

Validation of Questionnaires in Screening for Restorative Treatment Need among 15-, 21-, and 40-year olds

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Abstract

Introduction: This cross-sectional study aims to investigate the association between three age-specific questionnaires in three age groups and restorative dental treatment need. **Materials and methods:** Three separate questionnaires were designed on etiology of dental caries in different age groups. Randomly selected 15- ($n=36$), 21- ($n=21$), and 40-year-old ($n=45$) subjects answered these questionnaires. Responses were compared to restorative treatment need (DT) according to the clinical oral examination, which calibrated examiner performed. **Results:** Responses to questionnaires were only indicative in prediction of restorative treatment need at individual level. Kappa values for 15-, 21-, and 40-year olds, between responses and restorative treatment need were 0.01, 0.44, and 0.33, respectively. **Conclusion:** The need for restorative care could plausible be screened with a questionnaire among the 21- and 40-year olds, but not among 15-year olds in a country with low caries prevalence. Further development of questionnaires and studies are needed.

Keywords: Caries, questionnaire, validation

INTRODUCTION

In 2015, dental caries poses a very serious public health problem when untreated caries in permanent teeth affected 2.5 billion people and untreated caries in deciduous teeth affected 573 million children worldwide.^[1] Despite great improvement in overall oral health among Finnish population in past decades, dental caries is still a common disease. Of dentate Finnish adults, caries occurs in 31% (DT > 0, mean DT=0.8), more often in men (39%) than in women (23%).^[2] In addition, almost practically every middle-aged adult has enamel caries lesions.^[3] There has been a decreasing trend in restorative treatment need and restorative care for children in all age groups in Finland.^[3] In contradiction, the amount of treatment measures provided for children has been increasing between 2003 and 2013. An issue of concern is also that children in need for restorative dental treatment receive less preventive care compared to healthy children.^[4] The statistics have so far shown only slight indication of deterioration of oral health of the young.^[5]

Oral health behaviors are known to be associated with dental caries as well as with socioeconomic status.^[6] Tooth brushing frequency has improved during past decades in Finland, but still is low among adolescents compared to many European countries.^[7] It was reported that about 40% of the 14 to 15 years-old do not brush their teeth twice daily,^[7,8] when the respective figure for adults is 20% for females and about 50% for males.^[9] The main dietary problem among Finnish adolescents is high consumption of snacks and beverages and low consumption of vegetables and fruits.^[10] Directing resources toward oral health promotion instead of operative

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care would be cost effective for the public dental care in Finland. Any means to save resources are welcome.^[11] Polarization of dental caries lesions implies that finding those individuals needing oral health promotion and restorative treatment would help targeting resources efficiently.^[5]

Questionnaires are used routinely in dental general practice for investigating background factors but are seldom used as a diagnostic tool and specifically in estimating restorative treatment need. If found reliable, questionnaires could be a low threshold method in finding those children, adolescents, and adults at high caries risk or who need restorative dental treatment.^[12] However, some sets of questions do not apply for all age groups not to mention different ethnic backgrounds.

A questionnaire for 21-year olds predicting restorative treatment need has not been validated in another study group before.^[12] In addition, for the Finnish population in 15- and 40-year olds, an appropriate questionnaire to assess the need for restorative treatment has not been conducted or validated.

The aim of the study was to investigate the accuracy of questionnaire surveys in predicting restorative treatment need for 15-, 21-, and 40-year olds.

MATERIALS AND METHODS

This cross-sectional questionnaire validation study was conducted during 2018 to 2019 among residents of Vaasa municipality, Finland. Altogether 569 people were invited to the study. The subjects were randomly selected and invitation letters with an appointment were sent via post.^[13] Participation in this research was voluntary and free of charge for the participants.

One trained and calibrated examiner did all the clinical examinations during December 2019 to February 2020 in a fully equipped dental office of the City of Vaasa by using a three-in-one syringe to dry the teeth before the examination, an oral mirror, light of the unit, fiber-optic transilluminator, and a dental probe to visual-tactilely examine the tooth surfaces. Teeth were examined for dental caries lesions and registered accordingly as initial caries lesions, dentin caries lesions requiring restorative treatment, and caries lesions extending to the pulp/only root left. The findings were also registered for each tooth surface. Also, the fillings were recorded for each tooth surface. The DMF index (decayed, missing, filled due to dental caries) was calculated to describe the tooth-wise presence of the restorative treatment need together with caries history. Third molars were included in analyses. Bite-wing radiographs were taken from every patient when clinically indicated, for example, if at least one clinically detected caries lesion penetrated dentin or in patients with high caries risk and findings was included in clinical status.^[14]

To investigate the reliability of clinical findings, the examiner was trained by a senior researcher acquainted with training and calibrating the examiners by using a PowerPoint and extracted teeth. Intra- and interexaminer agreement for restorative treatment need was calculated using kappa value (κ) when the senior researcher acted as a golden standard being 0.64 to 0.85, respectively. Prior to the clinical examination, all age groups (15, 21, and 40 years) were given their own age-specific questionnaire.^[15]

For all three age groups, the questionnaires were based on the original one for school-aged children and modified and added with specific questions concerning each age group.^[16] Modification and additions were decided by the authors. Final age-group-specific questionnaires were modified by evaluating whether individual questions associated statistically significantly ($P < 0.05$) with restorative treatment need ($DT > 0$) in the age-specific databases (15-, 21-, and 40-year olds) from previous studies.^[2,12,16] Statistical inclusion criteria for this study were as follows: odds ratio (OR) value for $DT > 0$ should be statistically significant ($P < 0.05$) and similarly OR values of the sum variables, constructed from the selected question sets.

Cutoff points for the question sets were decided after construction of the sum score variables and according to their OR values, statistical analysis (sensitivity and specificity), and according the best knowledge of the authors. Cutoff points were determined to be ≥ 2 for 15-year olds and ≥ 5 and ≥ 3 for 21- and 40-year olds, respectively (later predetermined cutoff points). These cutoff points were used in preparing the participants feedback for the questionnaires, that is, homecare and seeking professional restorative treatment.^[17]

For responding the questionnaire, a software was installed on a laptop and a tablet computer. Responders were given advice and clarifications about the questions, if needed by the dental team. After answering the questions, the software gave the respondents a sum score and feedback according to their risk points and recommendation when to visit a dentist.^[14] The subjects also had the possibility to get the feedback via email.

Based on clinical status and examination, DT and DMFT values as well as standard deviation were calculated. Area under curve (AUC) and kappa values, for each possible cutoff points for sum variable, were calculated at the individual level $DT > 0$ being response variable. The cutoff point considered to be the best when AUC and κ -values were at their greatest. Predetermined cutoff points were compared to the sum scores according to the new data. Confidence intervals (95%) and P -values were also reported. P -values < 0.05 were considered statistically significant. All analyses were performed using SPSS version 25.0 (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA).

The study protocol is in line with the guidelines Declaration of Helsinki (1975, revised in 2000). The Ethical Committee of the Northern Ostrobothnia Hospital District has given their

permission to this study 6.8.2018 (EETMK: 42/2018, 176). The city of Vaasa has given permission for the project in the city of Vaasa primary healthcare on October 5, 2018 (b94/2018 doc ID: 548582). Participants signed the informed consent before examination, and guardians of under 18 years old had to be informed of the study beforehand. For the analyses, the IDs were excluded. The register of this study was protected with a password and only the researchers in this project had access to it.

RESULTS

For the 15-year olds, in the set of three questions, neither the predetermined cutoff point nor cutoff point chosen according the best AUC and kappa values associated statistically with restorative treatment need ($D > 0$) [Table 1].

For the 21-year olds (set of 10 questions), the predetermined cutoff value predicting restorative treatment need was in accordance within the one gained from the new data despite of the small sample size. According to the AUC and kappa value (0.714 and 0.444), with the cutoff ≥ 5 , screening ability of identifying restorative treatment need was moderate [Table 1].

For the 40-year olds (set of seven questions), the cutoff value was also predetermined correctly. Predetermined cutoff value for the 40 years old showed statistically fair agreement ($\kappa = 0.33$) in predicting restorative treatment need (AUC = 0.665) [Table 1].

The amount of treatment history (DMFT) in the study population increased steadily with age, whereas DT value was the lowest in 15-year olds and the highest in 21-year olds [Table 2]. DT value was higher in males in all age groups compared to the female counterparts.

In the group of the 15-year olds, 15% of men and 6% of women had at least one caries lesion ($DT > 0$), when the respective proportions among the 21-year olds were 43% and 14%. In the group of the 40-year olds, more than half of the men and one-third of the women had at least one caries lesion, and the mean DMFT scores were 12.2 and 12.0, respectively.

DISCUSSION

Evaluation of the questionnaire set and using the predetermined cutoff points produced expected results for the 40- and 21-year olds, restorative treatment need could be predicted at least in moderate level.

Among the 15-year olds, restorative treatment need was small compared to the other two age groups. The questionnaire designed for the 15-year olds could not screen those in need for restorative treatment. Three questions in the questionnaire concerned favorable or unfavorable dietary habits. In a previous study, the

Table 1: Area under the curve (AUC), P, 95% confidence interval, and kappa (κ)-values for sum variable of responses of age-specific questionnaires and restorative treatment need at individual level

	Cutoff points in validation material											
	≥ 0	≥ 1	≥ 2	≥ 3	≥ 4	≥ 5	≥ 6	≥ 7	≥ 8	≥ 9	≥ 10	
15 years	AUC	0.500	0.516	0.453	0.500	-	-	-	-	-	-	-
	P	1.000	0.920	0.763	1.000	-	-	-	-	-	-	-
	95% CI	0.20-0.80	0.22-0.81	0.15-0.76	0.20-0.80	-	-	-	-	-	-	-
	κ	0.000	0.007	-0.033	0.000	-	-	-	-	-	-	-
21 years	AUC	0.500	0.571	0.643	0.679	0.536	0.714	0.536	0.500	0.500	0.500	0.500
	P	1.000	0.602	0.296	0.192	0.794	0.117	0.794	1.000	1.000	1.000	1.000
	95% CI	0.23-0.77	0.32-0.83	0.40-0.88	0.44-0.92	0.27-0.80	0.46-0.97	0.26-0.81	0.26-0.77	0.23-0.77	0.23-0.77	0.23-0.77
	κ	0.000	0.100	0.211	0.294	0.063	0.444	0.087	0.000	0.000	0.000	0.000
40 years	AUC	0.500	0.500	0.575	0.665	0.530	0.555	0.500	-	-	-	-
	P	1.000	1.000	0.392	0.060	0.732	0.530	1.000	-	-	-	-
	95% CI	0.33-0.67	0.33-0.67	0.41-0.74	0.50-0.83	0.36-0.70	0.38-0.73	0.33-0.67	-	-	-	-
	κ	0.000	0.000	0.137	0.328	0.063	0.120	0.000	-	-	-	-

-, not available.

Table 2: DMFT and DT scores for oral examination

Gender (n)	n	DMFT	DT + dt	DT = 0		DT > 0	
		Mean (SD)	Mean (SD)	%	n	%	n
15-year olds	36	2.64 (3.65)	0.36 (1.10)	89	32	11	4
Male	20	2.60 (3.71)	0.55 (1.40)	85	17	15	3
Female	16	2.69 (3.70)	0.13 (0.50)	94	15	6	1
21-year olds	21	4.48 (3.76)	1.62 (2.89)	67	14	33	7
Male	14	5.07 (3.97)	2.29 (3.34)	57	8	43	6
Female	7	3.29 (3.25)	0.29 (0.76)	86	6	14	1
40-year olds	45	12.07 (4.72)	1.11 (1.87)	56	25	44	20
Male	21	12.19 (5.39)	1.71 (2.41)	43	9	57	12
Female	24	11.96 (4.17)	0.58 (1.02)	67	16	33	8

children with favorable dietary habits showed less demineralization on occlusal surfaces in their dentition measured by fluorescence induced by laser light (DIAGNOdent® device, DIAGNOdent™ pen, KaVo, Biberbach, Germany) than those children with unfavorable dietary habits.^[16] In this study, questions of dietary habits (scored as risk points) did not have a correlation with caries prevalence and the need for restorative treatment. This is most likely due to the small study population with low prevalence of treatment need. In a previous cross-sectional study, it was found that school children with poor oral health knowledge had twice as much caries compared to the children with adequate knowledge.^[18] Parental attitudes and knowledge of oral health also play a significant role in passing on these oral health behavior patterns and daily tooth-brushing routines into young children.^[19] These factors should be included in the questionnaires in future. The set of questions for the 15-year olds was constructed from more than 600 patients' examination and questionnaire data, but the data had been collected more than 10 years ago.^[16] It may be possible that there have been changes in health behaviors compared to these times. In the future, the creation and testing of a survey of 15-year olds should be carried out with a clearly larger study population.

In the group of the 21-year olds, the questionnaire was able to screen fairly well at individual level those in need for restorative treatment. The set of questions for the 21-year olds was constructed from more than 8500 conscripts' oral examination and questionnaire data. Predetermined cutoff value was exactly same for seeking professional restorative treatment, compared to the current results. This is in line with the previous study in the same age group.^[12] In the study, Kämppi *et al.* investigated association between restorative treatment need and 50 questions (known to be associated with caries according to literature) among Finnish conscripts. Of those, 22 questions had significant ($P < 0.05$) association with restorative treatment need and were selected for further analyses.^[12] Ten questions with the best statistical association to restorative treatment need were selected to the final set, which correlated well with the restorative treatment need,

specifically when sum scores were calculated. In 2004, Levin and Shenkman studied the relationship between dental caries status and oral health attitudes by The Hiroshima University-Dental Behavioral Inventory (HU-DBI) questionnaire, in a sample of young Israeli army recruits.^[20] They found also a positive correlation with good oral health attitudes and behaviors with DMFT. Their other study included a questionnaire of 20 questions concerning different caries risk factors and at the next stage of the study, a new questionnaire was developed based on the most predictive 10 questions.^[21]

For the 40 years old, predetermined cutoff value was accordance ($P = 0.06$, $AUC = 0.665$) with new results. The set of questions for the 40-year olds was constructed from more than 1961 examination and questionnaire data.^[2] This may be explained because the data in the group of 40 years old were large enough to highlight differences and the prevalence of caries was highest in this age group. Methodologically, it can be stated with caution that statistically well-chosen questions could have the opportunity to identify the same risk group with the same questions with the new data. However, the use of question sets requires a large sample for proper validation.

Here, it could be observed that those in their twenties had most present restorative treatment need. Previous studies have shown that men have more caries lesions and periodontal disease than women.^[22] Recently, in this age group or among the conscripts in the Finnish Defense Forces, 45% of men and 37% of women had at least one tooth that needed restorative treatment,^[23] which is in line with this study. The gender differences and caries prevalence are like previous studies. In the Northern Finland Birth Cohort 1966, the mean DMFT score was 14.9 and overall 39.8% of the study population had $DT > 0$ and almost half of the conscripts were in need for restorative treatment (men 58.6%, women 46.1%).^[2]

Most evident weakness of this study is lack of large enough study group specially in the group of the 21-year olds. There were only 21 participants in this age group, which may have influenced the outcome. In addition, number of questions for 15-year olds was limited to three. The number of 15-year-old participants should be bigger and their questionnaire should be reformed to comprise much larger number of questions to enable rational analyses. Despite the weaknesses, predetermined cutoff points and the results of this study are still aligned with each other, even if without statistical significance. Screening questionnaires indicate being selective enough instruments for detecting caries disease, but validation should be carried out with high accuracy and with large enough study groups.

CONCLUSION

The need for restorative care could plausible be screened with a questionnaire among the 21- and 40-year olds, but not among 15-year olds in a country with low caries prevalence.

Further development of questionnaires and studies are needed especially among the youngest age group.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Kassebaum NJ, Smith AGC, Bernabé E, *et al.* Global, regional, and national prevalence, incidence, and disability-adjusted life years for oral conditions for 195 countries, 1990-2015: a systematic analysis for the global burden of diseases, injuries, and risk factors. *J Dent Res* 2017;96:380-7.
2. <https://www.julkari.fi> [Internet]. Finnish institute for health and welfare: oral health in the Finnish adult population: Health 2000 Survey, 25th ed. Available at <https://www.julkari.fi/bitstream/handle/10024/103030/2008b25.pdf?sequence=1&isAllowed=y>. Accessed August 28, 2021.
3. Laajala A, Pesonen P, Anttonen V, Laitala M. Association of enamel caries lesions with oral hygiene and DMFT among adults. *Caries Res* 2019;53:475-81.
4. Linden J, Widström E, Sinkkonen J. Children and adolescents? dental treatment in 2001–2013 in the Finnish public dental service. *BMC Oral Health* 2019;19:131.
5. Kämppi A, Tanner T, Pääkkilä J, *et al.* Geographical distribution of dental caries prevalence and associated factors in young adults in Finland. *Caries Res* 2013;47:346-54.
6. Tanner T, Moilanen P, Pääkkilä J, Patinen P, Tjäderhane L, Anttonen V. Association of dietary habits with restorative dental treatment need and BMI among Finnish conscripts: a cross-sectional epidemiological study. *Public Health Nutr* 2019;22:3009-16.
7. <https://gateway.euro.who.int> [Internet]. WHO: Brushing Teeth (11, 13, 15 years). Available at https://gateway.euro.who.int/en/indicators/cah_25-brushing-teeth-11-13-15-years/visualizations/#id=27504. Accessed August 28, 2021.
8. <https://thl.fi/en/web/thlfi-en> [Internet]. Finnish institute for health and welfare: School Oral Health Survey 2019. Available at https://sampo.thl.fi/pivot/prod/fi/ktk/ktk1/summary_perustulokset2?alue_0=87869&mittarit_0=187209&mittarit_1=200280&mittarit_2=199373&vuosi_0=v2017&kouluaste_0=161293. Accessed August 28, 2021.
9. <https://www.julkari.fi> [Internet]. Finnish institute for health and welfare: Terveystieteiden tutkimuskeskus ja hyvinvointi Suomessa 2011. Available at https://www.julkari.fi/bitstream/handle/10024/90832/Rap068_2012_nettili.pdf. Accessed August 28, 2021.
10. Hoppu U, Lehtisalo J, Tapanainen H, Pietinen P. Dietary habits and nutrient intake of Finnish adolescents. *Public Health Nutr* 2010;13:965-72.
11. Fraihat N, Madae'en S, Bencze Z, Herczeg A, Varga O. Clinical effectiveness and cost-effectiveness of oral-health promotion in dental caries prevention among children: systematic review and meta-analysis. *Int J Environ Res Public Health* 2019;16:2668.
12. Kämppi A, Pääkkilä J, Tanner T, Patinen P, Tjäderhane L, Anttonen V. Validity of a questionnaire in estimating restorative treatment need among young adults. *Community Dent Health* 2014;31:245-50.
13. Antti K. Study population. figshare. Journal contribution. 2021. <https://doi.org/10.6084/m9.figshare.16529187.v1>.
14. <https://www.kaypahoito.fi/en/> [Internet]. Duodecim: Current Care Guidelines for Controlling Dental Caries 2020. Available at <https://www.kaypahoito.fi/hoi50127>. Accessed August 28, 2021.
15. Antti K. Questionnaires. figshare. Journal contribution. 2021. <https://doi.org/10.6084/m9.figshare.16529064.v2>.
16. Anttonen V, Hausen H, Seppä L, Niinimaa A. Effect of dietary habits on laser fluorescence values of visually sound occlusal surfaces among Finnish schoolchildren. *Int J Paediatr Dent* 2008;18:124-30.
17. Antti K. Feedback. figshare. Journal contribution. 2021. <https://doi.org/10.6084/m9.figshare.16529103.v1>.
18. Oliveira ER, Narendran S, Williamson D. Oral health knowledge, attitudes and preventive practices of third grade school children *Pediatr Dent* 2000;22:395-400.
19. Pine CM, Adair PM, Nicoll AD, *et al.* International comparisons of health inequalities in childhood dental caries. *Community Dent Health* 2004;21:121-30.
20. Levin L, Shenkman A. The relationship between dental caries status and oral health attitudes and behavior in young Israeli adults. *J Dent Educ* 2004;68:1185-91.
21. Levin L, Shpigel I, Peretz B. The use of a self-report questionnaire for dental health status assessment: a preliminary study. *Br Dent J* 2013;214:E15.
22. Suominen AL, Varsio S, Helminen S, Nordblad A, Lahti S, Knuuttila M. Dental and periodontal health in Finnish adults in 2000 and 2011. *Acta Odontol Scand* 2018;76:305-13.
23. Tanner T, Kämppi A, Pääkkilä J, *et al.* Prevalence and polarization of dental caries among young, healthy adults: cross-sectional epidemiological study. *Acta Odontol Scand* 2013;71:1436-42.