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ORIGINAL ARTICLE

Self-perception of periodontal health and pain experience during periodontal examination in 14- to 15-year-old Danish adolescents

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ABSTRACT

Objective: To evaluate different aspects of periodontal examination among Danish adolescents.

Materials and methods: In all, 521 Danish adolescents underwent a periodontal examination and answered a questionnaire concerning their self-perception of periodontal health (PH). Furthermore, 107 participants reported their pain experience during periodontal examination using a visual analog scale. The self-perception of PH and the pain experience were correlated with plaque score (PS), bleeding on probing (BOP), probing pocket depth (PPD), and interdental clinical attachment loss (CAL).

Results: Good PH was reported by 424 (81%) of the participants. However, the association between PH and PS, BOP, PPD, and CAL was small (sensitivity: 7.7, 7.8, 12.0, and 0.0%, respectively). Only 57 (11%) of the participants reported bleeding gums (BG) during tooth brushing, but the correlation with BOP showed a sensitivity of 11.7%. The specificity of both self-perception of PH and BG was high. Sixty-seven (66.6%) of the participants experienced 'mild pain' during periodontal examination. There were no differences in periodontal outcomes between the pain groups ($p > .05$).

Conclusions: The adolescents showed a poor ability to identify themselves as having poor PH and BG, and 67 (66.6%) of the adolescents experienced mild pain during periodontal examination. The findings emphasize the need for dental staff to monitor the PH of Danish adolescents and advise them as necessary.

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Introduction

Examination of the periodontal tissues is of outmost importance to prevent the development of periodontal diseases, for example, gingivitis, gingival recessions, and periodontitis [1]. Gingivitis is a common condition affecting most individuals throughout life, whereas periodontitis in children and adolescents is a rare finding [2]. However, periodontitis may have a considerable impact on diseased individuals, resulting in impaired masticatory function, aesthetic problems, exacerbation of systemic disease in addition to affecting oral health-related quality of life [3–5]. Furthermore, individuals having periodontitis at a young age also present with a higher level of dental anxiety [6].

The recommendation is to include an assessment of the periodontal tissue in the examination of children and adolescents, and the simplified basic periodontal examination (simplified BPE) is widely used [4,7]. The screening approach with the use of the simplified BPE is based on measurement of probing pocket depth (PPD) and clinical attachment loss (CAL) on index teeth, i.e. incisors and permanent first molars, due to the localised appearance of periodontitis in young individuals and the risk of measuring pseudo pockets on erupting and exfoliating teeth in the mixed dentition [4]. In addition, a routine full-mouth periodontal examination may be too comprehensive in young individuals due to the potentially painful experience associated with periodontal probing [8,9].

Results concerning the self-perception of oral and periodontal health in adults vary [10], and a poor self-perception of periodontal health may be expected in adolescents. Hence, dentists and dental hygienists have the responsibility to detect, prevent, and treat periodontal diseases at an early age and stage of disease, and guidance and teaching concerning periodontal health should be mandatory in an adolescent population.

The main goals of the paediatric dentist are the maintenance of good oral health, education of patients and families, and the prevention of disease and painful conditions. However, the prevention of dental anxiety by creating trustful, calm, and painless situations in the clinic is crucial, and knowledge about children and adolescents' self-awareness of oral health and pain experience in the dental clinic may contribute positively to treatment planning.

In the present study, we aimed at evaluating different aspects and the importance of periodontal examination in adolescents, taking into account both the self-perception of periodontal health and the pain experience during periodontal examination. Furthermore, evaluation of the association

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between these two parameters and periodontal outcomes, defined by plaque scores (PS), bleeding on probing (BOP), PPD, and interdental CAL, may determine the need for the simplified BPE and underline the importance of guidance regarding periodontal health in the Danish adolescent population.

Materials and methods

Study population

The study population was enrolled as previously described [11]. Briefly, in 2018, 3165 15-year-old individuals were affiliated with the dental clinics of the municipality of Aarhus, Denmark. With the aim to examine 25% of the 14- to 15-year-old individuals residing in the municipality of Aarhus, 1145 (1/3 of the population of 14- to 15-year-olds) were randomly selected for enrolment in the present cross-sectional study. The criteria for the participation were Danish citizenship, being born in the year 2003, and no previous dental examination in the calendar year 2018. Of the 1145 selected individuals, 220 (19.2%) adolescents had unintentionally already had their routine and mandatory clinical examinations carried out by the clinical staff of the municipality before enrolment. Therefore, 917 (80.1%) of the original sample were invited to participate in the study by email as part of their regular invitation to the mandatory examination at the age of 15. Of the 648, who underwent their mandatory examination, 523 (approximately 60%) individuals agreed to participate in the clinical study. The participants were equally distributed according to all parts of the municipality of Aarhus, comprising six districts.

The study was approved by the ethics committee of the central region of Denmark (regionmidtjylland) (1-10-72-385-17). Written informed consent was obtained from all participants.

Clinical examination

The clinical examinations were carried out as previously described [11]. Briefly, six different districts and 16 different clinics were visited during 2018. One examiner (ABJ) carried out the clinical examinations, which included periodontal measurements of all fully erupted permanent teeth present in the oral cavity. All periodontal measurements were carried out at six sites per tooth (mesio-facial, facial, disto-facial, mesio-oral, oral, and disto-oral) with the use of a Deppeler^{TM} periodontal probe (HH12FMS, 3-6-9-12 mm, 0.48 Ø) (Deppeler SA, A-One Business Centre, La Pièce 6,CH-1180 Rolle, Switzerland). PS and BOP were recorded as present or not present. PPD was recorded from the gingival margin to the bottom of the periodontal pocket. CAL was recorded from the cemento-enamel junction to the bottom of the clinical periodontal pocket. All measurements were undertaken to the nearest millimetre.

Eleven individuals agreed to be examined twice within 48 h with the purpose of performing intra-examiner calibration as previously described [11]. All six sites on all permanent teeth present were measured at both occasions. The calibration process was undertaken under the same conditions as the clinical examination in the clinical study. The intra-examiner reproducibility was 99.9% for PPD and 99.4% for CAL with a margin-off-error of ± 1 mm.

At the beginning of the study, we experienced that some participants found the periodontal probing too painful and declined the invitation to participate. To further investigate the pain experience during the periodontal examination, the participants were asked to rate their experience of pain on a visual analog scale (VAS), with 'feeling no pain at all during the periodontal examination' being 0 and 'feeling so much pain that the periodontal examination could not be continued' being 100. The VAS scale was filled out under instructions given by the examinator (ABJ).

Questionnaire

As a part of the clinical examination, all participants were asked to answer a questionnaire concerning oral hygiene habits, daily intake of medications, smoking habits, and consumption of antibiotics within the last 3 months. Furthermore, all participants were asked about their self-perception of periodontal health using the following two questions: 'Do your gums bleed when you brush your teeth?' and 'Do you think that you have healthy gums?'. The participants had to answer one of the following three options 'Yes', 'No', or 'I don't know'.

Periodontal outcomes

The periodontal outcomes were defined as described previously with a few modifications [11]. Briefly, the cut-off level for having a poor periodontal health defined by the PS and BOP was a PS >20% of the sites and BOP >20% of sites. Only interdental CAL was used to describe the periodontal health of the individuals because the majority of the facial and buccal clinical attachment loss was without additional PPD >3 mm. Only one individual presented with facial and buccal PPD ≥4 mm in addition to CAL, thus defining a periodontitis lesion [12]. The cut-off for PPD was set at 4 mm, thereby indicating a deep periodontal pocket [1,13]. Furthermore, the participants were also characterised by the presence of PPD ≥6 mm. According to the new consensus for diagnosis of periodontal diseases, it is important to recognise CAL at 1 mm in the diagnosis of periodontitis so that milder cases are not overlooked [13]. However, in epidemiological studies, a cut-off above 1 mm is needed because there is a margin of error of ±1 mm in measuring CAL [14]. Therefore, we chose a cut-off at 2 mm in the present study in order not to miss early cases of periodontitis in this young and otherwise healthy adolescent Danish population.

Statistical analysis

The statistical analysis was performed using STATA 15 (StataCorp. 2017. *Stata Statistical Software: Release 15*. College Station, TX, USA: StataCorp LLC.) and SciPy [15],

which is an open source scientific tool for Python® (Beaverton, OR, USA).

Intra-examiner reproducibility was calculated as a percentage of total agreement and with a margin of error of ± 1 mm between two measurements of PPD and CAL. The periodontal outcomes were converted to binary data by dividing the patients into groups according to the cut-off values defined for the periodontal outcomes (PS >20%, BOP >20%, PPD ≥4 mm, and CAL ≥2 mm). The chi square test was used to compare the periodontal health outcomes between the total population and the subpopulations.

The self-perception of the periodontal health was evaluated based on the answers to two questions. The association between these answers and the periodontal outcomes was assessed by calculation of sensitivity and specificity (95% confidence interval). Sensitivity indicates the participants' ability to identify themselves correctly as diseased when clinically diagnosed as diseased, and the specificity indicates the participants' ability to identify themselves correctly as healthy when clinically diagnosed as healthy.

The participants were distributed into four groups based on their pain experience during the periodontal examination as described previously [16]. The 'no pain' group comprised participants with a score on the VAS scale under 5. 'Mild pain' was defined as a score that ranged from of 5–44 on the VAS scale, 'moderate pain' ranged from 45 to 74, and 'severe pain' ranged from 75 to 100. The pain experience according to gender was compared using Kruskal–Wallis test. The pain groups were compared according to periodontal outcomes by chi square test. Statistical significance was defined as a $p < .05$.

Results

Description of the participants

The descriptive data of the participants are seen in Table 1. The distribution between boys and girls was even (Table 1). Two hundred fifty-five boys and 251 girls (98.8 and 96.5%, respectively) in the total population defined themselves as being healthy. However, 32 boys and 32 girls (12.4 and 12.4%, respectively) consumed prescribed medications. These included drugs for constipation, allergies, ADHD, immunosuppressive treatment, hepatic disease, gastro-intestinal disease, skin diseases, diabetes mellitus, and arthritis. Furthermore, a few participants reported taking growth hormones, antipsychotics, or anti-depressives. Only seven boys and 13 girls (2.7 and 5.0%, respectively) reported that they smoked tobacco. The difference between boys and girls was statistically significant only in relation to number of times a day of tooth brushing. However, 216 boys and 238 girls (83.4 and 91.5%, respectively) reported brushing their teeth twice a day.

Subpopulations of the total population

Figure 1 illustrates a flowchart of the participants in the study. Five hundred twenty-three underwent a periodontal examination and 521 answered the two questions concerning self-perception of periodontal health. Two individuals answered the questionnaire, but not these two specific questions. Four hundred fifty-three participants answered the questions concerning periodontal health sufficiently by answering 'Yes' or 'No'. Sixty-eight answered 'I don't know', and were excluded from further analysis. Five hundred seventeen answered the question concerning bleeding gums sufficiently ('Yes' or 'No'). Four participants answered 'I don't know', and were excluded from further analysis. Furthermore, 107 participants reported their experience of pain during the periodontal examination on a VAS scale.

Periodontal outcomes

The periodontal outcomes of the total population and of the two subpopulations are listed in Table 2. The difference between the total population and the two subpopulations with regard to periodontal outcomes was not statistically significant ($p > .05$). The difference in periodontal outcomes between the group of excluded participants, based on their answer regarding periodontal health, and the remaining group of participants did not attain statistical significance ($p > .05$). In the total population, only nine participants had interdental clinical attachment loss (1.7%), but a substantial proportion of the participants (108 [20.7%]) did show PPD at 4 mm or more. However, only nine participants presented with PPD at 6 mm or more (1.7%). Three hundred ninety-two showed a high percentage of bleeding on probing (75%) and 379 showed high percentage of plaque score (72.5%), indicating a poor oral hygiene in this otherwise periodontally healthy adolescent population. The periodontal outcomes of the two subpopulations were not statistically significantly different from the total population (Table 2).

Table 1. Data on the total population and the two subsamples.

	Total population ($n = 523$)		Subpopulation analysed according to the questionnaire according to periodontal health ($n = 453$)		Subpopulation analysed according to the VAS scale ($n = 107$)	
Study groups	Boys ($n = 260$†)	Girls ($n = 261$)	Boys ($n = 221$†)	Girls ($n = 230$)	Boys ($n = 54$)	Girls ($n = 53$)
Define themselves as healthy (%)	255 (98.8)	251 (96.5)	218 (99.1)	221 (96.5)	54 (100)	50 (94.3)
Daily use of medicine (%)	32 (12.4)	32 (12.4)	30 (13.6)	30 (13.2)	7 (13.0)	9 (17.0)
Cigarette smokers (%)	7 (2.7)	13 (5.0)	7 (3.2)	11 (4.8)	2 (3.7)	2 (3.8)
Tooth brushing twice pr. day (%)	216 (83.4)*	238 (91.5)*	187 (84.6)*	210 (91.3)*	43 (79.6)*	50 (94.3)*

†Two subjects did not report their gender.
*Statistical significant difference between boys and girls within the same population sample ($p < .05$).

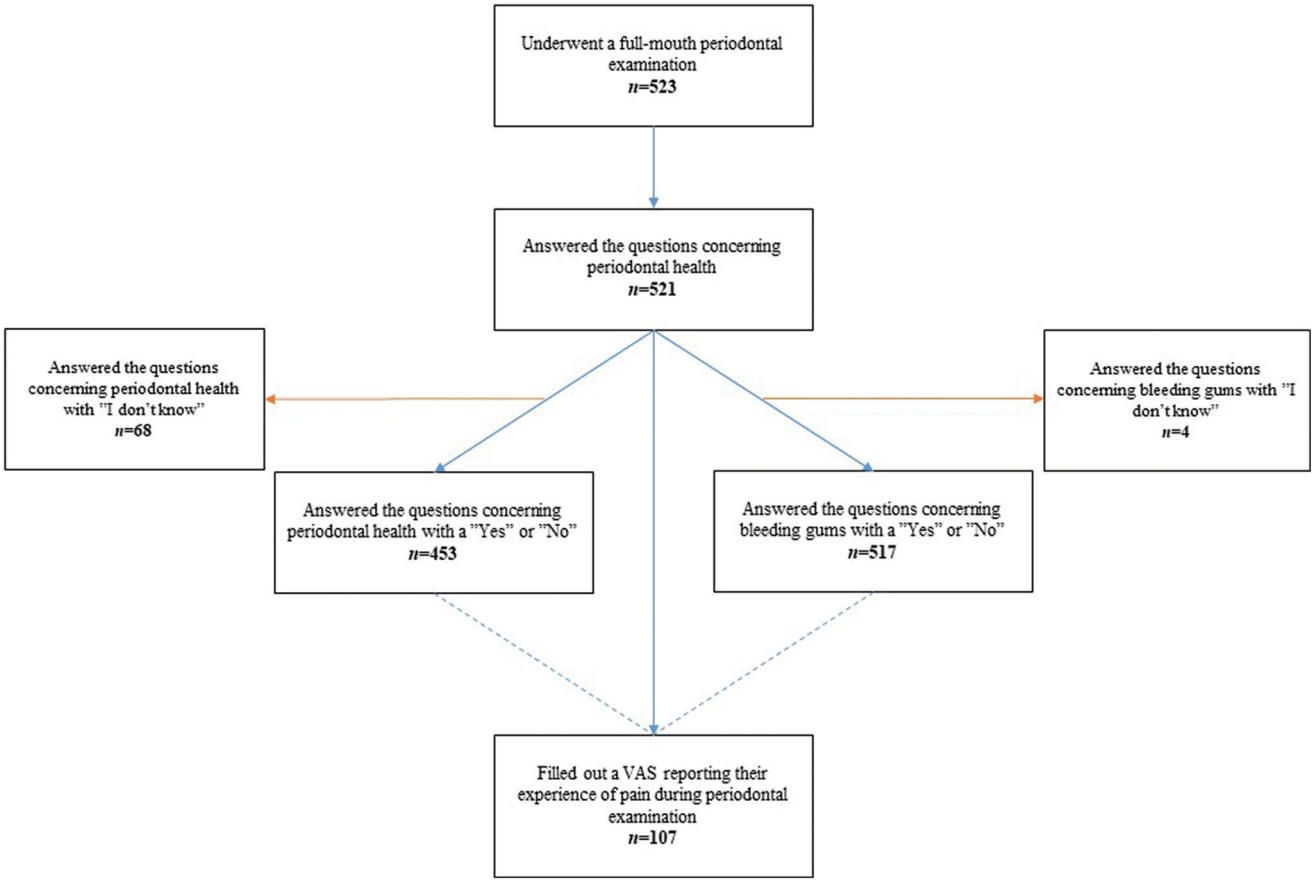

Figure 1. Illustration of the 523 participants who underwent a full-mouth periodontal examination and the 521 who answered questions concerning their perception of their periodontal health. A smaller subsample also rated their pain experience during periodontal examination on a visual analogue scale (VAS).

Table 2. The number of individuals (%) in the total sample population and in the two different subpopulations reported according to periodontal outcomes.

Periodontal outcomes	Total population ($n = 523$)	Subpopulation analysed according to the questionnaire ($n = 453$)	Subpopulation analysed according to the VAS scale ($n = 107$[a])
PS[b] >20% (%)	379 (72.5)	323 (71.3)	89 (83.2)
BOP > 20% (%)	392 (75.0)	338 (74.6)	84 (78.5)
PPD ≥ 4 mm (%)	108 (20.7)	92 (20.3)	18 (16.8)
PPD ≥ 6 mm (%)	9 (1.7)	8 (1.8)	0
CAL ≥ 2 mm (%)	9 (1.7)	6 (1.3)	3 (2.8)

[a]The 107 subjects analysed according to the VAS scale were also included in the subsamples analysed according to the self-perception of periodontal health.
[b] PS: plaque scores; BOP: bleeding on probing; PPD: probing pockets depth; CAL: clinical attachment loss.

Distribution of interdental clinical attachments loss according to tooth type

The examination of the 521 participants included periodontal measurements on more than 14,000 teeth. In total, 43 teeth were diagnosed with interdental CAL. The majority of the teeth (38 ([88%]) were incisors and first permanent molars. The additional five teeth (12%) diagnosed with interdental clinical attachment loss were one permanent second molar, one canine and three second premolars.

Self-perception of periodontal health compared to clinical findings

Four hundred twenty-four (81%) of the participants reported having good periodontal health, and only 29 (5.6%) reported having poor periodontal health. The correlation between self-perception of the periodontal health and periodontal outcomes based on PS, BOP, PPD, and CAL was determined by calculating sensitivity and specificity (Table 3). The self-perception, judged by the answer to the question concerning periodontal health, showed a low sensitivity with regard to PS, BOP, PPD, and CAL, with percentage scores of 7.7, 7.8, 12.0, and 0.0, respectively. However, the specificity for PS, BOP, PPD, and CAL was high with percentage scores of 96.9, 97.5, 95.0, and 93.5, respectively.

Fifty-seven (11%) of the participants reported bleeding of the gums during tooth brushing, and 460 (89%) reported no bleeding of the gums during tooth brushing. The correlation between the answer to this question and the clinical measurement of BOP was assessed by calculation of sensitivity and specificity. The sensitivity was 11.7% and the specificity was 91.0%. The differences in periodontal outcomes between participants with a self-perception of either having a good or

Table 3. Sensitivity and specificity (95% confidence interval, CI) of self-perception of periodontal health and bleeding of gums of the 453 adolescents who answered the questionnaire.

	BOP[a] >20%		PS > 20%		PPD ≥ 4 mm		CAL ≥ 2 mm	
Questions asked	Sensitivity [CI]	Specificity [CI]	Sensitivity [CI]	Specificity [CI]	Sensitivity [CI]	Specificity [CI]	Sensitivity [CI]	Specificity [CI]
Think they have healthy gums	7.8 [5.1:11.2]	97.5 [92.7:99.5]	7.7 [5.1:11.2]	96.9 [92.3:99.2]	12.0 [6.2:20.4]	95.0 [92.2:97.0]	0 [0:45.9]	93.5 [90.8:95.6]
Think that gums bleed during tooth brushing	11.7 [8.7:15.4]	91.0 [84.9:95.3]	–	–	–	–	–	–

[a]BOP: bleeding on probing; PS: plaque score; PPD: probing pockets depth; CAL: clinical attachment loss.

bad periodontal health and experiencing either bleeding ofthe gums or no bleeding of the gums were not statistically significant ($p > 0.05$).

Pain experience during periodontal examination

The mean VAS scores for the experience of pain was 29.76 ± 25.00 for boys and 39.83 ± 23.16 for girls, gender difference ($p > .05$). There were nine participants (8.4%) designated in the 'no pain' group. Sixty-seven (66.6%) experienced 'mild pain', 22 (20.6%) experienced 'moderate pain', and only nine (8.4%) experienced 'severe pain' during periodontal examination. The distributions of boy and girls in the four pain groups were not statistically significantly different ($p > .05$). Figure 2 demonstrates the periodontal outcomes in the four pain groups. Visual inspection of Figure 2 shows that the 'severe pain' group had poorer periodontal outcomes. The difference in periodontal outcomes between the four pain groups did not, however, attain statistical significance ($p > .05$).

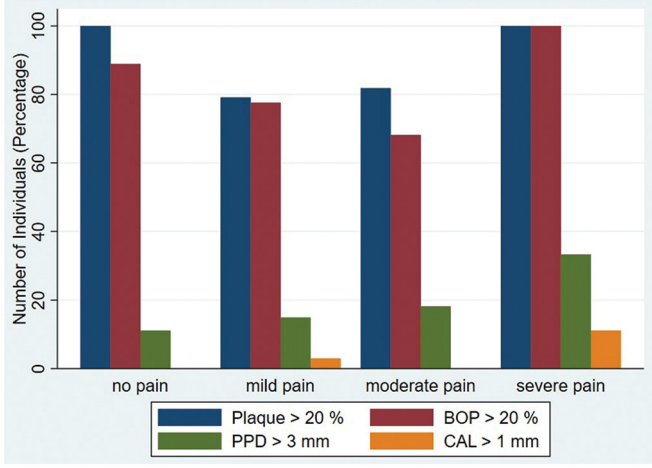

Figure 2. shows the number of participants (percentage) with plaque score (PS) >20%, bleeding on probing (BOP >20%), probing pocket depth (PPD) ≥4 mm, and clinical attachment loss (CAL) ≥2 mm in the four pain groups. The pain groups were defined according to the participants' ranging of their pain experience on a 100 mm visual analogue scale (VAS) scale: 'no pain' (range 0–4), 'mild pain' (range 5–44), 'moderate pain' (range 45–74), and 'severe pain' (range 75–100). The difference in periodontal outcomes between the four pain groups did not attain statistical significance ($p > .05$).

Discussion

The present study emphasises the importance of dentists and dental hygienists in the prevention and the monitoring of periodontal health in adolescents. The findings indicate that young people have a low ability to identify themselves correctly as suffering from periodontal diseases. Furthermore, the majority of this group of Danish adolescents experienced some pain during periodontal examination independently of their periodontal health status.

We carried out a full-mouth periodontal examination of the participants. Interdental CAL was found in only nine (1.7%) adolescents. In total, 43 teeth were diagnosed with interdental CAL, and 38 (88%) of these teeth were incisors or molars. The occurrence of CAL was very low, and we cannot exclude the possibility of interdental CAL being distributed differently in a population with a higher prevalence of severe periodontal diseases. However, CAL is often localised, affecting incisors and first permanent molars in young individuals diagnosed with periodontitis [17]. In the present population, 108 (20.7%) showed one or more sites with PPD ≥ 4 mm, but only very few participants showed additional CAL at these sites. Most of the sites were considered pseudo-pockets caused by exfoliation or eruption of the teeth or adjacent teeth, ongoing orthodontic treatment, or gingivitis (data not shown). The first step in preventing further development of periodontal diseases, for example, periodontitis, is treatment of gingivitis [1]. In the present population, the high levels of PS (379 [72.5%]) and BOP (392 [75%]) among participants emphasise the need for sufficient instruction and education concerning the maintenance of periodontal health.

Age and behavioural factors are reported to be important and significantly associated with the development of CAL and periodontitis [18,19]. Behavioural factors, for example, oral hygiene habits and the subjective need to seek treatment and guidance by professionals, may partly rely on the individual's self-perception of oral and periodontal health. In the present population, the self-perception of periodontal health and bleeding of the gums showed low sensitivity, but high specificity. Others have reported the same tendency in adult populations, but with higher levels of sensitivity [10,20,21]. The low sensitivity may reflect a lack of knowledge about the periodontal tissue and periodontal health among Danish adolescents that makes them unable to identify themselves correctly as having periodontitis or gingivitis. On the other hand, the high specificity indicates a good ability to identify themselves correctly as periodontally healthy. We assessed the self-perception of periodontal health by asking two simple questions. The design and wording of the

questions were similar to questions used previously, but inseveral studies additional questions have been asked [10,21,22]. However, previous studies were carried out in adult populations with a higher prevalence of periodontitis and with more obvious clinical signs of periodontitis, for example, tooth mobility and malodour [10,21,23]. Such questions may have been considered inappropriate considering the expected and confirmed very healthy state of the present population. Social background, age, gender, access to dental care, and educational level may influence the self-perception of oral health [22,23]. Hence, one should keep in mind that the findings of the present study may not apply to the general Danish population.

Sixty-seven (66.6%) participants experienced 'mild pain' during the periodontal examination, but only nine (8.4%) reported having 'severe pain'. We expected that the experience of pain during the periodontal examination might be associated with worse periodontal outcomes, e.g. BOP, PPD $\geq$4 mm, and interdental CAL [9]. Based on visual inspection of Figure 2, it is likely to assume such a tendency concerning PPD and CAL. However, the difference in periodontal outcomes between the four pain groups did not attain statistical significance. The present study population was composed primarily of periodontally healthy adolescents, and an association may be present in a population with a higher occurrence of periodontitis, i.e. higher prevalence of deep pockets and CAL. Furthermore, only 18 individuals experienced either no pain or severe pain (nine in each group), which might have resulted in a type II statistical error. Whether or not this is the case must be a topic for future investigation. The pain experience may have been affected by the use of a periodontal probe without a pressure threshold in addition to physiological and psychological factors [24–26]. We attempted to decrease the risk of adolescents feeling uncomfortable during the examinations by carrying them out in known settings at the clinics where the participants were affiliated and by an experienced paediatric dentist seeking to reach a pressure of 25 g during the periodontal probing. Previous studies have reported similar pain experience with the use of an electronic probe [9,27,28], and Laugisch and colleagues recently reported no difference in the pain sensitivity with the use of an electronic probe compared to a standard probe [29].

In conclusion, the findings of the present study emphasise the need for continuous periodontal screening in the Danish adolescent population. Although, interdental CAL and deep periodontal pockets are rare among adolescents, the lack of self-awareness of periodontal health calls for the services of dental professionals. Furthermore, the distribution of interdental CAL and the experience of pain during the periodontal examination support the use of the simplified BPE in a Danish adolescent population.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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