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ORIGINAL ARTICLE

The frequency of enamel and dentin caries lesions among elderly Norwegians

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ABSTRACT

Aim: To describe the distribution of enamel-, dentin-, root- and secondary caries within an elderly population in Northern-Norway.

Material and methods: A study population ($n = 1\ 173$) was divided into age groups: 65–69 (seniors), 70–74 (young elderly), 75–79 (elderly) and 80–94 (old elderly). Seven examiners registered presence, location and severity of caries lesions on x-rays and intra-oral photos. Severity of approximal, occlusal, secondary and root caries was graded (D_{1-2}: into enamel; D_{3-5}: into dentin, root caries), and decayed missing filled surfaces/teeth (DMFS/DMFT) were calculated. T-test, ANOVA and a Bonferroni correction were used.

Results: The seniors had more primary caries (DS_{1-5}) compared to the oldest age groups, while the old elderly had significantly more secondary caries than the other groups ($p < .05$). Of those ≥65 years 13.8% were affected with root caries, 21% among the oldest. About 48% of the old elderly had one or more surfaces with untreated caries lesions into dentin, while for the other groups the number was 35% ($p < 0.05$).

Conclusion: Individuals seem to maintain good oral health up to at least 80 years of age. Those older than 80 years have more root caries needing more intensified caries-controlling measures and a higher prevalence of untreated dentin lesions often in need of operative treatment.

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Caries prevalence; elderly; root caries; secondary caries

Introduction

The world is facing a situation with a higher proportion of older people than ever before. In Norway out of the total population of ≈5.2 mill people in 2017, 12.4% were between 65 and 79 years, and 4.2% were ≥80 years old. Prognoses indicate that 20% of the population will be more than 70 years in 2060 [1]. Increasing numbers of older adults maintain their natural teeth, which are often restored with fillings or crowns and bridges. These individuals need continuous preventive, restorative, and periodontal services throughout their retirement years. The World Health Organization (WHO) set a goal that 50% of the elderly (≥65 years old) should have more than 20 remaining teeth in 2000 [2].

As knowledge about oral health status among the elderly population in Norway is scarce, little is known whether oral health data meet these goals [3]. However, recording prevalence and distribution of disease in the population is a prerequisite to plan prevention, treatment and follow-up of interventions.

A review and a systematic analysis study reported higher prevalence of untreated caries among older populations as a global trend [4] with a peak in caries incidence at 70 years. Recent findings among 20–79-year-olds in Norway report the contrary; the prevalence of primary caries was highest in the youngest part of that population [5]. In that study both enamel and dentin lesions were recorded, which could explain the different findings from the published global trend. The caries distribution was particularly skewed in the two oldest age groups (50–64 and 65–79); 20% of the population carried 80% of the caries burden [5]. In a Swedish study of the period 1973–2013, an increase in decayed and filled teeth (DFT) among the 70-and 80-year-olds was found. This was explained by the increasing number of remaining teeth [6]. Also, in that study both enamel and dentin lesions were recorded.

Several previous cross-sectional studies [7–9] have used cavitation level as the diagnostic threshold for dental caries registration, according to the diagnostic criteria defined by the WHO [10]. However, diagnostic thresholds, registering only dentin caries and excluding enamel lesions cause an underestimation of the caries prevalence in the population studied. Consequently, comparing prevalence studies may be difficult. Even more important, planning non-operative caries treatment, and recording lesion progression will be impossible. In order to determine the level of untreated caries in the elderly populations, it is important also to record secondary- and root caries, as caries prevalence is often associated with restorations or exposed root surfaces in this age group.

Recent Norwegian population studies from 2018 (Norwegian Public Health Institute) (www.fhi.no/publ/) have shown that individuals aged 65 to 74 years have lower prevalence of general disease and use less prescriptions than older seniors, i.e.

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>75 years old. In the population, mortality caused by heart conditions and diabetes are postponed to higher age groups than previously (www.fhi.no/publ/). It is of interest to investigate whether a change in oral health status follows the general health trend in the Norwegian population.

Therefore, the aim of the present study was to describe the distribution of enamel-, dentin-, root- and secondary caries within an elderly population in Northern-Norway.

Material and methods

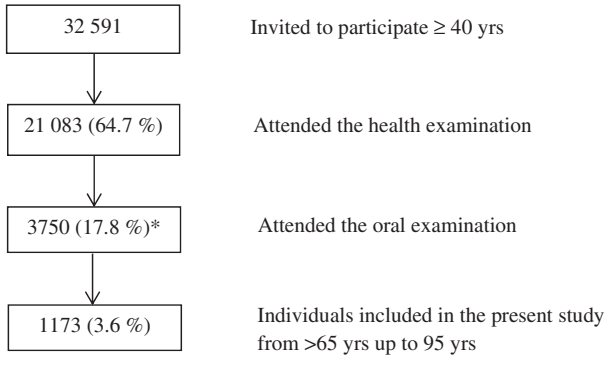
Population

This study was part of a more comprehensive health survey carried out for the seventh time in Tromsø (Tromsø 7), Northern Norway [11]. All data were collected between March 2015 and November 2016. Tromsø (69.4°N: 70,358 inhabitants) is the administrative center of the Troms county and is a center for education, commerce and transportation. Figure 1 shows the study population. The individuals attending the examination were all living at home, and they came to the health examination in randomized order. The two first individuals every hour were then asked to participate in an oral health examination, and only three refused to participate.

The present study refers to the elderly age group, from 65 years old and up to 94 ($n = 1173$) (Figure 1). To visualize the difference between age groups, the study population was sub-divided into the following age groups: 65–69 (seniors), 70–74 (young elderly), 75–79 (elderly) and 80–94 (old elderly). To be able to make comparison with a younger age group, individuals being 60–64 years old (middle age group) were included for reference.

Ethical perspectives

The data collection in Tromsø 7, including the oral health examination was performed according to the guidelines from The Norwegian Social Science Data Services (NSSDS) and The Regional committee for medical and health research ethics (REK); REK Nord 10.02.2015 ref.2014/940. The individuals gave written consent to participate in the study. They were at all times free to deny the use of their own data in the research projects leading to exclusion from the analyses.



*The edentulous (n=108) were not included.

Figure 1. Study population included in the study.

For the oral health part of Tromsø 7, each participant received a dental examination free of charge and personal information about treatment needs related to findings during the examination. The participants, who did not visit a dentist on a regular basis, were presented a list with all private- and public dental health clinics, willing to take care of their dental care needs.

Oral health examination

The screening of oral health status consisted of a clinical examination at the research station, including pocket depth probing, one orthopantomogram (OPG), 4 bite wing x-rays (BWs) and 8 close-up clinical intra oral digital photos of all teeth (Canon EOS 60D, Canon 105 mm; Sigma EM-140 DG). Third molars were excluded from analysis. OPG was used to assess radiographic bone level.

Prior to study start all ($n = 8$) dental hygienists, who collected the data at the research station, were trained by an experienced dentist to take valid x-rays and standardized clinical photos. The clinicians repeated the examination procedures twice during the study period, to secure high quality of data.

Examiner reliability

Seven experienced dentists registered dental caries based on examination of BWs and clinical intra oral photos.

Prior to the registration of caries severity, all dentists were calibrated on 64 surfaces on both BWs ($n = 39$) and clinical photos ($n = 25$). The applied registration system is described below.

Caries registration

The seven calibrated dentists registered the presence, location and severity of caries lesions strictly based on visual examination of BWs and intra-oral photos in a computerized protocol Carestream-T4 (Carestream Dental AB, Stockholm, Sweden).

For registration of approximal and occlusal caries on BWs a five-graded (D_{1-2}: decay into enamel; D_{3-5}: decay into dentin) diagnostic scale was used [12]. For occlusal, buccal and lingual clinical caries registrations on photos a five-graded caries decay system including a picture illustration guide was applied [13].

In addition to the primary caries lesions, the presence, severity and location of the root and secondary caries lesions were registered. The root caries severity was graded D_{3-5} since the root caries lesions are present in cementum/dentin only, while secondary caries was registered and graded D_{1-5}. The number and type of teeth present, missing (M) and filled (F) were also included. Caries experience decayed missing filled surfaces/teeth (DMFS/DMFT) were thereafter calculated.

Statistics

The statistical analyses were performed with IBM® SPSS® Statistics 24 (Armonk, NY). Bivariate analyses were conducted to identify differences between caries prevalence, gender and age, using *t*-test and one-way analysis of variance (ANOVA). As there were multiple comparisons in the ANOVA test, a Bonferroni correction of significant levels was made to protect against type 1 errors. The level of significance was set to 5% throughout.

Calibration of the examiners

The calibration of the dentists was assessed measuring inter-examiner and intra-examiner agreement by weighted Cohen's kappa (κ_w). The statistical analysis for the κ_w was calculated using a spreadsheet programme (Microsoft Excel, Microsoft Corporation, Redmond, WA). Cohen's kappa was rated as suggested by Landis and Koch [14]: <0.40; 0.41–0.60; 0.61–0.80; 0.81–1.0. For the calculation of the intra-examiner agreement, a re-examination of the x-rays and intra-oral photos was performed 14 d after the initial examination.

Results

The results of the present study are presented in Tables 1–5.

Examiner reliability

The mean inter-examiner and intra-examiner agreement for the seven dentists both for x-rays and clinical intra-oral photos was $\kappa_w = 0.70$ and $\kappa_w = 0.81$, respectively. The values indicated substantial agreement and very good level of agreement, respectively [14].

Remaining and intact teeth

The seniors (65–69-year-olds) had on average 21.9 remaining teeth; 1.6 teeth more than in the age group 70–74, which again had 2.5 teeth more than in the 75–79 age group. The number of intact teeth was nearly the same in the age groups 65–69 and 70–74. In the oldest age group (80–94), a

Table 2. Percentage distribution (%) of secondary caries surfaces into enamel; Sec_{1-2}

	Participants	Number of secondary caries-surfaces$_{1-2}$ (percent)				
Age group	*n*	0	1	2	3	4 to 6
Elderly group						
65–69	471	91.7	5.8	2.1	0.4	0.0
70–74	347	91.9	5.5	0.9	1.4	0.3
75–79	205	97.5	1.0	1.0	0.5	0.0
80–94	150	88.6	6.7	2.0	1.3	1.4
Middle-aged						
60–64	539	90.9	6.7	1.1	0.4	0.9

Table 1. Number of carious surfaces and teeth on enamel and dentin level in relation to age and gender.

SURFACE LEVEL	*n*	DMFS Mean (SD	DFS Mean(SD)	DS_{1-2} Mean (SD)	DS_{3-5} Mean (SD)	DS_{1-5} Mean (SD)	Sec_{3-5} Mean(SD)	Sec_{1-5} Mean(SD)	$DS_{1-5\ +\ sec}$ Mean (SD)	$RootS_{3-5}$ Mean (SD)
ALL	1173	84.4(25.3)	46.3 (23.3)	0.24 (0.7)	0.33 (1.2)	0.6 (1.4)	0.3 (0.8)	0.4 (1.1)	1.0 (1.3)	0.4 (1.4)
GENDER										
Men	552	82.5 (25.8)*	44.5 (22.7)	0.3 (0.7)	0.5 (1.5)*	0.8 (1.7)*	0.3 (0.9)	0.5 (1.1)	1.3 (1.5)*	0.6 (1.8)*
Women	621	86.0 (24.8)	47.9 (23.8)	0.2 (0.6)	0.2 (0.8)	0.4 (1.1)	0.3 (0.8)	0.4 (1.0)	0.8 (1.6)	0.3 (1.2)
AGE										
*60–64***	*539*	*68.5 (23.8)*[a]*	*50.1 (19.5)*	*0.3 (0.8)*	*0.4 (1.2)*	*0.7 (1.6)*	*0.3 (0.8)*	*0.4 (1.1)*	*1.1 (1.3)*	*0.4 (1.1)*
65–69	471	78.9 (24.8)*[a]	49.5 (23.0)	0.3 (0.7)	0.4 (1.5)	0.7 (1.7)	0.3 (0.8)	0.4 (0.9)	1.1 (1.3)	0.4 (1.4)
70–74	347	84.2 (24.6)*[b]	47.1 (22.9)*[a]	0.3 (0.7)	0.3 (1.1)	0.6 (1.4)	0.3 (0.8)	0.4 (1.0)	1.0 (1.2)	0.5 (1.5)
75–79	205	90.5 (23.7)*[c]	41.6 (23.5)*[e]	0.2 (0.5)	0.3 (1.0)	0.5 (1.2)*[e]	0.3 (1.0)	0.4 (1.1)	0.9 (1.1)	0.5 (1.5)
80–94	150	93.5 (26.3)*[d]	40.1 (23.2)*[f]	0.2 (0.6)	0.3 (0.7)	0.5 (0.9)	0.4 (0.8)	0.6 (1.3)*[a]	1.1 (1.1)	0.7 (1.9)*[a]
TEETHLEVEL	*n*	Number-T Mean (SD)	Intact-T Mean (SD)	DMFT Mean (SD)	DFT Mean (SD)	FT Mean (SD)	DT Mean (SD)			
ALL	1173	20.1 (6.9)	5.9 (4.8)	22.1 (4.8)	14.11 (6.2)	14.0 (6.3)	0.2 (0.6)			
GENDER										
Men	552	20.0 (6.8)	6.2 (4.9)*	21.8 (4.9)	13.8 (6.1)	13.6 (6.2)	0.3 (0.8)*			
Women	621	20.1 (7.0)	5.6 (4.7)	22.4 (4.7)*	14.4 (6.3)	14.4 (6.4)	0.1 (0.5)			
Age										
*60–64***	*539*	*24.2 (4.7)*[a]*	*7.8 (4.8)*[a]*	*20.3 (4.8)*	*16.4 (5.3)*	*16.3 (5.3)*	*0.3 (0.8)*			
65–69	471	21.9 (6.2)*[a]	6.5 (4.9)	21.5 (4.9)	15.3 (6.1)*[a]	15.2 (6.1)*[a]	0.2 (0.7)			
70–74	347	20.3 (6.5)*[a]	6.1 (4.6)	21.9 (4.6)	14.1 (5.9)*[b]	14.0 (6.0)	0.2 (0.6)			
75–79	205	17.8 (7.5)*[a]	5.1 (4.3)	22.9 (4.3)	12.7 (6.5)*[e]	12.6 (6.5)*[e]	0.2 (0.5)			
80–94	150	16.9 (7.3)*[a]	4.6 (5.1)*[f]	23.4 (5.1)*[f]	12.2 (6.3)	12.2 (6.4)	0.3 (0.6)			

*$p < .05$.
[a]significant differences with all other age groups.
[b]significant differences between 70–74 years old and all other age groups.
[c]significant differences between 75 and 79 years old and all other age groups.
[d]significant differences between 80 and 84 years old and all other age groups.
[e]significant differences between all other age groups except 80–94 years old.
[f]significant differences between all other age groups except 75–79 years old.
DS_{1+2} = Enamel caries grade 1–2; DS_{3-5} = Dentin caries grade 3–5; DS_{1-5}= Enamel and dentin caries grade 1–5; Sec_{3-5} = secondary caries grade 3–5; Sec_{1-5} = secondary caries grade 1–5; $DS_{1-5+sec}$ = Enamel-, dentin caries grade 1–5 and secondary caries 1–5. $RootS_{1-5}$ = Dentinal Caries on root surfaces. Intact teeth = no fillings or dentin caries.
**The middle-aged group (*60–64*), just inserted for comparison with the elderly groups and not included in All.

marked reduction in number of intact teeth was registered (Table 1).

The mean number of remaining teeth showed no significant gender differences for individuals of 65 years or older. However, men had significantly more intact teeth than women (Table 1).

Removable dentures and implants

In the present population of individuals being ≥65 years old with remaining teeth, 7.4% had removable denture in the upper jaw, and 0.3% in the lower jaw. Only individuals in the age group 65–69 years ($n = 471$) had dental implants ($n = 213$), women having a slightly higher number than men (115 vs. 98). The range was from 1 to 12 implants, and the mean number was 2.6.

Caries experience

Mean caries experience (DMFT) was 22.1. There was significantly higher DMFT among women who had significantly fewer decayed teeth, but a higher number of filled teeth than men (Table 1).

The mean number of surfaces with primary and secondary caries severity (DS_{1-5}) was 1.0 (Table 1). Men had 2.5 times more primary dentin caries (DS_{3-5}), and two times more surfaces with root caries (RC_{3-5}) compared to women (Table 1).

Primary caries

Prevalence of primary caries (DS_{1-5}) was the same in the middle age group (60–64) and the senior group (65–69) (mean 0.7), but they both had more primary caries compared to the two oldest age groups (mean 0.5) (Table 1).

The mean number of primary caries restricted to the enamel (DS_{1-2}) was nearly the same in all age groups except the oldest (75–94) who had slightly fewer such lesions (Table 1).

Secondary caries

The mean number of teeth with secondary caries (Sec_{1-5}) among the whole population was 0.4, with no gender difference (Table 1). Secondary caries (Sec_{1-5}) was evenly distributed among all age groups and similar to the middle age group (60–64). However, the old elderly group (80–94) had significantly more teeth affected (0.6) (Table 1).

Table 2 shows that Sec_{1-2} (restricted to enamel) was most prevalent among the old elderly (80–94) 11.4%, while age group 75–79 showed the prevalence of 2.5%. The prevalence of secondary caries in dentin (Sec_{3-5}) was about 15% for all participants from 65 to 79 years. However, for those older than 80, the prevalence was 24% (Table 3). Table 3 shows a detailed distribution of dentinal secondary caries surfaces in the different age groups.

Root caries

Root caries ($RootS_{3-5}$) was found in 162 (13.8%, $n = 1173$) patients being 65 years or older, and this prevalence was almost similar to the prevalence in the middle age group (16%). However, significantly more root caries was found in the oldest age group (21%). For all the groups, overall mean number of surfaces with $RootS_{3-5}$ was 0.4 (significantly more in males (0.6) than in females (0.3)) (Table 1). The oldest individuals (80–94) had mean $RootS_{3-5}$ (0.7) compared to the younger age groups (0.4–0.5) (Table 1).

Table 3. Percentage distribution (%) of dentinal secondary caries surfaces; Sec_{3-5}.

Age group	Participants *n*	Number of secondary caries surfaces$_{3-5}$ in percent				
		0	1	2	3	4 to 8
Elderly group						
65–69	471	84.1	8.8	4.5	1.3	1.3
70–74	347	82.7	10.4	3.2	1.7	2.0
75–79	205	84.3	6.3	5.4	2.0	2.0
80–94	150	76.0	14.0	5.4	3.3	1.3
Middle-aged						
60–64	539	85.2	8.8	2.5	1.9	1.6

Table 5. Percentage distribution (%) of untreated dentinal caries surfaces; DS_{3-5} + Secondary caries$_{3-5}$ + Root Caries$_{3-5}$ in the elderly (age 65–94 year) and the middle-aged group (age 60–64 year).

Age group	Participants *n*	Number of dentinal caries-surfaces (percent)						
		0	1	2	3 to 4	5 to 6	7 to 10	11 to 32
Elderly group								
65–69	471	65.8	15.3	6.0	6.6	2.4	2.7	1.2
70–74	347	65.6	14.2	6.5	6.5	2.9	3.4	0.9
75–79	205	65.2	12.2	7.8	7.3	2.5	4.5	0.5
80–94	150	52.4	17.6	12.2	7.5	6.1	2.7	1.5
Middle-aged								
60–64	539	63.1	16.7	6.3	7.4	3.6	1.9	1.0

Table 4. Percentage distribution (%) of dentinal root caries surfaces; $RootS_{3-5}$.

Age group	Participants *n*	Number of dentinal root caries surfaces$_{3-5}$ in percent)					
		0	1	2	3 to 5	6 to 8	9 to 14
Elderly group							
65–69	471	85.2	7.9	1.7	3.8	1.4	
70–74	347	83.1	5.9	5.5	3.7	0.9	0.9
75–79	205	84.8	6.3	2.9	2.5	3.0	0.5
80–94	150	79.1	7.3	5.3	4.1	2.8	1.4
Middle-aged							
60–64	539	84.0	8.0	3.5	3.0	1.1	0.4

Number of affected surfaces increased with age: e.g. 1.4% of individuals being 80–94 years had 9–14 surfaces with root caries, while none of the individuals in the senior group (65–69) had that many affected surfaces (Table 4).

Dentin caries

About 35% of individuals in each of the age groups (65–79) had one or more surfaces with caries lesions into dentin (primary, secondary or root caries). In the middle age group, 60–64, about 37% had the same number of caries lesions. However, in the oldest age group (80–94), nearly 48% ($n = 71$) had one or more untreated caries lesions; while 30% had two or more untreated lesions (Table 5).

Discussion

To be able to plan resource allocation for non-operative activities, there is a need to understand the present situation regarding oral health status among the elderly. Presenting detailed caries registrations for all severities of lesions gives the opportunity to discriminate between different treatment options: those lesions dentists suggest for operative treatment and those they suggest for non-operative caries treatment. Treatment principles outlined in the FDI (International Dental Federation) statement on Minimal Intervention Dentistry [15] aim to base treatment of caries and oral disease on the understanding of the caries process and disease control. [16]. Today, it is recognized that early lesions, i.e. caries grade 1–2, and in some cases grade 3, should be treated without operative measures, since there is strong evidence that such lesions can be arrested [17]. To be able to plan non-operative measures, treatment and recall intervals, it is important to register and grade initial caries lesions, as well as the more severe dentin lesions. To disclose the number of enamel lesions could motivate the clinicians to non-operative treatment, which is in accordance with new concepts of modern caries treatment [18].

Due to time restrictions at the research station, dental hygienists at the station were trained to take high quality intra oral pictures with close up images of all dental surfaces. Afterwards, trained dentists registered dental caries on both clinical photos and BW radiographs. Advantages of using clinical photos for recording dental caries are; no time restriction, possibility to magnify the lesions and directly compare with the pictorial manual used for registrations. A main limitation of the present study was that the probing was not possible. No tactile examination leaves the examiner without a proper assessment of caries activity (active/inactive lesions), which are important information to base treatment decision on. Other limitations are; the view perspective cannot be changed and some approximal caries lesions may be visually overlooked and only detected radiographically.

The results show that the presence of both primary and secondary caries restricted to enamel was low. Though, not directly comparable due to different research protocol, a considerably higher prevalence of enamel lesions was found in a young age group (20–34) in the study from Northern Norway [5]. On average, 5.4 surfaces with primary caries in enamel were registered among the 20–34-year-olds compared with 0.3 (65–74 year-olds) and 0.2 (75–94 year-olds) in the present study. Previous treatment philosophy, treating enamel lesions operatively, left only a few approximal enamel lesions untreated [19]. Nowadays, in adolescents and young adults, high prevalence of enamel lesions is an indication for non-operative measures.

The prevalence of primary dentin lesions ($DS_{3–5}$) in the present study was low in all age groups. In the study from Northern Norway, a higher proportion of the young individuals had dentin lesions, 1.5 and 0.8 in the age groups 20–34 and 35–49, respectively [5]. The reason for this may be that the individuals in the older age groups have more filled and extracted teeth than the younger.

Worldwide, untreated caries in permanent teeth was the most prevalent oral condition in 2010, affecting 35% of the global population [4]. All dentin lesions ($DS_{3–5} + Sec_{3–5} + Root_{3–5}$) should be defined as untreated caries, as operative treatment may be indicated. It has been suggested that the prevalence of untreated caries reach a peak at age of 25 years, and thereafter there is a second peak later in life (around 70 years of age) [4]. The prevalence of such lesions among the present population was almost 35% in the age groups up to 79 years, 37% among the 60–64 year-olds and nearly 48% among the old elderly (80–94) indicating considerable need for treatment among the oldest. In addition, treatment of enamel lesions, usually using non-operative methods, is important for arresting caries activities.

Relatively high occurrence of root caries was found in the present study. Lopez et al. [20] summarized studies on prevalence of root caries from different countries. The majority of these studies included individuals aged $\geq$60 and prevalence from 12% to 77% was reported, illustrating the magnitude of root caries existence. However, there are only a few prevalence studies in Norway reporting such lesions. Henriksen and co-workers [21] found a prevalence of root caries to be 14% among 394 elderly people $\geq$67 years of age. In one other cross-sectional study involving 135 participants (mean age 85.7, SD 8.8 years) 24% had root or coronal–root caries [22]. These values correspond with the findings in the present study. Schwendicke et al. [23] defined a young senior group as those being between 65 and 74 years of age, and they found a lower root caries experience (i.e. filled and unfilled root caries lesions together) in that group compared to older individuals. Though, this was a longitudinal study and not comparable with the present study, it proves a changed caries burden among the youngest elderly during the last 17 years.

In Sweden, Norderyd et al. 2015 [6] found the prevalence of secondary caries to be 1%, 1.2% and 2.7% among 60-, 70- and 80 years-old, respectively. However, data from Northern Norway by Oscarson et al. [5] reported a higher prevalence of secondary caries than the Swedish study, and nearly the same prevalence as found in the present study. Recording both secondary caries lesions restricted to enamel and those into dentin, which was done in this study, makes it easier to plan different treatment options. Among the old elderly

group (80–94), 24% had secondary caries into dentin, and were therefore, in need for repair or replacement of restorations. One should also be aware of the fact that about 10% had several secondary caries lesions restricted to enamel, indicating need of non-operative treatment.

A recent review showed that in several prevalence studies the age group of ≥65 is often included [24]. However, selecting cut-off at this age level does not make it possible to investigate if there could be any difference between those ≥75 and those between 65 and 75 [23]. In previous Norwegian studies reporting caries prevalence in elderly, only two of the studies divided the included population based on age; one into three age groups; 67–74, 75–84 and ≥85 [21], and another into age group 67–79 and ≥80 years [25]. Two other studies divided the population into 65–79 years of age [5] and elderly with a mean age of 85.7 [22]. In the two first studies [21,25], they found a difference in dental caries between the youngest and the oldest elderly in line with the results in the present study.

Generally the elderly in the present study had less enamel lesions, more root caries and a higher prevalence of untreated dentin lesions compared to younger individuals. An increase in prevalence of caries was found among the individuals around 80 or older. This suggests that the risk of getting new caries lesions and having untreated caries is higher when people reach their eighties. Therefore, it is essential to implement individualized non-operative strategies for this age group.

In particular, the occurrence of root caries, which is markedly higher among the oldest (80–94), indicates that this group needs specific non-operative measures focusing on root caries, in addition to a higher need of operative treatment of dentin caries in general.

Indicators, like caries experience, number of remaining teeth and intact teeth, prevalence of enamel and dentin caries, point to no specific differences in the age group 65–69 and 70–74 from the age group 60 to 64 in the present study. Hence, the shift seems to be around 80 years of age. The Swedish study has documented major trends in oral health improvement between 1973 and 2013 [6], expressed by less edentulous individuals, a higher number of remaining teeth, less carious lesions, less restorations and better periodontal status. The impression from the current study is that individuals maintain good oral health up to at least 80 years of age.

Conclusion

Assessment of all levels of caries is required for planning dental services. It is widely accepted that caries lesions into dentin may need restorative treatment, and enamel lesions might benefit from non-operative therapy. Individuals seem to maintain good oral health up to at least 75 years of age, since an increase in prevalence of dental caries is found among the individuals of 80 years or older.

As individuals above 80 years of age have more secondary caries, root caries and a higher prevalence of untreated dentin lesions compared to younger, regularly recall examination should be established with focus on preventive strategies. However, to map the total cariological treatment need, assessment of the caries activity and the quality of restorations, as well as number and reasons for replacement, need to be recorded.

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Availability of data and materials

The data sets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Disclosure statement

The authors declare that they have no competing interests. The authors alone are responsible for the content and writing of the article.

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