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Research Article

General Features and Dental Treatment Profile of Referred German Children

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Received: May 15, 2019; **Published:** June 28, 2019

Abstract

Background: Pediatric dentistry and referrals to specialized pediatric treatment seem to rise in Germany, especially for children under 5 years of age, especially with regard to early childhood caries and the need for comprehensive dental treatments. The objectives were to investigate the characteristics of referred children to Greifswald university dental clinic in 2008 and 2011 in Germany, which is the only specialized pediatric facility in the region of Pomerania.

Methods: This retrospective comparative study examined records of all children under 18 years of age referred to the university dental clinic in Greifswald between 2008 and 2011. All data including age, gender, dental status, referral reasons and needed dental treatments were collected and anonymously analyzed.

Results: Younger children (≤ 5 years: 47.2%) with more rampant caries (42.1%) and orthodontic/oral surgery problems (16.4%) were referred in 2011 in comparison with 2008 (37.1%, 29.3%, 10.1% resp.). Non-invasive dental treatment followed by dental consultation were more delivered during first dental visit in 2011 (63%/23.6%) and 2008 (53.6% and 21.3% resp.). Considerably more restorations (fillings and S.S.C) were supplied in 2008 (11.5%) than in 2011 (2.6%), but more children underwent GA (27%) with more extraction (16.1%) and less restorative procedures (26.3%) in 2011 compared to 2008.

Conclusions: Dental caries persists to be the most common reason for dental referral to specialized pediatric dentistry. Non-invasive treatment was almost exclusively provided at the first dental visits in 2011 and later more subsequent GAs and dental extractions were performed than in 2008. Thus, specialized dental facilities are needed, even in low caries prevalence areas.

Keywords: *Children; Dental Referral; Caries Prevalence; Treatment Needs*

Background

Dental visits are often associated with anxiety and expected pain. This more true for young children, which makes it difficult to perform adequate dental treatment [1]. Dental behavior management problems (DBMP) were defined as difficulties approaching unfamiliar situations and people [2]. This includes a variety of problematic "uncooperative and annoying" behaviors that children display when confronted with dentistry, resulting in delay of treatment or making treatment impossible [3].

Blomqvist., *et al.* (2006) found that DBMP was reported more frequently among children with attention deficit and hyperactivity disorders (ADHD), while no differences concerning dental fear were detected [4]. Moreover, many patients fear the dental pain, which is closely correlated to negative experiences during a prior dental visit. Regardless of behavior management techniques by the dentist, many patients with fear, anxiety or the expectation of pain will miss out on needed treatment and allow the dental diseases to progress [4].

Referral to dental specialist

Dental referral could be necessary for several reasons such as dental anxiety, behavior management problems and the need for specialized dental treatment [5].

The most common reason for referrals was non-cooperation by the child, followed by extensive caries and the need of comprehensive dental treatments [6,7].

Lack of the child cooperation during caries excavation, cavity preparation or application of restorative materials often leads to negative consequences such as secondary caries, filling loss, acute pulpitis, periapical diseases or abscesses. Therefore, materials with easier and faster handling and application properties might allow adequate treatment results in the pediatric dentistry [8].

Due to the difficulties in managing children in the dental practice, almost half of the lesions in primary teeth remain untreated in Germany [TEAM DAJ 2017] [9]. Although there has been an increase in the number of pediatric dentists in Germany there still seems to be a considerable unmet need for dental treatment in children [10]. Unfortunately, there is little scientific research about the provision of caries treatment and the general characteristics of children referred to specialists in Germany.

Aim of the Study

The aim of the present study was to determine the characteristics and dental status of the children with referral from the family dentists to specialized pediatric dental care for 2011 to the Department Of Preventive and Pediatric Dentistry at the University of Greifswald (North-East Germany) in comparison to earlier data from 2008.

Methods

Study population

All patients under 18 years old (n = 389) who had been referred by dental practitioners into the University Dental Clinics in 2008 and 2011 were analysed retrospectively from the central data system. The University of Greifswald is the only provider for pediatric dentistry in whole Pomerania, which has about 4.4 million inhabitants in an area of 48.309 km^2 (Wikipedia 2012) [11].

The characteristics of the referred patients were characterized for age, gender, dental status and caries levels (dmft/DMFT), diagnosis, referral reasons and provided treatment. For each patient, this information transferred to an Excel data spreadsheet.

Oral examination

All patients referred for dental treatment received a full consultation, proper medical/dental history and a clinical examination by pediatric dentists. Dental caries were examined and calculated according to WHO standards and evaluated by an oral examination based on visual inspection and mostly also x-rays.

Different types of dental treatments like restorations (fillings and stainless steel crowns) and pulp therapies including the final restoration which was often a stainless steel crown as well as dental extractions were also assessed and recorded in the data sheet for statistical analyzing.

Statistical analysis

Collected data from the dental records were analyzed SPSS 16 for Windows. Descriptive statistics such as frequencies, mean values, standard deviations (SD) and distribution kinds were calculated.

Univariate analysis of variance (ANOVA) and Chi square tests were used for cross-tabulations. Moreover, differences between 2008 and 2011 were tested for statistical significance using parametric or non-parametric tests like Mann-Whitney U test and Student's t-test

for two independent groups as appropriate for normal or non-normal distribution. Results were considered statistically significant at a p-value equal or lower than 0.05. To assess these distribution patterns (normal/non-normal) a Kolmogorov-Smirnov analysis was conducted.

Results

Characteristics of the study sample

Three hundred eighty nine children (age range 1-18 years, 205 males and 184 females) were referred to the Dental University Clinics at Greifswald in 2008 and 2011. The mean age decreased from 8.75 ± 5.08 years in 2008 (n = 194) to 7.38 ± 4.97 years in 2011 (n = 194, p = 0.005, Mann-Whitney U-test, table 1). The portion of the genders was very similar for 2008 and 2011 (2008: 88% females and 106% males, 2011: 96% and 99% resp.).

Referred patients were divided in four age groups (5 years or younger, 6 to and 8, 9 to 11 years and 12 years or older), which revealed statistical significant differences in patients' ages between 2008 and 2011 (p = 0.015, Chi square test). Children with an age of 12 years or older decreased considerably from 2008 to 2011 while the age group of 5 years or younger increased in 2011 (Table 1).

Age	N	Mean	SD	Median	*P*	6 - 8 years	9 - 11 years	≥-11 years	P
2008	194	8.75	5.08	8	0.005	13.9%	19.1%	29.9%	0.015 (Chi^2-*Test*)
2011	195	7.38	4.97	6	(Mann-Whitney U-Test)	19%	10.3%	23.6%	

Table 1: *Mean and standard deviation of the age of referred patients in 2008 and 2011.*

Characteristics of referring dentists and patients

In 2008, the highest numbers of referred patients and referring dentists (34% and 31.7% resp.) lived more than 50 km away from the University Clinics, while this decreased for 2011 to 31 and 40 km. These differences were statically significant (p < 0.001 and p = 0.002 resp.) according to the Chi Square test (Figure 1).

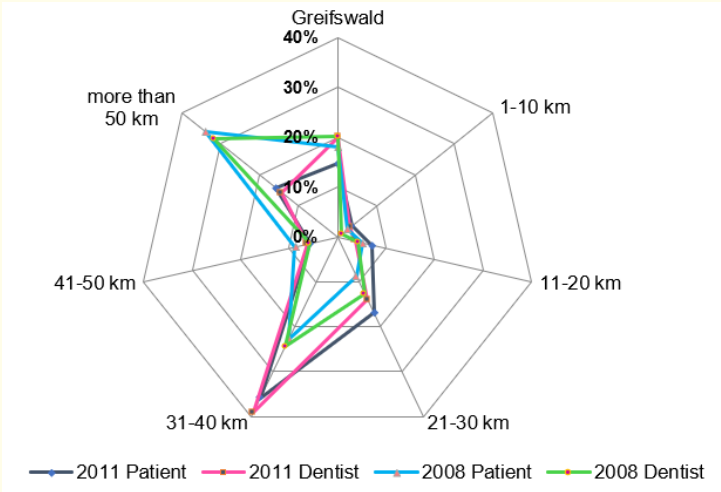

Figure 1: *Distribution of distance for referred patients and referring dentists in 2008 and 2011 (patients: Chi^2= 26.53, p < 0.001, dentists: Chi^2= 21.22, p = 0.002).*

Reasons for referral

The reason for referral to the University of Greifswald was determined at the first visit by the specialist dentist using clinical findings along with the letter of referral (Figure 2).

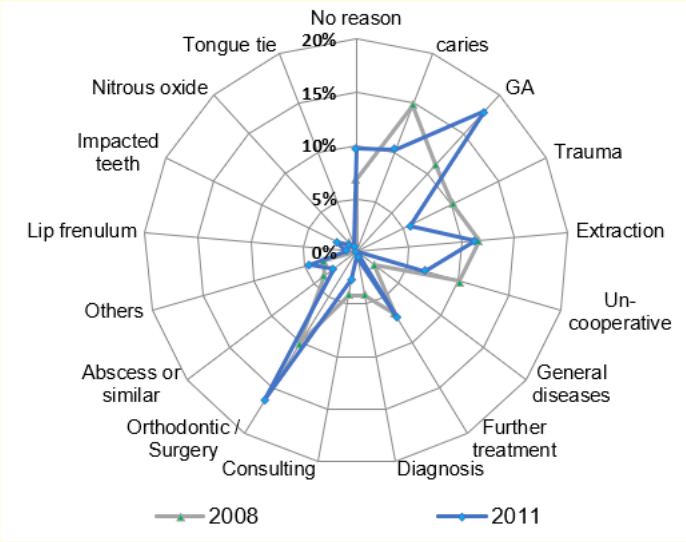

Figure 2: *Distribution of reasons for referring patients in 2008 and 2011 from general practice to the university clinics in Greifswald (Chi^2= 30.55, p = 0.015).*

Thirty-five children (17.9%) in 2011 were referred for comprehensive dental treatment under general anaesthesia, followed by 32 referrals (16.4%) due to orthodontic and/or oral and maxillofacial surgery treatment needs. A further 22 (11.3%) referrals were for dental extractions which mostly was associated with non-cooperation. More patients (n= 28; 14.8%) were referred in 2008 because of extensive dental caries, followed by dental extractions (n = 22; 11.6%), and 21 patients (11.1%) had needed dental treatment under GA. In spite of only minor shifts, the changes in the reasons for referral between 2008 and 2011 were statistically significant (p = 0.015, Chi square test).

The age-specific analysis for 2011 reveals a very high proportion of referrals for GA in children under 5 years of age (29.3%) which decreases for the older age groups continuously (Table 2, p < 0.001, Chi Square test).

Referral reasons	≤ 5 years	6 - 8 years	9 - 11 years	≥ 12 years
Extensive caries	10.9%	16.2%	20%	0%
GA demand	29.3%	16.2%	5%	2.2%
Trauma	6.5%	2.7%	10%	4.3%
Extraction	4.3%	13.5%	25%	17.4%
Non-cooperation	12%	2.7%	5%	0%
Orthodontic/Surgery	3.3%	18.9%	25%	37%
Abscess	2.2%	0%	0%	6.5%

Table 2: *Distribution of referral reasons in 2011 according to age groups (Chi^2= 1.23, p < 0.001).*

Referred patients in 2011 had more carious lesions (dt= 5.13, DT= 1.73, table 3) and higher values for the overall caries experience (dmft 5.40, DMFT 2.15) than the patients in 2008, but these differences failed to reach the level of statistical significance ($p > 0.05$).

Year	Dt (n)	DT (n)	Dmft (n)	DMFT (n)
2008	4.64 ± 4.99 (116)	1.35 ± 3.14 (86)	5.16 ± 5.31 (116)	1.57 ± 3.37 (86)
2011	5.13 ± 4.86 (146)	1.73 ± 3.61 (100)	5.40 ± 4.94 (146)	2.15 ± 3.82 (100)

Table 3: *Means, standard deviations and frequencies of caries lesions and caries experience in referred children at the university dental clinics in Greifswald for 2008 and 2011.*

Clinical diagnoses of referred patients

In 2011, almost half of the referred patients were diagnosed to have rampant caries/ECC (42.1%/8.7%) followed by orthodontic/oral surgery problems (16.9%) which was similar to 2008 (29.3%/14.4% and 10.1%, resp. $p < 0.001$, figure 3a and 3b).

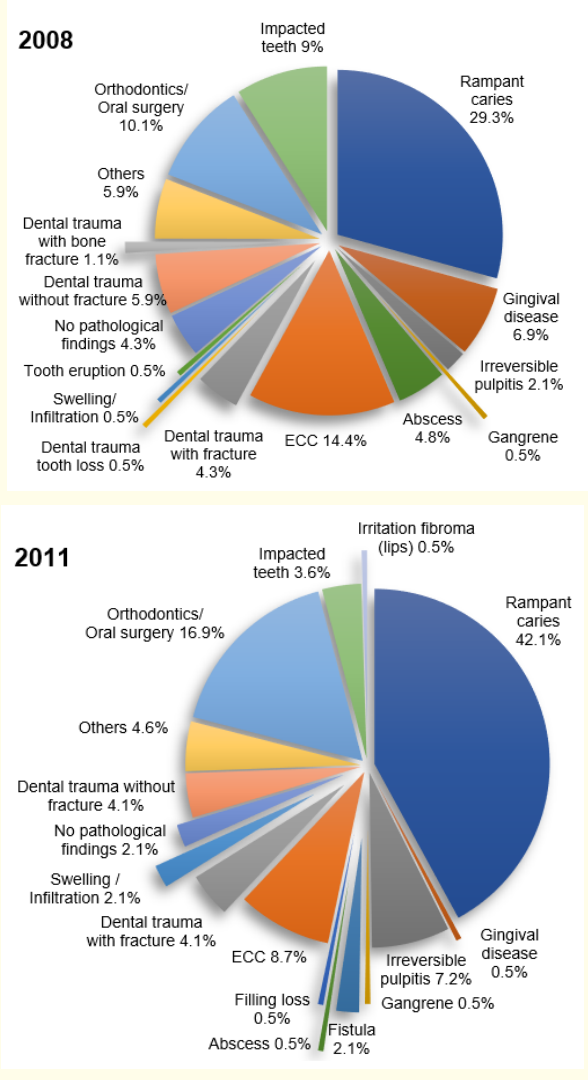

Figure 3a and 3b: *Distribution of dental diagnosis in referred children to university dental clinics in 2008 and 2011 ($Chi^2 = 51.467$, $p < 0.001$).*

Dental treatments for referred patients

Sixty-three percent of referred patients received non-invasive treatment in first dental visit in 2011 and 23.6% of patients got dental consultation only. Dental extraction and endodontic treatment were very rare to be performed at the first appointment (6.7% and 2.6%, resp.). In 2008, all these treatments were performed less often (non-invasive treatment 53.6%, consultations 21.3% only, extractions 4.9% and pulp treatment 0%), while restorations (fillings and stainless steel crowns) were applied in 2008 considerably more often (11.5%) compared to 2011 (2.6%, Chi square test, $p < 0.001$, figure 4).

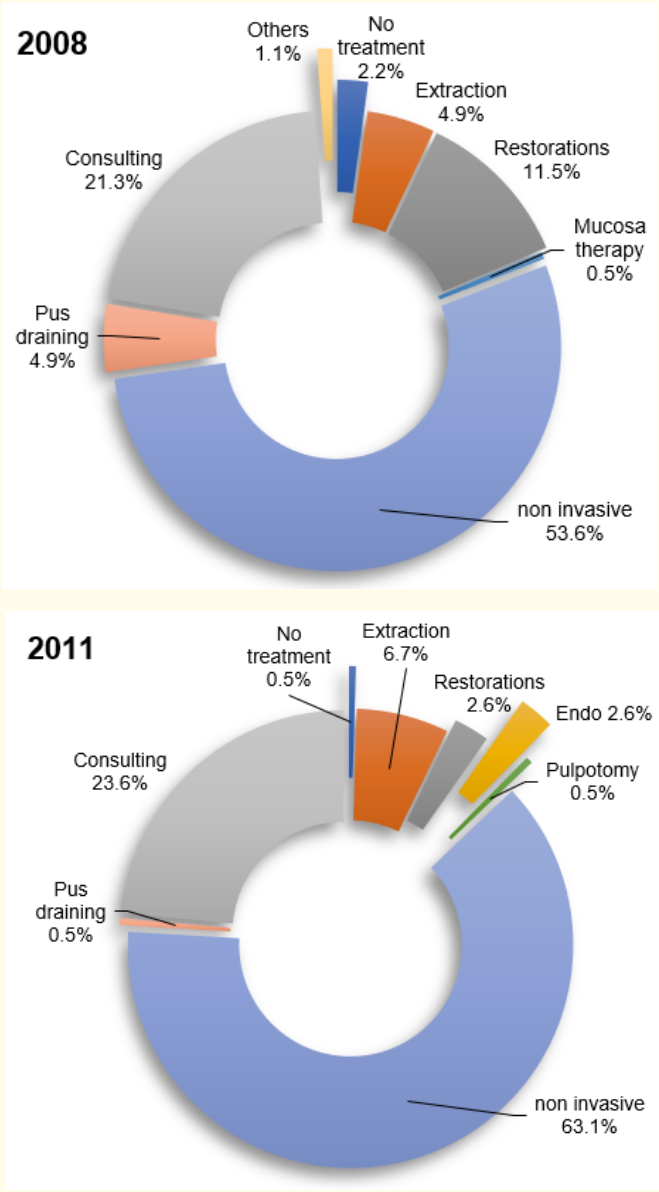

Figure 4a and 4b: *Distribution of first conducted dental treatment in referred children to the university dental clinics in 2008 and 2011 ($Chi^2 = 30.83$, $p < 0.001$).*

In addition, the subsequent dental treatment pattern revealed a higher use of GA (27%) and a slightly more extractions (16.1%) in 2011 compared to 2008 (20.9% and 15.5%, resp.). On the contrary, less restorative and preventive procedures were supplied in 2011 (26.3% and 4.4%, resp.) in comparison with 2008 (31% and 10.9%, resp., figure 5).

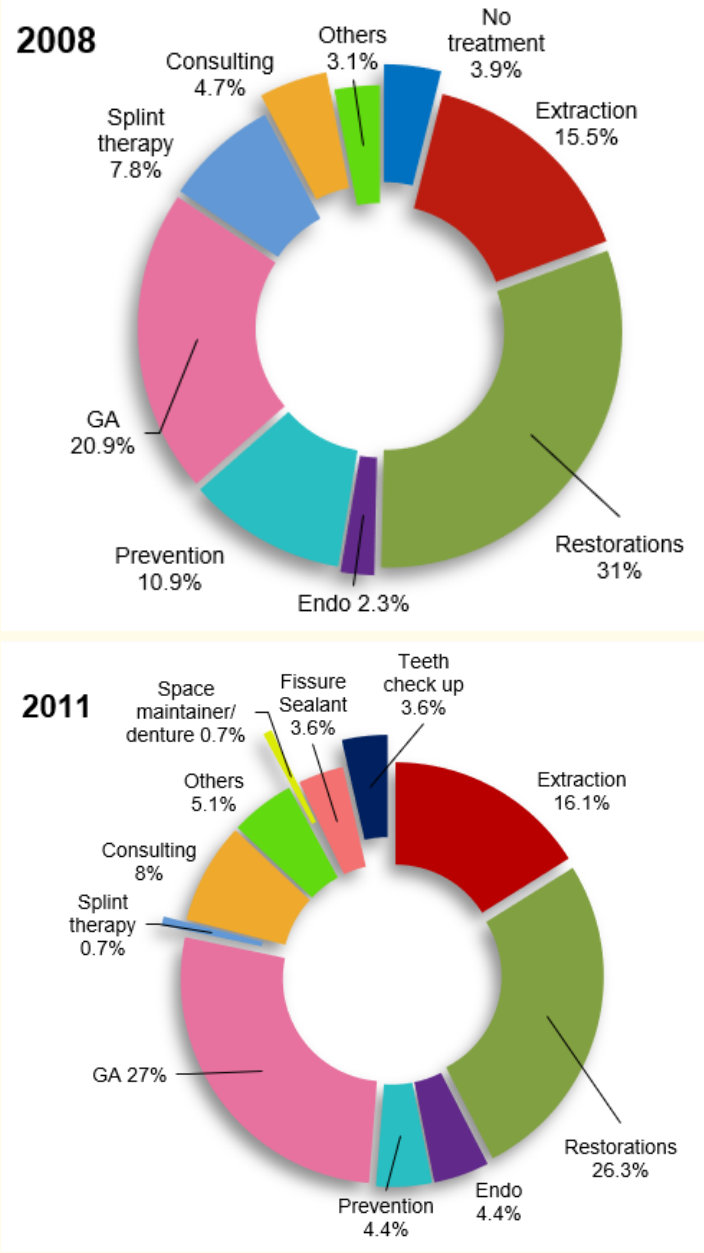

Figure 5a and 5b: *Distribution of following treatment in referred children to the university dental clinics in 2008 and 2011 (Chi^2= 31.51, p = 0.001).*

Discussion

Dental caries remains the most prevalent chronic disease in both children and adults in the world [WHO 2003] [12], even though it is largely preventable. However, there are very few studies on the circumstances of dental referral and the context of dental treatment in children in Germany. The present study sample clearly deviates from a representative German child population and it reflects the standard characteristics of specialized pediatric treatment in Germany, as the university dental clinics are the only referral institution for pediatric dentistry in Pomerania. It receives mostly small children with high caries level.

Both dental caries indices (dmft, DMFT) for the primary, mixed and permanent dentition were drastically higher than in a German norm population (TEAM DAJ 2017) [9], but similar to an equivalent study by Alcaino., *et al* [13]. Due to these high caries levels, this often results in a high number of extractions and restorations performed under general anesthesia [14].

Age's comparison among children between 2008 and 2011

The results of this study showed a significant increase of referred children in 2011 (47.2%) under the age of 5 years, compared to 2008 (37.1%). This was accompanied by a statistically significant decrease in the average age of the referred children from 2008 (8.75 ± 5.1) to 2011 (7.38 ± 5). This indicates a high or even rising level of early childhood caries or at least higher referral rates, mostly due to poor cooperation for the required dental treatment by the children. This was in disagreement with other studies where a higher mean age between 9 and 9.5 years of referred children was reported [15,16].

Comparing the travel distance of referred patients

The current study showed a significant decrease in the number of referred patients residing more than 50 km away from the clinic in comparison with 2008 (34%), but still the biggest group of patients had to cover a distance of 31 - 40 km for treatment in 2011 (35.9%). In this time, no other specialized treatment facilities for pediatric dentistry were available in Pomerania apart from the university clinics. Thus, more patients had to travel quite far in the sparsely populated Pomerania, which is in contrast to other studies, where more children were coming from areas close to the specialized dental practice [17,18].

Reasons for referrals to a specialist dental clinic

The slight reduction for referrals due to dental caries, trauma and low cooperation in 2011 (10.3%, 5.6% and 6.7% resp.) compared with 2008 (14.8%, 10.1% and 10.1% resp.) is compensated by the increase of direct referrals for GA (17.9%, 2008: 11.1%). This is in line with Klingberg., *et al*. [19] who found a reduced ratio of referrals due to traumatic dental injuries, disabilities and complex medical histories. Also, Stewart., *et al.* (2012) and Shaw., *et al.* (1994) reported predominantly insufficient cooperation for dental treatment as reason for referrals [15,18]. This is supported by British analytical study where the most common reason for a referral by a general dental practitioner was the explicit need of treatment under general anesthesia for anxious children. With very few referrals (14%) were based on complex medical risks [20]. Thus, most of specialized dental care is required due to preventable caries problems.

Prevalence and severity of dental caries in referred children

Slightly increasing incidence of referrals due to early childhood caries was noticed in 2011 (71.3%) compared to 2008 (67.6%). A reduction in the mean age and a higher mean dmft value in 2011 indicate that in spite of a caries decline in the primary dentition and moderate caries levels of 2.5 dmft in 6 - 7-year-olds in Pomerania, the burden of early childhood caries in a small group of children is quite considerable (DAJ 2010) [9]. This also reveals a high degree of polarization, as Germany generally experiences a caries decline in children and adolescents and it reflects the persistent or even increasing high caries levels in a small group of children which required specialized treatment in an environment of normally very low caries values. This is in line with other reports on a growing prevalence and severity of dental caries [21,22].

Clinical diagnosis

The significant decline in the formal diagnosis "ECC" in 2011 (8.7%) compared to 2008 (14.4%), is compensated by the higher degree of direct referrals for GA and the trend for younger children and higher caries values. Maybe the wording for the referral has shifted over time, as the numbers of decayed primary molars and "irreversible pulp inflammation" have increased also for 2011 (42.1%, 2008: 29.3%). This highlights the persistent problem of dental decays and its clinical consequences of pulp inflammation and non-cooperation for dental treatment in small children being the most relevant problem in pediatric dentistry [23].

Type of initial and further dental treatment

Non-invasive dental treatment was provided more often at the first visit for referred children in 2011 (63.1%) compared to 2008 (53.6%), followed by consulting (23.6% in 2011 and 21.3% in 2008). Immediate extractions were rather rare (2011: 6.7%, 2008: 4.9%), while restorations in the first session decrease considerably from 2011 (2.6%) to 2008 (11.5%), which reflects a trend of less invasive treatment at the initial appointment, but not for the whole treatment as the subsequent GA rates were higher (2008: 20.9%/2011: 27%). Thus, the increased rate of younger and more severe cases leads to diagnosis and assessment alone in the first session, often followed by GA or urgent extractions. The standard restorations seems less often needed or possible. In addition, an internal shift towards more behavior management and preventive counseling in the first session reflects the rise of non-operative caries treatment in the dental literature [24-27].

This study revealed that more dental therapy under GA, dental extraction and endodontic treatment were carried out in 2011 as a subsequent treatment (27%, 16.1% and 4.4% resp.) in comparison with 2008 (20.9%, 15.5%, and 2.3% resp.), while dental restorations (fillings and stainless steel crowns) were performed less often (2011: 26.3%; 2008: 31%) which supports the trend of the first visit. These findings may be explained through the increased number of referred children under 5 years of age who were uncooperative in the dental chair and had a rampant aggressive caries which had to be treated urgently and more invasively under GA. Those outcomes agree with Clayton., *et al.* (2003) and Holt., *et al.* (1999), where an increased number of teeth were extracted after referral to a specialist pediatric dentist resulting in a reduction in the need for repeated GA [28,29].

Conclusions

There is a growing definite need for specialized pediatric dentistry in spite of the caries decline. Especially children under 5 years of age being referred with rampant caries and behavior management problems have to be treated in specialized pediatric dentistry, while complex medical co-factors are less frequent.

The present study showed, in contrast to the general caries decline, higher mean caries values (dmft, DMFT) for children in specialized preventive practice from 2008 to 2011 in Pomerania. This reveals the urgent needs of effective dental prevention programs for all young children and a currently strong need for adequate dental treatment in mostly preschool children who are often incapable of cooperation in the dental chair.

Declarations

- Ethics approval and consent to participate.
- The present study was approved by the Research Ethics Committee of the University of Greifswald under number BB002/16. Informed consent was obtained from all individual participants included in the study.
- Consent for publication.

Availability of Data and Material

The data sets generated and/or analysed during the current study are not publicly available due to Regional Ethical Review Board regulations but are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests.

Funding

This work has No Funding.

Authors' Contributions

S.CH. and T.M. conceived of the presented idea; T.M. developed the theory and performed the computations; T.M. collected the data; T.M., AL.D. and AL. M. performed the analytic calculations; S.CH., AL.D. and AL. M. verified the analytical methods; T.M. wrote the manuscript with support from AL.D. and S.CH; S.CH. supervised the project. All authors discussed the results and contributed to the final manuscript.

Acknowledgements

The authors would like to express sincere gratitude to the Registration Office at the dental clinic at Greifswald University for their support in collecting the data of the referred patients.

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Volume 18 Issue 7 July 2019