

# Dental caries and enamel fluorosis among the fluoridated population in the Republic of Ireland and non fluoridated population in Northern Ireland in 2002

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**Background** An all Ireland/North South survey of Oral Health was carried out in 2001/2002. **Aims:** To compare levels of dental caries and enamel fluorosis among children and adolescents in the fluoridated Republic of Ireland (RoI) with those in the non fluoridated North of Ireland (NI). **Methodology:** Cross sectional oral health survey of a representative, random, stratified sample of 5-, 8-, 12- and 15-year-olds in RoI and in NI (N=19,950). WHO examination criteria with the addition of visible, non cavitated dentine caries were used for recording caries. Fluorosis was measured using Dean's Index. **Results:** In the RoI, the mean  $d_{3c,mft} / D_{3c,MFT}$  for 5-, 8-, 12-, and 15-year-olds with full domestic water fluoridation (n=9,975), was 1.0, 0.3, 1.1 and 2.1 respectively. The corresponding means in non fluoridated NI (n=1,475) were 1.8, 0.3, 1.5 and 3.6 respectively. ( $p < 0.0001$ , NS,  $p < 0.0005$  and  $p < 0.0001$ ). The prevalence of enamel fluorosis has increased in RoI since 1984, 23% and 36% of 8- and 15-year olds respectively in fluoridated areas had Dean's Index scores at the questionable or greater level in 2002 compared with 6% and 5% respectively in 1984. **Conclusions:** In 2002 apart from 8-year-olds, caries levels were lower amongst children resident in fluoridated communities in RoI than amongst corresponding age groups in non-fluoridated NI. Caries has declined in fluoridated and non fluoridated groups in both jurisdictions since the early 1960s. In RoI fluorosis levels were higher amongst lifetime residents of fluoridated communities and have increased since 1984.

*Key Words:* Caries, epidemiology, fluoridation, fluorosis, national survey

## Introduction

The island of Ireland is governed under two jurisdictions, the Irish (Republic of Ireland) and British (Northern Ireland) governments. Thus oral health care services are delivered within two different health care delivery systems. One of the major differences likely to impact on oral health is the level of fluoride in domestic water supplies. Since the implementation of the Health (Fluoridation of Water Supplies) Act (1960), in 1964, domestic water supplies in the Republic of Ireland (RoI) have been adjusted to 0.8 to 1.0 parts per million (ppm) fluoride. Currently 71% of the population of the RoI receive fluoridated domestic water supplies. There are no water fluoridation programmes in Northern Ireland (NI). Epidemiological studies conducted in the early 1960s indicated that dental caries levels in Dublin (RoI) (Minister for Health, 1961-1965) and Belfast (NI) (Sheane 1963) were similar prior to water fluoridation. More recent reports indicate that caries levels in NI were higher than in fluoridated areas of the RoI (Forum on Water Fluoridation, 2002) However none of the studies reported were contemporaneous and different caries diagnostic criteria were used. This study is the first contemporaneous North/ South study of the oral health of children and adolescents in both jurisdictions.

A criticism of past studies of the effectiveness of water fluoridation was their failure to control for confounding factors (McDonagh et al., 2000). Socio economic factors are important variables to take into account when

comparing caries levels amongst different communities. Since the 'Black Report' on inequalities in health was published in the UK (Townsend and Davidson, 1980), the association between disadvantage and ill health has been widely acknowledged. As with general health, there are many reports of poorer oral health among the less well off. It has been reported that water fluoridation reduces this inequality (Jones and Worthington, 2000)

It is well established that persons residing in fluoridated communities have higher levels of questionable and very mild fluorosis (Dean et al, 1954). A national survey conducted in RoI in 1984 and local studies conducted since then have indicated that there is a slight increase in these levels of fluorosis amongst Irish children and adolescents (O'Mullane et al 1986, Whelton et al 2001).

The study reported in this paper had three main aims. Firstly, to compare the prevalence of caries among child and adolescent residents in fluoridated communities in RoI with residents of non-fluoridated communities of NI whilst controlling for disadvantage. Secondly, to compare the levels of dental fluorosis in fluoridated (RoI) and non-fluoridated (NI) communities. Finally, to compare changes in caries levels over time in RoI and NI.

A comparison of caries and fluorosis between children and adolescents with fluoridated and non fluoridated water supplies in RoI has been reported previously (Whelton et al 2004). This paper focused on comparing caries and fluorosis levels in the fluoridated samples in RoI and the non fluoridated sample in RoI. The halo effect of water fluoridation must be considered when comparing caries

and fluorosis levels among children and adolescents living in adjacent fluoridated and non fluoridated areas in RoI. Those living in the non fluoridated areas are likely to consume foods and beverages manufactured or processed with fluoridated water in the local cities or towns. Hence the RoI non fluoridated group probably derives some of the benefits of water fluoridation through their diet. This unknown exposure is less in NI as the foods consumed there are unlikely to be manufactured in RoI because of the border and historical trade restrictions. The population in RoI and NI are otherwise similar in terms of factors that might impact oral health. Comparison of caries levels and fluorosis between children and adolescents with water fluoridation in RoI and those with no exposure to environmental fluoride (no halo effect) in NI caries provides a further insight into the effectiveness of water fluoridation.

## Methods

Ethical approval for the survey was obtained from the relevant ethics committees in RoI and NI. The groups chosen were children in Junior Infants, Second Class, Sixth Class and Junior Certificate in RoI and Primary 1, Primary 4, Year 1 and Year 4 in NI. The groups will be referred to as five, eight, twelve and fifteen year olds as the approximate ages of children in the classes selected. These age groups are comparable with earlier Irish studies and with studies conducted internationally as they include those age groups recommended for study by the WHO (1987).

The survey was cross sectional with a total target sample of 14,400 in RoI, based on the goal of 120 children per cell in each of the four age groups in 30 community care areas (120 X 4 age groups X 30 Community Care Areas = 14,400) to allow reliable estimates of dmft / DMFT by fluoridation or disadvantage status. In NI, the target sample was 2,390, dictated by power calculations. The samples had a power of 80% to show a difference in  $d_{3c}mft / D_{3c}MFT$  level of at least 0.5 in 5-, 12- and 15-year-olds and at least 0.2 in the 8 year olds between NI (non fluoridated) children and adolescents and those in fluoridated areas in the RoI according to socioeconomic status. The target sample sizes indicated the minimum sample required to achieve the aims of the survey. A larger sample was selected for a number of reasons; to account for non-response; to ensure an adequate sample size of those classified as disadvantaged and those classified as non fluoridated. Further, the sample size for the 5-year-old group was inflated due to a request from the North Eastern Health Board (NEHB) to do a population survey of the 5-year-old group in that area.

A cluster sampling technique was used with schools as the clustering unit. Children were selected randomly on the basis of age, gender, and geographical location of the school attended and whether they attended a school with fluoridated or non-fluoridated water supply (RoI). Parents of the selected children were asked to complete consent forms and at the same time were asked to indicate whether they were in possession of a Medical Card ('MC yes' or 'MC no') in RoI or whether they were in receipt of low-income benefits in NI ('LIB yes' or 'LIB no'); these two variables were used as surrogates for

disadvantage. The consent forms also requested details of the water supply to the child's current and any previous home(s) and their use of fluoride supplements, current or historical. This information was used to determine the child's lifetime exposure to domestic water fluoridation and fluoride supplements.

Thirty-four teams from the RoI and five teams from NI conducted the fieldwork for the survey. Training and calibration of the teams, data management and examining criteria are described in detail elsewhere (Whelton et al, 2004)

Caries was recorded according to WHO criteria (WHO, 1987) with the addition of caries that was visibly into dentine but was not obviously cavitated ('visual caries'). Caries data were analysed at cavitation level, denoted  $d_{3c}mft / D_{3c}MFT$  for historical comparisons and at the 'visual level', denoted  $d_{3cv}mft / D_{3cv}MFT$ , for comparison of 2002 data between RoI and NI. Fluorosis was recorded on permanent teeth among eight, twelve and fifteen year old children using Dean's Index (Dean, 1934) in natural light.

The fieldwork was conducted between October 2001 and June 2002 in both areas. The overall response rate for RoI was 68% (68%, 68%, 68% and 66% in the 5-, 8-, 12- and 15-year-old age groups, respectively). The overall response rate for NI was 53% (56%, 63%, 59% and 43%, respectively). Although the response rate was lower in NI, the sample sizes in both disadvantaged and non disadvantaged groups was more than adequate. Non-response did not appear to differ according to disadvantage status and there is no reason to believe that the samples differ from the general population.

The data were exported from the direct entry software as an ASCII type 11 file and imported on to SAS statistical package for analysis. The impact of fluoridation and disadvantage on caries levels was investigated using generalised linear models with appropriate distribution and link functions. The factors included were fluoridation status of the home water supply since birth ('Full fl' in RoI and 'Non fl' in NI) and disadvantage (ownership of a medical card by the parents or child in RoI ; 'MC yes', 'MC no'. receipt of any low income benefits in NI ('LIB yes', 'LIB no'). The interaction between these two factors was also included. This determines whether any difference between groups, for example between fluoridated and non-fluoridated groups, is the same for the disadvantaged and non disadvantaged groups or if the difference between disadvantaged and non disadvantaged groups is the same for residents of fluoridated and non fluoridated communities. Caries levels were compared between 1984 and 2002 using two-sample t-tests. Levels of dental fluorosis were compared between 'Full fl' and 'Non fl' groups using Fishers exact tests. All tests were two sided with a 5% level of significance.

The dental teams examined 17,838 children and adolescents in RoI and 2,112 in NI (Table 1). The North Eastern Health Board requested a population survey of all 5-year-old children in that area, hence the 5-year-olds sample size was larger than that for the other age groups. An even gender balance was achieved in the sample, which was 50% male in RoI and 49% male in NI.

The degrees of exposure of subjects to fluoridated water supplies at home and at school, to fluoride tablets

and to fluoride mouth rinsing varied a great deal (Whelton et al, 2004). In this paper the results for the following two groups are presented:

1. The subjects' home water supply had been fluoridated continuously since birth; they may also have had exposure to school fluoridation, fluoride tablets or fluoride mouthrinses (Full; residents of ROI).
2. The subjects' home water supply had never been fluoridated, their present school water supply is not fluoridated and they never had fluoride tablets or mouthrinses (Non; residents of NI).

The number of children and adolescents in these

groups are shown in Table 1.

The mean age on the day of examination of the children examined in the four age groups in ROI were 4.8, 7.9, 11.9 and 14.7 respectively. In NI, the corresponding mean ages were 4.9, 7.8, 11.7 and 14.7.

## Results

### *Caries levels according to age group, fluoridation status and disadvantage.*

The level of cavitated dental caries,  $d_{3c}mft / D_{3c}MFT$ , in 2002 among 5-, 8-, 12- and 15-year-old children and

**Table 1.** Distribution of children examined in the Republic (Fluoridated sample) and Northern Ireland (Non Fluoridated sample) according to gender, their level of disadvantage as classified by their parents' ownership of a Medical Card (MC, MC = less well off, ROI) or receipt of low income benefits (LIB, LIB = less well off, NI) within age group and fluoridation status.

		Age Group					
Gender		5	8	12	15	total	
ROI	Female	3,236	1,875	1,992	1,754	8,857	
	Male	3,425	1,894	1,894	1,768	8,981	
	Total	6,661	3,769	3,886	3,522	17,838	
NI	Female	420	144	183	324	1,071	
	Male	411	158	163	309	1,041	
	Total	831	302	346	633	2,112	
ROI	Full	Disadvantage status					
		No MC	2,661	1,654	1,618	1,493	7,426
		MC	945	541	470	561	2,516
		Total*	3,616	2,208	2,090	2,062	9,976
		<b>Mean Age Years</b>	<b>4.8</b>	<b>7.9</b>	<b>11.9</b>	<b>14.7</b>	
NI	None	No LIB	407	119	117	261	904
		LIB	259	86	76	129	550
		Total*	669	209	201	396	1,475
		<b>Mean Age Years</b>	<b>4.9</b>	<b>7.8</b>	<b>11.7</b>	<b>14.7</b>	

\* includes children for whom MC/LIB details were missing

**Table 2.** Mean number and standard deviation of decayed, missing and filled teeth ( $d_{3c}mft$  5-year-olds,  $D_{3c}MFT$  8-, 12-, 15-year-olds) at cavitation level among children and adolescents with fluoridated domestic water supplies according to disadvantage in ROI (MC/No MC) and in NI (non fluoridated, LIB/No LIB) in 2002. Statistical significance of difference between groups, p values

	Full Fl ROI		Non Fl NI		Full Fl ROI	MC/LIB	Interaction
	$d_{3c}mft / D_{3c}MFT$	Sd	$d_{3c}mft / D_{3c}MFT$	Sd	v Non Fl NI	v no MC/LIB	Fluoride/ Disadvantage
					p-value	p-value	p-value
5 MC/LIB	1.5	2.6	2.7	3.5			
5 no MC/LIB	0.9	1.9	1.3	2.2			
5 all	1.0	2.1	1.8	2.9	0.0072	< 0.0001	0.2532
8 MC/LIB	0.4	0.9	0.4	0.7			
8 no MC/LIB	0.3	0.7	0.2	0.6			
8 all	0.3	0.8	0.3	0.6	0.4460	0.0036	0.7446
12 MC/LIB	1.2	1.6	1.5	1.6			
12 no MC/LIB	1.0	1.4	1.6	1.9			
12 all	1.1	1.4	1.5	1.7	0.0022	0.0003	0.2189
15 MC/LIB	2.3	2.6	4.6	4.1			
15 no MC/LIB	2.1	2.3	3.2	3.2			
15 all	2.1	2.3	3.6	3.5	< 0.0001	0.0528	0.0403

**Table 3.** Mean number (and standard deviation) of decayed, missing and filled teeth ( $d_{3vc}$  mft 5-year-olds,  $D_{3vc}$  MFT 8-, 12-, 15-year-olds) at the dentinal level of involvement ( visual plus cavitation level) among children and adolescents with fluoridated domestic water supplies according to disadvantage in RoI (MC/No MC) and in NI (non fluoridated, LIB/No LIB)) in 2002. Statistical significance of difference between groups (p values).

	<i>Full Fl ROI</i>		<i>Non Fl NI</i>		<i>Full Fl ROI</i>	<i>MC/LIB</i>	<i>Interaction</i>
	$d_{3vc} mft / D_{3vc} MFT$	<i>Sd</i>	$d_{3vc} mft / D_{3vc} MFT$	<i>Sd</i>	<i>v</i>	<i>v</i>	
					<i>Non Fl NI</i>	<i>no MC/LIB</i>	<i>p-value</i>
					<i>p-value</i>	<i>p-value</i>	<i>p-value</i>
5 MC/LIB	1.9	2.9	3.3	3.8			
5 no MC/LIB	1.1	2.1	1.7	2.5			
5 all	1.3	2.3	2.3	3.2	0.0011	< 0.0001	0.2034
8 MC/LIB	0.6	1.1	0.5	0.9			
8 no MC/LIB	0.3	0.8	0.3	0.7			
8 all	0.4	0.9	0.4	0.8	0.3148	< 0.0001	0.5613
12 MC/LIB	1.5	1.8	2.0	1.8			
12 no MC/LIB	1.2	1.6	2.0	2.0			
12 all	1.3	1.6	1.9	1.9	< 0.0001	< 0.0001	0.1347
15 MC/LIB	3.0	3.0	5.3	4.1			
15 no MC/LIB	2.5	2.5	3.8	3.5			
15 all	2.6	2.6	4.3	3.7	< 0.0001	0.0008	0.1834

**Table 4.** Mean  $d_{3c}$  mft 5-year-olds,  $D_{3c}$  MFT 8-, 12-, 15-year-olds in fluoridated communities (Full Fl) in RoI in 1984 and 2002 and non fluoridated communities (Non Fl) in RoI and NI in the 1960s, 1984 (RoI), 1983 (NI) and 2002

	<i>5 year-olds</i>			<i>8 year-olds</i>			<i>12 year-olds</i>			<i>15 year-olds</i>		
	<i>Full Fl</i>	<i>Non Fl</i>	<i>Non Fl</i>	<i>Full Fl</i>	<i>Non Fl</i>	<i>Non Fl</i>	<i>Full Fl</i>	<i>Non Fl</i>	<i>Non Fl</i>	<i>Full Fl</i>	<i>Non Fl</i>	<i>Non Fl</i>
	<i>ROI</i>	<i>ROI</i>	<i>NI</i>	<i>ROI</i>	<i>ROI</i>	<i>NI</i>	<i>ROI</i>	<i>ROI</i>	<i>NI</i>	<i>ROI</i>	<i>ROI</i>	<i>NI</i>
1960	-	5.6	4.8	-	1.7	2.5	-	4.7	6.1	-	8.2	10.6
1983/'84	1.8	3	4.5	0.6	1	1.9	2.6	3.3	4.8	4.1	5.4	9.2
2002	1	1.7	1.8	0.3	0.3	0.3	1.1	1.3	1.5	2.1	3.2	3.6

adolescents according to fluoridation status and disadvantage for RoI and NI is shown in Table 2. Table 3 shows the same data for caries at the  $d_{3vc}$  mft /  $D_{3vc}$  MFT, cavitated + visual dentine caries level. In both tables the statistical significance of the comparison of caries levels according to fluoridation status (jurisdiction) whilst controlling for disadvantage is shown. Also, the statistical significance, p value, for the comparison of caries according to disadvantage whilst controlling for fluoridation status (jurisdiction) and the interaction between these factors are presented.

In the RoI, five-year-old children with full water fluoridation had a mean  $d_{3c}$  mft of 1.0 (Table 2). For 8-, 12- and 15- year olds with full domestic water fluoridation, the mean  $D_{3c}$  MFT scores were 0.3, 1.1 and 2.1 respectively. The mean  $d_{3c}$  mft /  $D_{3c}$  MFT scores for 5-, 8-, 12-, and 15-year-olds in NI were 1.8, 0.3, 1.5 and 3.6 respectively. The mean scores recorded in non fluoridated NI were statistically significantly higher than those recorded in fluoridated communities in RoI, except in the case of

8- year-olds, for whom caries levels in the permanent dentition were relatively low in both jurisdictions. For 5-, 8-, 12- and 15-year-olds the p values for the significance of the difference between the two groups (RoI fluoridated vs NI non fluoridated) were  $p=0.0072$ ,  $p=0.4460$ ,  $p=0.0022$  and  $p<0.0001$  respectively (Table 2).

In all age groups the  $d_{3c}$  mft /  $D_{3c}$  MFT (Table 2) was higher among the less well off with the exception of 15-year-olds where the p value was borderline insignificant ( $p=0.0528$ ). However, for this age group the interaction between fluoridation status (jurisdiction) and disadvantage was significant ( $p=0.0403$ ). This means that the difference in cavitated caries levels according to disadvantage was less for the fluoridated children than the non fluoridated children.

The inclusion of non cavitated dentine caries results in a higher caries score as would be expected: for example the  $d_{3c}$  mft is 1.0 among 5-year-olds (Table 2) whereas the  $d_{3cv}$  mft is 1.3 (Table 3). Using the additional information provided by measurement at the  $d_{3cv}$  mft /  $D_{3cv}$  MFT

level, caries levels are compared according to fluoridation status controlling for disadvantage and according to disadvantage controlling for fluoridation status. Using this measure the mean  $d_{3cv}mft / D_{3cv}MFT$  for 5, 8, 12 and 15 year olds is 1.3, 0.4, 1.3 and 2.6 respectively for those in the 'Full FI' group in RoI, the corresponding mean  $d_{3cv}mft / D_{3cv}MFT$  levels for 'Non FI' NI children and adolescents are 2.3, 0.4, 1.9 and 4.3 respectively (Table 3). For 5, 12 and 15 year olds caries levels at the  $d_{3cv}mft / D_{3cv}MFT$  level are higher in non-fluoridated NI than in fully fluoridated RoI. These differences are significant for the three age groups. The impact of disadvantage on dental caries levels is estimated in table 3 which also presents comparison of disadvantaged and non-disadvantaged groups (MC/LIB vs. no MC/LIB). Caries levels are higher among the less well off (having controlled for fluoridation status) with statistical significance levels of  $p < 0.0001$ ,  $< 0.0001$ ,  $< 0.0001$  and  $< 0.001$  for 5, 8, 12 and 15 year olds respectively. Within each age group the interaction between fluoridation status and disadvantage was not significant for caries at the  $d_{3cv}mft / D_{3cv}MFT$  level ( $p > 0.05$ ). This means that the difference in caries at  $d_{3cv}mft / D_{3cv}MFT$  level according to disadvantage was similar for the fluoridated children and the non-fluoridated children.

#### *Changes in caries levels over time*

Caries levels in RoI and NI have changed dramatically between the early 1960s and the early 1980s and also between 1983/1984 and 2002 in both fluoridated and non-fluoridated areas. The changes are shown in Table 4. For RoI data are shown for 1961-1965 (Minister for Health, 1961 – 1965) and 1984 (O'Mullane et al, 1986). The 1961-1965 data are from the statutory pre-fluoridation surveys, which were carried out in all areas of the country at the time. These data are therefore not broken down by fluoridation status. The 1984 data are from the National Survey of Children's Dental Health (O'Mullane et al, 1986), and are presented for non-fluoridated and fully fluoridated groups, which are comparable with the similar groupings in the present survey. For NI the 1963 data is taken from a survey of Belfast schools (Sheane, 1963) carried out at that time. The 1980s data is from the NI sample in the 1983 OPCS decennial UK Child Oral Health Survey (Todd and Dodd, 1985). Data for all of the early studies was recorded at the  $d_{3c}mft / D_{3c}MFT$  level and so all historical comparisons are drawn for this level of caries. In the 1984 and 1961-1965 surveys a sharp probe was used to confirm a diagnosis of cavitation. The use of sharp probes was abandoned in the later studies and replaced with a probe with a 0.5 mm ball tip, which was used to confirm cavitation. This change is likely to have a small impact on caries levels as slightly less caries would be confirmed with a 0.5 mm probe than with a sharp probe. Within the different studies identical standardised criteria were used for contemporaneous measurement of all conditions across fluoridated and non-fluoridated groups.

The data show that for both children and adolescents with (Full) and without (Non) water fluoridation, decay levels were much lower in 2002 than they were in 1984 ( $p < 0.0001$  all groups) and in 1961/'63 in all

age groups.

#### *Dental Fluorosis*

For 8, 12 and 15 year olds, the prevalence of fluorosis in 2002 at the questionable, very mild and mild grades was higher in the "full" fluoridated groups in the RoI than it was in the "non" fluoridated groups in NI. For example amongst 8 year olds, the relevant percentages in the RoI were 11%, 8% and 4% compared with 6%, 3% and 0% in NI ( $P < 0.01$ ). The data in Table 5 also show that the prevalence of fluorosis in the full fluoridated group in RoI in 2002 was significantly higher than it was in the same group in 1984.

### **Discussion**

The results show that the oral health of children and adolescents resident in fluoridated communities in RoI is better than those who reside in non-fluoridated areas in NI. Whelton et al. (2004), previously reported that caries levels among children and adolescents resident in fluoridated areas of RoI also have lower caries levels than those resident in non-fluoridated areas in RoI. Caries levels have declined dramatically since 1961/'63 and have continued to decline since 1984 in both fluoridated and non-fluoridated areas in RoI and NI. This decline is considerably greater amongst lifetime residents of fluoridated communities. Fluoride toothpaste were introduced to both RoI and NI in the early 70's and since the early 90's over 95% of the toothpaste sold in both jurisdictions contained fluoride. The toothbrushing habits of the subjects included in this Report were determined by questionnaire for 8 and 15 year old children and adolescents. 58% of parents of 8 year olds in RoI and 67 of parents of 8 year olds in NI reported that their children brushed their teeth at least twice per day. Similarly amongst the 15 year olds who answered the questionnaire themselves, 57% in RoI and 64% in NI reported brushing at least twice per day (unpublished data), thus differences in frequency of tooth brushing does not account for the higher caries levels among those in NI. To the contrary, there is a higher prevalence of favourable brushing habits in among NI children and adolescents. It is possible that various sociological, dietary and other factors account for the differences in caries levels between the fluoridated communities in RoI and those in non-fluoridated NI. However perhaps a more valid conclusion regarding these closely matched populations is that the observed differences represent the additive caries preventive effect of a programme which includes both water fluoridation and fluoride toothpaste, as in RoI, over and above that of a programme that includes toothpaste alone as in NI. Further analysis of the data collected in this North/South Survey together with scrutiny of toothpaste sale patterns and usage in the two jurisdictions is required to address this important question.

Despite the overall decline in decay levels over the last three decades, there is little cause for complacency since tooth decay continues to be a very common childhood disease. For example, in 2002 in both RoI and NI over two thirds of 15-year-olds were found to have decay in their permanent teeth.

**Table 5.** Dean's Index of Fluorosis, % of 8-, 12- and 15-year-olds affected according to fluoridation status in RoI and NI in 2002 and in 1984. Statistical significance of difference in distribution of Dean's Index scores between Full Fl RoI 2002 and Non Fl RoI 2002 <sup>1</sup>, between Full Fl RoI 2002 and Full Fl RoI 1984 <sup>2</sup> and between Full Fl RoI 2002 and Non Fl NI 2002 <sup>3</sup>.

8-year-olds	Full Fl RoI 2002	Non Fl RoI 2002	Full Fl RoI 1984	Non Fl RoI 1984	Non Fl NI 2002
Normal	76	90	94	98	90
Questionable	11	7	5	2	6
Very Mild	8	2	1	0	3
Mild	4	0	0	0	0
Moderate	0	0	0	0	0
Severe	0	0	0	0	0
	P<0.0001 <sup>1</sup>		P<0.0001 <sup>2</sup>		P=0.0001 <sup>3</sup>
12-year-olds	Full Fl RoI 2002	Non Fl RoI 2002	Non Fl NI 2002		
Normal	72	82	78		
Questionable	14	10	12		
Very Mild	9	4	7		
Mild	5	2	2		
Moderate	1	0	0		
Severe	1	0	0		
	P<0.0001 <sup>1</sup>		P=0.15 <sup>3</sup>		
15-year-olds	Full Fl RoI 2002	Non Fl RoI 2002	Full Fl RoI 1984	Non Fl RoI 1984	Non Fl NI 2002
Normal	61	81	95	99	83
Questionable	19	10	4	1	5
Very Mild	10	4	1	0	8
Mild	5	3	0	0	0
Moderate	1	0	0	0	0
Severe	1	0	0	0	0
	P<0.0001 <sup>1</sup>		P<0.0001 <sup>2</sup>		P<0.0001 <sup>3</sup>

The survey found that, in general, the oral health of the less well off is worse than that of the rest of the population. Decay levels among dependants of medical card holders (RoI) and those in receipt of low-income benefits (NI) were higher than in the rest of the population. Innovative approaches to further reduce decay levels and address inequalities in oral health are required. Although the difference in cavitated caries levels ( $d_{3c}$  mft /  $D_{3c}$  MFT) according to disadvantage was less for the fluoridated children than the non fluoridated children, this difference disappeared when the comparison of caries was made at the cavitated plus visual dentine caries level ( $d_{3cv}$  mft /  $D_{3cv}$  MFT).

Twenty four per cent of the total sample examined in RoI had medical cards, this figure is likely to be similar to the proportion of children in the entire population who are dependants of medical card holders as the General Medical Service (GMS) payments board estimated that in 2001 31% of the entire population of RoI was eligible for medical card benefits (General Medical Services Payments Board, 2002). In NI 39% of the sample were in receipt of low-income benefits. This difference in disadvantage percentages between RoI and NI arises because of the use of different measures of disadvantage in the two regions. Notwithstanding the lack of comparability of these two classification systems, it is useful to compare the pattern of caries and untreated disease between dependants of medical cardholders and others in the RoI and between those with any low-income benefit and others in NI. However,

comparisons between data for disadvantaged children in RoI with those in NI should be interpreted with caution due to the use of different classification systems in the two jurisdictions. A measure of disadvantage applicable in both NI and RoI would be useful, however none was available for this study.

The prevalence of dental fluorosis is higher amongst children and adolescents with fluoridated water supplies. Comparisons with 1984 data show an increase in the prevalence of fluorosis since that time. Studies on the level at which the public perceive fluorosis to be a problem are currently being designed. The relative contribution of fluoride toothpastes and water fluoridation to enamel fluorosis in Ireland should be studied further. Recent research suggests a significant relationship between patterns of toothpaste usage in infancy and prevalence of fluorosis at age eight years amongst children in counties Sligo and Leitrim (Ormsby, 1999, Crowley et al., 2001). These findings support those of international research (Osugi et al., 1988, Milsom and Mitropoulos, 1990) which indicate that early use of fluoride toothpaste in infants leads to excessive ingestion and absorption of fluoride at a time when the enamel of the permanent teeth is forming, leading to fluorosis of the permanent incisor teeth. A review of water fluoridation in Ireland 'The Forum on Water Fluoridation (2002, www.fluoridationforum.ie)' was commissioned by the Minister for Health. The report of the review group made recommendations regarding the rational use of fluoride toothpaste and the

reduction of the level of fluoride in the water supplies. It is anticipated that adoption of the recommendations will minimize the occurrence of dental fluorosis and at the same time maintain the important caries preventive benefits experienced to date. There is a need for constant monitoring of dental fluorosis in Ireland.

### Conclusions

Caries levels are lower among children who get fluoride in their water supply in RoI than they are among children with non fluoridated water supplies in RoI and NI

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- Decay levels are much lower in 2002 than they were in 1984 in both fluoridated and non-fluoridated areas. There has also been a dramatic decline in dental caries levels since the 1960s.
- The survey found that in general the oral health of the less well off is worse than that of the rest of the population in both RoI and NI.
- The prevalence of dental fluorosis is higher amongst children and adolescents with fluoridated water supplies. Comparisons with 1984 data show an increase in the prevalence of fluorosis since that time.
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