Acta Odontologica Scandinavica, 2013; 71: 1436–1442

informa
healthcare

ORIGINAL ARTICLE

Prevalence and polarization of dental caries among young, healthy adults: Cross-sectional epidemiological study

TARJA TANNER[1], ANTTI KÄMPPI[1,2,3], JARI PÄKKILÄ[4], PERTTI PATINEN[5], JUKKA ROSBERG[1], KAISA KARJALAINEN[6], MARJO-RIITTA JÄRVELIN[7,8,9], LEO TJÄDERHANE[1,10] & VUOKKO ANTTONEN[1,10]

[1]*Institute of Dentistry, University of Oulu, Finland,* [2]*Institute of Dentistry, University of Helsinki, Finland,* [3]*Dental teaching Unit, City of Helsinki, Finland,* [4]*Institute of Mathematical Science, University of Oulu, Finland,* [5]*Centre for Military Medicine, Finnish Defence Forces, Lahti, Finland,* [6]*Dental Teaching Unit, City of Oulu, Finland,* [7]*Imperial College, London, UK,* [8]*Institute of Health Sciences, University of Oulu, Finland,* [9]*Department of Children, Young People and Families, National Institute for Health and Welfare, Finland, and* [10]*University Hospital, Oulu, Finland*

Abstract

Objective. Oral health of young people has improved in the industrialized countries during past decades. However, stagnation of this progress has been reported recently. The main aim of this epidemiological study was to investigate the level of cariological treatment history and need (DMFT, DT) and polarization of dental caries among a healthy young male population born in the early 1990s. ***Materials and methods.*** Oral health of 13,564 men and 255 women born in 1990, 1991 or 1992 was screened based on the WHO criteria for epidemiological studies by 15 calibrated dentists in 20 garrisons (of a total 24) of the Finnish Defence Forces in January and July 2011. Mean DMFT and DT (SD) values and their distribution were calculated excluding wisdom teeth. Polarization was investigated using the Lorentz analysis. ***Results.*** Mean DMFT, DT and FT values were DMFT = 4.1 (SD = 4.2), DT = 1.4 (SD = 2.5) and FT = 2.7 (SD = 2.9). Almost half of the men (45.1%) and one third of the women (37.3%) had at least one tooth needing restorative treatment. About 30% of the conscripts had 90% of all caries lesions and ~ 10% of the conscripts had half of all lesions. ***Conclusions.*** Oral health of young males has not improved since the previous study among conscripts 15 years ago. Polarization of dental caries still exists. About half of the young male population still has manifested dental caries. Oral health promotion must not be neglected, even in countries with low caries prevalence.

Key Words: *caries prevalence, young adult, polarization, treatment need, screening oral health, epidemiology*

Introduction

Oral health of young people has significantly improved in the industrialized countries during past decades [1]. The decline in caries prevalence has mainly been believed to be due to frequent use of fluoride toothpaste and other topical fluoride products [2]. Recently this decline, however, has shown signs of leveling or even deterioration, particularly in terms of childhood caries [3,4].

Conventional methods, such as removal of plaque with fluoride toothpaste and restriction of sugar consumption, still play an important role in caries control [5,6]. However, dietary habits of young people in particular have undergone changes worldwide during past decades. More processed foods, take-away-type of meals and beverages are consumed than ever before [7]. This kind of a diet can be defined by high intake of refined carbohydrates, added sugars and fats [7]. Brushing teeth twice a day is a common habit among the young in most European countries. However, tooth brushing frequency of young people, and especially boys and men, in Finland has remained among the lowest in Europe. Less than half of them brush their teeth twice a day [8]. Such dietary and oral hygiene habits may cause a threat to the oral health of young adults.

At the beginning of the 1990s, oral health of the young in Finland had reached, and even exceeded, the goal set by WHO (DMF <2 for 12-year-olds) [3].

Correspondence: Vuokko Anttonen, Institute of Dentistry, University of Oulu, POB 5281, 90014, Finland. Tel: +358 40 7137079. Fax: +358 8 5375560. E-mail: vuokko.anttonen@oulu.fi

(Received 8 June 2012; accepted 14 January 2013)

ISSN 0001-6357 print/ISSN 1502-3850 online
DOI: 10.3109/00016357.2013.767932

Therefore, the individual recall system was applied at public health clinics instead of comprehensive, regular dental check-ups. A weak associaton has been reported between prolonged check-up intervals and caries prevalence [9]. In the early 1990s, the economic recession caused a reduction in resources of the public health services, and this reduction was mainly targeted at health promotion.

In Finland, military service is obligatory for men and voluntary for women under 28 years, unless they have any physical or mental disability preventing the military service. Around 25 000 young adults enter the service annually. The military service attendance rate is by far the highest in Finland compared to other countries: 79% of the males in each age cohort complete their service [10], therefore comprising an excellent study group for epidemiological studies. All conscripts have an obligatory general health inspection during their first week of military service, and an oral health examination is a part of it. In earlier decades, Finnish conscripts' oral health has been widely studied by Ankkuriniemi [11] in 1979 and Läärä [12] in 1999 in their doctoral theses. Conscripts have been used as study groups for cariological studies also elsewhere [13–18].

Marthaler [1] in his article on caries prevalence during the past five decades expressed the need for continuous epidemiological research on dental caries prevalence. This study aims to meet that need by investigating the level of cariological treatment history and need (DMFT, DT) among the healthy young male population born in the early 1990s. This study group was born during the time of economic recession and limited resources in oral health. They also faced in their teens changes in dietary culture towards snacking. Another aim was to study if polarization of dental caries among the study population still exists. Recent reports on oral health indicate stagnation in improvement of children's oral health [3,4]. Our hypothesis is that oral health among young males in Finland has deteriorated compared with the results of a study conducted in the late 1990s among a similar study group [12] and polarization has become weaker.

Materials and methods

This epidemiological cross-sectional study was designed in the spring of 2010 and carried out in 20 garrisons health centers (of a total 24) of the Finnish Defence Forces in January and July 2011. Four garrisons were excluded from the study because of the outsourced dental services. However, those garrisons were small, the total number of conscripts serving in them not exceeding 400.

The protocol was piloted in summer 2010 and has been reported [19]. The screening of the conscripts' oral health was carried out as a part of the obligatory general health inspection during the conscripts' first week in the military service. All the dentists working in the Defence Forces, a dentist conscript doing his military service and two external researchers (AK and TT, both DDS) (n = 15) carried out the oral health examinations.

A representative sample of the entire group of draftees in 2011 was achieved by examining all conscripts in 15 garrisons and every fifth conscript in alphabetical order in the five largest garrisons. The study sample was randomized in the five biggest garrisons because of the limited manpower resources for examinations. No one refused, because the clinical examination is obligatory.

All the dental units at the garrison dental clinics were used for the examinations. The dental unit light was used for the examination as well as a probe and an oral mirror. The aim of the oral examination was to record the cariological treatment need of each conscript according to the 1997 criteria for epidemiological studies by WHO [20], excluding wisdom teeth, and following the protocol of the Defence Forces [19]. In borderline cases, the trainees were advised to choose the alternative representing a more severe option. The Mildoc® computer program of the Finnish Defence Forces was used to record the oral findings. Recording findings was carried out by a dental assistant.

The dentists performing the examinations were trained and calibrated at two full-day sessions in November 2010 and June 2011. To ensure that all examiners would have similar knowledge, brush-up lessons were given during the training on the signs of activity and the depth of caries lesions by their clinical appearance. The lessons were available to the examiners throughout the field study on the website of the Institute of Dentistry, University of Oulu, designed for this purpose. Following the lessons, and to practice their diagnostic skills, the dentists determined the treatment need for 30, previously photographed and radiographed, extracted teeth with a variety of caries lesions using the WHO criteria. The same teeth were used in the calibration sessions in November 2010 and June 2011. The photographs and radiographs of the teeth were presented to the trainees as a Power Point presentation on a screen using a PC and a data projector. A consensus about the treatment need for all 30 teeth based on the clinical findings and supported by radiographic ones was achieved among the entire group at both sessions. Treatment need for the teeth recorded by the trainees at both sessions was collected for analyses of inter- and intra-examiner agreement.

Bitewing radiographs were taken of every fifth conscript with clinical indication for radiography or with at least one clinically detected active lesion having penetrated into dentin [21]. Conventional number 2 oral films (Kodak Insight Dental Film®, Eastman Kodak Co., Rochester, NY) and Minray DC SL-9®

X-ray devices (Compare Networks, Inc., San Francisco, CA) were used. The exposure time was 0.28 s. The films were processed in an automatic processor, the Dürr Dental Periomat Plus® (Dürr Dental AG, Bietigheim-Bissingen, Germany) using fresh processing solutions (Periomat Intra). The dentists were advised to use the information on radiographs to support their clinical findings.

In connection with the oral screening, all conscripts entering the examination had an opportunity to answer a computer-based questionnaire developed at the University of Oulu, Institute of Dentistry, Finland, for investigating individual background factors and health behavior, i.e. dietary and oral hygiene habits. Three laptop computers were delivered to each garrison (altogether 43 computers) for this purpose. Answering the questionnaire was voluntary and, by answering it, the conscripts gave their consent to use their personal military records for future studies. Medical trainee conscripts assisted the conscripts with the questionnaire and, after the field survey, delivered the memory sticks with the data to the dentist in charge of the garrison, who delivered them for further analyses.

The postal code of the place of residence of each conscript, as well as the unit and court of the service, i. e. issues connected with the military service, were extracted into separate databases from the Mildoc® system. These data were united with the data of the oral examinations and prepared for analyses. All IDs of the conscripts were excluded from the data before the analyses. The key to the IDs is held by the University of Oulu and the Finnish Defence Forces, as agreed in the Project Agreement between the parties.

Statistical issues

For statistical analyses, only data about the conscripts born in 1990, 1991 or 1992 were investigated. To illustrate the level of treatment need, the mean DMFT and DT (SD) values were calculated for males and females. Data on third molars were excluded from the analyses. The distribution of the DMFT and DT values among both genders was illustrated using bar plots. Because the proportion of the female conscripts is small among the study group, they were excluded from the rest of the analyses. To study the distribution of the DT values among the male conscripts in different DMFT categories, the DMFT values were categorized as follows: $DMFT_1 = 0$, $DMFT_2 = 1$, $DMFT_3 = 2$–4, $DMFT_4 = 5$–9 and $DMFT_5 > 9$ and the categories were illustrated using box plots. Bar plots were also used to illustrate the components of DMFT for all teeth in permanent dentition separately. The frequencies and proportions of filled and decayed teeth were calculated. A Lorentz curve was drawn to describe caries polarization among the male conscripts.

To estimate intra- and inter-examiner agreement on treatment decisions, the examiners estimated treatment need on 30 extracted teeth with a variety of caries lesions in two separate sessions by the criteria of WHO as described above. To describe inter-examiner agreement ICC values (intra-class correlation coefficient) were calculated in both sessions and their means (min, max) are presented. For validation, the consensus treatment decision of the whole group was considered as a gold standard. To investigate intra-examiner agreement of the examiners, ICC values were calculated for the treatment decisions of each examiner in the two calibration sessions and means (min, max) of their values are presented.

All analyses were executed and figures drawn using the SPSS software (versions 16.0 and 18.0, SPSS, Inc., Chicago, IL) and R software (version 2.13.2 Patched. A language and environment for statistical computing; R Foundation for Statistical Computing, Vienna, Austria, URL; http://www.R-project.org).

Ethical considerations

The research plan was evaluated by the Ethical Committee of the Northern Ostrobothnia Hospital District and a positive statement was issued on March 29, 2010. The Center for Military Medicine and the Defence Forces Staff gave the permission for the study in June 2010 (AG14218/June 23, 2010). Here only index (DMFT, DT) data of the conscripts were collected from the Defence Forces database with their permission (register owner), which is considered sufficient in Finland. For the analyses, the IDs were excluded.

Results

The study population consisted of 13 564 men and 255 women born in 1990, 1991 or 1992 (Table I). The total number of conscripts in the military service in 2011 was 26 492 (born in 1983–1993).

Distribution of mean DMFT and DT values

The DMFT index of 21.3 % of the conscripts was 0 (men 21.4 and women 21.2) (Figure 1). The mean DMFT, DT and FT values were 4.1 (SD = 4.2), 1.4 (SD = 2.5) and 2.7 (SD = 2.9), respectively (Table I). Almost half of the men (54.9%) and almost two thirds of the women (62.7%) had no need of restorative treatment (Figure 1). Those with low DMFT (≤4) had only some, if any, restorative treatment need, whereas the treatment need increased with increasing cariological treatment history: among those with DMFT 5–9, the median DT = 2 ($n = 3544$) and among those with DMFT >9, median DT = 5 ($n = 1517$) (Figure 2).

Table I. Distribution of the conscripts according to their gender, service entering month and mean DMFT, DT and FT values.

	Gender		Group		
	Male, *n* (%)	Female, *n* (%)	January, *n* (%)	July, *n* (%)	Total
Year of birth					
1990	1 044 (96.0)	44 (4.0)	631 (58.0)	457 (42.0)	1 088
1991	8 442 (98.7)	111 (1.3)	6119 (71.5)	2434 (28.5)	8 553
1992	4 078 (97.6)	100 (2.4)	256 (6.1)	3922 (93.9)	4 178
Total	13 564 (98.2)	255 (1.8)	7006 (50.7)	6813 (49.3)	13 819
Mean (upper, lower quartile)					
DMFT	4.1 (1, 6)	3.9 (1, 6)	4.3 (1, 6)	3.9 (1, 6)	
DT	1.4 (0, 2)	0.8 (0, 1)	1.5 (0, 2)	1.3 (0, 2)	
FT	2.7 (0, 4)	3.0 (0, 4)	2.8 (0, 4)	2.6 (0, 4)	

Polarization of dental caries

Dental caries lesions were unevenly distributed among the male conscripts. The worst fifth (19.2 %) had at least three decayed teeth. Approximately 30% of the conscripts had 90% of all caries lesions and ~ 10% of the conscripts had half of all lesions (Figure 3).

Tooth-wise distribution of DT-, FT- and MT components

Dental caries lesions were most prevalent in the first and second molars (8.6–12.1%), followed by the upper second premolars (5.3–6.1%), first incisors (5.5%) and lower second premolars (3.4–3.6%) (Figure 4). Teeth in the lower canine-incisor sextant were almost intact (0.2–0.6%) (Figure 4).The first permanent molars and lower second molars were most filled (25.0–30.2%), followed by the upper second molars (19.7–20.8%) (Figure 4). Missing teeth due to dental caries were almost non-existent.

Inter-examiner agreement on treatment need *in vitro* before the field surveys was ICC = 0.733 (min = 0.315, max = 0.846) before January's survey and ICC = 0.717 (min = 0.583, max = 0.861) before July's survey. Intra examiner agreement on treatment need was ICC = 0.717 (min = 0.275, max = 0.935).

Discussion

Military service in Finland provides an excellent opportunity to conduct epidemiological studies on a specific age cohort; here those born in the early 1990s. Hence, a great advantage of the present study is its uniquely large study population, representative of the healthy, young Finnish males in the era after cessation of improvement of caries prevalence. In general, obtaining true random samples is considered difficult [1]. Here, the oral health examination was obligatory and carried out during the first week of the

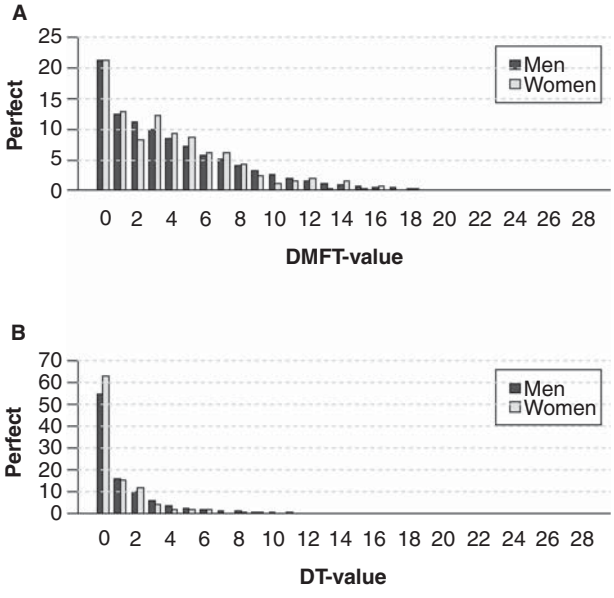

Figure 1. Distributions of DMFT and DT values among male and female conscripts.

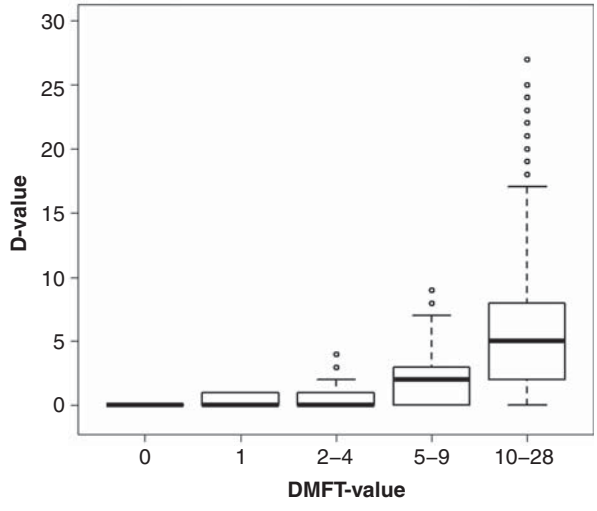

Figure 2. Distributions of DT values in five different DMFT categories.

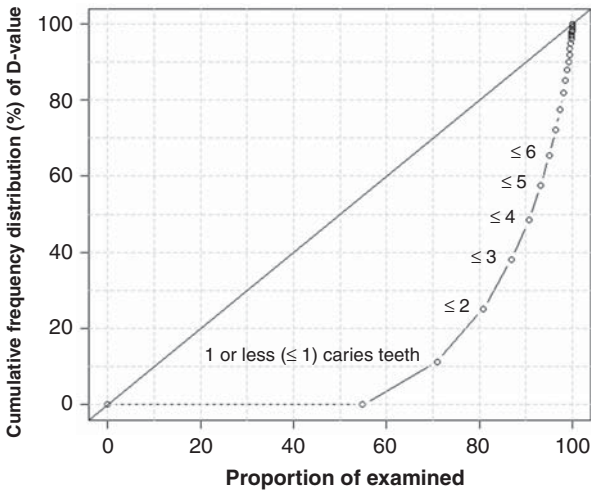

Figure 3. Lorentz curve presenting caries polarization among male conscripts.

military service, which limited the number of drop-outs to non-existent, increasing the validity. Four garrisons were excluded from the study because of the outsourced dental services. However, those garrisons were small, the total number of conscripts serving in them not exceeding 400. Therefore, the bias in the results caused by the exclusion can be considered minimal.

This age cohort have lived their childhood during the economic recession—a time of reduction in dental resources in municipalities targeted to mainly health promotion. In addition they have lived their teens at a time when snacking has replaced meals and consumption of sweet fizzy drinks is common [7]. Brushing once a day is more common among this age group than twice a day. All these factors can be considered risk factors for dental caries [8].

The oral health of those not entering the military service—those with physical or mental limitations or entering civil service instead of the military one—can only be speculated upon. Mental problems are associated with cariological problems, the same is true for those with asthma and juvenile diabetes, which are the large sub-groups set free from the military service [22–24]. Therefore, the situation may actually have been even worse than presented here.. The proportion of those doing civil service (7% of men in that age group) instead of military service has increased in Finland, so investigating their oral health could be a theme for another study [10].

In the present study, almost half of the young men had at least one tooth needing restorative treatment, even with third molars excluded. This figure can be considered high for a population having been entitled to free dental care up to 18 years of age [25]. In the present study, women's mean DMFT and DT values were lower compared to those of men, but FT values were higher, indicating higher dental attendance and treatment rate among females; thus the female conscripts had less treatment need but more treatment history than the males. However, the proportion of the female conscripts is very small among the study group and, since the military service for females is voluntary, they most likely do not form representative sample of oral health and, therefore, generalizations should be avoided. In the Health 2000 survey, the mean DT of men (1.4) was double to that of women (0.7) [26], which are in accord with the findings in the present study (1.4 vs 0.8). The value of radiographs in oral health examination might be the theme of further study; here the radiographs were used to support clinical findings.

In the present study, the mean DMFT value (4.1) was smaller than in the studies by Läärä (6.8) [12] and Ankkuriniemi (15.8) [11]. It must, however, be reminded that the third molars were not included in the present study, whereas in Ankkuriniemi's and Läärä's studies they were. The results are not directly comparable. According to the figures, the proportion of the conscripts with no need for restorative treatment (54.9 %, wisdom teeth excluded) has increased significantly since the 1970s (23.7%), being practically the same as in the 1990s (44%, wisdom teeth included). In the Health 2000 survey [26], the mean DT value for men aged 30–34 was 1.0 and for women 0.3 (third molars not included). Compared to that survey, the cariological situation is worse in our study group, even though the subjects were 10 years younger at the time of the examination than the youngest age group in the Health 2000 survey. This supports the suggested deterioration of oral health of young males. The causes for this can only be speculated upon: the youngest age group in the Oral Health 2000 survey had lived their school age and teens in the 1970s and 1980s, which are regarded as the golden

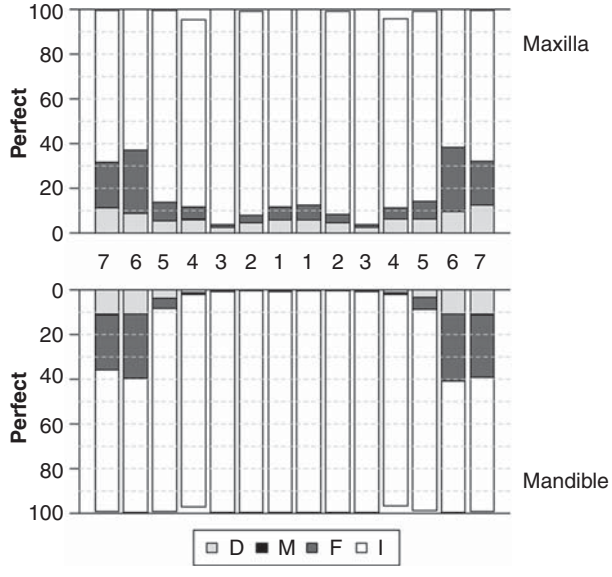

Figure 4. Distribution of DMFT components in permanent dentitions.

era of children's oral health promotion in Finland [3]. In comparison, the present study group lived their childhood at a time of reduced resources for oral health promotion during the economic recession. Good oral health of the young was taken for granted. Simultaneously, the previously mentioned dietary changes took place and tooth brushing frequency has not yet improved.

In the present study, one third of the study group accounted for 90% of all caries burden and, compared to the previous studies, polarization was more pronounced than in Ankkuriniemi's [11] study, but similar to that in the study by Läärä [12]. In the present study, polarization of dental caries was distinctly weaker than in the Health 2000 study [26]. When DMFT values improve, the number of individuals with no cavities increases and polarization becomes more pronounced [27]. The obverse of this appears to be the case in the present study—the increased caries experience leads to less pronounced polarization. In addition, the pattern of distribution of intact, filled, decayed and removed teeth in the present study are in accord with findings in the literature [11,28].

Mandatory military service similar to that in Finland still exists in Israel, Greece and Turkey, but has been replaced by volunteer military systems in most Western countries [10]. According to the results of the present study, caries prevalence among Finnish conscripts is at the same level as among conscripts in Brazil [13] and in Australia [16], but better than among conscripts in Israel [17], in Turkey [14], in Croatia and among police students in Hungary [15].

Screening of dental treatment need of the conscripts entering the service has been part of the Defence Forces' protocol and thus easily converted into a survey by training and calibrating the examiners and introducing them to the WHO criteria for epidemiological studies [20]. Almost all examiners were experienced and familiar with the protocol and criteria, which helped to manage the tight schedule. They showed good intra- and inter-examiner agreement in their treatment decisions, reinforcing the validity of this study. It might have been valuable to use clinical calibration. However, the use of a clinical golden standard during the examinations would have been impossible due to distances between the garrisons. Hausen et al. [29] have reported that data, large enough, collected from public health records (of non-calibrated examiners) are not inferior to those obtained from examinations by calibrated examiners. In Ankkuriniemi's [11] survey, calibration was carried out clinically, but in Läärä's [12] survey, calibration was not done at all.

It can be concluded that the present study offers epidemiological data from an era subsequent to that when the cariological situation had been continually improving..Our findings suggest stagnation in the improvement or even deterioration of the cariological status of the healthy, young adult, male population, despite dental care being free of charge to all under 18s. Caries burden still was polarized among the study group. Yet, polarization was weaker in this study than in a previous national survey [26],,as one might expect given the apparently higher caries level. We know that the health habits of young Finnish males do not support good oral health, and therefore caries control will be challenging in the future. That is why new ways for oral health promotion targeted in particular to men should be developed and studied. During the field survey of the present study, we have collected specific data not only on oral health but also on health behaviour of this study group. Our valuable data provide the possibility to investigate health behavioural patterns associated with oral health among the young. We hope that this information facilitates ways to maintain and promote oral health of the young in our country and elsewhere. Good oral health promotes good general health.

Acknowledgments

We gratefully acknowledge the dental staff at the dental clinics of the Finnish Defense Forces for their enthusiasm and work in conducting the field survey, as well as the medical conscripts for their assistance. We also want to express our thanks to Mrs Mari Saario at the Centre for Military Medicine, Finnish Defence Forces for her co-operation in collecting data. We are grateful to Mr Matti Paadar for his work in getting the computers needed for the field survey. We also thank Dr Ahti Niinimaa for his contribution in developing the computer program used in this study and preparing the computers for delivery. We appreciate the time and effort given by Mr Juhani Vänttilä and Mr Eino Kemppainen for delivering the computers to the garrisons in December 2010. Golgate Gaba in collaboration with the Finnish Dental Society Apollonia, as well as the society of the Finnish Female Dentists supported the study by grants to TT and VA. Also the Finnish Association for Dentists in Public Health supported the study by a grant to TT.

***Declaration of interest*:** The authors report no conflicts of interests. The authors alone are responsible for the content and writing of the paper.

References

[1] Marthaler TM. Changes in dental caries 1953–2003. Caries Res 2004;38:173–81.

[2] Seppä L, Kärkkäinen S, Hausen H. Caries frequency in permanent teeth before and after discontinuation of water fluoridation in Kuopio, Finland. Community Dent Oral Epidemiol 1998;26:256–62.

[3] Nordblad A, Suominen-Taipale L, Rasilainen J, Karhunen T. Oral health care at Health Centers from the 1970's to the year

2000. Saarijärvi, Finland: Gummerus; STAKES Reports (National Institute for Health and Welfare, NIHW); 2004; Finnish with an English summary.

[4] Pitts N, Chestnutt I, White D, Chadwick B, Steele J. The dentinal caries experience of children in the United Kingdom, 2003. Br Dent J 2006;200:313–20.

[5] Ellwood R, Fejerskov O, Cury J, Clarkson B. Fluorides in caries control. In Fejerskov O, Kidd E, editors. Dental caries. 2nd ed. Oxford: Blackwell Munksgaard; 2008. p 288–327.

[6] Zero D, Moynihan P, Lingstrom P, Birkhead D. The role of dietary control. In Fejerskov O, Kidd E, editors. Dental caries. 2nd ed. Oxford: Blackwell Munksgaard; 2008. p 329–52.

[7] Popkin B, Adair L, Ng S. Global nutrition transition and the pandemic of obesity in developing countries. Nutr Rev 2012; 70:3–21.

[8] Currie C, Gabhainn S, Godeau E, Roberts C, Smith R, Currie D, et al. Inequalities in young people's health: health behavior in school-aged children (HBSC) International report from the 2005/2006 survey. Copenhagen, Denmark: World Health Organization regional office for Europe; 2008; ISBN 978 92 890 7195 6.

[9] Suominen-Taipale AL, Widström E, Sund R. Association of examination rates with children's national caries indices in Finland. Open Dent J 2009;3:59–67.

[10] Siilasmaa R, Ahtisaari M, Ala-Pietilä P, Junger M, Komi K, Ojajärvi A, et al. Finnish mandatory military service. A report. Helsinki, Finland: Ministry of Defense; 2010; ISBN: 978-951-25-2135-7 nid. [in Finnish] ISBN: 978-951-25-2136-4.

[11] Ankkuriniemi O. The dental status and need for dental treatment among Finnish conscripts [dissertation]. Finland: Helsinki University; 1979; ISSN 0300-8789.

[12] Läärä M. Polarization of dental caries and the explanatory background factors in a Finnish conscript population [dissertation]. Finland: Turku University; 1999; ISBN 951-29-1423-9.

[13] Bastos JL, Nomura LH, Peres MA. Dental caries and associated factors among young male adults between 1999 and 2003 in Southern Brazil. Community Dent Health 2007;24:122–7.

[14] Ceylan S, Acikel CH, Okcu KM, Kilic S, Tekbas OF, Ortakoglu K. Evaluation of the dental health of the young adult male population in Turkey. Mil Med 2004;169:885–9.

[15] Farago I, Nagy G, Marton S, Tury F, Szabo E, Hopcraft M, et al. Dental caries experience in a Hungarian police student population. Caries Res 2012;46:95–101.

[16] Hopcraft MS, Yapp KE, Mahoney G, Morgan MV. Dental caries experience in young Australian Army recruits 2008. Aust Dent J 2009;54:316–22.

[17] Levin L, Shenkman A. The relationship between dental caries status and oral health attitudes and behaviour in young Israeli adults. J Dent Educ 2004;68:1185–91.

[18] Skec V, Macan JS, Susac M, Jokic D, Brajdic D, Macan D. Influence of oral hygiene on oral health of recruits and professionals in the Croatian Army. Mil Med 2006;171: 1006–9.

[19] Anttonen V, Tanner T, Kämppi A, Päkkilä J, Tjäderhane L, Patinen P. A methodological pilot study on oral health of young, healthy males. Dent Hypotheses 2012;3:106–11.

[20] World Health Organization. Oral health surveys – basic methods. 4th ed. Geneva: World Health Organization; 1997. p 39–44. Available online at http://www.mah.se/CAPP/Methods-and-Indices/for-Measurement-of-dental-diseases/Extracts-from-WHO-Oral-Health-Surveys/Dentition-status/.accessed 10 November 2010.

[21] Hausen M, Alaluusua S, Alalnen P, Anttonen V, Hiiri A, Jokela J, et al. Evidence based guidelines for controlling dental caries. Finn Dent J 2009;5:1–29.

[22] Kisely S, Quek LH, Pais J, Lalloo R, Johnson NW, Lawrence D. Advanced dental disease in people with severe mental illness: systematic review and meta-analysis. Br J Psychiatry 2011;199:187–93.

[23] Twetman S, Johansson I, Birkhed D, Nederfors T. Caries incidence in young type 1 diabetes mellitus patients in relation to metabolic control and caries-associated risk factors. Caries Res 2002;36:31–5.

[24] Alavaikko S, Jaakkola MS, Tjäderhane L, Jaakkola JJ. Asthma and caries: a systematic review and meta-analysis. Am J Epidemiol 2011;174:631–41.

[25] Ministry of Social Affairs and Health, Finland. Primary Health Care Act (66/1972).1972. Available online at www.finlex.fi/fi/laki/577alkup/1992/19920912. accessed 30 January 2013.

[26] Suominen-Taipale L, Nordblad A, Vehkalahti M, Aromaa A. Oral health of Finnish adults. Health 2000 survey. Helsinki, Finland: NIHW; 2004; In Finnish with English abstract.

[27] Sheiham A, Sabbah W. Using universal patterns of caries for planning and evaluating dental care. Caries Res 2010;44:141–50.

[28] Batchelor PA, Sheiham A. Grouping of tooth surfaces by susceptibility to caries: a study in 5-16 year-old children. BMC Oral Health 2004;4:2.

[29] Hausen H, Karkkainen S, Seppä L. Caries data collected from public health records compared with data based on examinations by trained examiners. Caries Res 2001;35: 360–5.