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Abstract

Background: Early childhood caries remains an unsolved problem in children under three worldwide. Midwives are important health care persons around birth and can shape behavior. They possibly can play a positive role in preventing early childhood caries in young children.

Objective: to assess how involved midwives are in early childhood caries prevention, what preventive measures they recommend and what knowledge they have about early childhood caries, as well as to study the potential differences between the various federal states or due to their work experience.

Materials and Methods: An online survey targeted midwives in Germany on their knowledge about early childhood caries as well as the preventive measures they recommended. Participants were members of the German midwives' association (DHV). The survey invitation was published with the monthly newsletter and in the association journal of the DHV. Data was collected anonymously.

Results: 191 midwives nationwide responded to the questionnaire. Most midwives were aware about ECC prevalence, consequences, causes and the teeth mainly affected. Midwives gave excellent recommendations regarding diet, oral hygiene and avoiding prolonged bottle feeding. However, only 40.8% of midwives recommended the first dental visit with the eruption of the first tooth. 71.7% recommended a fluoride tooth paste with the eruption of the first tooth. The rest advised a later use or non-fluoridated toothpaste. Regional differences were minimal.

Conclusion: Midwives have good oral health knowledge, but there is some variability in recommendations on the first dental visit and the use of fluoride toothpaste which reflects an inconsistency of professional recommendations delivered by different health care institutions in Germany.

1. Introduction

Early childhood caries (ECC) is a significant public health problem affecting preschool children (AAPD, 2006). The American Dental Association (ADA) defined early childhood caries as the presence of one or more decayed (cavitated or non-cavitated), missing (due to caries), or filled tooth surfaces in any primary tooth in a preschool age child from 0 till 71 months old (AAPD, 2015).

ECC can cause multiple disturbances upon children as pain, malfunction of mastication and digestion, interference with growth and development process, phonetic and articulation disturbances, disruption of sleep and daily activities, malocclusion in permanent dentition and finally low self-esteem (Filstrup et al., 2003). Infants and toddlers having ECC in their primary dentition are at higher risk of developing new carious lesions in their primary and mixed dentitions (Heller et al., 2000, Al-Shalan et al., 1997).

Furthermore, the repair and replacement of carious teeth is time consuming and costly. The treatment of ECC is expensive because it often requires the use of general anaesthesia.

ECC is characterized by its rapid progression. Initial carious lesions progress in to cavitation within 6 to 12 months (Weinstein et al., 1994). When ECC is detected, immediate intervention is required to minimize further damage and prevent subsequent health problems. Oral hygiene instructions, therapeutic restorations, more frequent dental visits with scheduled applications of fluoride and full crown coverage are often necessary.

Inappropriate feeding practices, frequent intake of sugary snacks, plaque formation, lack of tooth brushing are important risk factors of early childhood caries. Frequent prolonged contact between sugars in fermentable carbohydrates and cariogenic bacteria increases the risk on the susceptible teeth. Many parents are unaware of the timing they should brushing their child's teeth, the timing they should first visit the dentist, the use for a fluoride.

The highest prevalence of ECC is in Africa and South-East Asia. The prevalence of ECC varies from less than 1% in certain areas in Europe to 85% in certain areas in east Asia. The prevalence of ECC in Germany ranges from 10-15% (Splieth et al., 2009).

Germany has a good system of individual, group and intensive prophylaxis for children and adolescents. Germany, with a dmft value of less than 2, is ranked at the top among European countries together with countries as Netherlands, Denmark, Great Britain, Switzerland, and Austria (Hellwig et al., 2009, Micheelis and Schiffner, 2006). However, the prophylaxis of children under 3 years old is considered insufficient since not even 25% of these children attend for dental clinics or supervised institutions (Eßer, 2014). As reported by the Institute of German Economics in Cologne (IWD, 2016), 10% of under 3-year old children in Germany are missing a place in kindergarten. This percentage varies from one state to another being the greatest in Bremen and Nordrhein-Westfalen. Which means that 10% of children in Germany are already missing group prophylaxis.

In early 2012, the KZBV initiated a group of experts in which representatives from KZBV, BZÄK, Deutschen Gesellschaft für Kinderzahnheilkunde DGKZ, the Bundesverbandes der Kinderzahnärzte (BuKiZ) and the Deutschen Hebammenverband (DHV) for a public health caries prevention approach working together to create a legal framework for the first dental visit with the eruption of the first tooth.

Lack of oral health knowledge in parents, especially how to provide appropriate oral health care, were reported in several studies (Rothnie et al., 2012, Spanier, 2009). Many studies reported mothers of children with early childhood caries to lack information about the causes and preventive measures of ECC compared to mothers of children without ECC (Johnsen et al., 1982, Febres et al., 1997)

Networking with midwives, gynaecologists and paediatricians can certainly play an important role in early childhood caries prevention through informing the parents/care givers about inappropriate feeding practices and the timing of the first dental visit for their infants (with the eruption of the first tooth).

Midwives are one of the first health care persons having contact with expectant mothers. They can play an important role in increasing parental awareness of the disease and passing over the dental examination booklet (Kinderpass).

Aim of the study

The study aims to assess

1. which caries' prophylactic measures are recommended by midwives.
2. how much midwives know about early childhood caries.
3. if there are regional differences in knowledge and prevention.
4. if potential differences are related to their working experience.

2. Literature Review

2.1. ECC description

The American Association of Pediatric Dentists (AAPD, 2013) recognized caries as a common chronic disease resulting from an imbalance between multiple risk factors and preventive factors.

ECC has been described by multiple terms including “nursing bottle caries”, “baby bottle caries”, “milk bottle syndrome” and “nursing caries”. The term “early childhood caries” is the most common.

Because ECC is not consistently associated with poor feeding practices, the AAPD adopted the term “Early Childhood Caries” rather than “Nursing bottle caries” as it reflects the multifactorial etiology of the disease (AAPD, 2013).

The term “Severe early childhood caries” (S-ECC) indicates atypical progressive acute or rampant patterns of dental caries and it is an advanced form of this disease. Any signs of smooth surface caries in children under 3 years is considered S-ECC. The presence of one or more decayed, missing due to caries or filled teeth in children 3-5 years old is considered S-ECC.

Furthermore, the repair and replacement of carious teeth is time consuming and costly. The treatment of ECC is expensive because it often requires the use of general anesthesia. A treatment of a single case of ECC exceeds 2,000 U.S. Dollars (Cook et al., 1994).

2.2. Clinical description

ECC appears usually in a special pattern where the labial surfaces of maxillary incisors and the buccal and lingual surfaces of maxillary and mandibular molars are mainly affected. It begins with white spots on the labial surface of the primary maxillary incisors along the margin of the gingiva. the salivary flow from the



Figure 1: Early childhood caries in maxillary incisors.

ZA Eissa, Kinderzahnheilkunde, Greifswald Universität

submandibular and sublingual salivary glands protect the mandibular incisors from being affected (Fejerskov et al., 2008).

ECC is characterized by its rapid progression. Initial carious lesions progress into cavitation within 6 to 12 months (Weinstein et al., 1994).



Figure 2: Early childhood caries in maxillary incisors and molars.

ZA Eissa, Kinderzahnheilkunde, Greifswald Universität

A clinical study reported progression of initial carious lesions into cavities in one year in 64% of a group of 2-5-year-olds (Gindefjord et al., 1995).

When ECC is detected, immediate intervention is required to minimize further damage and prevent subsequent health problems. Oral hygiene instructions, therapeutic restorations, more frequent dental visits with scheduled applications of fluoride and full crown coverage are often necessary.

2.3. ECC classification

Several attempts have been made to classify ECC. Wyne et al. classified ECC into three types according to its severity (Wyne et al., 1999):

- Type I (mild to moderate)

Isolated carious lesion(s) involving incisors and/or molars. The cause is usually a combination of semi solid or solid food and lack of oral hygiene in children 2-5 years old.

- Type II (moderate to severe)

Labiolingual carious lesions affecting maxillary incisors with or without molar caries, depending on the age of the child and the stage of the disease. The mandibular incisors are typically unaffected. It is usually caused by inappropriate feeding bottle use or on demand breastfeeding or a combination of both with or without poor oral hygiene,

- Type III (severe)

Carious lesions affecting almost all teeth including the mandibular incisors. It is

caused by a combination of cariogenic food substances and poor oral hygiene.

The first branch in this classification comes contradictory to the definition that the EAPD adopted in its ECC prevention policy. Where, it was defined as the occurrence of any sign of dental caries on any tooth surface in the first three years of life (Ismail, 1998).

2.4. Etiology

Understanding the etiology of early childhood caries is the first step in the route of its prevention. ECC is a multifactorial chronic disease influenced by several factors. The most important of which are the plaque biofilm, the diet and oral hygiene (Berkowitz, 2003, Davies, 1998). Regular intake of carbohydrates in diet exposes plaque to low pH levels more frequently. This local environment affects the gene expression by oral bacteria and favors the predominance of acid tolerating cariogenic species such as mutans streptococci and lactobacilli which can adapt in low pH levels and upregulating genes that protect them against acid stress according to the ecological plaque hypothesis (Marsch, 2006). The interaction between these microorganisms and fermentable carbohydrates produces further acids that cause the tooth structure to demineralize and often cavitate. Reduced salivary flow, immature enamel, presence of tooth tissue defects are host factors predisposing to dental caries (Seow et al., 1998).

The demineralization depends on the absolute pH decline and the duration of declination under the critical pH 5.5.

Infants are not born with cariogenic bacteria. The bacteria are usually transmitted from the mother vertically to her infant later on (Berkowitz, 2006). Infants whose mothers have high levels of mutans streptococci are at greater risk of acquiring the organism earlier than infants whose mothers have lower levels (Berkowitz et al., 1981). Furthermore, suppressing maternal reservoirs of MS can prevent or delay infant inoculation of the organism (Isokangas et al., 2000). non-cariogenic bacterial floral colonizing caries susceptible areas as pits and fissures have been reported to block the colonization of cariogenic bacterial species as MS (Loesche et al., 1986, Loesche et al., 1984)

Inappropriate feeding practices, frequent intake of sugary snacks, plaque formation,

lack of tooth brushing are important risk factors of early childhood caries. Frequent prolonged contact between sugars in fermentable carbohydrates and cariogenic bacteria increase the risk on the susceptible teeth.

The type of sugar taken frequently can affect the severity of ECC. A study reported more severe ECC with infants receiving sweetened condensed milk (which is a common feeding practice among some low-income families) rather than infants receiving formula milk. Sweetened condensed milk contains sucrose which is the most cariogenic sugar. Formula milk contains lactose which is less cariogenic. (Sugito et al., 2008)

2.5. Epidemiology

Accurate determination of ECC prevalence is somehow difficult due to the fact of toddlers and preschool children being difficult to examine and not readily accessible for examination.

In Scandinavian countries, a remarkable caries decline among children and adolescents has been witnessed over the past decades. In Sweden, the caries decline was particularly noticeable in the period between 1988 and 1994. Axelsson et al. (1993) reported in a 12-year longitudinal study, an increase in the percentage of caries-free three year olds from 51% to 94% in Varmland, Sweden. However, no further decline was noticed later on in the 3-year age group (Jacobsson et al., 2011, Axelsson et al., 1993). On the other hand, Norway has witnessed an overall remarkable increase in the caries free increment of 5-year-olds in the period between 2001 and 2015 (Statistics Norway, 2015). This caries decline goes back to these countries following a population preventive strategy, in addition to an individual high-risk strategy. Such remarkable decline could be explained by the incorporation of oral health messages in public health services starting from birth on. Furthermore, caries risk children are referred by the public health nurses to public dental services (Skeie et al., 2011, Wigen et al., 2016).

The highest prevalence of ECC is in Africa and south-east Asia. The prevalence of ECC varies from less than 1% in certain areas in Europe to 85% in certain areas in east Asia (Table 1). In the US, high-risk north American populations include hispanic

and native American children, as well as children enrolled in “Head Start” which is a federally funded program for poor preschool children. The prevalence of early childhood caries among these children ranges from 11% to 72% (Berkowitz, 2003). Mexican-American children were reported to be among the highest groups with ECC prevalence (CDC, 2005). Serwint et al. (1993) reported 20% of 110 Mexican American Children (8-36 months old) in Los Angeles to have ECC.

In England, a survey performed in 2013 to assess the prevalence of caries among three-year old children showed that overall caries prevalence was 4%. However, it varied from one local authority to another with a range of less than 1% in certain areas to more than 10% in others (Public Health England, 2013).

Caries prevalence seems to vary from country to country and from area to area within a country somehow depending on the population socioeconomic status and education. Disadvantaged children are more susceptible to ECC regardless of race, ethnicity or culture (Ismail, 1998). Children from families of low socioeconomic status show higher caries levels than children from high socioeconomic status groups (Chen et al., 1995, Reisine et al., 2001). Children from immigrant families also seem to show greater risk of developing early childhood caries rather than nonimmigrant children (Hallett et al., 2003). The prevalence of initial carious lesions among infants and toddlers (6-34 months old) of high caries risk populations is about 30% (Domoto et al., 1994)

Country	Reference	Age	Prevalence Percentage
Philippines	Carino KM et al., 2003	3 years	85%
Florence (Italy)	Bigagli et al., 2004	3 years	35%
Nancy (France)	Droz et al., 2004	4 years	11.6%
Beijing (China)	Deng et al., 2006	1-4 years	38%
Ghent (Belgium)	Martens et al., 2006	24-35 months	18.5%
Jakarta (Indonesia)	Sugito et al., 2008	<3 years	52.7%
Singapore	Hong et al., 2014	18-48 months	48%
Greifswald (Germany)	Berndt and Splieth., 2008	<3 years	2.7%
Brandenburg (Germany)	Rojas, 2013	13-36 months	7.4%
Germany	Splieth et al., 2009		10-15%
USA	Nunn et al., 2009	1-3 years	6.3%
Boston (USA)	Nunn et al., 2009	1-3 years	3%
Xiamen (China)	Li et al., 2011	36-47 months	56.8%
Bangalore (India)	Subramaniam et al., 2012	8-48 months	27.5%
England	Public Health England, 2013	3-year-old	4%
Tanta (Egypt)	Abu Hamila, 2013	1-3.5 years	69.6%

Table 1: Worldwide prevalence of early childhood caries between 2003-2013

The comparison between early childhood caries' prevalence levels in different

countries still remains difficult due to the inconsistent terminology of ECC and the different diagnostic criteria used.

2.6. Early childhood caries prevention

2.6.1. Oral health education and counseling

Potentially effective interventions should be performed during the first two years of life for successful dental disease prevention (Gussy et al., 2006). Early screening health assessment helps in early identification of initial carious lesions and thereby early intervention. It also allows for parents counseling for modification of inappropriate feeding practices and habits. Furthermore, it allows for planning a program of professional fluoride application (Nowak, 1997).

Parental counseling on diet and oral hygiene measures results in better effects in caries prevention rather than community campaigns (Kay and Locker, 1996). In areas with high caries risk populations as low income families and immigrants, interactive advice, home visits, motivational interviewing seem to show good results in caries prevention (Feldens et al., 2007, Kowash et al., 2000, Weinstein et al., 2006). Health promotion programs that promote tooth brushing have been among the most successful preventive educational programs (Jackson et al., 2005, Curnow et al., 2002).

2.6.2. Fluoride

The effect of fluoride in caries prevention is well established (Twetman, 2008, Ammari et al., 2007). The anti-caries effect of fluoride is due to its action locally on tooth-plaque interface promoting remineralization of initial carious lesions and reducing tooth enamel solubility (Featherstone, 1998). Fluoride can be delivered either systemically or topically. The approach of community water fluoridation delivers fluoride in both ways. When fluoride is ingested systemically it becomes incorporated in the developing dental tissues which makes them more resistant to demineralization (Gussy et al., 2006). It is considered a highly effective method in caries prevention in primary dentition. Its effect reaches all people regardless their socio-economic status. It does not require parental motivation or dental visits to obtain its effect.

Topical means of delivering fluoride include fluoride toothpaste, rinses and professionally applied fluoride varnishes, gels. Topical fluoride application delivers

fluoride to enamel surface and subsurface carious lesions forming deposits of calcium fluoride and providing a reservoir of fluoride ions (Ogaard, 1994)

Fluoride tooth paste is considered a cost-effective homecare measure. The efficacy of fluoride tooth paste is well supported by the Cochrane systematic review which concluded a clear evidence on its caries inhibitive effect (Marinho et al., 2003).

Professional fluoride varnish application in dental clinics began back in the 1960s as a preventive measure for dental caries. Fluoride varnish now is extensively used in Europe, Canada, Scandinavia and the U.S. It has been reported to show good results in caries prevention. The varnish results in a sustained fluoride release. The greatest release is during the first three weeks from varnish application. This process retards enamel softening by making it more resistant to demineralization.

Some concerns came up regarding the use of fluoride in young children and the acquisition of fluorosis. Fluorosis is an alteration in the appearance of enamel ranging from white flecking to brown mottling and pitting due to excessive fluoride ingestion during tooth development (DenBesten et al., 2011). A review on the evidence of fluorosis caused by fluoride tooth paste showed a weak relationship between them. (Warren et al., 1999)

The EAPD recommends that children's teeth should be brushed daily with fluoride tooth paste as soon as they erupt (EAPD, 2008).

Supervised brushing with fluoride tooth paste has shown to reduce caries among preschool children (Shwartz et al., 1998, You et al., 2002, Rong et al., 2003)

Professional application of fluoride varnish should be performed in dental clinics at least twice yearly in high caries populations (EAPD, 2008). Topical application of fluoride varnish in primary dentition shows good effect in caries prevention in moderate to high caries risk populations (Marinho et al., 2002, Peterson et al., 2004, Weintraub et al., 2006, ADA, 2006).

Prenatal fluoride was found to be ineffective in caries prevention (Leverett et al., 1997).

2.6.3. Enhancement of mother's / primary care giver's oral health

An important approach in caries prevention is the suppression of maternal levels of MS (Gussy et al., 2006, AAPD, 2015) whether by xylitol chewing gums or chlorhexidine in order to delay the transmission of the organism to the child.

Maternal use of xylitol chewing gum during the period of primary teeth eruption of

their child has shown to minimize caries levels in their offspring. Xylitol impairs the ability of MS to adhere to the tooth surface (Isokangas et al., 2000, Thorild et al., 2006).

Chlorhexidine rinses are relatively safe and commercially available. Some studies showed its effectiveness on reducing MS and caries levels. Immediate short term reduction in MS after intensive chlorhexidine treatments was reported by Riberio et al. (2007). However, other studies showed no evidence of long term effect in bacterial levels or caries (Gripp et al., 2002, Gunay et al., 1998). A systemic review also concluded that evidence of its effect in high risk populations was insufficient (Bader et al., 2001)

Gunay et al. (1998) and Gomez et al. (2001) reported that dental care and preventive programs targeting the mother may improve the dental health of their offspring.

2.6.4. Topical anti-microbial therapy

Early childhood caries is associated with high levels of *Streptococcus mutans*. In a clinical study performed in Puerto Rico among 12-19-month-old infants at high caries risk where 10% povidone iodine solution was applied topically on teeth surfaces at regular intervals, it was found to increase the disease-free survival in children at high risk of ECC. However, it is still unknown whether the caries preventive effect remains after withdrawal of the anti-microbial agent or not. Povidone iodine is also known to be highly allergenic. More studies and clinical trials are needed before introducing 10% povidone iodine as a preventive method for ECC. (Lopez et al., 2002)

Chlorhexidine is used to control dental caries in throughout the world. Although the FDA has not ruled its use in caries prevention, clinicians use it as an off-label drug.

Chlorhexidine disrupts the cell membrane of *streptococcus mutans* and disrupts the ability of *streptococcus mutans* to use sugar as a metabolic substrate. It is present in different forms gels, rinses and varnishes. A meta-analysis demonstrates that chlorhexidine gels can be highly effective in high risk populations while the evidence for the effectiveness of chlorhexidine varnishes is inconsistent (Rozier et al., 2001) another meta-analysis of chlorohexidine clinical studies demonstrates a 46% caries inhibiting effect (Van Rijkom et al., 1996). A study investigating the effect of chlorohexidine-thymol varnish on high caries group of school children (8-10 years old) reported a good acceptance of the varnish by the children and 40% reduction in caries prevalence (Splieth et al., 2000).

2.6.5. Xylitol

Suhonen et al. (1997) recommended pacifiers containing 0.25 mg fluoride, xylitol and sorbitol for high caries risk infants. A study of the effect of Fluoride tablets containing (NaF 0.25mg, xylitol 159mg, sorbitol 153mg) on a group of 1-year old infants when placed in slow release device (fall asleep pacifier) showed a decrease in the plaque levels of mutans streptococci in addition to less new dentinal caries development. (Aaltonen et al., 2000).

A randomized trial where 15-25-month-old children received xylitol syrup 8gm daily reported reduced early childhood caries by 50%-70% (Milgrom et al., 2009). Another study where tablets containing xylitol were introduced, concentrations of xylitol were reached high enough to inhibit mutans streptococci (Taipale et al., 2007). The current evidences support that children from moderate to high risk groups less than 4 years old receive a daily dose of xylitol syrup 3-8 gm in divided doses (AAPD, 2013).

2.6.6. Bacteriotherapy (Probiotics)

The microflora on the tooth surface changes with the development of dental caries from non-mutans streptococci and actinomyces predominance to mutans streptococci, lactobacilli (other non mutans streptococci) and bifidobacterium species (Takahashi et al., 2011). A recent trend in caries prevention administered certain colonies of bacteria in order to maintain or restore the natural saprophytic microflora (Cagetti et al., 2013). These colonies are either delivered with dairy products as a natural mean of oral administration this was found to be easily applicable too or delivered in slow release devices as a pacifier.

Several studies were performed to investigate the effect of probiotics on caries prevention in infants, children and adolescents. Stecksen-Blicks et al. (2009) reported statistically significant decrease in caries increment in a children group (1-4-year old) who received lactobacillus rhamnosus LB21 introduced in milk once daily for 21 months. Tapile et al. (2012) investigated the effect of bifidobacterium animalis subspecies lactis BB-12 on MS level suppression. The probiotic was delivered in tablets with xylitol and sorbitol in slow release pacifiers to 106 infants aged 1-2 months old (from low caries population) till they reached 2 years old. At the end of the study rather low MS colonization percentages were reported. However, Lactobacilli and yeasts levels did not differ in mucosa and teeth cultures.

The evidence in the efficacy of probiotics in suppression of MS is consistent. However, their effect on caries prevention is not yet well established and still under investigation.

2.6.7. Preventive community approaches

In America, North Carolina was ranked the lowest of the states that provide dental care access for its citizens. Almost 40% of children have experienced dental caries by the time they reach kindergarten. Two successful preventive programs were carried out in North Carolina in order to enhance dental care access of children of low income families from birth till thirty-five months of age. These were “Smart Smiles” and “Into the Mouths of Babes”.

Smart smiles program was implemented in western North Carolina in the mid-1990s till 2001. This program aimed at integrating dental services in to medical practices in order to increase the accessibility of low income children to dental care. Considering that low income children had significantly better access to medical care rather than dental care, Smart Smiles involved primary medical care practitioners in oral preventive health services. The program included screening of oral problems, fluoride varnish application and counseling of care givers (Rozier et al., 2003)

In Glasgow and Clyde (Scotland), a 9% caries decline was reported among three-year-olds over a four-year period after incorporating Childsmile intervention program. This program targeted children from birth and focused on health visitor-led health promotion, clinical prevention within primary dental care and community based initiatives establishing formal links between primary dental care services and public health services (Mc Mahon et al., 2011, Blair et al., 2004).

In a low socioeconomic area in Sweden, Wennhall et al. (2005) organized a three-year oral health education program in the process of investigating the efficacy of community based oral health education centered on diet, tooth brushing and fluoride tablets free of charge. 804 two-year old children were enrolled in the program and recalled every 3 months till the age of three. The results were outstanding. There was high attendance and compliance from the children and their families and significantly low caries lesions among the intervention group. Fluoride supplements and tooth paste were suggested to be the key factors in caries reduction. The results strongly

emphasized the importance of early intervention, motivation, explaining the reasons of intervention.

It is well highlighted in the literature; how non-dental health care persons such as nurses and midwives can contribute in reducing early childhood caries if they receive proper training. U.S. oral health national reports pointed out the importance of establishing partnerships with different health care providers including nurses and midwives (Office of the Surgeon General, 2003).

Kressin et al. (2009) reported a 77% decrease in risk for developing ECC following counseling sessions delivered through clinical pediatricians (nurses and physicians) who had received an intervention training. Kowash et al. (2000) organized a three-year dental health education DHE program in a low socioeconomic area in Leeds (England) for mothers of infants whose teeth were starting to erupt. The mothers received regular home visits each time by a dental hygienist and a pediatric nurse who had previously received dental health education training. The results were remarkable and emphasized the efficacy of dental visits commencing at or just after the eruption of the first deciduous teeth and educating mothers about diet and oral hygiene. The authors suggested midwives and health visitors to be as effective in the process of DHE if they receive proper DHE training.

Many previous studies targeted midwives addressing their role in counseling expectant mothers regarding their own and their child's oral health. Midwives believed caries prophylaxis to be a part of their field (Rahman et al., 2016, Ehlers et al., 2014). In Australia, the center of applied nursing and research developed a midwifery initiated oral health online program (MIOHP) to incorporate oral health guidelines into normal midwifery practice. The program was reported to have significantly improved midwives' confidence and skills in delivering oral health recommendations and promoting oral health of expectant mothers (Heilbrunn-Lang et al., 2015).

The midwives' association in Germany has made several efforts in cooperation with other institutions to increase the awareness and attention of midwives concerning early childhood caries and its prevention and involving them in this issue (Steppat, 2013, KZBV, 2014). In the midwives' annual congress in Hamburg, in May 2016, a

symposium “Gesund beginnt in Mund” (which means “Healthy begins in the mouth”) was held in cooperation with the Bundeszahnärztekammer (ZM Online, 2016).

Many dental organizations worldwide issued policies and guidelines for ECC prevention. In 1978, the AAPD issued a policy on ECC encouraging professional and at home preventive measures. The policy was revised and modified several times in the following years till 2008.

The European Academy of Pediatric Dentistry (EAPD) issued guidelines as well for preventing early childhood caries in November 2008.

All these approaches and yet early childhood caries still remains a main public health problem affecting the cornerstone of the society.

In summary, children under 3 years old haven't yet established adequate meal patterns, they feed almost every 2-3 hours whether milk or semi solid and solid food. This frequent feeding pattern favors the predominance of cariogenic bacteria in plaque when formed. Lack of oral hygiene delivered by the care giver leads to an environment promoting caries development in small children.

Oral health education on diet and on tooth brushing through outreach community approaches, will be more effective in preventing caries in this age group rather than booklets given to the mother by any health care personnel (Holt et al., 1985).

It is recommended that the pediatric examination booklet of each child includes a compulsory referral to the dentist for screening. Furthermore, Networking with midwives, gynecologists and pediatricians can certainly play an important role in caries prevention in this age group through informing the parents/care givers about inappropriate feeding practices and the timing of the first dental visit for their infants (with the eruption of the first tooth).

Midwives can play a significant role in early childhood caries prophylaxis being the first health care persons to contact new mothers. Midwives care for women during pregnancy, birth, the post-partum period and till the end of the child's 9th month of life.

Vulnerable groups should receive special motivational and counseling programs and concepts tailored to their needs.

3. Materials and Methods

3.1. Study design and sample

An online questionnaire survey designed by the investigator on www.surveymonkey.de was distributed among midwives in Germany. Participants were members of the German midwives' association (Deutscher Hebammenverband). After the Ethics Committee of Greifswald University (Ernst-Moritz-Arndt-Universität Greifswald) approved the study (Reg. Nr.: BB 069/16), midwives were invited to participate in the survey through the newsletter of the German Association of Midwives (Deutscher Hebammenverband) which was issued through the association's website in July, 2016. The newsletter is published online once monthly and reaches 9000 of its members. The midwives were also invited through the monthly published association journal (Hebammenforum) issued in August, 2016. The questionnaire was activated online starting July till the 4th of September. The questionnaire included 13 multiple-choice questions which took about 10 minutes to answer. It was formulated in German language. Multiple answers were allowed for questions No. 3, 5, 6, 10, 12 and 13 while only one answer was allowed in the rest of the questions regarding knowledge. All midwives were asked about their working experience, the federal state they worked in, their recommendations to parents regarding oral hygiene, diet and early childhood caries prevention, their opinion about fluoride tablets and fluoridated tooth paste, the timing of the first dental visit for the child, as well as the causes and clinical appearance of ECC, its prevalence in Germany and its consequences.

3.2. Data collection

The data were collected online anonymously and automatically registered in a data bank which is an option provided by surveymonkey.de. Then the answers of the participants were extracted and summarized in charts and tables.

3.3. Statistical Analysis

The dataset was later transferred to the program SPSS version 20 for statistical analysis.

The descriptive analysis of the data included ranges, frequency distributions and mean values. All the data and results were in German language and were translated by the investigator to the English language. Charts were made using the Excel program to clarify the results and compare between different variables. The data were analysed differently for ordinal and nominal categorical values, mostly employing the Pearson Chi-square test. The results were considered statistically significant for p-values ≤ 0.05 .

Regarding the midwives' knowledge and recommendations, data were divided into two groups domains. Statistical significance here was measured using Anova test on comparing the knowledge and recommendations of midwives in different German federal states and comparing their responses to their working experience. In the analysis of the regional differences, midwives that mentioned working in two German states were excluded (n=2). Midwives that responded to their working state by a misleading answer were also excluded (n=1). States with a low response of <5 were excluded (n=14 midwives/ 6 German federal states) considering them as not representative.

Analysing the source of oral health knowledge, the 2-tailed t-test was used.

4. Results

4.1. Sample description

As soon as the questionnaire was uploaded on the newsletter of the midwives' association (Hebammenverband), the responses started to flow. Within the 2-month period of survey activation, 191 midwives nationwide responded to the questionnaire. Participants from Baden-Württemberg comprised the largest group of the sample, followed by Bayern and Nordrhein-Westfalen, Hessen and Niedersachsen which represent the most populated federal states. In the smaller states, less midwives took part (Fig. 3).

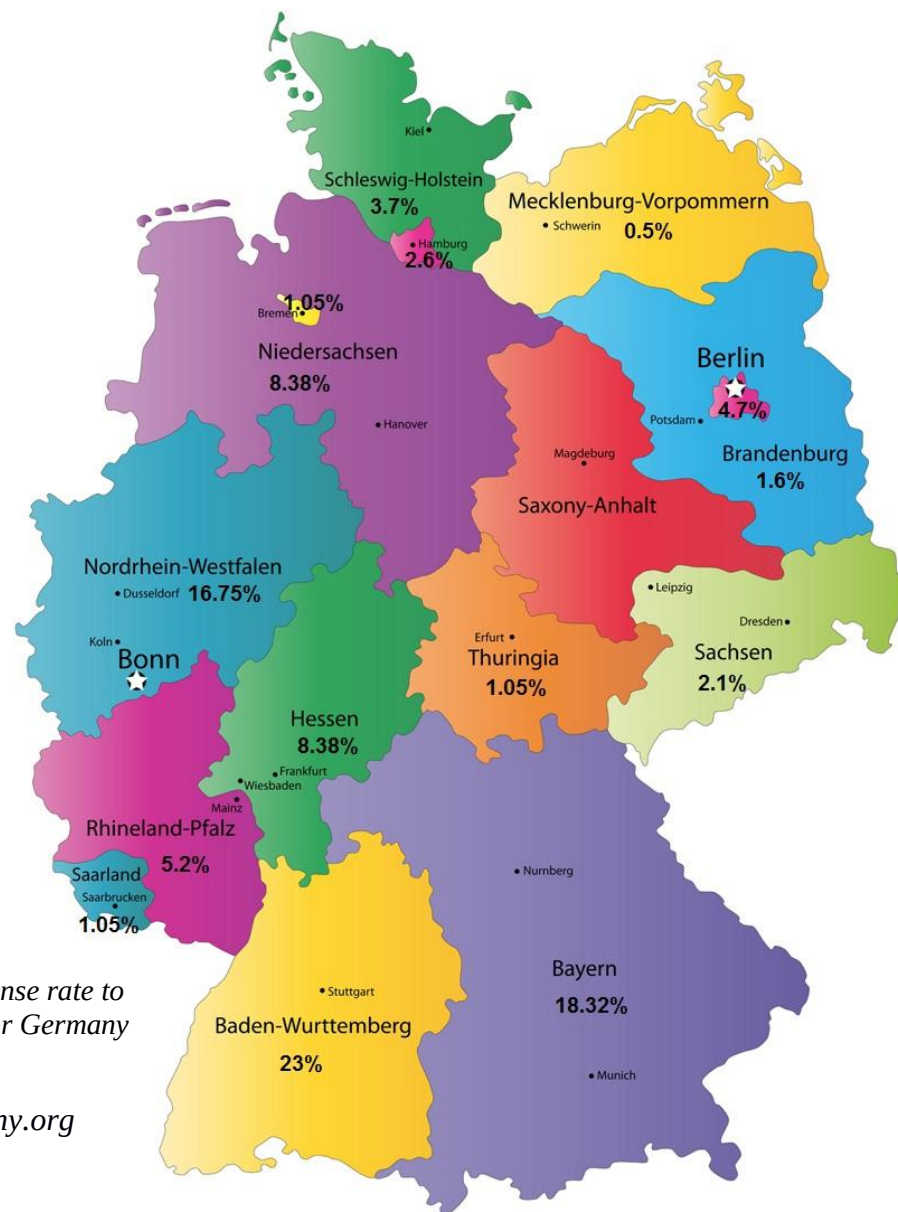


Figure 3: Response rate to questionnaire for Germany regions

map-of-germany.org

Most of the participants (84.29%) had working experience of over 10 years and very few recently trained midwives took part as illustrated in figure 4.

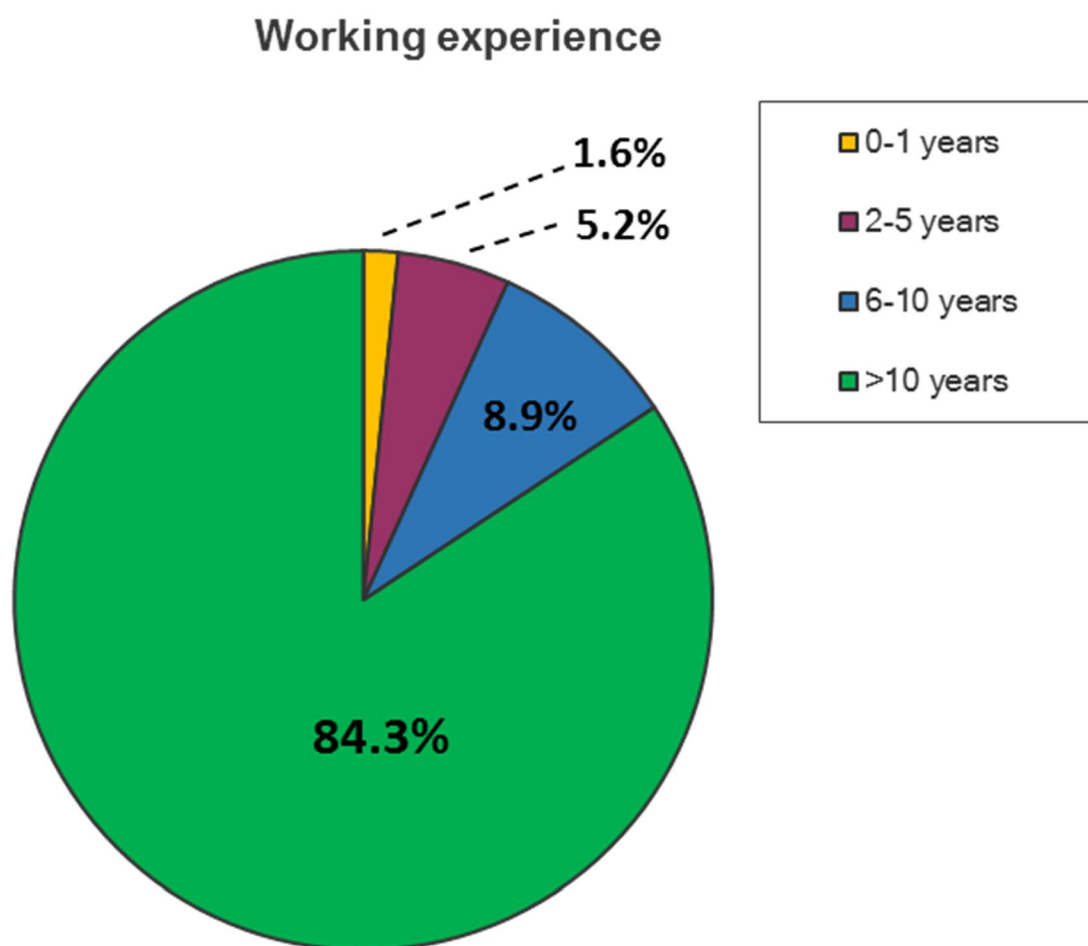


Figure 4: Working experience of the participating midwives

4.2. Oral health knowledge

More than half the midwives (53.4%) gained their oral health knowledge from advanced training or conferences which they attended for continuous education (Fig. 5). Other sources of knowledge were their undergraduate education (Hebammenausbildung), journals and the internet.

Personal contact to dentists or dental health care personnel (27.7%) or health care association (5.2%) such as the Gesundheitsamt, Zahnärztekammer or DGKiZ played a minor role as well as books, flyers or their own personal experience as a parent (6.8%). 1 midwife mentioned she gained her oral health knowledge from a midwives' circle (Hebammenzirkel).

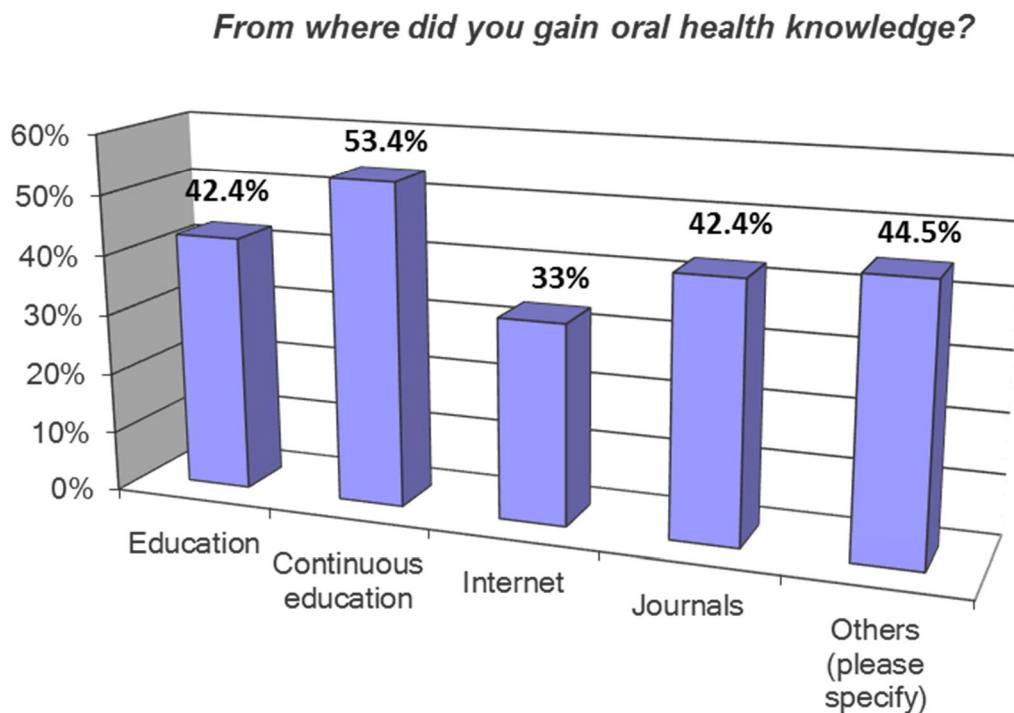


Figure 5: Different oral health knowledge sources

The vast majority of the midwives 84.8% were willing to learn more about oral health care and prevention in young children.

ECC clinical appearance

Most midwives (84.3%) were aware that ECC mainly affected the maxillary incisors. However, about 40% of the midwives also mentioned mandibular incisors which are least affected. 11 midwives refrained from answering this question.

Which teeth are mainly affected by early childhood caries?

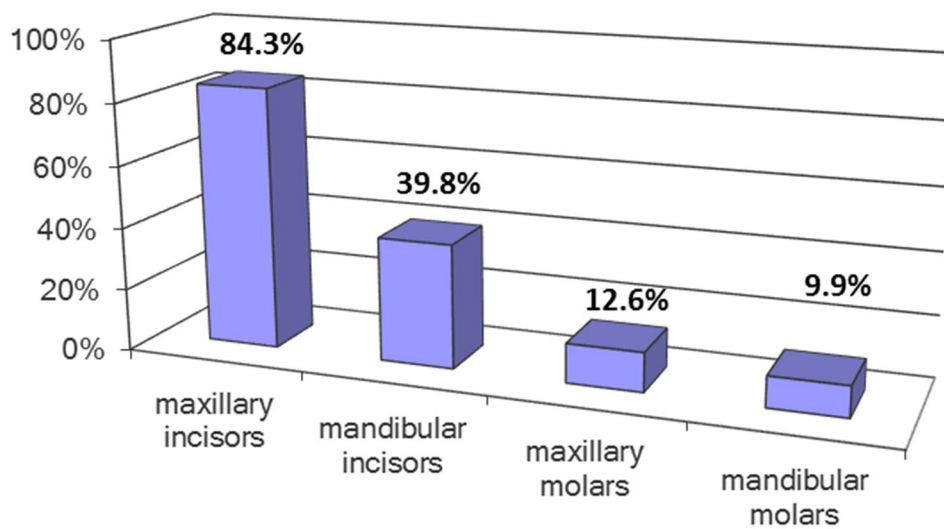


Figure 6: Distribution of midwives' responses to the question "which teeth are mainly affected with early childhood caries?"

ECC prevalence

Most midwives were aware about the degree of prevalence of early childhood caries in Germany, ranging from 10-15%. Only 5.8% of the midwives were underestimating its prevalence.

How prevalent is early childhood caries in Germany?

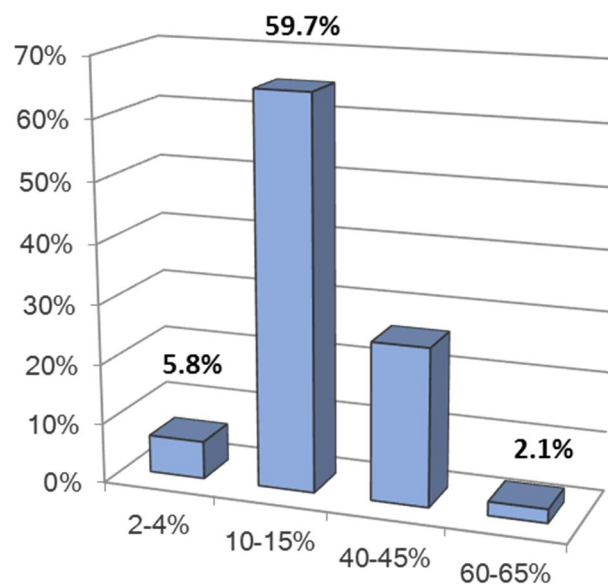


Figure 7: Distribution of midwives' responses to the question "How prevalent is ECC in Germany?"

Early childhood caries etiology

Almost all midwives (98.4%) were aware that sweetened drinks may cause early childhood caries. Very few midwives considered unsweetened tea and mineral water as causes of ECC which is not correct. Most midwives knew that prolonged bottle feeding during the night could lead to ECC while only half of the midwives (50.8%) were aware that milk can cause early childhood caries and only 25.1% of midwives were aware that highly frequent breast feeding till kindergarten age could cause ECC.

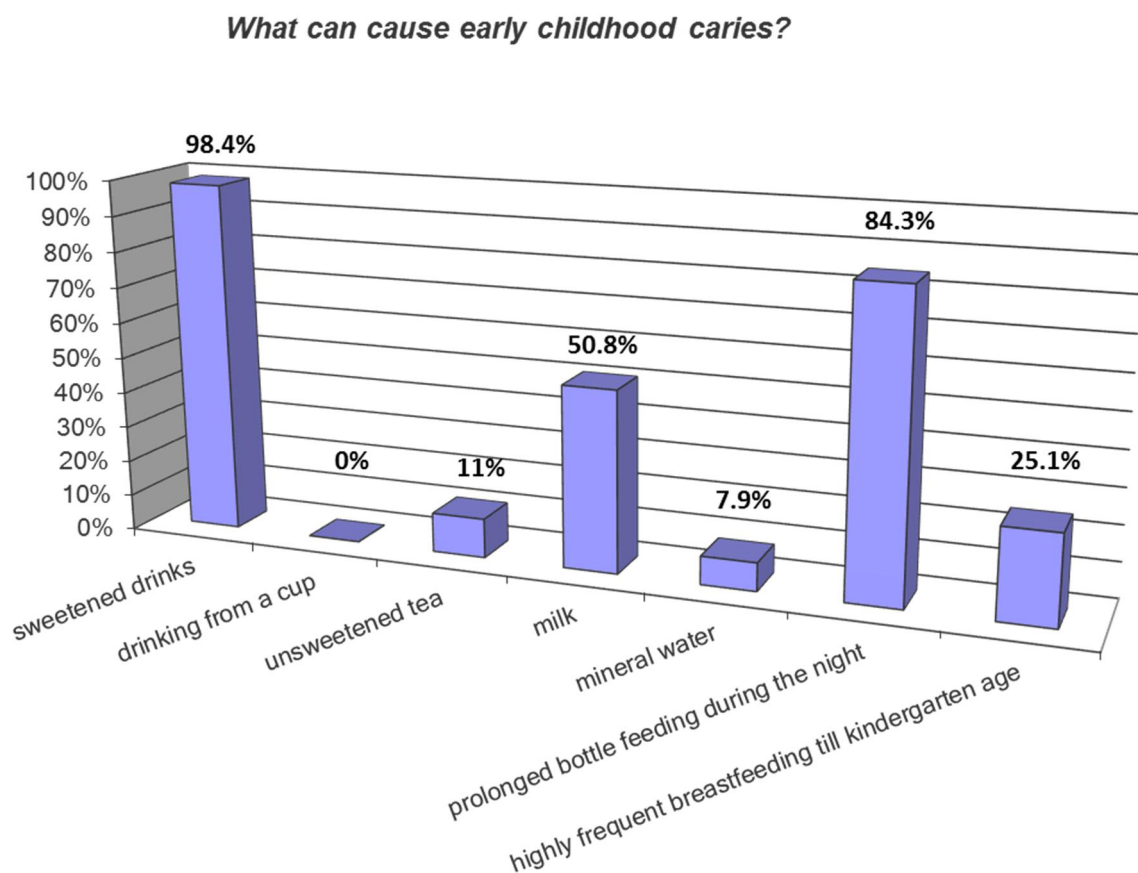


Figure 8: Distribution of midwives' responses to the question "What can cause early childhood caries?"

Early childhood caries consequences

A high number of midwives were aware of the consequences of ECC: 89% of them knew that early childhood caries could cause tooth pain, most midwives (75%) registered possible malfunction of mastication and digestion. 82.7% knew that it could lead to speech problems. However, more than half the midwives 57.1% checked plaque as a consequence of ECC which is the other way round, and 37.9% saw calculus wrongly as a consequence of ECC.

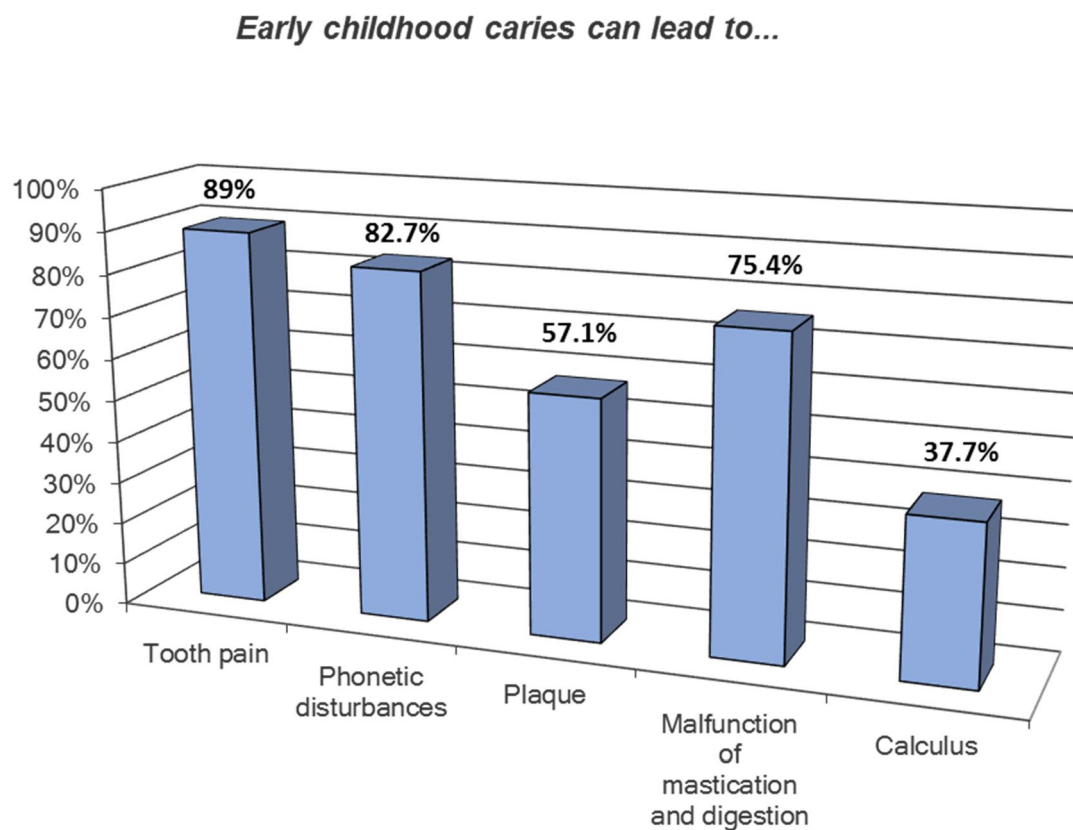


Figure 9: Distribution of midwives' responses to the question "ECC can lead to..."

Fluoride tablets

Midwives were confused about the effect of fluoride tablets probably because of the huge debate in this issue. 40.3% of midwives were aware that fluoride tablets have mostly local effect on the teeth in the mouth. 43.5% of midwives checked incorrectly that the tablets benefit is mostly the mineralization of the primary and permanent dentition. 10% marked incorrectly that they have no benefit on the teeth (Fig. 10). 9.4% of the midwives skipped answering this question.

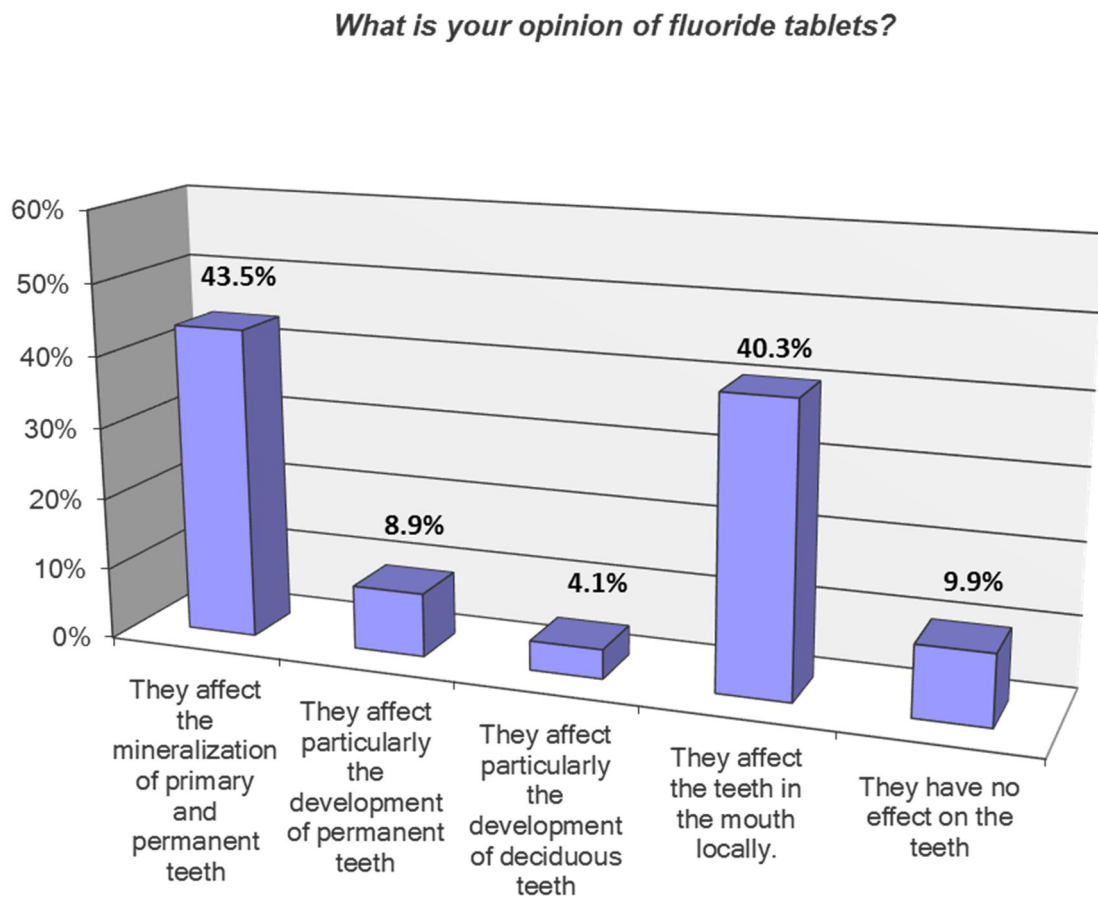


Figure 10: Distribution of midwives' responses to the question "What is your opinion of fluoride tablets?"

Regional differences in early childhood caries knowledge

There were only minor regional differences in ECC knowledge among midwives regarding ECC clinical appearance, prevalence, causes, consequences and effect of fluoride tablets (Table 2) which were far from reaching a statistically significant level.

German State		N	Mean	SD
ECC knowledge	Baden-Württemberg	44	14.4	2.3
	Bayern	35	14.6	2.0
	Berlin	9	15.4	2.0
	Hamburg	5	15.6	2.1
	Hessen	16	14.3	1.7
	Niedersachsen	16	15.6	2.2
	Nordrhein-Westfalen	32	15	2.1
	Rheinland-Pfalz	10	14.9	2.4
	Schleswig-Holstein	7	14.7	2.4
	Total	174	14.8	2.1

Table 2: Regional differences in midwives' ECC knowledge

4.3. Oral health recommendations

Oral health care advice was given to the parents by midwives regardless of their working experience. Almost all midwives (96.34%) recommended a low sugar or sugar-free diet. 94.76% of midwives recommended to avoid prolonged drinking from the baby bottle, 82.72% of midwives advised the parents about tooth brushing with fluoridated toothpaste, 71.7% of which recommended that (tooth brushing with fluoridated tooth paste) to start with the eruption of the first tooth while 17.28% recommended to avoid the use of fluoride. 7.85% of midwives recommended to the parents the use of fluoride tablets (Table 3).

Low sugar/ sugar-free diet	<ul style="list-style-type: none"> • Yes 96.3% • No 3.7%
Avoid prolonged drinking from the baby bottle	<ul style="list-style-type: none"> • Yes 94.76% • No 5.24%
Drinking from a cup starting child's 1st birthday	<ul style="list-style-type: none"> • Yes 82.7% • No 17.3%
Toothbrushing with fluoridated toothpaste	<ul style="list-style-type: none"> • Yes 82.2% • No 17.8%
Tooth brushing with fluoridated tooth paste with the eruption of the first tooth	<ul style="list-style-type: none"> • Yes 71.7% • No 28.3%
Fluoride tablets	<ul style="list-style-type: none"> • Yes 7.9% • No 92.1%
First visit to the dentist with eruption of the first tooth	<ul style="list-style-type: none"> • Yes 40.8% • No 59.2%

Table 3: Distribution of midwives' responses regarding their oral health recommendations to parents

What do you advise the parents of small children?

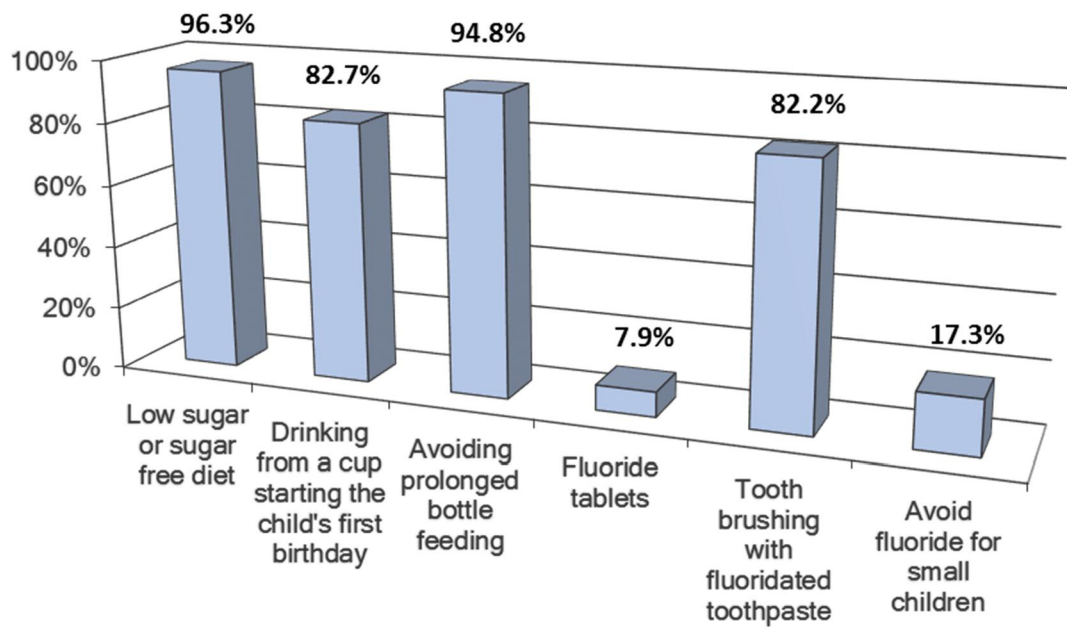


Figure 11: Distribution of midwives' responses regarding their caries prophylaxis recommendations to the parents.

Tooth brushing

Almost all midwives (99.5%) recommended tooth brushing to start either with the eruption of the first tooth (93.2%) or for the gumpads after birth (6.3%) (Fig.12). Only 1 midwife refrained from answering this question. Their opinions differed in the recommendation of fluoridated tooth paste and when should the child start using it. More than two third the midwives (71.7%) recommended brushing with fluoride tooth paste with the eruption of the first tooth at about 6 months while 6.3% of them recommended it to be when the child can spit out (Fig. 13).

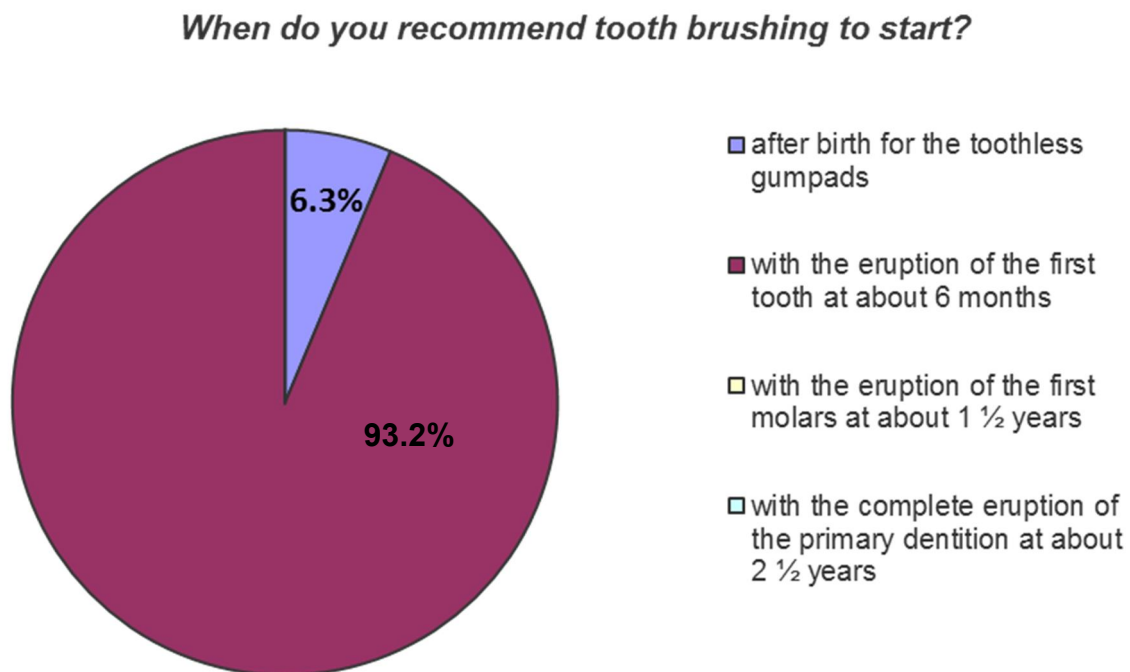


Figure 12: Distribution of midwives' responses to the question "When do you recommend tooth brushing to start?"

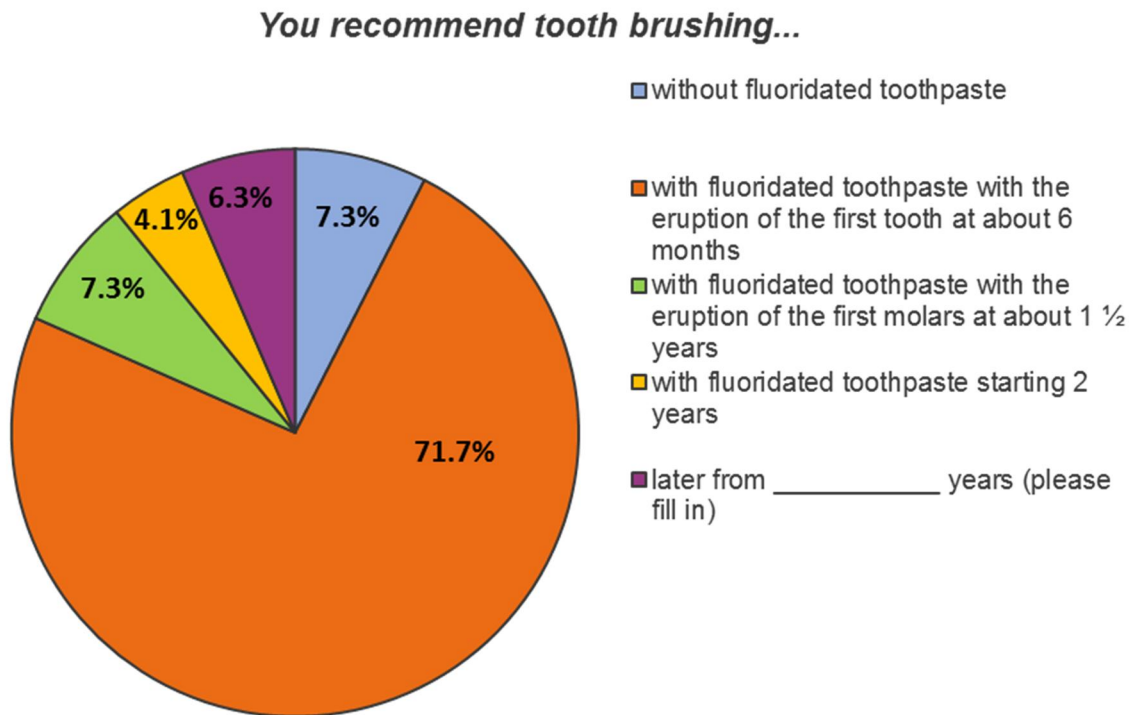


Figure 13: Distribution of midwives' responses to the question "You recommend tooth brushing....."

First visit to the dentist

There was a great variability in recommending the timing of the first visit to the dentist where less than half the midwives (40.8%) recommended the first visit to the dentist to be with the eruption of the first tooth (Fig. 14).

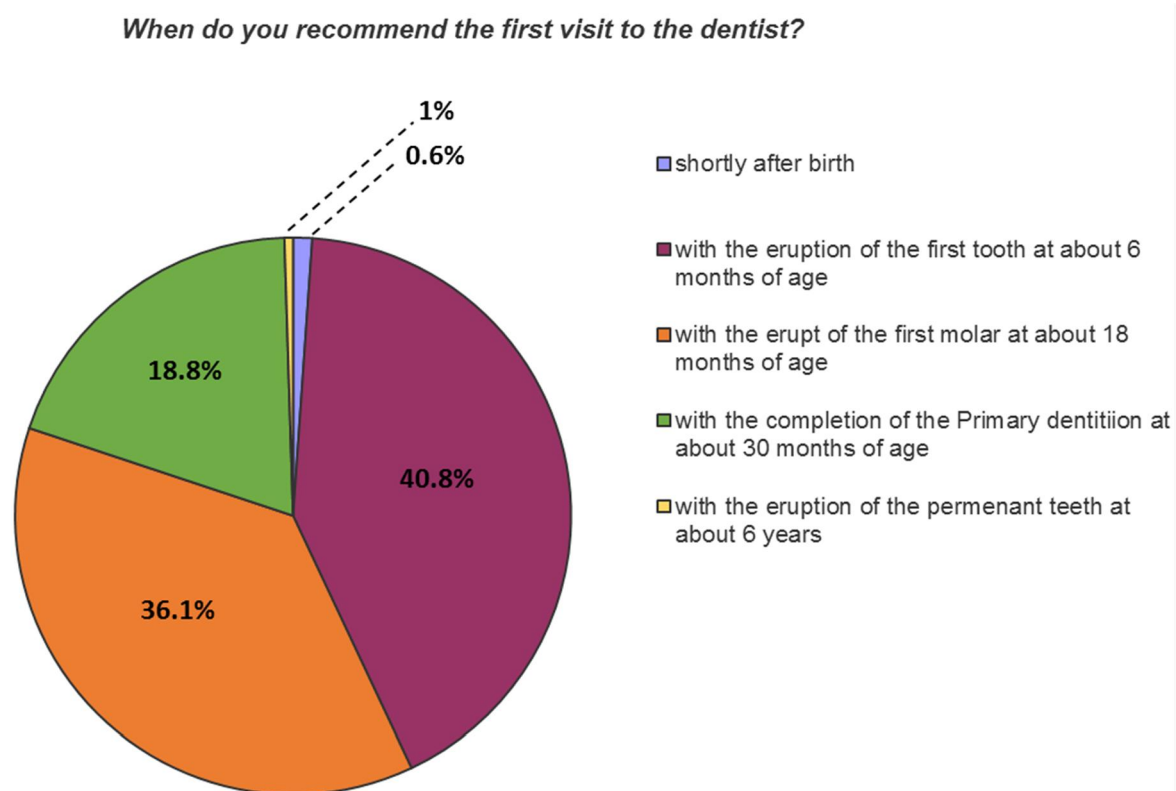


Figure 14: Distribution of midwives' responses to the question "When do you recommend the first visit to the dentist?"

Regional differences in oral health recommendations

There were regional differences in oral health recommendations given by midwives to the parents nationwide (p-value= 0.108) where the highest recommendations were given in Hamburg (n= 5, mean= 8.8, SD \pm 0.45) and Hessen (n= 16, mean= 7.9, SD \pm 1.3) and the lowest in Nordrhein-Westfalen (n= 32, mean= 6.8, SD \pm 1.87) as illustrated in Table 4.

	State	N	Mean	SD
Oral health Recommendations	Baden-Württemberg	44	7.2	1.3
	Bayern	35	7.4	1.3
	Berlin	9	7.6	1.9
	Hamburg	5	8.8	0.4
	Hessen	16	7.9	1.3
	Niedersachsen	16	7.5	1.5
	Nordrhein-Westfalen	32	6.8	1.9
	Rheinland-Pfalz	10	7.5	1.3
	Schleswig-Holstein	7	7.9	0.9
	Total	174	7.4	1.5

Table 4 Regional differences in midwives' oral health recommendations

	Baden- Württem- berg (n=44)	Bayern (n=35)	Berlin (n=9)	Hamburg (n=5)	Hessen (n=16)	Niedersa- chsen (n=16)	Nordrhein - Westfale n (n=32)	Schleswig- Holstein (n=7)	Rheinland- Pfalz (n=10)	p- value
Fluoride tablet recommendation	11.4% (n=5)	2.85% (n=1)	0%	0%	0%	0%	18.75% (n=6)	0%	0%	0.096
Tooth brushing with fluoridated tooth paste with the eruption of the 1 st tooth	75% (n=33)	71.4% (n=25)	66.7% (n=6)	100% (n=5)	100% (n=16)	56.3% (n=9)	65.6% (n=21)	71.4% (n=5)	70% (n=7)	0.186
Avoid fluoride	13.6% (n=6)	14.3% (n=5)	22.2% (n=2)	0% (n=0)	25% (n=4)	18.75% (n=3)	28.1% (n=9)	0% (n=0)	20% (n=2)	0.634
First visit to the dentist with eruption of the 1 st tooth	22.7% (n=10)	31.4% (n=11)	44.4% (n=4)	80% (n=4)	75% (n=12)	50% (n=8)	37.5% (n=12)	57.1% (n=4)	50% (n=5)	0.01
Drinking from a cup from the child's 1 st birthday	72.7% (n=32)	88.6% (n=31)	88.9% (n=8)	100% (n=5)	81.25% (n=13)	93.75% (n=15)	75% (n=24)	85.7% (n=6)	90% (n=9)	0.466

Table 5: Regional differences in oral health recommendations

4.4. Effect of different knowledge sources on midwives' ECC involvement

Midwives who contacted health care associations showed better knowledge of early childhood caries particularly regarding the role of fluoride tablets (p-value= 0.045), the timing of the first visit to the dentist (p-value= 0.001) and gave better recommendations (p-value= 0.021) than those getting their oral health knowledge from other sources (Table 6).

Almost all (98.78%) midwives who gained their knowledge from undergraduate education (Hebammenausbildung) did not recommend fluoride tablets (p-value= 0.003).

Almost all (98%) midwives that gained their knowledge through continuous education advise the parents to avoid prolonged bottle feeding (p-value= 0.03). more than two third the midwives (70.6%) who gained their knowledge from continuous education recommended tooth brushing with fluoridated tooth paste with the eruption of the first tooth (p-value= 0.262).

Total; ECC knowledge and recommendations	Source of oral health knowledge		N	Mean	SD	p-value
	Undergraduate education (Hebammenausbildung)	No	109	22.2	2.9	0.776
		Yes	82	22.1	2.6	
	Continuous education	No	89	22.1	3.1	0.739
		Yes	102	22.2	2.5	
	Internet	No	128	22.1	2.9	0.574
		Yes	63	22.3	2.6	
	Journals/Magazines	No	110	22.1	2.8	0.598
		Yes	81	22.3	2.6	
	Contact with dentist/ dental health care personnel	No	138	22.1	2.4	0.829
		Yes	53	22.2	3.6	

	Contact with health care institutions	No	181	22.1	2.8	0.040
		Yes	10	23.9	2.3	
	Personal experience as a parent	No	178	22.1	2.8	0.107
		Yes	13	23.3	2.5	
	Books, brochures, flyer	No	182	22.1	2.8	0.330
		Yes	9	22.8	1.8	

Table 6: Effect of different knowledge sources on midwives' ECC knowledge and recommendations

4.5. Effect of working experience on midwives' ECC involvement

There was no relationship between the midwives' working experience and their knowledge about ECC (p-value= 0.481) or their prophylaxis recommendations (p-value= 0.97) as illustrated in Table 7.

However, there was a positive relationship between working experience and advising the parents to avoid prolonged bottle feeding (p-value= 0.019).

Working experience	N	Knowledge		Recommendations	
		Mean	SD	Mean	SD
0-1 year	3	15.3	1.5	7.7	1.2
2-5 years	10	14.2	2.4	7.3	1.5
6-10 years	17	15.4	1.8	7.5	1.3
>10 years	161	14.8	2.1	7.4	1.5

Table 7: Midwives working experience in relation to their ECC knowledge and recommendations

5. Discussion

5.1. Study design and sample

This study aimed to evaluate how involved midwives in Germany are in caries prevention by raising the awareness of mothers about early childhood caries and how to avoid it. Furthermore, evaluate whether regional differences exist from one state to another and if such differences are related to special knowledge sources.

To reach the broadest audience of midwives possible, midwives were invited to participate through the German midwives' association by means of the association's online newsletter and its printed journal (Hebammenforum). 191 midwives from 15 out of 16 different German federal states responded to the questionnaire. The number of participants is comparable to previous surveys targeting midwives in Germany in regard to their role in early childhood caries prevention. There, the number of participants varied between 149 midwives in the Hannover midwives' conference in 2009 and 947 midwives in response to an online survey in 2015 (Ehlers et al., 2014, Rahman et al., 2016, Wagner et al., 2016).

The distribution of responses was corresponding with the distribution of the population and number of live births nationwide. The lower responses received were from the smaller states of Bremen, Saarland, Mecklenburg-Vorpommern, Sachsen-Anhalt, Hamburg and Thüringen showing the lowest numbers of live births thus smaller population and less midwives. While the highest responses came from Nordrhein-Westfalen, Bayern, Baden-Württemberg, Niedersachsen and Hessen representing the states with high numbers of births and, therefore, higher population and also midwives (Statistisches Bundesamt, 2015).

5.2. Materials and methods

The survey was conducted online and posted to the Midwives' association newsletter. The highest responses came after the upload of the survey invitation in July 2016 in the newsletter of the midwives' association (n=184), mainly in the first two days after the upload, while only 7 responses came after the publication of the midwives' association journal in August 2016 with the survey invitation. This could be

due to the easy accessibility of the online survey through the direct link in the newsletter of the midwives' association rather than being in a printed journal.

The numbers and the regional distribution of the sample should ensure an adequate representativeness, although a selection bias in favour of interested and knowledgeable midwives cannot be excluded.

Self-selection bias is a main disadvantage of online surveys (Thompson et al., 2003). This systematic bias results from the tendency of some individuals to respond to online survey invitations while others just ignore it. Moreover, evidence on the representativeness of self-selected samples in online studies is inconsistent. This does not necessarily mean that all midwives in Germany would have responded in the same way. Attention must be drawn to this bias as a limitation of the study when looking on the results. There could be a possible tendency to a more optimistic picture. However, this is not too likely, as this topic has been on the agenda of the midwives' association for the last years (ZM Online, 2016, Steppat, 2013, Splieth et al., 2013, KZBV, 2014).

In a trial to overcome this issue and evaluate representativeness, the results were compared to other paper-printed and online German surveys (Rahman et al., 2016, Wagner et al., 2016). Many findings came similar with a previous nationwide paper printed survey, while there were great differences in comparison with a previous nationwide online survey. These are highlighted in the following discussion.

5.3. Results

5.3.1. Oral health knowledge

Only 81 midwives (42.4%) mentioned that they gained their oral health knowledge from midwives' undergraduate education which indicates that not all curricula of the 52 midwives' schools in Germany have information about infant and pregnant woman's oral health in their content.

It was quite impressive how many midwives made personal efforts contacting dentists or nurses or even health care associations such as the German Dental Council (BZÄK) or the local public health office (Gesundheitsamt), German association of pediatric dentistry (DGKiZ) seeking to know more about oral health.

The different knowledge sources all together influenced the results of midwives' ECC knowledge and recommendations to the better. The most effective source was contacting health care associations such as the Zahnärztekammer, Gesundheitsamt, DGZMK, Zahnärzteverband. Kassenzahnärztliche Vereinigung.

Early childhood caries knowledge

The knowledge of the midwives about early childhood caries seemed to be fair. Most were aware of its prevalence in Germany, that it's appearance is mainly in the maxillary front teeth and that sweet drinks may cause it. However, 75% were not aware that highly frequent breastfeeding till kindergarten age could cause ECC and 15% of midwives were not aware that bottle feeding during the night could cause ECC. They were aware of its consequences of tooth pain and disturbed mastication, digestion and phonetics, but confused about plaque and calculus where 57.4% and 37.9% of midwives respectively incorrectly marked them as consequences, this could be due to misunderstanding the terminology.

In a similar study, good to excellent knowledge of ECC etiology was reported among midwives (Ehlers et al., 2014).

5.3.2. Caries prevention recommendations

The recommendations midwives gave were considered good to excellent. Where almost all midwives advised the parents about the importance of a low sugar or sugar free diet, avoiding prolonged bottle feeding, tooth brushing. More than two third the midwives recommended brushing with a fluoridated toothpaste with the eruption of the first tooth. However, there was a drawback in recommending the first visit to the dentist with the eruption of the first tooth where this was recommended by only 40.8% of the midwives. Likewise, were the results of a questionnaire study performed from 338 midwives that were participating in the midwives' conference in Hannover in 2014 where 45.6% of midwives from the 16 German states, Spain and Austria recommended the first dental visit with the eruption of the first tooth (Rahman et al, 2016). On the other hand, a clear difference came with the results of Wagner et al. (2016) where only 6.8% of midwives recommended the first visit with the eruption of the first tooth in response to an online survey. This difference can be a result of

selection bias which is well known to associate online surveys.

More than half the midwives were recommending the first visit later at 18 months or 30 months of age which could be too late.

In contrast to this, the German Dental Council (BZÄK) recommends the first visit to the dentist with the eruption of the first tooth. In referral to the analysis of insurance covered treatment procedures, 10 from each 100 cases of children from 1 till under 2 years and 27 from each 100 cases of children from 2 till under 3 years of age need fillings (KZBV and BZÄK, 2014).

Children who have their first dental visit during their first year are more likely to have afterwards preventive visits, but unlikely to have later restorative or emergency visits. On the other hand, children having their first dental visit by the age of 2 or 3 are more likely to have later preventive, restorative and emergency visits and consequently more dental related costs (Savage et al, 2004). Thus, it could be advisable to recommend dental visits early on unanimously

5.3.3. Fluoride recommendation

There was some variability in recommending fluoride as a prophylactic measure, the mean of its intake and the timing of brushing with a fluoride tooth paste. Where, 82.2% of midwives recommended the use of fluoridated tooth paste. The results of 264 midwives in the state of Hessen where 79.9% of the midwives recommended fluoride tooth paste were very similar (Ehlers et al., 2014). On the other hand, a questionnaire study in 2014 of 338 midwives found contradictory results, as only 55.3% of the midwives recommended fluoride tooth paste (Rahman et al., 2016). The current higher values might be a result of the recent campaigns on ECC by the midwives (KZBV, 2014, Steppat, 2013, ZM Online, 2016). According to Rahman et al. (2016) an increase in oral health knowledge among midwives in Germany was also recorded in the past 5-year period to his study. Moreover, the issue of early childhood caries has been raised up several times among the midwives' community whether in their yearly conference or on the association's website.

Meanwhile, 17.6% of midwives recommended avoiding the use of fluoride which is in line with the 20.7% found by Rahman et al. (2016).

Fluoride tablets were recommended by 7.3% of midwives, while in the results of Ehlers et al. (2014) and Wagner et al. (2016) where 40% of midwives in Hessen and 65.1% of midwives throughout Germany recommended fluoride tablets in the two studies, respectively. Once more, this difference could be an impact of selection bias.

71.7% of midwives recommended brushing with fluoridated tooth paste with the eruption of the first tooth while the rest were recommending it later or brushing without.

This variability could be due to the huge debate in this issue between pediatricians and pediatric dentists. Where pediatricians and the German Society of Pediatrics (Deutsche Gesellschaft für Kinder- und Jugendmedizin) recommend the use of fluoride tablets in the first 12 or 18 months of the child's life and advise to avoid fluoride toothpaste 500 ppm fluoride content, because they consider the evidence on the efficacy of such a fluoride concentration in toothpaste to be weak. They recommend the use of a thin film of fluoridated tooth paste 1000 ppm twice daily only when the child can spit out at about 4 years of age (Koletzko et al., 2013).

On the other hand, the German association for dental and oral health (DGZMK, 2000) recommend the use of a thin film of fluoridated tooth paste with 500 ppm fluoride content once daily with the eruption of the first tooth, and a pea size amount twice daily starting the child's second birthday. In addition, the use of fluoride containing salt is recommended

Still, very few midwives seem to follow the guidelines of the pediatricians/DGKJ recommending a late use of fluoride tooth paste, while most stick to the dental recommendations.

Midwives in Germany gave very good recommendations for caries prophylaxis. However, only 10.6% of mothers got information about their child's oral health from a midwife (11.6% of German mothers and 7.6% of mothers with migration background) and 11.9% of mothers received healthy diet recommendations from a midwife according to a questionnaire study involving 442 mothers of 3 and 4- year old

children in Hannover (Spanier, 2009).

This could be due to a fact, the press brought up several times in the past years, of midwives' shortage in Germany. Not every woman in Germany had the chance to find a midwife for pregnancy care, birth and postpartum care (Bund, 2015).

This also could be due to midwives mainly visiting the mothers till the end of the postpartum period (the first 8 weeks of the child's life) and only when necessary later (Governmental insurance companies pay up till 8 extra visits till the end of the child's 9th month of life). Every mother decides herself how much of these visits she wants. The first 8 weeks of the child's life is probably not the time the mother will be thinking of her child's teeth or diet or whatever will come later on after several months. The mothers' main concerns then are rather breastfeeding, diapers or her child's sleeping. Family midwives visit mothers till the end of her child's first year of life but they support only families with specific difficult living situations such as physically or mentally disabled newborn, premature birth, chronic illness of the mother. Such mothers' concerns are probably much bigger than her child's teeth and when to visit the dentist

Meanwhile, many mothers with migration's background do not have the idea of midwifery in their culture and may probably not even seek one on birth.

5.3.4. Regional differences

The differences between midwives' ECC knowledge from one state to another were minor. However, the difference in their recommendations was remarkable especially recommending the timing of the first visit to the dentist. This could be due to the focusing on the issue of caries prophylaxis by midwives' associations in certain states rather than others. Most correct recommendations were given in Hamburg and Hessen and Schleswig-Holstein.

Many experiences in different countries worldwide have demonstrated the role of midwives and primary health nurses in promoting oral health of expectant mothers and their infants. The U.S. adopted the RAMP program incorporating oral health promotion into prenatal care for pregnant teenagers and their babies through nursing staff and midwives. The program has not been evaluated yet (Stevens et al., 2007).

Caries reduction, improved oral hygiene and increased dental access have been significantly reported to associate preventive oral health programmes delivered by nurses or midwives (Abou El Fadl et al., 2016)

Australia proposed the midwifery initiated oral health online program (MIOHP) to incorporate oral health guidelines into normal midwifery practice (Heilbrunn-Lang et al., 2015).

Many studies reported non-dental health models as nurses and midwives to be effective in oral health promotion if they receive proper training. In the current study, the majority of midwives (84.8%) mentioned their will to learn more about oral health. Moreover, midwives in Germany believe that caries prophylaxis belongs to their field (Ehlers et al., 2014, Rahman et al., 2016). Midwives in Germany can definitely contribute to early childhood caries prevention if they receive proper intervention evidence based programs.

5.4. Critical appraisal

The current study evaluated the knowledge and recommendations for caries prevention of midwives' in Germany. The survey was performed online to provide easiness of accessibility, save time and effort for the investigator and the participants. The questions were simple, clear and direct with preformed options for answers. This study aimed to contribute to the prevention of early childhood caries through increasing the awareness of midwives about early childhood caries and its prevention as well as assess their involvement in the caries prophylaxis in young children in Germany.

One of the weaknesses of this study is non-response bias which is a common limitation of online surveys. Another drawback to mention is that 6 states were not evaluated in the comparison of regional differences due to low number of participants from these states. On the other hand, the regional difference among the evaluated states were so minimal that a uniform knowledge base and distribution of the recommendations by midwives can be assumed for the missing states and the whole of Germany.

6. Conclusions and Recommendations

Midwives' involvement in educating mothers about early childhood caries prevention has increased over the past years which is apparent from the results of this study and different questionnaire studies in the past years (Ehlers et al., 2014, Rahman et al., 2016, Wagner et al., 2016). The midwives' association (Deutscher Hebammenverband) has drawn great focus on this issue during the past years (ZM Online, 2016, KZBV, 2014, Steppat, 2013). However, there are still some inconsistencies regarding the use of fluoride, the timing of brushing with fluoridated tooth paste and the timing of the first visit to the dentist due to non-uniform guidelines of different health professions in Germany. Thus, there are a few points which could possibly improve the benefit of the midwives' work:

- Uniform consistent guidelines for caries prophylaxis and the use of fluoride should be emphasized. Where fluoride is the main key to caries prevention (Twetman, 2008, Ammari et al., 2007)
- The early preventive visits at the dentist (FU) for children should start during the first year of life rather than at the age of 30 months (Savage et al., 2004, AAPD, 2014).
- All health care personnel from gynecologists, midwives, pediatricians, and dentists should cooperate by guiding, referring new mothers to the dentist by the timing of the first tooth eruption
- Including the preventive dental visits in the child's examination booklet
- More information about early childhood caries and its prevention could be introduced to the curricula of midwives' schools in Germany as well as oral health education programs.

7. References

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Appendix

Fragebogen zum Thema “Vermeidung von Nuckelflaschenkaries”

Sie können mehr als eine Auswahl auswählen

1. Wie lange haben Sie Berufserfahrung?
a. 0-1Jahre b. 2-5 Jahre c. 6-10 Jahre d. >10 Jahre
2. In welchem Bundesland sind Sie tätig? _____
3. Woher haben Sie Ihr Wissen über Zahngesundheit?
a. Ausbildung Hebamme b. Fortbildungen c. Internet d. Zeitschriften
e. Sonstiges: _____
4. Würden Sie über Zahngesundheit und Prävention bei Kindern gerne mehr lernen?
a. Ja b. Nein
5. Was empfehlen Sie die Eltern von kleinen Kindern?
a. Zuckerarme oder zuckerfreie Ernährung
b. Trinken aus Tassen und/oder Bechern ab dem 1. Geburtstag
c. Nuckelflasche nicht zum Dauernuckeln überlassen
d. Fluoridtabletten
e. Zähneputzen mit Fluoridzahnpaste
f. Auf Fluoride beim Kleinkind zu verzichten
6. Was ist Ihre Meinung zur Fluoridtabletten?
a. Sie wirken auf die Mineralisierung von Milch- und bleibenden Zähnen.
b. Sie wirken vor allem auf die Bildung von bleibenden Zähnen.
c. Sie wirken vor allem auf die Bildung von Milchzähnen.
d. Sie wirken vor allem lokal auf die Zähne im Mund.
e. Sie haben keine Wirkung auf die Zähne.
7. Ab wann empfehlen Sie das Zähneputzen?
a. auf dem zahnlosen Kieferkamm nach der Geburt
b. ab dem Durchbruch der ersten Frontzähne mit ca. 6 Monaten
c. ab dem Durchbruch der ersten Backenzähne mit 1 ½ Jahren

- d. ab einem vollständigen Milchgebiss mit 2 ½ Jahren
8. Empfehlen Sie das Zähneputzen...
- a. Ohne Fluoridzahnpaste
 - b. Mit Fluoridzahnpaste ab dem Durchbruch der ersten Frontzähne mit ca. 6 Monaten
 - c. Mit Fluoridzahnpaste ab dem Durchbruch der ersten Backenzähne mit 1 ½ Jahren
 - d. Mit Fluoridzahnpaste ab 2 Jahren
 - e. Später ab _____ Jahren
9. Wann empfehlen Sie den ersten Zahnarztbesuch?
- a. Kurz nach der Geburt
 - b. ab dem Durchbruch der ersten Frontzähne mit ca. 6 Monaten
 - c. ab dem Durchbruch der ersten Backenzähne mit 1 ½ Jahren
 - d. ab einem vollständigen Milchgebiss mit 2 ½ Jahren
 - e. wenn die bleibenden Zähne mit ca. 6 Jahren durchbrechen
10. Welche Zähne sind hauptsächlich betroffen bei Nuckelflaschenkaries?
- a. obere Frontzähne
 - b. unten Frontzähne
 - c. obere Backenzähne
 - d. unteren Backenzähne
11. Wie häufig ist Nuckelflaschenkaries in Deutschland?
- a. 2-4%
 - b. 10-15%
 - c. 40-45%
 - d. 60-65%
12. Wodurch kann Nuckelflaschenkaries verursacht werden?
- a. gesüßte Getränke
 - b. das Trinken aus einer Tasse oder einem Becher
 - c. ungesüßten Tee
 - d. Milch
 - e. Mineralwasser
 - f. nächtliches Dauernuckeln
 - g. hochfrequentes Stillen bis in das Kindergartenalter
13. Nuckelflaschenkaries kann führen zu:
- a. Zahnschmerzen
 - b. einer gestörten Sprachenentwicklung
 - c. Zahnbelag

- d. gestörtem Kau- und Schluckvermögen
- e. Zahnstein

Herzlichen Dank für Ihre Teilnahme!

Eidesstattliche Erklärung

Hiermit erkläre ich, dass ich die vorliegende Dissertation selbständig verfasst und keine anderen als die angegebenen Hilfsmittel benutzt habe.

Die Dissertation ist bisher keiner anderen Fakultät, keiner anderen wissenschaftlichen Einrichtung vorgelegt worden.

Ich erkläre, dass ich bisher kein Promotionsverfahren erfolglos beendet habe und dass eine Aberkennung eines bereits erworbenen Doktorgrades nicht vorliegt.

Datum

Unterschrift

Dalia Somaie

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