

Impact of individual-risk factors on caries treatment performed by general dental practitioners

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ABSTRACT

Objective: This prospective study investigated how individual patient risk factors impacted non-operative and operative treatment decisions in a dental practice-based research network in The Netherlands.

Methods: Data from were collected from 11 dental practices, whose patients visited the practice at least once during the observation period (January 2015 to September 2017). Descriptive analysis was performed, followed by multiple logistic regression.

Results: The records of 39,690 patients were analyzed. Approximately one-half of the population (n = 21,056) underwent a restoration procedure during the observation period, of which 5981 (28.4%) were classified with fair oral hygiene, and 5341 (25.4%) with a high risk for caries. The population without restorative intervention (n = 18,634) consisted mainly of patients with good oral health (n = 5132 [27.5%]) and low risk for caries (n = 7792 [41.8%]). A high risk for caries was associated with a greater chance of preventive instruction (odds ratio [OR] 1.60), applications of topical fluoride (OR 1.20) or sealants (OR 1.39), and restorative interventions (OR 5.72). There was wide variation among practices regarding the treatment provided.

Conclusion: Of the 11 general dental practices that participated in this study, there was a higher chance of patients with a high risk for caries to receive preventive instructions, and professionally applied topical fluoride and sealants in the majority of practices promoting a personalized treatment approach to patients with caries.

Clinical significance: A more personalized treatment approach for patients with caries was associated with a higher prevalence of high caries risk patients in the majority of practices. More studies, however, are needed to investigate whether general dental practitioners consider the assessment of individual patient risk factors in planning personalized treatment strategies.

1. Introduction

A recent review reported primary caries as the main reason for placement of restorations, ranging from 48.8% to 100% of cases, and secondary caries for restoration replacement (28.5–59%) [1]. Dental caries remain the most common disease in dentistry, and inequalities are observed in disease distribution, mainly related to factors including age and socioeconomic status (SES) [2]. These inequalities support the need to identify individuals who are at high risk for development the disease given that diagnostic and management strategies should be guided and implemented according to individual patient risk factors [3]. Age, SES, oral hygiene (presence of dental biofilm) are examples of risk factors that have already been associated directly or indirectly with the development of dental caries [2,4,5]. For this reason, these factors

are usually used to determine caries risk in patients [6].

Thus, it appears logical that when general dental practitioners (GDPs) encounter these risk factors in patients and use them in clinical decision making, the result will be better and more personalized oral healthcare. Moreover, using risk factors to plan individual treatment strategies may improve the effectiveness of care and reduce treatment costs [3], thus enabling efficient allocation of resources in terms of government policies. The assessment of caries risk, for example, enables individualized treatment planning [7], based on strategies that can range from non-operative treatments, such as biofilm control and fluoride application, to operative treatments such as tooth restoration. Nevertheless, despite recommendations for less-invasive treatment [8], it has been reported that traditional approaches, based on “drill and fill” and “one-size-fits-all” methods, remains dominant among dentists

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[9].

It remains unknown to what degree GDPs use patient risk factors in their clinical decision making process. Given that dentists would need to devote more clinical time to risk assessment planning and individualized treatment, this could imply an increase in the costs of dental visits, especially for high-risk patients, due to shorter recall intervals and more preventive treatments, at least in the short term. It would then be expected that risk assessment would determine the type and frequency of interventions, especially in patients with high risk for caries. Therefore, the primary aim of this study was to investigate the association between individual patient risk factors and non-operative and operative treatment decisions among 11 general dental practices whose clinicians were members of a dental practice-based research network in The Netherlands.

The secondary aim was to describe the risk profile of the population attending the practice-based research network related to their need for restorative treatment.

2. Materials and methods

2.1. Study design

This was a prospective single-blinded (the statistician) study based on data from a dental practice-based research network in The Netherlands. Data were collected from 11 dental practices. Descriptive analysis was performed, followed by multiple logistic regression. The primary outcome investigated was the association between patient risk factors and type of clinical approach. The secondary outcome was the treatment profiles of patients with and without restorative treatment during the study period. Ethics approval was granted by the local Ethics Committee, METC (CMO file no. 2015-1565).

2.2. Study population

Eleven dental general practices were recruited from the dental practice-based research network in 2015 to participate in this study with anonymized data from electronic patient files (EPF). The sample included two solo practices, seven small group practices (two to three dentists), and two larger group practices (> 3 dentists). Four practices were located in rural areas, and 7 in urban areas (> 40,000 inhabitants). The population attending these practices was investigated. To be considered eligible for inclusion, patients were required to have visited the practice at least once during the observation period, between January 2015 and September 2017.

2.3. Data extraction

All practices had the same EPF software system (Exquise₁, Vertimart, Kwadijk, NL); data from patients attending the practices were collected digitally and anonymously transferred to a spreadsheet (Excel, Microsoft Corporation, Redmond, WA, USA) by the software company.

2.4. Variables of interest

The following patient-related variables were collected for analysis: practice the patient was attending; sex; age; and general health based on the American Society of Anesthesiologists (ASA) physical status classification system. SES scores, based on the level of education and income of the district the patient resided (i.e., ZIP code), were provided by the Dutch Ministry of Public health, Welfare and Sports. Patients were ranked and divided into one of three groups: low, medium, and high SES. Specific patient-related factors were considered and assessed, and are described below:

2.4.1. Oral hygiene

This was assessed as good, fair or poor, and was classified by the GDPs based on the presence of plaque on the teeth. When more than one evaluation was performed during the observation period, the worst level of oral hygiene recorded for each patient was used.

2.4.2. Caries risk assessment

The risk for caries was assessed as high or low. A high risk for caries was attributed to patients by the GDPs based on the presence of the following: active lesions; number of new caries lesions (≥ 1 new caries lesions in the past year); number of restorations present; degree of self-care (insufficient plaque control); and frequent sugar consumption. Low risk was assigned to patients without active lesions and new caries lesions (last restoration due to caries ≥ 2 years previously), without or with few restorations, and sufficient plaque control. When risk assessment was performed more than once during the observation period, the worst level of caries risk was used.

2.5. Outcomes

For each patient, all applied relevant dental treatments were registered from the EPFs including the total number of visits, preventive instruction consults, oral cleaning sessions, professional topical fluoride application, sealant application, and restorations. For the patient group with restorations, the total number of restorations during the observation period was calculated, including the number of interventions and re-interventions on the same tooth.

2.6. Statistical analysis

Descriptive statistics of the study population were calculated. Statistical analysis was performed using SPSS version 22.0 (IBM Corporation, Armonk, NY, USA) for Windows (Microsoft Corporation, Redmond, WA, USA). Logistic regression was used to determine the influence of the variables of interest (sex, age, SES, caries risk, oral hygiene and practice) on the outcome variables related to the clinical approach (preventive instructions, dental cleaning sessions, professional topical fluoride applications, sealants, restorations, and total number of visits). In this first model, the practices were also included as a variable because each one has particularities, which should be considered in the analysis. For the statistical analysis, the significance level was set at 5%. Considering the large amount of data regarding caries risk and other risk factors not registered by the GDPs, a multiple imputation analysis was also executed. However, the results were virtually the same as those obtained originally, and the authors chose to give preference to the simplest technique and omit the imputation process.

In addition, as a second analysis, the same regression model described above, with the same variables of interest and outcome variables, was executed individually for the population of each practice, resulting in 11 logistic regressions. However, only the odds ratio (OR) regarding caries risk—the main variable of interest—are shown. These data were retrieved from the regression analyses and presented in a table according to each practice (Table 3a and 3b).

3. Results

The records of 39,690 patients were included in the analysis. Table 1 presents the characterization of the population profile according to the performed interventions during the observation period. More than one-half of the population (21,056 patients) received a restoration. The older the population, the more patients received restorations: from 34% of patients ($n = 2176$) in the age group 5–15 years, up to 63% in the group 46–65 years of age ($n = 7545$).

Considering risk factors and their association with restorative treatment, general health status was assessed in 25,703 (65%) cases, with most patients exhibiting good general health (ASA I, $n = 18,635$

Table 1

Demographic characteristics of the study population according to the group treated with restorative intervention and without restorative intervention (n = 39,690).

Variable	No restorative intervention n = 18634		Restorative intervention n = 21056	
	n	%	n	%
Gender				
Male	8698	(46)	10,243	(54)
Female	9936	(48)	10,813	(52)
Age				
5 – 15 years	4283	(66)	2176	(34)
16 – 25 years	3222	(53)	2857	(47)
26 – 45 years	4620	(44)	5811	(56)
46 – 65 years	4478	(37)	7545	(63)
66 years and older	2031	(43)	2667	(57)
Socioeconomic status				
Low	7482	(46)	8739	(54)
Medium	4395	(46)	5214	(54)
High	6757	(49)	7103	(51)
General health				
ASA I	8317	(45)	10,318	(55)
ASA II	2583	(40)	3945	(60)
ASA III	194	(35)	322	(65)
ASA IV	9	(38)	15	(62)
Not recorded	7531	(54)	6456	(46)
Oral hygiene				
Good	5132	(48)	5616	(52)
Fair	3476	(37)	5981	(63)
Poor	325	(30)	770	(70)
Not recorded	9701	(53)	8689	(47)
Caries risk				
Low	7792	(52)	7067	(48)
High	1142	(19)	5341	(81)
Not recorded	9700	(53)	8648	(47)

[73%]). A higher number of patients with ASA II (n = 3945 [60%]) and ASA III (n = 322 [65%]) underwent a restorative intervention, compared with the healthy (n = 10,318 [ASA I, 55%]) group. Oral hygiene was assessed in 21,300 patients, of whom the majority exhibited good oral hygiene (n = 10,748 [50%]), while 9457 (44%) had fair and 1095 (5%) exhibited poor oral hygiene. Of the group with good oral hygiene 52% (n = 5616) received a restoration while this number increased to 63% (n = 5981) and 70% (n = 770) for fair and poor oral hygiene, respectively. Caries risk was assessed in 21,342 (53.77%) of the patients, with 6483 (16.33%) recorded as having high and 14,859 (37.44%) having a low risk for caries. Of the patients with high risk, 5341 (81%) received a restoration, while 7067 (48%) were in the low risk group.

Regarding the restorative intervention group, a total of 68,740 restorations were placed during the observation period. The primary reasons for intervention included primary (n = 21,119 [30.7%]) and secondary (n = 12,729 [18.5%]) caries. Restorations to address primary and secondary caries were distributed according to age group, as presented in Fig. 1. In the patients classified as low risk, 33.6% of 19,981 restorations were performed due to caries (primary caries, n = 3926 [19.6%]; secondary caries, n = 2792 [14.0%]), while 63.9% from the total of 22,910 restorations performed on the high caries risk group was attributed to caries detection (primary caries, n = 9244 [40.3%]; secondary caries, n = 5402 [23.6%]).

The results of logistic regression analysis according to clinical approach are shown in Table 2. The ORs reveal that most preventive instructions were provided to the young age groups, as well as fluoride and sealant applications. Risks for restorative treatment increased with age. A high risk for caries demonstrated a significant association with greater chance for receiving preventive instruction (OR 1.61; p = 0.001), topical fluoride application (OR 1.20; p = 0.013), sealants (OR 1.39; p < 0.001) and restorations (OR 5.72; p < 0.001). High-

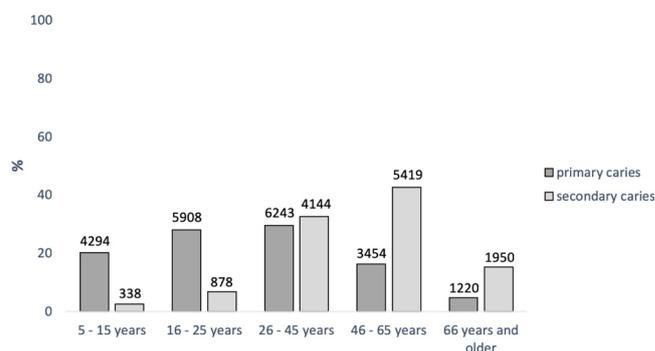


Fig. 1. Distribution of the restorations due to primary (n = 21,119) and secondary caries (n = 12,729) according to age groups in the population.

risk patients had a chance of 1.14 of undergoing up to 3 visits during the observational period. Patients with good/fair oral hygiene were less likely to receive preventive instruction (OR 0.40; p = 0.001/OR 0.48; p < 0.001), topical fluoride application (OR 0.59; p < 0.001/OR 0.67; p = 0.003) and sealants (OR 0.68; p = 0.011/OR 0.69; p = 0.015) than patients with poor oral hygiene.

The odds of high caries risk patients receiving non-operative and operative procedures (compared with low-risk patients) in each practice separately are shown in Table 3a and 3b. A wide variation is evident between practices regarding the treatment applied to high caries risk patients. The chance of high caries risk patients to receive preventive instruction and professional topical fluoride was higher compared with low-risk patients in the majority of practices, although the higher chance for topical fluoride was statistically significant for only 4 practices. The chance of high-risk patients receiving sealants was significantly higher in only 3 practices.

4. Discussion

This practice-based cohort study investigated the patient population of a group of general dental practices in the Netherlands, and compared profiles of patients receiving restorative treatment with those who did not. In addition, the effect of patient risk profile on the applied treatment protocols was analyzed. To our knowledge, this was the first study to analyze the patient population of a group of practices in this manner, based on EPFs and including the entire population attending the practices during the observation period. However, this study had some limitations. Although dentists were engaged in the project and stimulated to collect data into the EPFs during the observation period, a large amount of missing data—primarily related to risk assessments—was revealed. This factor was considered in the data analysis, and an imputation process for missing data was used; however, the outcomes were not affected. The present study demonstrated that extensive record keeping, which is essential in contemporary personalized care, remains a challenge for dentists in their daily routine. The practice sample size was also a limitation of our study; more specifically, it was too small to generalize the results, and should be considered as a special selection of practices related to the practice-based research network.

Another limitation of the study is that the caries risk assessment was performed once in some cases and, in other cases, more than once, in which the worst score was considered. However, it is reported in the literature [10]—as it was observed in our data—that in general, patient risk for caries at baseline and after the follow-up periods usually remains the same. Another limitation to the risk assessment is that it was based on the clinical judgement of one dentist and, therefore, it should be realized that the division of patients into high and low caries risk are likely based on the different thresholds of each GDP. The classification regarding oral hygiene of the patient in terms of good, fair and poor, may also be influenced by this factor.

Results of this study demonstrate that, over an interval of 2 years

Table 2
Logistic regression analysis of the characteristics and risk factors of patients according to the clinical approach related to non-operative and operative procedures.

Variables	Prevention		Dental cleaning		Fluoride		Sealants		Restorations		Number of visits during observational period			
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	up to 3 visits		more than 3 visits	
											OR	Sig.	OR	Sig.
Gender (ref.: male)	1.05	0.33	0.90	0.01	0.98	0.76	1.18	0.02	1.01	0.81	0.84	0.00	1.19	0.00
Age (ref.: 5 – 15 y)		0.00		0.00		0.00		0.00		0.00		0.00		0.00
16 - 25 years	0.35	0.00	6.48	0.00	0.08	0.00	0.23	0.00	1.74	0.00	2.31	0.00	0.43	0.00
26 - 45 years	0.12	0.00	5.76	0.00	0.00	0.00	0.02	0.00	2.67	0.00	2.51	0.00	0.40	0.00
46 - 65 years	0.07	0.00	3.46	0.00	0.00	0.00	0.00	0.00	4.83	0.00	1.75	0.00	0.57	0.00
66 or older	0.05	0.00	2.26	0.00	0.00	0.00	0.00	0.98	4.53	0.00	1.65	0.00	0.61	0.00
Socioeconomic status (ref.: low)		0.79		0.33		0.16		0.43		0.09				0.00
Medium	1.02	0.82	1.06	0.31	0.90	0.26	0.91	0.35	0.94	0.21	1.11	0.02	0.91	0.02
High	1.05	0.49	0.97	0.55	0.85	0.07	1.06	0.59	0.91	0.03	1.13	0.00	0.89	0.00
Caries risk	1.61	0.00	0.77	0.00	1.20	0.01	1.39	0.00	5.72	0.00	1.14	0.00	0.88	0.00
Oral hygiene (ref.: poor)		0.00		0.00		0.00		0.04		0.00				0.00
Good	0.40	0.00	0.92	0.36	0.59	0.00	0.68	0.01	0.76	0.00	1.29	0.00	0.77	0.00
Fair	0.48	0.00	1.16	0.11	0.67	0.00	0.69	0.02	1.01	0.94	1.14	0.06	0.88	0.06
Practices (ref.: practice 1)		0.00		0.00		0.00		0.00		0.00				0.00
Practice 2	0.96	0.74	0.18	0.00	11.17	0.00	9.06	0.00	1.02	0.75	0.76	0.00	1.32	0.00
Practice 3	10.42	0.00	1.15	0.32	11.45	0.00	19.65	0.00	0.55	0.00	2.61	0.00	0.38	0.00
Practice 4	1.17	0.47	0.63	0.01	5.98	0.00	2.61	0.12	4.73	0.00	1.61	0.00	0.62	0.00
Practice 5	6.42	0.00	0.36	0.00	6.24	0.00	12.16	0.00	5.95	0.00	2.70	0.00	0.37	0.00
Practice 6	1.81	0.00	0.51	0.00	6.08	0.00	3.74	0.00	3.23	0.00	2.56	0.00	0.39	0.00
Practice 7	1.04	0.80	0.65	0.00	3.23	0.00	3.07	0.02	1.36	0.00	3.16	0.00	0.32	0.00
Practice 8	0.03	0.00	0.00	0.00	51.34	0.00	1.75	0.22	0.62	0.00	1.42	0.00	0.71	0.00
Practice 9	1.64	0.00	0.17	0.00	0.77	0.44	1.44	0.41	1.02	0.78	1.73	0.00	0.58	0.00
Practice 10	0.57	0.00	1.10	0.45	37.78	0.00	3.27	0.00	1.10	0.14	1.92	0.00	0.52	0.00
Practice 11	0.74	0.03	0.10	0.00	14.49	0.00	4.67	0.00	1.02	0.77	1.83	0.00	0.55	0.00
Constant	0.49	0.00	6.45	0.00	0.38	0.01	0.06	0.00	0.06	0.00	0.19	0.00	5.40	0.00

and 9 months, more than one-half of the patient population received a restorative treatment. There are no data regarding this finding available in other studies; nevertheless, our perception is that > 50% of a population receiving a restorative treatment in such a relatively short period is a considerable number. We performed two analyses on the results, one regression to show which treatment strategy was chosen related to patient characteristics and risk factors, and another regression focused on the caries risk assessment performed by different dentists and the way they adjusted their treatment to the higher or lower caries risk.

The population that did not receive a restorative intervention

during the observation period consisted mostly of patients with good oral health and low risk for caries. In contrast, the group that underwent restorative intervention was characterized mainly by fair oral hygiene and high risk for caries, which is consistent with a previous study reporting higher development of primary and secondary caries lesions in high caries risk patients compared with low caries risk [5], resulting in greater need for restorative intervention. In our study, patients 46 to 65 years of age had the highest chance for restorative interventions during the observational period, which may be explained by the progressive and linear increase in caries that occurs throughout life [11]. Moreover, it corresponds to the generation with late access to

Table 3a
Odds ratio of caries risk patients' dental visits according to each practice.

Practice	Preventive instruction visits				Total number of visits							
	HR	LR	OR	Sig	up to 3 visits				More than 3 visits			
					HR	LR	OR	Sig	HR	LR	OR	Sig
1	48	65	1.8	0.01	219	491	1.5	0.00	314	1045	0.7	0.00
2	89	174	1.7	0.00	234	759	0.9	0.39	625	1934	1.1	0.39
3	408	411	1.5	0.00	488	619	0.5	0.00	452	365	2.1	0.00
4	23	12	2.2	0.05	86	155	0.7	0.05	121	161	1.5	0.05
5	238	66	1.6	0.01	350	143	1.3	0.14	230	118	0.8	0.14
6	112	136	1.6	0.00	375	590	1.2	0.09	259	509	0.8	0.09
7	12	60	1.1	0.80	98	718	1.1	0.56	73	448	0.9	0.56
8	0	4	0.0	0.99	125	452	1.5	0.00	133	681	0.7	0.00
9	75	124	1.3	0.13	210	519	1.2	0.18	221	662	0.8	0.18
10	72	151	1.4	0.04	399	1122	1.2	0.03	403	1371	0.8	0.03
11	165	167	2.2	0.00	551	800	1.5	0.00	517	1197	0.7	0.00
total	1242	1370			3135	6368			3348	8491		

Note: Odds ratio retrieved from logistic regression analysis. The following variables were considered in the analysis: gender, age, socioeconomic status, caries risk and oral hygiene. Only the impact of caries risk factor is shown in the table.

HR = number of high risk patients registered performing dental visits.

LR = number of low risk patients registered performing dental visits.

*reference group: low caries risk.

Table 3b
Odds ratio of caries risk patients receiving procedures according to each practice.

Practice	Dental cleaning				Professional topical fluoride				Sealants				Restorations			
	HR	LR	OR	Sig.	HR	LR	OR	Sig.	HR	LR	OR	Sig.	HR	LR	OR	Sig.
1	486	1458	0.6	0.01	11	2	12.8	0.00	2	5	0.5	0.44	433	781	5.0	0.00
2	599	1936	0.8	0.02	96	305	1.2	0.43	50	167	1.0	0.90	686	1209	5.3	0.00
3	892	909	1.7	0.01	95	176	2.0	0.01	84	149	1.5	0.07	712	241	9.0	0.00
4	190	287	1.6	0.21	12	4	1.6	0.52	3	2	0.9	0.88	198	258	9.6	0.00
5	492	218	1.2	0.52	88	2	16.6	0.00	73	8	1.1	0.83	559	212	8.5	0.00
6	525	998	0.5	0.00	48	110	0.7	0.15	30	32	2.0	0.03	593	774	5.7	0.00
7	155	1061	0.8	0.34	6	31	1.1	0.84	3	14	1.6	0.53	163	631	17.9	0.00
8	16	74	1.1	0.85	56	179	1.4	0.20	6	12	1.7	0.35	189	416	5.5	0.00
9	298	846	0.7	0.03	32	8	13.4	0.00	12	12	2.7	0.03	361	541	6.9	0.00
10	721	2344	0.6	0.01	193	692	0.7	0.02	39	106	1.3	0.17	642	1160	4.6	0.00
11	604	1143	0.9	0.09	293	553	1.1	0.664	112	141	1.5	0.01	805	844	5.21	0.00
total	4978	11274			930	2062			414	648			5341	7067		

Note: Odds ratio retrieved from logistic regression analysis. The following variables were considered in the analysis: gender, age, socioeconomic status, caries risk and oral hygiene. Only the impact of caries risk factor is shown in the table.

HR = number of high risk patients registered receiving the respective procedure.

LR = number of low risk patients registered receiving the respective procedure.

*reference group: low caries risk.

fluoride, given that fluoride was introduced for prevention of dental caries in the 1950s [12] and, in the Netherlands, fluoride content in drinking water is low, while from the late 70s onward, most commercially available toothpastes contained fluoride. As a result, this age group had a history of active caries in their youth, leading to considerable damage and restorative work, which requires maintenance and replacement during a lifetime. This also explains the higher number of restorations placed due to secondary caries compared with primary caries in this age group. Our study also demonstrated that in patients ≥ 66 years of age, the chance for restorative intervention decreases again, probably due to a reduced demand for restorative dental care attributed to tooth loss, decreased motivation for oral health care, and use of dental prostheses [13].

For patients with lower SES, the chance to receive a restoration was higher. SES has been reported to be strongly associated with dental treatment needs [14–16]. Additionally, for patients with general health problems, indicated by ASA II and III classifications, a higher chance for restorative intervention was observed. Oral health usually reflects general health [17], and systemic diseases may decrease the motivation for oral health care maintenance, resulting in a higher risk for caries [18], and also influenced by the effects caused by disease and medications [19].

From this we conclude that in the practices investigated, restorative work was performed in an important proportion of the high-risk group. In recent years, it has been demonstrated that patient-related factors play an important role in restorative treatment prognosis [20], and age, caries risk, parafunctional habits, and SES influence the success of restorative treatment [15,20–24]. Furthermore, it is often suggested that higher failure rates by practitioners are caused by operator failures or misdiagnosis; however, it is important to realize that the population in which practitioners place their restorations is mainly a high-risk population.

In our first logistic regression, we also investigated how patient factors impacted the clinical approach. Younger patients (5–15 years of age) were more likely to receive preventive instruction visits, fluoride, and sealants [25]. This may be due to extra attention provided by practitioners for this age group because it is the period of eruption of permanent teeth, which requires more attention to plaque control, and also because dietary habits in this age group often changes in this period [26]. In the Netherlands, these preventive treatments are reimbursed by public health until patients are 18 years of age, which may also explain the findings. Older patients had a higher odds of undergoing dental cleaning, which may be related to the onset of periodontal disease later in life.

In the second analysis, we investigated the role the caries risk assessment played in decision making. We found that caries risk was associated with higher chance of the patient receiving preventive instruction, topical fluoride application, and sealants and restorations, and a higher chance of the patient requiring up to 3 visits to the dental office during the observational period. This indicates that risk evaluation was used to guide treatment decisions. Although a wide variation among practices regarding the treatment applied to high caries risk patients was observed, it appears that some type of individualized, risk-oriented care was applied by the practices.

Notwithstanding the statistically significant associations, the odds of preventive procedures in high caries risk patients, compared with those in low-risk patients, still appears to be rather low. Moreover, low-risk patients, who theoretically would not require prevention procedures, such as professional application of fluoride and sealants, are also undergoing these measures, especially young children. Performing these treatments in low-risk children may be related to demands from concerned parents, but may also be promoted by financial stimulus because these treatments are reimbursed by the public health system. A previous study reported a low level of preventive measures for high-risk individuals, which was only slightly different in amount and type from that in individuals with low caries risk [5].

Regarding the practices evaluated, significant differences in performing non-operative and operative procedures were observed. This may be related to factors such as the location of the practices in different areas (urban or rural), size of each practice (solo, small, or large) and to the populations attending the practices (i.e., younger or older patients). However, it may also reflect the personal attitude of the dentist in promoting or not promoting the concept of individualized care [27].

Finally, it appears that a restorative focus on caries treatment remains dominant, notwithstanding the scientific evidence supporting less invasive therapies [8]; in the present study, patients with high risk for caries were more likely to receive operative rather than non-operative treatment. It has been suggested that dentists do not trust patients to control caries lesions with self-directed preventive measures and, instead, trust the effect of restorative treatment [5,28].

In conclusion, a high caries risk was associated with higher chance of the patient receiving preventive instruction, application of topical fluoride, and sealants and restorations. Although it appears that individualized treatment is being applied by some practices, further investigations are needed to examine whether the GDPs are, in fact, using risk assessment to plan individual treatment strategies.

Conflicts of interest

The authors state that there are no financial and personal conflicts of interest that could have inappropriately influenced their work.

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