

# Dental caries experience in Australian Army recruits 2002-2003

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## Abstract

**Background:** Recent data have suggested that the trend of decreasing caries experience in Australian children is slowing with increasing dmft and DMFT scores seen in children. However, there are limited data on dental caries experience in young Australian adults.

**Methods:** A cross-sectional study of 973 Australian Army recruits was conducted between November 2002 and March 2003. A clinical examination with bitewing radiographs was conducted and a questionnaire was used to elicit socio-demographic information.

**Results:** Mean DMFT scores were 2.43, 3.44, 5.48, 7.02 and 10.77 for subjects aged 17-20, 21-25, 26-30, 31-35 and 36-51 years respectively. Subjects with a lifetime exposure to fluoridated drinking water had a mean DMFT of 2.80 while subjects with no exposure to fluoridated drinking water had a mean DMFT of 3.91. Multivariate Poisson regression found that age, level of education and lifetime exposure to fluoridated drinking water had a statistically significant effect on caries experience.

**Conclusions:** It appears that there has been a continual decline in caries experience and prevalence in young Australian adults between 1996 and 2002-2003. Lifetime exposure to fluoridated drinking water conferred an appreciable benefit for subjects in this study compared with subjects with no exposure to fluoridated drinking water.

**Key words:** Caries, fluoridation, epidemiology, DMFT, adults.

**Abbreviations and acronyms:** dmft = decayed, missing, filled teeth in the primary dentition; DMFT = decayed, missing, filled teeth in the secondary dentition; SES = socio-economic status; TAFE = Technical and Further Education.

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## INTRODUCTION

Recent data have suggested that the trend of decreasing caries experience in Australian children is slowing with increasing decayed, missing, filled teeth in the primary dentition (dmft) and decayed, missing, filled teeth in the secondary dentition (DMFT) scores seen in a cross-section of children aged between five and 14 years at the end of the 1990s.<sup>1</sup> However, there is limited data on dental caries experience of young Australian adults with the last national survey conducted more than 15 years ago. The available data suggest that the picture for young Australian adults is somewhat better with surveys of military personnel showing a decrease in caries experience over the past 40 years.<sup>2</sup>

A cross-sectional study of Australian Army recruits was conducted for a number of reasons. The first aim of this study was to determine the dental caries experience of a group of adults aged 17-51 years of age, especially in relation to lifetime exposure to fluoridated drinking water. The second aim was to compare these data with the results of a similar study conducted in 1996 to determine changes in caries experience for this age group.

## MATERIALS AND METHODS

This paper reports the findings of a cross-sectional study of Australian Army recruits at the Army Recruit Training Centre, Kapooka. The study was conducted between November 2002 and March 2003, examining recruits as they enlisted into the Army. All recruits presenting for their initial dental examination were asked to participate in the study with a total of 973 recruits out of 1036 giving consent to use their clinical data and complete a questionnaire.

## Clinical examination

All recruits were examined by one of three calibrated examiners in a dental operatory using a plane mouth mirror and sickle probe with the aid of a dental chair light. A pair of posterior bitewing radiographs was taken of each subject using Kodak Ultra-Speed D Size 2 films and a Philips Dens-o-mat X-ray unit. Adhesive tags were used to position the films. The radiographs

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were viewed separately from the clinical examination by a single examiner. The clinical and radiographic data were recorded separately for each subject.

The clinical diagnostic criteria for dental caries were visually apparent cavitation, discolouration showing through enamel or visual evidence of recurrent caries. Radiographs were used to assess tooth surfaces from the distal surface of the second molar to the mesial surface of the first premolar and were viewed on a light box using a x2 magnification viewer. The radiographic diagnostic criteria for dental caries was a radiolucency clearly extending into dentine. Inter-examiner reliability was tested by comparison with the chief investigator (MH) and intra-examiner reliability was tested for the clinical and radiographic examinations. Kappa scores of 0.70 (MH and MC), 0.87 (MH and RH) were reported for inter-examiner reliability in the clinical examination, 0.87 (RH), 0.93 (MC) and 0.90 (MH) for intra-examiner reliability in the clinical examination and 0.90 for intra-examiner reliability in the radiographic examination.

### Questionnaire

Subjects completed a questionnaire prior to examination to elicit socio-demographic data and lifetime exposure to water fluoridation. Both the clinical and radiographic examinations were conducted blind to the questionnaire data and the radiographic examination was conducted blind to the clinical examination. Socio-economic status (SES) was determined by parental occupation using Australian Bureau of Statistics classifications.<sup>3</sup> The socio-economic groups were as follows: SES 1 – managers and professionals; SES 2 – associate professionals and tradespersons; SES 3 – advanced and intermediate clerical and service; SES 4 – intermediate production, elementary clerical and labourers. Lifetime exposure to fluoridated drinking water was calculated using data obtained from State Health Departments.

### Statistical analysis

The data were analyzed using the statistical software program Stata<sup>®</sup> Version 5.0. Caries experience was calculated by applying the DMFT index and using the combined clinical and radiographic examination. Mean values of DMFT were calculated for age, gender, educational, socio-economic and lifetime exposure to fluoridated water cohorts. Bivariate and multivariate analysis was performed using Poisson regression with variables found to be significant in the bivariate analysis included in the multivariate model.

### Ethics

The study was approved by the Australian Defence Human Research Ethics Committee and the University of Melbourne Human Research Ethics Committee. Informed written consent was obtained from all the participants. Participation in the study was voluntary and non-participation had no bearing on the subjects' military careers.

**Table 1. Socio-demographic characteristics of the sample population**

	n	%		n	%
Age			Socio-economic status		
17-20 yrs	525	54	SES 1	380	39
21-25 yrs	238	25	SES 2	304	31
26-30 yrs	116	12	SES 3	124	13
31-35 yrs	51	5	SES 4	97	10
36-51 yrs	43	4	Not classified	68	7
			Lifetime exposure to water fluoridation		
Gender			0%	163	17
Male	852	88	1-20%	61	6
Female	121	12	21-40%	63	6
			41-60%	48	5
Education			61-80%	58	6
<Year 12	269	28	81-99%	67	7
Year 12	504	52	100%	344	35
TAFE	126	13	Not classified	169	17
Tertiary	74	7			

## RESULTS

A total of 973 recruits consented to participate in the study with their socio-demographic profile and lifetime exposure to fluoridated drinking water shown in Table 1. The age range of subjects was between 17 and 51 years with 79 per cent of subjects aged between 17 and 25 years. There was also a strong male predominance with males comprising 88 per cent of the sample. More than half of the subjects had completed secondary school with 20 per cent attaining some form of tertiary education. The subjects reported coming from a relatively high socio-economic background with approximately one quarter of subjects in the lower two socio-economic groups.

More than one third of the subjects reported living exclusively in areas with a fluoridated water supply while 17 per cent had no exposure to fluoridated water during their life. Of the remainder, 30 per cent had a variable lifetime exposure to fluoridated water and 17 per cent could not be classified due to difficulty with subjects recalling where they had lived or investigator inability to obtain information of water fluoridation status of overseas locations. The subjects displayed a high degree of geographical mobility during their lifetime.

### Dental caries

Caries prevalence was high with only 26.2 per cent of subjects having no permanent dentition caries experience (DMFT=0). The proportion of subjects with no permanent dentition caries experience (DMFT=0) decreased with age, from 32.8 per cent in subjects aged 17-20 years to only 2.3 per cent in subjects aged 36-51 years. The distribution of caries experience was heavily skewed with 51 per cent having a DMFT score of 2 or less and 81 per cent having a score of 6 or less, while 26 per cent of subjects had 66 per cent of the caries experience.

There was an increase in caries experience with increasing age with the oldest subjects having more than four times the level of caries experience of the

**Table 2. Dental caries experience (DMFT) by explanatory variable**

	DT	MT	FT	DMFT	SD	DMFT=0
<b>Age</b>						
17-20 yrs	0.95	0.03	1.45	2.43	2.82	32.8%
21-25 yrs	1.53	0.07	1.84	3.44	3.61	26.5%
26-30 yrs	1.50	0.34	3.64	5.48	4.58	11.2%
31-35 yrs	1.51	0.59	4.92	7.02	4.93	11.8%
36-51 yrs	1.53	1.12	8.12	10.77	5.57	2.3%
<b>Gender</b>						
Male	1.29	0.15	2.26	3.70	4.12	26.2%
Female	0.67	0.14	2.48	3.29	3.70	26.5%
<b>Education</b>						
<Yr 12	1.65	0.31	2.50	4.46	4.61	21.9%
Yr 12	1.00	0.05	1.92	2.97	3.47	30.2%
TAFE	1.22	0.22	2.64	4.09	4.50	23.8%
Tertiary	1.01	0.16	3.35	4.53	4.30	18.9%
<b>Socio-economic status</b>						
SES 1	0.98	0.09	2.09	3.17	3.52	32.1%
SES 2	1.26	0.18	2.41	3.85	4.26	24.0%
SES 3	1.38	0.09	2.15	3.62	3.56	18.6%
SES 4	1.66	0.25	2.04	3.95	4.31	21.7%
<b>Lifetime exposure to water fluoridation</b>						
0%	1.44	0.10	2.36	3.91	4.41	29.0%
1-20%	1.57	0.26	2.62	4.46	4.53	26.2%
21-40%	1.33	0.36	3.03	4.72	5.00	18.8%
41-60%	1.35	0.23	2.25	3.83	4.58	22.9%
61-80%	1.12	0.09	2.14	3.34	3.34	20.7%
81-99%	0.85	0.24	2.45	3.54	3.64	19.4%
100%	0.97	0.07	1.76	2.80	3.36	32.6%

youngest subjects aged 17-20 (Table 2). The mean number of decayed teeth varied from 0.95 to 1.53 across the age groups, while missing teeth comprised only 1 per cent and filled teeth 60 per cent of the mean DMFT score in the youngest age group, increasing to 10 per cent and 75 per cent in the oldest age group respectively. Caries experience was similar for both males and females although female subjects reported nearly half the mean number of decayed teeth as the males. There was no apparent trend observed with the effect of the level of education that the recruits had attained on caries experience. Recruits who had not completed secondary school had a mean DMFT score of 4.46, 50 per cent higher than the score of 2.97 reported by recruits who had completed secondary school. However, recruits who had completed a Technical and Further Education (TAFE) or tertiary qualification had mean DMFT scores of 4.09 and 4.53 respectively, much higher than subjects who had completed secondary school. It is likely that the level of education was confounded by age. There appeared to be an increase in caries experience with decreasing socio-economic status. Decayed teeth made up proportionally more of the mean DMFT score in subjects from the lowest socio-economic group (42 per cent) than subjects from the highest socio-economic group (31 per cent).

Subjects with a lifetime exposure to fluoridated drinking water had a lower level of caries experience (DMFT 2.80) than subjects who had lived totally in areas with no fluoridated drinking water (DMFT 3.91). There appeared to be a strong linear relationship

**Table 3. Poisson regression models for DMFT**

	Unadjusted model		Adjusted model	
	IRR	p	IRR	p
<b>Age</b>				
17-20 yrs	1		1	
21-25 yrs	1.42	<0.001	1.52	<0.001
26-30 yrs	2.26	<0.001	2.06	<0.001
31-35 yrs	2.89	<0.001	3.19	<0.001
36-51 yrs	4.44	<0.001	4.01	<0.001
<b>Gender</b>				
Male	1		1	
Female	0.89	0.028	0.94	0.290
<b>Education</b>				
<Yr 12	1		1	
Yr 12	0.67	<0.001	0.80	<0.001
TAFE	0.92	0.097	0.76	<0.001
Tertiary	1.01	0.812	0.84	0.034
<b>Socio-economic status</b>				
SES 1	1		1	
SES 2	1.22	<0.001	1.05	0.317
SES 3	1.14	0.015	1.10	0.116
SES 4	1.25	<0.001	1.05	0.453
<b>Lifetime exposure to water fluoridation</b>				
0%	1		1	
1-20%	1.14	0.069	0.98	0.750
21-40%	1.21	0.007	0.96	0.574
41-60%	0.98	0.819	0.77	0.006
61-80%	0.86	0.058	0.68	<0.001
81-99%	0.91	0.191	0.68	<0.001
100%	0.72	<0.001	0.76	<0.001

Goodness-of-fit:  $\chi^2=2506.106$ ;  $\text{Prob}>\chi^2<0.001$ ; Pseudo  $R^2=0.1225$ .

between caries experience and exposure to fluoridated drinking water.

In the bivariate analysis, age, gender, level of education, socio-economic status and lifetime exposure to water fluoridation were shown to be statistically significant with respect to caries experience. Table 3 shows the results of Poisson regression analysis. In the multivariate model, age, level of education and lifetime exposure to fluoridated drinking water were statistically significant with gender and socio-economic status having no effect on caries experience.

## DISCUSSION

The results from this study show that, when taking into account the effects of age, gender, level of education and socio-economic status, lifetime exposure to fluoridated drinking water had a significant effect on dental caries experience. However, subjects with less than 40 per cent lifetime exposure to fluoridated drinking water showed no appreciable difference in caries experience compared with subjects who had no exposure to fluoridated drinking water. There was a 23-32 per cent reduction in mean DMFT scores for subjects who had greater than 40 per cent lifetime exposure to fluoridated drinking water.

Previous studies have demonstrated a relationship between socio-economic status and caries experience in children and young adults.<sup>4,6</sup> However, in the present study, socio-economic status did not appear to have an effect on the caries experience of the subjects. Socio-economic status was measured using self-reported parental occupation and it is possible that this is not a

**Table 4. Comparison of dental caries experience (DMFT) in Army recruits between 1996 and 2002-2003**

	1996 DMFT	DMFT=0	2002-2003 DMFT	DMFT=0	Decrease in DMFT
<b>Age</b>					
17-20 yrs	3.59	19%	2.43	32.8%	32.3%
21-25 yrs	4.63	11%	3.44	26.5%	25.7%
26-30 yrs	7.07	11%	5.48	11.2%	22.5%
31-35 yrs	9.04	4%	7.02	11.8%	22.3%
<b>Lifetime exposure to water fluoridation</b>					
0%	5.15	19%	3.91	29.0%	24.1%
100%	3.80	15%	2.80	32.6%	26.3%

suitable indicator in this population. Parental occupation can change over the course of 20 years, making it difficult to adequately classify subjects. Furthermore, it is difficult to determine the relative impact of socio-economic changes on the risk of developing dental caries over a period of 20 or more years. However, other measures such as parental income and education would also be unsuitable for the same reasons. Socio-economic status of the subject themselves, measured by occupation or income, would still have the same problem of ignoring the socio-economic environment of childhood and adolescence during which a substantial proportion of caries experience may have occurred.

A recent study by the same researchers reported that there had been a decreasing trend in caries experience in Australian adult military personnel over the previous 50 years with the greatest decline occurring after the introduction of water fluoridation in Australia.<sup>2</sup> The authors showed a relatively low level of caries experience in Australian Army recruits in 1996 with a caries prevalence of 84.8 per cent. Table 4 shows a comparison of caries experience between recruits in 1996 and 2002-2003. Mean caries experience has decreased by 32 per cent in the youngest age group and 22 per cent in the oldest age group over the intervening six years. There is also a much higher proportion of subjects with no permanent dentition caries experience (DMFT=0) across all age groups except subjects aged 26-30 years where 11 per cent of subjects in this age group had no permanent dentition caries experience (DMFT=0) in 1996 and in 2002-2003. Subjects aged 21-25 years in the present study were shown to have a similar caries experience to subjects aged 17-20 years in 1996 and subjects aged 26-30 years, 31-35 years and 36-51 years also had similar caries experience to subjects aged 21-25 years, 26-30 years and 31-35 years in 1996 respectively. This seems to indicate that there is not a significant contribution to caries experience once people move into young adulthood. This hypothesis would need to be examined using a longitudinal study design.

Caries experience appeared to decrease uniformly by approximately 25 per cent irrespective of exposure to fluoridated drinking water. This indicates a secular decline in caries experience over the last six years but

significant differences still exist for subjects with a lifetime exposure to fluoridated drinking water.

The most noticeable trend from 1996 to 2002-2003 was the change in the pattern of decayed, missing and filled teeth. The proportion of missing teeth in subjects aged 17-20 years and 21-25 years decreased from 2-4.6 per cent in 1996 to 1.2-2 per cent in 2002-2003 while in subjects aged 26-30 years and 31-35 years, missing teeth contributed 17.1-21.7 per cent of the DMFT index in 1996 compared to 6.2-8.4 per cent in 2002-2003.

Although care must be taken when comparing data from different cross-sectional studies, the populations in these two studies are similar. However, there is a greater proportion of males in the present study and subjects from the present study were generally from a higher socio-economic background and with a higher level of education. More subjects had a lifetime exposure to fluoridated water in the present study (35 per cent compared to 29 per cent) and less with no lifetime exposure (17 per cent compared with 20 per cent). Also, the same 'gold standard' examiner was used in both studies, so the clinical data obtained are also comparable.

Another interesting finding from this study was the proportion of subjects who had a lifetime exposure to fluoridated drinking water. Spencer *et al.*<sup>7</sup> reported that approximately two-thirds of the Australian population were resident in areas with a fluoridated drinking water supply at one time, yet the present study shows only 35 per cent of subjects having a lifetime exposure to fluoridated drinking water.<sup>7</sup> Even in subjects aged 25 years or less, only 46 per cent had a lifetime exposure to fluoridated drinking water with 21 per cent having no lifetime exposure and 33 per cent having a variable lifetime exposure. This suggests a large degree of mobility within this population with subjects moving in and out of areas with fluoridated drinking water supplies. Given that a statistically and clinically significant difference existed in the caries experience of lifetime residents of fluoridated areas compared with those having a partial lifetime exposure, it is important to maintain efforts to introduce water fluoridation into those communities where it is currently unavailable.

## CONCLUSION

The results from this study suggest that there has been a continual decline in caries experience in young Australian military recruits, varying from 22-32 per cent in adults aged between 17 and 35 years. The prevalence of dental caries has also decreased with only 19 per cent of 17-20 year-old subjects having no permanent dentition caries experience (DMFT=0) in 1996 compared with 33 per cent in the present study and 4 per cent of 31-35 year-olds in 1996 compared to 12 per cent in the present study. The latest data in Australian children show 64.5 per cent of 12-year-olds and 44.1 per cent of 15-year-olds with no permanent dentition caries experience (DMFT=0) in 1999.<sup>1</sup> Lifetime exposure to fluoridated drinking water

conferred an appreciable benefit for the subjects in this study compared with those who had no such exposure during their life.

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