical Guideline 19*. London: NHS National Institute for Health and Clinical Excellence, 2004.
- Nunn, J.H., Murray, J.J., Smallridge, J., British Society of Paediatric Dentistry. (2000): British Society of Paediatric Dentistry: a policy document on fissure sealants in paediatric dentistry. *International Journal of Paediatric Dentistry*, **10**, 174-7.
- Riley, J.C., Lennon, M.A., Ellwood, R.P. (1999): The effect of water fluoridation and social inequalities on dental caries in 5-year-old children. *International Journal of Epidemiology*, **28**, 300-5.
- Rose, G. (1985): Sick individuals and sick populations. *International Journal of Epidemiology* **14**, 32-8.
- Seppa, L. (2001): The future of preventive programs in countries with different systems for dental care. *Caries Research* **35** (supplement **1**), 26-9.
- Siegrist, J., Marmot, M. *Social Inequalities in Health: New Evidence and Policy Implications*. Oxford: Oxford University Press, 2006.
- Weintraub, J.A. (2001): Pit and fissure sealants in high-carries-risk individuals. *Journal of Dental Education* **65**, 1084-90.
- Whelton, H., Crowley, E., O'Mullane, D., Harding, M., Guiney, H., Cronin, M., Flannery, E., M. and Kelleher, V. (2006): *North South Survey of Children's Oral Health 2002*. Dublin: Department of Health and Children. http://www.dohc.ie/publications/oral_health.html
- World Health Organization. (1997): *Oral Health Surveys, basic methods*. 4th edn. p39-44. Geneva: World Health Organization.