Dental health and dental treatment needs among recruits of the Finnish Defence Forces, 1919–91

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The first two surveys of the dental health of young Finnish men were conducted in 1919 and 1965. The objective of four subsequent surveys (1976, 1981, 1986, and 1991) was to collect both interview and clinical examination data for the monitoring of changes in the oral health status of the recruits. A significant reduction in self-reported toothache, gingival bleeding, and number of decayed teeth was observed from 1976 to 1991. At examination, the numbers of decayed teeth, teeth indicated for extraction, teeth in need of fillings, and missing teeth decreased substantially, as did the teeth with visible plaque, subgingival calculus, and teeth with 4-mm or deeper periodontal pockets. This comprehensive series of successive cross-sectional oral health surveys clearly shows that since 1976 a significant decrease in oral disease and treatment needs has taken place among the Finnish population of young men. □ *Dental caries; epidemiology, oral; military dentistry; periodontal disease; successive cross-sectional surveys*

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Since the beginning of the 20th century the Defence Forces recruits have been the subjects of several oral epidemiological surveys. In particular, researchers in the Nordic countries (1–7) and Switzerland (8–10) have shown interest in clarification of changes in the oral health of conscripts. Reports have also been published from Australia (11), Britain (12), Germany (13, 14), and Turkey (15).

In Finland national service is compulsory for young men, and about 90% of the men of each age cohort complete an 8- to 11-month term of service in the Defence Forces. Each age cohort forms a cross-section of the entire male population both geographically and socioeconomically and offers an excellent opportunity to investigate the effects of the health care received before the age of conscript service.

The first survey of the dental health of Finnish recruits was carried out by Gunnar Siven in the autumn of 1919. He examined the dental conditions of about 1000 conscripts serving in the Helsinki garrison and assessed their needs for dental treatment. In 1965 a commission appointed for the improvement of dental care in the Defence Forces ordered a study of the dentitions of about 3000 conscripts in 5 large garrisons in different parts of the country (16).

The first dental health survey including all the garrisons of the Defence Forces was conducted in 1976 (17). In addition to a clinical examination a questionnaire was used to obtain information about the examinees' socioeconomic background and subjective observations of symptoms related to dental or periodontal disease. The survey comprised about 3300 men with an age range of 19–29 years and a mean age of 20.3 years. In the light of the results it was decided to repeat the survey every 5 years so as to follow the changes in the dental status of the recruits and in their need for dental treatment. Accordingly, the 1976 survey was repeated in 1981, 1986, and 1991.

Materials and methods

In all garrisons taking in new recruits a comprehensive dental health survey was conducted in June and July 1976, 1981, 1986, and 1991, in addition to the customary compulsory screening of the recruits' general and dental health. The total number of garrisons in the Finnish Defence Forces was 35 in 1976, 37 in 1981 and 1986, and 34 in 1991. In 1976 there were 34, in 1981 and 1986 35, and in 1991 30 garrisons taking in new recruits. The participants were picked at random from the roll of names of every company. Depending on the number of recruits entering the service in each garrison, every fourth, every second, or every recruit was included in the sample. The number of recruits included varied from 80 to 300 per garrison. The recruits were assigned to garrisons on a regional basis. The regional distribution of the recruits participating in the study corresponded well with the regional distribution of all 20-year-old Finnish men and with all the men in each corresponding age class of recruits entering the service. The total number of examinees was 3334 in 1976, 3904 in 1981, 3733 in 1986, and 4057 in 1991. The mean age of the four pooled samples was 20.3 years, with a range of 17–29 years.

Questionnaire and background information

Each participant completed a questionnaire with inquiries about the profession of his father or other

Table 1. Percentage of Finnish recruits by self-reported oral disease symptoms and study year. Recruits' own observations

Symptom	1976, n = 3334	1981, n = 3904	1986, n = 3733	1991, n = 4057
Toothache	62.3	8.4	6.1	7.5
Bleeding	50.5	22.1	19.5	17.4
Decay	–	52.7	33.7	28.4
Gingivitis	–	8.8	8.7	9.6

provider, frequency of brushing his teeth, frequency of dental visits before being called up, and type and frequency of self-observed symptoms of dental or periodontal disease. Additional background information was obtained from the Defence Forces register of conscripts and official statistics.

Clinical examination

All clinical examinations were performed by the Defence Forces dental officers, for whom a special 2-day training and calibration course was organized in each year of examination about 2 weeks before carrying out the survey. The number of examiners was 34 in 1976, 41 in 1981, and 36 in 1986 and 1991. Caries status was determined by using a mouth mirror and an explorer. Only 'clinical' caries, depicting carious teeth that would be restored or extracted, was recorded. Incipient enamel lesions, discolorations, and minor irregularities of the tooth surface were ignored. Root tips and remnants of teeth were classified as decayed teeth (DT). Wisdom teeth were included to show the total treatment need. Radiographs were not used. Periodontal conditions were assessed with a mouth mirror and a WHO-type ball-pointed periodontal probe and recorded on the basis of the Gingival Bleeding and Visible Plaque Index systems (18).

Statistical methods

Data were processed by the Defence Forces Computer Center. Correlations of the variables were analyzed using correlation coefficients and cross-tabulation. The t test and chi-square tests were used for statistical evaluation.

Results

Questionnaire study

The frequency with which the participants observed symptoms of oral disease during the year before the examination is given in Table 1. During the 1960s and 1970s fluoride toothpaste was not yet commonly used, and the rapid increase in sugar consumption resulted in an extensive deterioration of the oral health of children and young people. The percentage of recruits having experienced toothaches during the previous year decreased from 62% in 1976 to less than 10% in 1986. Correspondingly, in 1981 half and in 1991 less than one-third of the recruits assumed that they had decayed teeth. Self-observed bleeding from the gums decreased from 50% to around 20% at subsequent examinations, while only fewer than 1 of 10 recruits thought that they might have gingivitis.

In 1976 one-third (33.7%) of the participating recruits reported that they had not visited a dentist during the last 2 years before being examined, another third (33.6%) reported one to two visits, and the rest (32.7%) three or more visits. The use of public and private dental health services in 1981, 1986, and 1991 is given in Table 2. Dental care in the community health center had started at an average age of 7 years, the age when starting primary school. The 1981 recruits had received dental care through the public health care system for an average of 9.4 years, whereas the 1986 recruits had received dental care for 11.2 years and the 1991 recruits for 11.8 years. In comparison, the 1981, 1986, and 1991 samples had visited a private practitioner during an average of 1.6, 0.7, and 0.5 years, respectively. Whereas 36% of the recruits in 1981 had visited a private practitioner at least irregularly, the corresponding number in 1991 was less than 12%.

Applying the classification used in the official population census, the recruits were divided in five groups on the basis of the profession of their fathers or other providers. The substantial changes in the distribution of the occupations of the fathers or other providers representing the recruits' socioeconomic background are presented in Table 3. The population employed in agriculture and forestry decreased from 25.8% in 1976 to 11.2% in 1991. A corresponding

Table 2. Percentage distribution of recruits by frequency of use of dental services before military service and source of care and study year

	Community health center			Private services		
Frequency	1981, n = 3904	1986, n = 3733	1991, n = 4057	1981, n = 3904	1986, n = 3733	1991, n = 4057
Failed to answer	3.1	2.1	2.3	3.9	1.1	1.7
Regularly every year	61.4	72.4	75.8	17.3	9.0	6.5
Less frequently than every year	33.6	24.6	21.2	18.6	7.0	5.2
Not at all	1.9	0.9	0.7	60.2	82.9	86.6

Table 3. Percentage distribution of occupation of the fathers or other providers of Finnish recruits in the years 1976, 1981, 1986, and 1991

Occupation	1976, n = 3344	1981, n = 3904	1986, n = 3733	1991, n = 4057
Failed to answer	0.3	0.2	0.7	0.5
No occupation	4.1	3.2	2.8	2.0
Farmer, worker in agriculture or forestry	25.8	18.4	12.3	11.2
Worker in industry, trade, traffic, or public administration	38.8	38.5	40.0	38.1
Foreman, functionary, official, middle management, or administration	18.5	23.1	25.2	27.4
Professional, entrepreneur, director, executive, administrator	12.5	16.6	18.7	20.8

increase was observed in the proportion of foremen, middle management, directors, and administrators, while the proportion of workers in industry, trade, traffic, and public administration remained unchanged.

The proportion of recruits brushing their teeth less than once a day decreased from 23.6% in 1976 to only 8.6% in 1991, whereas the proportion of recruits brushing more often than once a day increased from 32.2% in 1976 to 45.5% in 1991 (Table 4).

Clinical findings

Caries findings and their comparison with findings from earlier studies of Finnish recruits are given in Fig. 1 and Tables 5 and 6. The DMFT score tripled from 1919 to 1976. From 1976 to 1981 the DMFT score decreased, and the number of intact (sound) teeth increased. This trend continued and increased during the next two examination periods, 1981–86 and 1986–91. The number of decayed (DT) and missing (MT) teeth per man reached peak scores in 1965.

Of the total number of decayed teeth, 38.1% were indicated for extraction in 1919, 33% in 1965, 14.7% in 1976, 7.3% in 1981, only 4.8% in 1986, and 6.4% in 1991. The mean number of filled teeth with no decay (FT) per recruit increased until 1981 and then decreased by 20% during 1981–86 and further by 40% during 1986–91. The mean number of full crowns per man remained at the same level for the period 1965–91, whereas the number of teeth replaced with removable dentures decreased significantly (Table 6). The proportion of totally edentulous recruits was 0.3% in 1976 and 0.1% in 1991. In 1976 only 0.6% of the recruits had a completely sound (intact) dentition as compared with 7.3% in 1991.

The periodontal findings from 1976 to 1991 are given in Table 7. During the 15-year period there was a decrease of 35% in the mean number of teeth with visible plaque and about 13% in the percentage of subjects with visible plaque. The visible calculus and the gingival bleeding remained at the same level during the entire study. The subgingival calculus decreased by one-third and the 4-mm or deeper gingival pockets by more than 80%.

Correlations of clinical findings and background variables

The self-reported occurrence of toothaches during

Table 4. Percentage distribution of toothbrushing frequency of Finnish recruits and study year

Brushing frequency	1976, n = 3344	1981, n = 3904	1986, n = 3733	1991, n = 4057
Failed to answer	0.1	0.5	0.4	0.5
Less than once a day	23.6	15.3	9.6	8.6
Once a day	44.1	44.5	44.4	45.4
More than once a day	32.2	39.7	45.6	45.5

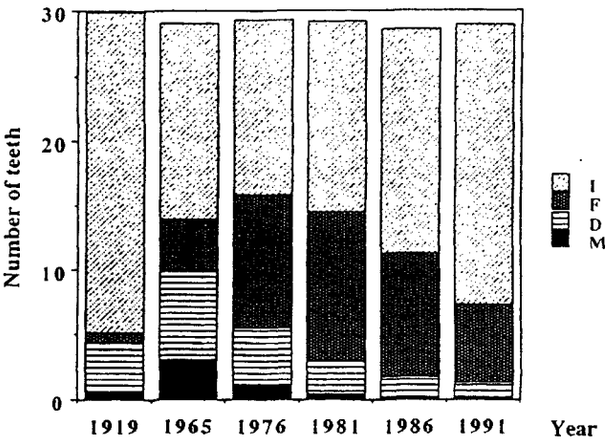

Fig. 1. Numbers of intact (I), filled (F), decayed (D), and missing (M) teeth in the mouths of young Finnish men in 1919, 1965, 1976, 1981, 1986, and 1991.

Table 5. Mean number and standard deviation (*s*) of sound, DMFT, and replaced teeth of Finnish recruits in the years 1919, 1965, 1976, 1981, 1986, and 1991. Wisdom teeth are included

	Year of investigation and no.									
	1919, *n* = 946	1965, *n* = 3120	1976, *n* = 3444		1981, *n* = 3904		1986, *n* = 3733		1991, *n* = 4057	
	Mean	Mean	Mean	*s*	Mean	*s*	Mean	*s*	Mean	*s*
No. of natural teeth	29.3	25.9	28.2	3.3	28.7	2.9	28.4	3.7	28.9	2.0
Sound (intact) teeth = SD	24.8	15.2	13.5	5.6	14.7	5.7	17.3	6.1	21.7	5.2
Decayed teeth = DT	3.9	6.7	4.3	5.0	2.6	3.9	1.7	2.9	1.3	2.5
Missing teeth = MT	0.6	3.2	1.2	2.8	0.5	1.7	0.1	0.6	0.1	0.5
Filled teeth with no decay = FT	0.7	4.1	10.3	5.7	11.4	5.2	9.4	4.6	5.9	4.2
DMFT	5.2	13.9	15.8	6.0	14.5	5.8	11.2	5.4	7.3	5.1
Teeth indicated for extraction	1.5	2.0	0.6	1.8	0.2	0.9	0.1	0.5	0.1	0.5
Teeth in need of filling	2.4	4.7	3.7	4.1	2.4	3.4	1.6	2.7	1.2	2.3
Pin, jacket gold, or other crown	–	0.03	0.06	0.3	0.04	0.3	0.03	0.3	0.02	0.2
Teeth replaced with removable denture	–	0.9	0.2	1.9	0.08	1.1	0.01	0.1	0.0005	0.02

the previous year correlated with the number of decayed teeth recorded during the clinical examination ($P < 0.001$). Self-reported gingival bleeding was found to correlate with the gingival bleeding at clinical examination ($P < 0.001$). While 50% of the recruits in 1976 and only about 20% in 1981–91 reported bleeding (Table 1), gingival bleeding at one or more sites was recorded for 70–75% of the recruits at clinical examination (Table 7).

In 1976 the recruits who had visited a dentist most frequently had the smallest number of intact (sound) teeth per man ($P < 0.001$). In 1981, 1986, and 1991 neither the number of dental visits nor the number of years of regular dental care correlated with the number of intact teeth. Visible plaque and both visible and subgingival calculus correlated significantly ($P < 0.001$) inversely with the number of dental visits and significantly ($P < 0.01$) with gingival bleeding. There was no correlation between the number of dental visits and the number of 4-mm-deep or deeper gingival pockets.

The occupation of the father or other provider of the recruit, used to assess his socioeconomic background, correlated with the clinical findings so that in the lower social groups there were fewer intact teeth and a higher number of decayed teeth ($P < 0.001$). In the higher social groups there was significantly less visible plaque, subgingival calculus, and gingival bleeding ($P < 0.001$), but there was no correlation between the occupation of the father or other provider and visible calculus or 4-mm or deeper periodontal pockets.

In the first examination of the series in 1976 the daily frequency of toothbrushing did not correlate significantly with the number of intact teeth. In the year 1981 that correlation was significant ($P < 0.01$), and in 1986 and 1991 highly significant ($P < 0.001$). The frequency of toothbrushing correlated inversely with the number of decayed teeth at each of the surveys ($P < 0.001$).

In the year 1976 all the periodontal findings correlated inversely highly significantly with the frequency of toothbrushing ($P < 0.001$). However, in 1981, 1986, and 1991 visible calculus and 4-mm or deeper

Table 6. Percentage of subjects with filled teeth with no decay, decayed teeth, teeth indicated for extraction, in need of filling, missing, with pin, jacket, or gold crowns, removable dentures, and DMF teeth. Wisdom teeth are included

Status	1919, *n* = 946	1976, *n* = 3344	1981, *n* = 3904	1986, *n* = 3733	1991, *n* = 4057
Decayed teeth = DT		76.3	61.2	50.6	40.5
Missing teeth = MT		39.1	17.8	8.1	3.6
Filled teeth with no decay = FT		96.3	98.5	98.3	91.1
DMF teeth	90.4	99.4	99.3	98.7	92.7
Teeth indicated for extraction		22.6	9.0	7.8	4.7
Teeth in need of filling		75.6	60.9	50.3	39.6
Pin, jacket, or gold crown		3.2	2.2	1.6	1.3
Removable dentures		2.2	0.8	0.4	0.05

Table 7. Mean number and standard deviation (*s*) of periodontally affected teeth of 14 upper and lower teeth examined in the right sides of the jaws and the percentage of subjects with each condition among Finnish recruits in the years 1976, 1981, 1986, and 1991. Wisdom teeth are included

	Year of investigation and no.											
	1976, *n* = 3344			1981, *n* = 3904			1986, *n* = 3733			1991, *n* = 4507		
	Mean	*s*	%	Mean	*s*	%	Mean	*s*	%	Mean	*s*	%
Visible plaque	4.8	4.5	75.6	4.4	4.4	74.5	3.7	4.3	61.6	3.2	3.6	66.1
Visible (supragingival) calculus only	0.8	1.4	32.2	0.8	1.5	28.3	0.7	3.8	42.0	0.8	1.4	31.7
Subgingival calculus ± visible calculus	1.2	2.2	35.9	0.7	1.7	22.4	0.4	1.1	15.4	0.8	1.9	24.8
Gingival bleeding	4.3	4.3	73.4	4.4	4.5	69.1	4.2	4.4	68.5	4.2	4.0	74.9
4-mm or deeper gingival pockets	0.2	0.9	11.0	0.2	1.0	6.9	0.1	0.6	3.9	0.04	0.4	1.6

gingival pockets did not correlate significantly with the frequency of toothbrushing. Both the frequency of toothbrushing and dental visits correlated ($P < 0.001$) with a higher socioeconomic background.

Discussion

The six surveys of the dental health conditions of Finnish Defence Forces recruits extending over 70 years, 1919–91, offer a unique opportunity to assess the changes in their oral treatment needs, to evaluate the effects of oral health services received before entering the national service, and to monitor the many socio-economic changes in society. As early as in 1919, 90% of the Finnish recruits starting their military service had experienced dental caries. The total amount of caries experienced per man tripled from 1919 to 1976. The need for caries treatment measured by the number of decayed teeth per man clearly began to decline from the year 1965. Dental care was at that time concentrating mainly on reparative treatment, which was reflected in a doubling of the mean number of filled teeth per man from 1965 to 1976. From 1976 the mean number of sound (intact) teeth per recruit continued to increase. DMFT scores declined for the first time between 1976 and 1981, but the mean number of filled teeth per man (FT) continued to increase further. Not until from 1981 onwards did the FT score also decline rapidly, and the effects of preventive care began to show in the dental status of the recruits.

Asmyhr et al. (7) studied dental health among Norwegian recruits in 1988 and compared the findings with results of earlier studies. The average DMFT score was 19.7 in 1968, 17.2 in 1978, and 12.1 in 1988. The decrease was 39% from 1968 to 1988 and 30% from 1978 to 1988, whereas the corresponding decrease among Finnish recruits was 52% from 1965 to 1991 and 46% from 1976 to 1991. The average DT score of Norwegian recruits was 4.0 in 1968, 1.1 in 1978, but in 1988 again higher, 2.3 teeth per man. In 1988 76.3% of the Norwegian recruits had decayed teeth, as compared with 50% of the Finnish recruits in 1986 and 40% in 1991. A clear decline in mean caries experience and need of caries treatment has been shown also in dental health studies of Australian military personnel. In 1980 the mean DMFT count for 19- to 24-year-old Australian Army personnel was 13.6 with a DT count of 3.4. In 1988 the DMFT count for 19- to 24-year-old Navy recruits was 6.8 with a DT count of 2.3 (11).

Of the reasons behind the improved dental health of the Finnish recruits in the years 1976–91, the rapid development of the accessibility of dental services, the ever-increasing use of fluoride toothpaste, the emphasis on the preventive treatment and health education together with socioeconomic changes were apparently the most effective elements. Before 1972 public dental services in Finland were limited to civic primary school pupils only. From 7 to 11 years of age all children were entitled to free-of-charge services. Those children (approximately 50% of each age class) who continued their studies in secondary school were excluded from school dental care. Pupils staying in primary school were entitled to free dental care up to the age of 15.

In 1972 a new primary health act was passed, and the resources of the public dental services were concentrated on developing the care of children and young people. Newly established community health centers extended dental health care gradually to all children under the age of 19. In 1976 all 0- to 17-year-olds were entitled to incremental dental care in community health centers, in 1978 all 0- to 18-year-olds, and in 1994 all 0- to 19-year-olds. Since 1989, persons born in 1956 or later have been entitled to subsidized dental care in community health centers, or they may choose private services compensated by the national sickness insurance. Veterans of war are entitled to oral health services under the same system. The part of the costs paid by the patient is considerably higher in the private sector than in health centers. Since 1918 medical and dental care have been given free of charge to military conscripts during their national service.

The access to dental services improved substantially as the number of dentists increased. In 1965 the total number of dentists in Finland was 2204, in 1976 the number was 3471, and in 1991, 5451. In 1972, 377

dentists were working in community health centers as compared with 2186 dentists in 1992 (19). In 1981 already 61% and in 1991 76% of the recruits had visited a communal health center regularly every year during an average of 9–12 years. The emphasis in dental care was changed from reparative to preventive with a systematic use of sealants and fluoride preparations. At the same time the increasing frequency of toothbrushing and the ever-growing use of fluoride toothpaste led to an increasing frequency of daily self-administered fluoride applications. During the survey the effect was seen in the changes in the correlation between frequency of toothbrushing and number of intact teeth. Health education and preventive care influenced the awareness of the young men, and the changes in their socioeconomic background from agriculture and forestry to service industries were reflected in the positive development of their attitudes towards dental care.

It could have been expected that the same factors would also have affected the occurrence of periodontal diseases. However, all changes in the periodontal symptoms were not similar. The most severe periodontal findings, 4-mm or deeper periodontal pockets and subgingival calculus, decreased significantly, as did the amount of visible plaque, but the visible (supragingival) calculus and gingival bleeding remained constant during the entire study.

Altogether, the changes in the dental health and treatment needs of Finnish conscripts have been positive. It should be noted, however, that as late as in 1991, 9 of 10 Finnish recruits had experienced dental caries in their permanent teeth when starting their military service. At the same time, 40% of the recruits were in need of caries treatment, and about 75% needed periodontal treatment.

At the beginning of their military service the recruits can easily be reached for oral health surveys in conjunction with screenings for their general and dental health. Further, large-scale cross-sectional age-cohort studies of the type described in the present series of reports can be implemented, using large random samples of young adult males. Such surveys provide an excellent opportunity to obtain reliable and meaningful information about trends in oral health and should remain, preferably as a permanent responsibility of the Defence Forces Dental Services.

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