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# Further caries decline in Swiss recruits from 1996 to 2006

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**Summary** Swiss army recruits (N=606) from the army base at Thun were dentally examined with a standardized method in the year 2006. The results were compared with those of previous surveys (1985 and 1996). The mean DM6FT-value in the year 2006 was 3.11, whereas in 1996 it had been clearly higher (4.95). This corresponds to a caries decline of 37%. The observed caries decline can only partly be explained.

Recruits, who were smokers, showed an increased caries experience. Recruits of the German-speaking part of Switzerland who had profited from oral health lessons by oral health instructors in Kindergarten and primary schools did not differ in caries experience from recruits of the French-speaking part of Switzerland.

## Introduction

Dental examinations have been carried out on recruits in Switzerland since 1970 (CURILOVIC ET AL. 1972, CURILOVIC ET AL. 1980, MENGHINI ET AL. 1991, MENGHINI ET AL. 2001). Previous investigations showed a steady decline of the caries experience. The purpose of this study was to determine the caries experience of Swiss recruits in 2006 and to compare it to that of 1985 and 1996.

The results of a parallel investigation which dealt with the periodontal health of the same recruits have already been published (RÖTHLISBERGER ET AL. 2007).

Investigations on recruits in 1970 (CURILOVIC ET AL. 1972) and 1974 (CURILOVIC ET AL. 1980) used another methodology. Therefore, they were not included here for comparison.

## Materials and methods

### Site and date of the survey

The dental survey took place on the military base in Thun over 7 days in July 2006.

### Sample

In Switzerland there is general conscription for men. 20% of those who were called up were recognized as *unfit* for military service with the old recruitment criteria (Swiss army 1995). From 2003 on, more extensive medical investigations were carried out in the recruitment centers. Therefore, in 2006 notably more recruits (35%) were recognized as *unfit* for service (Report of the Swiss Federal Council 2007).

As in the earlier surveys (1985, 1996) recruits were from all parts of the country. All Swiss cantons were represented. Like-

wise, all levels of education were represented (RÖTHLISBERGER ET AL. 2007).

All recruits available at the Thun recruit school during the 7 study days (tank and logistics troops) were included. 606 recruits were examined clinically and radiologically. The average age of these recruits was 20.4 years and matched that of the 1985 and 1996 investigations.

## Methods

The caries experience was determined, as in 1985 and 1996, by means of a standardized method (MARTHALER 1966) in 28 teeth (without third molars). Details of how the examinations were carried out have already been described (MENGHINI ET AL. 1991, MENGHINI ET AL. 2001).

The recruits brushed teeth before the examination on their own initiative.

### Questionnaire

In 2006 37 questions were presented to the recruits on personal details, oral hygiene behavior, eating behavior, drinking customs, smoking habits and drug consumption. Most questions were aimed at identifying risk indicators for erosion. Nine questions were also of interest for identifying caries risk indicators.

### Investigators

In 1985 and 1996 the clinical assessment was carried out by two investigators (TM and GM). Both investigators agreed well (intraclass-correlation coefficient for DM6FT and DFS was 0.98 and 0.95). In 2006 the clinical investigation was carried out by only one investigator (GM). The assessment of the X-ray images was carried out in all 3 investigations by one and the same investigator (MS) (intraclass-correlation coefficient for DFS and D<sub>1-2</sub>S in approximal surfaces of molars and premolars was 0.93 and 0.88).

### Caries indices

The following indices were used to describe the caries experience:

DT	Sum of carious teeth
MT	Sum of missing teeth
FT	Sum of filled teeth
DMFT	Sum of carious, missing and filled teeth
DM6FT	Sum of carious, missing (first molars only) and filled teeth
DS	Sum of carious predilection sites
FS	Sum of filled predilection sites
DFS	Sum of carious and filled predilection sites
D <sub>1-2</sub> S	in pits and fissures of molars and premolars Sum of stained pits and fissures
D <sub>1-2</sub> S	in approximal surfaces of molars and premolars Sum of surfaces with radiolucencies confined to enamel
D <sub>1-2</sub> S	in free smooth surfaces of molars Sum of surfaces with white spots
D <sub>1-2</sub> S	in surfaces of anterior teeth Sum of surfaces with white spots

### Statistical analyses

Changes in caries experience were tested using the Mann-Whitney test.

Caries risk indicators were identified using the Mann-Whitney test or the Kruskal-Wallis test. Because 9 variables were examined (multiple test situation), the significance level was corrected according to Bonferroni:  $P < 0.05/9 = P < 0.006$ . This ensures that the probability of a type 1 error is less than 0.05.

## Results

### Changes in caries experience from 1985 to 1996

Changes in caries experience from 1985 to 1996 can be seen in Table I. This has been described previously (MENGHINI ET AL. 2001).

### Changes in caries experience from 1996 to 2006

Changes in caries experience from 1996 to 2006 are given in Table I. The DM6FT-value in 1996 was 4.95 on average; in 2006 it was still 3.11. This indicates a caries decline of 37%. Roughly three quarters of the DM6F-teeth were filled (FT).

The DFS-value in 1996 was 8.48 on average; in 2006 it was still 4.61. This gives a caries decline of 46%. According to predilection site, the decline amounted to between 41% (approximal surfaces of molars and premolars) and 74% (free smooth surfaces of molars). Most predilection sites (DFS) were filled (FS).

### Caries-free recruits

The percentage of recruits who were free of caries (DM6FT = 0) increased from 15.6% in 1996 on 27.9% in 2006.

### Sealed pits and fissures

In 1996 0.74 of pits and fissures were sealed on average; in 2006 it was 1.61 (Tab. I). Only very few sealed premolars were found.

### Caries risk indicators

Only one single risk indicator could be determined (Tab. II). Recruits who smoked had significantly ( $P < 0.006$ ) more caries than non-smokers (DM6FT 3.9 versus 2.8; DFS 5.9 versus 4.0; DFS approx Mol & PM 2.5 versus 1.4).

The 8 remaining variables were not associated with caries experience ( $P > 0.006$ ).

### Estimation of the caries increment between the ages of 15 and 20

Among the recruits examined was a group which had graduated from compulsory education in the Canton of Zurich. The mean caries experience of the 20-year-old recruits from the Canton of Zurich was compared with the mean caries experience of 15-year-old schoolchildren from the Canton of Zurich who had been examined 5 years earlier (Tab. III). The difference between these values was used to estimate the caries increment between ages 15 and 20. The estimated increment (DFS) amounted to 7.62 in the 1980s, 6.52 in the 1990s and only 2.24 in the first decade of the twenty-first century. In each case the increment was highest in the approximal surfaces of molars and premolars. The majority of the lesions was filled (FS).

## Discussion

### Samples

The recruits examined in 1985, in 1996 and 2006 were from all areas (cantons) and all educational levels in Switzerland.

Tab. I Caries experience (means) of Thun recruits in the years 1985, 1996 and 2006

	1985 <sup>1</sup> (N=753)	1996 (N=416)	2006 (N=606)	1996–2006 Change
<b>Teeth (28)</b>				
MT first molars	0.09	0.03	0.02	
MT other teeth	0.44	0.39	0.45	
DT	4.16	1.24	0.73	
FT	5.44	3.68	2.36	
DMFT	10.14	5.34	3.56	
DM6FT <sup>2</sup>	9.70	4.95	3.11	-37%***
<b>All predilection sites (92)</b>				
DS	4.99	1.52	0.83	
FS	13.82	6.95	3.78	
DFS	18.81	8.48	4.61	-46%***
<b>Pits and fissures of molars and premolars (22)</b>				
DS	0.50	0.23	0.09	
FS	8.34	4.53	2.53	
DFS	8.83	4.76	2.62	-45%***
D <sub>1-2</sub> S	5.53	6.83	4.20	
Sealed	0.16	0.74	1.61	+118%***
<b>Approximal surfaces of molars and premolars (24)</b>				
DS	4.14	0.94	0.66	
FS	4.26	2.10	1.13	
DFS	8.40	3.04	1.79	-41%***
D <sub>1-2</sub> S	8.98	3.75	2.30	
<b>Free smooth surfaces of molars (16)</b>				
DS	0.16	0.17	0.03	
FS	0.47	0.17	0.06	
DFS	0.63	0.34	0.09	-74%***
D <sub>1-2</sub> S	3.08	2.10	0.59	
<b>Surfaces of anterior teeth (30)</b>				
DS	0.19	0.19	0.06	
FS	0.76	0.15	0.06	
DFS	0.95	0.34	0.12	-65%***
D <sub>1-2</sub> S	0.92	0.92	0.44	

<sup>1</sup> Only the right side was examined. The mean values were doubled.  
<sup>2</sup> In the DM6FT Index "M" counts only the missing first molars.  
\*\*\* P<0.001

Nevertheless, the samples were not drawn at random and it is not certain that the Thun recruits represent 20-year-old Swiss men with regard to caries experience. It is conceivable, that 1.) those who qualified for conscription differed from those who were deemed unfit for military service and/or that 2.) those serving on the military base in Thun differed from those serving elsewhere in the Swiss army.

**Changes in caries experience from 1996 to 2006**

From 1996 to 2006 there was a clear caries decline. The cause for the decline is not known but two possible reasons may be put forward:

- More sealants were found in 2006 than in 1996. This may be a cause for the caries reduction in pits and fissures. However this does not explain the caries reduction in other predilection sites.
- The recruits examined in 1996 (born in 1976) were first exposed to fluoridated domestic salt (introduced in 1983) at

age 7. The recruits examined in 2006 were exposed all their life to fluoridated salt (250 ppm F). With the latter a pre-eruptive fluoridation effect may have contributed to the caries decline. However, up until now this effect has only been observed in areas with fluoridated drinking water (MARTHALER 1960, GROENEVELD ET AL. 1990, SINGH ET AL. 2007).

Other reasons for the caries decline which were taken into account:

- Improved oral hygiene does not seem to be a likely cause. RÖTHLISBERGER ET AL. (2007) found slightly higher plaque and gingivitis indices with the recruits examined in 2006 compared to those examined in 1996.
- In 2006 35% of those called up were found to be unfit for service. In previous years it was only 20% (Report of the Swiss Federal Council 2007). This could mean that selectively more "healthy" recruits were examined in 2006 compared to 1996. However, this is contradicted by the periodontal findings

Tab. II Caries risk indicators in Thun recruits examined in 2006

	N	DM6FT <sup>1</sup>		DFS		DFS Approximal Mol & PM	
		Mean	Median	Mean	Median	Mean	Median
School in French-speaking Switzerland	141	3.1	2.0	4.4	2.0	1.6	0.0
School in German-speaking Switzerland	458	3.1	2.0	4.7	2.0	1.9	0.0
		P=0.820		P=0.931		P=0.341	
Direct foreign ancestors	76	3.9	3.0	5.8	3.5	2.3	1.0
No direct foreign ancestors	527	3.0	2.0	4.5	2.0	1.7	0.0
		P=0.013		P=0.009		P=0.058	
Smoker	195	3.9	3.0	5.9	3.0	2.5	1.0
Non-smoker	410	2.8	2.0	4.0	2.0	1.4	0.0
		P=0.002*		P=0.001*		P=0.000*	
TB < 2× daily	53	4.2	3.0	6.9	3.0	3.2	1.0
TB ≥ 2× daily	551	3.0	2.0	4.4	2.0	1.7	2.0
		P=0.084		P=0.095		P=0.012	
TB within 15 minutes after eating	214	2.8	2.0	3.8	2.0	1.4	0.0
TB later	371	3.3	2.0	5.0	2.0	2.0	0.0
		P=0.211		P=0.158		P=0.081	
Different TB movements	273	3.0	2.0	4.4	2.0	1.6	0.0
Horizontal TB movements	45	2.9	2.0	4.6	2.0	2.1	0.0
Vertical TB movements	68	3.2	2.0	4.8	3.0	2.0	0.0
Circular TB movements	216	3.3	2.0	4.9	2.0	1.9	0.0
		P=0.804		P=0.821		P=0.762	
Use of dental floss	202	3.1	2.0	4.9	2.0	1.8	0.0
Does not use dental floss	402	3.1	2.0	4.5	2.0	1.8	0.0
		P=0.802		P=0.488		P=0.597	
Chewing gum use	423	3.2	2.0	4.8	2.0	1.9	0.0
Does not use chewing gum	176	2.9	2.0	4.2	2.0	1.6	0.0
		P=0.414		P=0.446		P=0.372	
Softdrinks ≤ 2× daily	321	2.8	2.0	4.1	2.0	1.5	0.0
Softdrinks > 2× daily	281	3.5	2.0	5.3	3.0	2.1	0.0
		P=0.314		P=0.301		P=0.476	

<sup>1</sup> In DM6FT Index "M" counts only the missing first molars.  
\* Only these differences are significant after Bonferroni correction (P<0.006).  
TB=Toothbrushing

of RÖTHLISBERGER ET AL. (2007). These authors found no improvement in periodontal conditions between 1996 and 2006.

- It is also possible that the examination was less strict in 2006 compared to 1996 ("examiner drift"). On the other hand, both the clinical and the radiological findings showed a caries decline. These findings were recorded by different examiners. Besides, a clear decline was seen in filled surfaces (FS) (Tab. I). This component is unlikely to be influenced much by the investigator.
- Further factors unknown to us may play a role.
- The caries decline in the approximal surfaces of molars and premolars is worth mentioning. In 1996 an average of 3.0 surfaces were carious or filled; in 2006 it was just 1.8 surfaces. The reduction in lesions in these surfaces is also important, because the class II composite fillings common today have a lower life span than the amalgam fillings, which were used previously (SJÖGREN & HALLING 2002).

#### Risk indicators for caries

A significantly higher caries experience was found in smokers. One possible explanation is that smokers are less health-conscious than non-smokers. Smokers reported brushing their teeth less frequently and consuming soft drinks more frequently. Additionally, smokers had untreated caries more often (40%) than non-smokers (27%) (results not shown). Smokers were also less highly educated (RÖTHLISBERGER ET AL. 2007). In the literature it has been pointed out that smokers consume more sugar (BENNETT ET AL. 1970).

The rest of the variables were – in part surprisingly – *not* associated with caries experience:

The recruits who completed compulsory education in the German-speaking part of Switzerland had been looked after, as a rule, during kindergarten and primary school by a dense network of oral health instructors; this in contrast to the recruits who graduated from compulsory education in the French-speaking part of Switzerland. However, no difference in caries experience was found.

Tab. III Estimation of the caries increment between the ages of 15 and 20

	Caries experience 15-year-old Schoolchildren 1979/80	Caries experience 20-year-old Zurich Recruits 1985	Caries "Increment" 15 to 20 Zurich Recruits 1985	Caries experience 15-year-old Schoolchildren 1991/92	Caries experience 20-year-old Zurich Recruits 1996	Caries "Increment" 15 to 20 Zurich Recruits 1996	Caries experience 15-year-old Zurich Schoolchildren 2000	Caries experience 20-year-old Zurich Recruits 2006	Caries "Increment" 15 to 20 Zurich Recruits 2006
Number of subjects	283	92		136	56		103	62	
Mean age	15.5	20.4		15.5	20.6		15.5	20.4	
DFS	9.71	17.33	7.62	2.87	9.39	6.52	1.71	3.95	2.24
DFS pits and fissures Mol & PM	6.06	8.30	2.24	2.21	4.84	2.63	1.33	2.32	0.99
DFS approximal surfaces Mol & PM	3.18	7.65	4.47	0.49	3.52	3.03	0.35	1.44	1.09
DFS free smooth surfaces Mol	0.13	0.52	0.39	0.07	0.43	0.36	0.02	0.10	0.08
DFS surfaces of anterior teeth	0.35	0.85	0.50	0.10	0.61	0.51	0.01	0.10	0.09
FS	7.04	13.14	6.10	2.58	7.57	4.99	1.36	3.34	1.98
DS	2.68	4.20	1.52	0.28	1.82	1.54	0.35	0.61	0.26

Recruits with foreign roots showed a tendency (not significant) for more caries.

In the recommendations for caries prophylaxis, brushing the teeth immediately after eating is often recommended. No advantage could be shown here for following this advice. The caries experience was not significantly lower in recruits, who reported brushing their teeth within 15 minutes after eating.

The advantages of one or other tooth brushing technique are often argued vehemently. No advantage with regard to caries could be shown here for any particular technique. Recruits using horizontal vertical or circular brushing techniques did not differ significantly in caries experience.

In the same way, lower caries experience could not be shown for the following behavior patterns: Frequent tooth brushing ( $\geq 2 \times$  daily), use of dental floss, using chewing gum and moderate consumption of soft drinks ( $\leq 2 \times$  daily).

### Estimation of the caries increment between the ages of 15 and 20

The caries increment was not measured longitudinally, but calculated from the difference in cross-sectional data. The estimated caries increment of 2.24 lesions for the first decade of the twenty-first century was well below the increment in the 1990s (6.52). But because these are not real longitudinal data, the results must be interpreted with care.

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### Résumé

606 recrues ont été soumises à un contrôle dentaire lors d'une enquête épidémiologique qui s'est déroulée à Thoune en 2006. Les résultats ont été comparés avec ceux de deux enquêtes préalables (1985 et 1996).

L'indice de carie CA6OD moyen était de 3,11; en 1996, cette valeur était sensiblement plus élevée (4,95). Cela correspond à une réduction de la carie de 37%. Cette réduction n'a pu être expliquée que partiellement.

Les recrues qui fumaient avaient davantage de caries.

Au niveau de la carie, aucune différence n'a été constatée entre les recrues provenant de la Suisse alémanique, qui à l'école maternelle et à l'école primaire ont été prises en charge par les opératrices de prévention dentaire, et celles de la Romandie.

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