Prevalence and determinants of early childhood caries in Italy

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Abstract

Aim Still limited data from representative surveys are available on the prevalence of Early Childhood Caries (ECC; i.e., the presence of one or more decayed, missing, or filled tooth surfaces in any primary tooth in a child aged 71 months or younger), particularly for infant. We conducted a survey in Italian children aged 0 to 71 months.

Materials and methods A cross-sectional study on ECC was conducted in Italy in 2018 on a sample of parents who were members of an online panel. Using an online questionnaire, 2,522 parents provided information on a total sample of 3,000 children, representative of the Italian population aged 0–71 months.

Results ECC prevalence was 8.2% overall, 2.9% in children aged 0–23 months, 6.2% in children aged 24–47 and 14.7% in children aged 48–71 months (p for trend<0.001). ECC was more frequently observed among children using baby bottle with milk to fall asleep (multivariate odds ratio, OR, 1.36, 95% confidence interval, CI: 1.03-1.78), baby bottle with sugary beverages (OR 2.87, 95% CI: 2.05-4.03) and pacifier with sugary substances (OR 2.49, 95% CI: 1.79-3.47), consuming beverages other than water (OR for ≥1/day vs never 2.29, 95% CI: 1.35-3.90), a higher number of snacks between meals (OR for ≥3 vs <2 meals 2.05, 95% CI: 1-38-3.06), a lower frequency of tooth brushing (OR for <1 vs ≥2 times/day 2.26, 95% CI: 1.42-3.58) and a high number of siblings (compared to 0, OR for ≥2 siblings 2.28, 95% CI: 1.56-3.34). ECC increased with parents' mean age (p for trend=0.048), parents' smoking habit (OR for at least one smoker 1.54, 95% CI: 1.17-2.03), parents' poor oral hygiene (OR for ≤1 vs >1 time/day of tooth brushing 1.42, 95% CI: 1.03-1.96) and high number of caries (OR for ≥7 vs 0 caries was 2.38, 95% CI: 1.35-4.20).

Conclusions The present large and representative survey for the first time shows that ECC might be frequent also among infants. We confirm that ECC might be prevented if parents follow simple good practices. Information campaign and intervention programmes are needed to inform parents about unfavourable habits that favour the onset of ECC.

KEYWORDS Early Childhood Caries; Children; Infants; Oral hygiene; Sugars; Survey; Italy.

Introduction

Early Childhood Caries (ECC) has been defined by the American Academy of Pediatric Dentistry as the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child aged 71 months or younger (American Academy of Pediatric Dentistry, 2016). ECC is a significant public health problem, being one of the most prevalent childhood diseases globally. When compared with other infancy diseases, the frequency of ECC is five times that of asthma and seven times that of hay fever [American Academy of Pediatric Dentistry, 2016].

The aetiology of ECC is multifactorial [Tinanoff et al., 2019]. Known ECC determinants include teeth susceptibility (lack of fluoride exposure, genetic factor or enamel defect), the oral colonisation by cariogenic bacteria (due to poor oral hygiene, saliva composition and maternal oral health) [Kirthiga et al., 2019; Paglia, 2017], diet (high sugar diet, feeding practices and nocturnal breastfeeding) [Paglia et al., 2016] and environmental factors (low socioeconomic status, poor parental education and premature birth/low birth weight) [Anil & Anand, 2017; Cianetti et al., 2017]. In particular, free sugars in the diet represent an important risk factor for dental caries [Paglia et al., 2019]; the latest dietary recommendations of the World Health Organization recommend limits on free sugar intake to reduce the incidence of caries [WHO, 2017a]. Free sugars include monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates, whereas milk sugars are excluded. The WHO recommends to limit free sugar intake to a daily average of no more than 10% of total calories ('strong recommendation') for adults and even less for children [WHO, 2015].

The consequences of ECC on a child's health and life quality are numerous and severe: increased risk of malocclusion and development of new decays in mixed and permanent dentition; increased episodes of pain and dental emergencies; risk of bacteremia; possible alteration of a child's development and growth; difficulties in learning with a reduced scholastic performance [Paglia et al., 2019].

Many children affected by ECC require treatment under general anaesthesia because of the higher number of decays in relation to the young age of the child [WHO, 2017b]. This kind of medical procedure weighs on the family when they choose private insurances or on the National Health Service.

Although during the early stages of ECC there may be no symptoms, the progression of the lesion is generally characterised by slight pain and discomfort [Anil and Anand, 2017]. Untreated ECC might cause difficulties in sleeping, eating or speaking and can hinder children's growth and development. It has been suggested that children who suffer from cavitated dentin caries have lower body weight and height, compared with those without dental caries [Li et al., 2015]. Moreover, the need of hospitalisation or emergency dental visits were reported in selected severe cases [Allareddy et al., 2014; Rajavaara et al., 2018]. Long-term complications include the development of dental malocclusion and a higher risk, up to 5–6 times, to develop new cavities in the permanent dentition [American Academy of Pediatric Dentistry, 2016] .

The prevalence of ECC differs widely. Various data [Meyer and Enax, 2018] showed that around 40% of children aged 2 to 11 years have cavities in the USA, whereas in Qatar the percentage is as high as 89%; while in Germany [Basner et al, 2016] a recent study showed that 10% of 3-years-olds have ECC and up to 26% have white-spot lesions. Limited information on ECC prevalence is available from Italy [Ferro et al., 2017; Nobile et al., 2014].

Given that before setting goals or implementing effective dental services it is important to assess the status of primary dentition with regard to caries, we conducted a representative survey in order to assess ECC prevalence and severity in Italian children aged 0 to 71 months, and to investigate its determinants in Italy.

Methods

We conducted a survey involving 2,522 parents aged ≥18 years (age groups: <35, 35–44 and ≥45 years), providing information on a sample of 3,000 children, representative of the Italian population aged between 0 and 71 months. Parents were interviewed using an online questionnaire after being recruited to participate in the research through the DOXA web panel, which today includes about 50,000 active panelists (individuals who have participated in at least one research over the last 12 months; average refresh: 25%), for a total of over 120,000 family members. The fieldwork was conducted in October and November 2018. The redemption rate was relatively high (i.e., 49%).

Beside general information on parental socio-demographic characteristics, data were collected on selected lifestyle habits of the parents, including smoking and dental hygiene. For each child aged 0–71 months information was collected on age, sex, anthropometric measures, breastfeeding, dental hygiene, use of pacifier and baby bottle, consumption of milk, other beverages and snacks.

Information on ECC was self-reported by the parent and was assessed by means of the question: "What condition better describes the current state of the mouth of your child?". Possible answers were: A) Healthy mouth (use this option also in case your child does not have teeth, yet); B) Presence of caries in one tooth; C) Presence of some teeth damaged; D) Presence of orange spots on the outer surface of the teeth; E) Presence of important alterations of the dental structure. Photograps

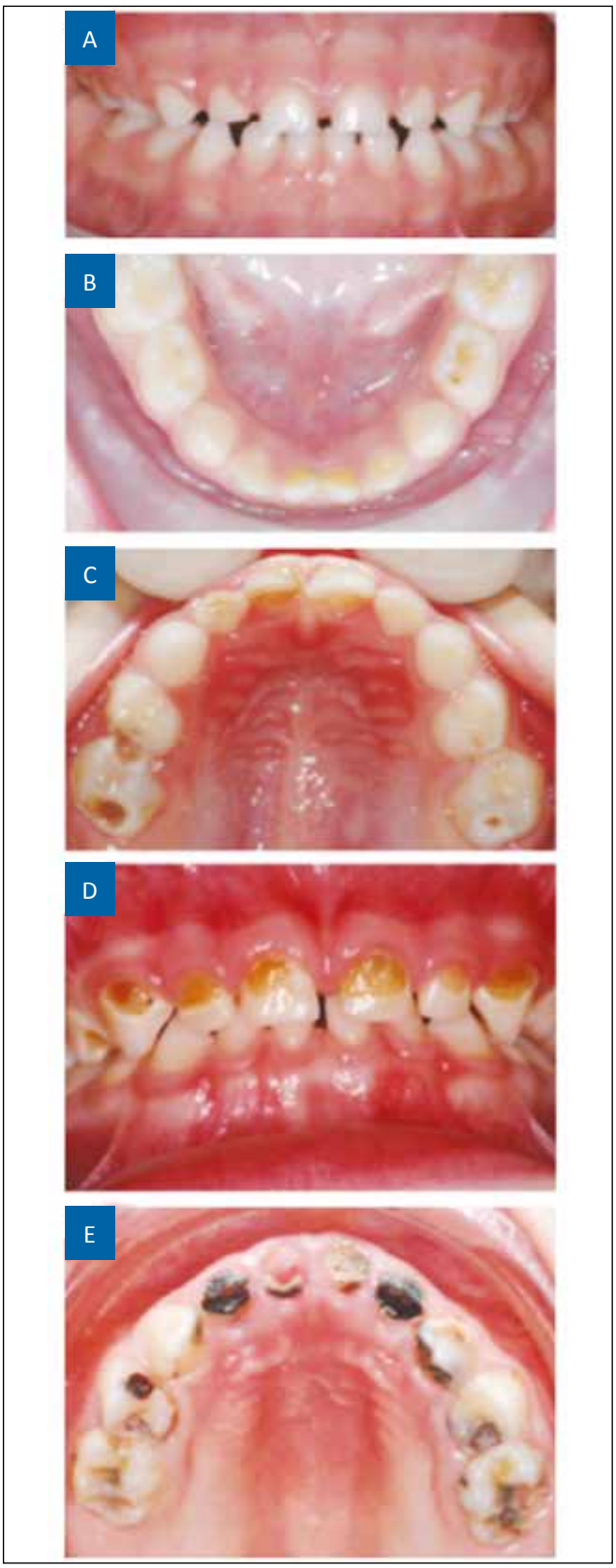

FIG. 1 Images used to help the parental assessment of children's oral condition.
A = Healthy mouth (use this option also in case your child does not have teeth yet).
B = Presence of caries in one tooth. C = Presence of damaged teeth.
D = Presence of orange spots on the outer surface of the teeth.
E = Presence of important alterations of the dental structure.

	N	%
Total	3,000	100.0
Socio-demographic		
Sex		
Male	1,543	51.4
Female	1,457	48.6
Age (months)		
0–11	427	14.2
12–23	513	17.1
24–35	478	15.9
36–47	526	17.5
48–59	487	16.2
60–71	568	19.0
Geographic area		
Northern Italy	1,376	45.9
Central Italy	587	19.6
Southern Italy and islands	1,037	34.6
Breastfeeding, baby bottle and pacifier		
Breastfeeding		
No	612	20.4
Yes	2,388	79.6
Duration		
<12 months	1,285	53.8
≥12 months	1,103	46.2
Duration breastfeeding in the night		
<12 months	1,296	54.3
≥12 months	1,093	45.7
Use of baby bottle with milk (to fall asleep)		
No	1,585	52.8
Yes	1,415	47.2
Use of baby bottle with sugared substances (to fall asleep)		
No	2,696	89.9
Yes	304	10.1
Use of pacifier		
No	930	31.0
Yes	2,070	69.0
Use of pacifier with sugared substances		
Non use	930	31.0
Never with sugared substances	1,530	51.0
Sometimes	457	15.0
Often	83	2.8
Oral health		
Visit to the dentist		
No	2,100	70.0
Yes	900	30.0
Reason of the visit		
Pain	64	7.2
Check-up	751	83.4
Trauma	63	7.0
Advised by a specialist	21	2.4
Paediatrician	18	88.0
GP	1	4.7
Pharmacist	0	0.0
Other	2	7.4
Start teeth cleaning		
0–12 months (before first tooth)	412	13.7
0–12 months (after first tooth)	936	31.2
13–23 months	848	28.3
2–5 years	360	12.0
Not yet (0–12 months)	273	9.1
Not yet (≥13 months)	172	5.7

TABLE 1 Data about selected characteristics of the 3,000 children, Italy, 2018.

were used to help parents in determining their children's oral condition (Fig. 1). We defined a child affected to ECC if the respondent reported an option from B to D. From height and weight of children we derived body mass index (BMI), that was categorised using standard age-and sex-specific international cut-offs [Cole et al., 2000; Cole et al., 2007].

This study received ethics approval from the University of L'Aquila, Italy (Prot. n. 50473 of 19/11/2018).

Statistical weights were used to guarantee representativeness of the children for sex and age. Odds ratios (OR) of ECC and corresponding 95% confidence intervals (CI) were estimated using unconditional multiple logistic regression models after adjustment for mean age of parents, marital status of parents, geographic area, monthly family income, number of siblings, and sex and age (in month) of the child.

Results

Table 1 shows the data of 3,000 Italian children (1,543 males and 1,457 females) aged 0–71 months according to selected characteristics. Overall, 79.6% of children had been breastfed; among them, 46.2% for a prolonged duration (i.e., ≥12 months) and 45.7% for a prolonged duration during the night. Almost half of children (i.e., 47.2%) used baby bottle with milk to fall asleep, 10.1% used baby bottle with sugary substances, 69.0% used the pacifier and 17.8% used the pacifier with sugary substances. Only 30.0% of children had been visited by a dentist. Among children aged 24 months or older, 59.2% had never been visited by a dentist (data not shown in tables). Main reasons for dental visits included check-up (83.4%), pain (7.2%) and trauma (7.0%). Only 21 children (i.e., 0.7% of the entire sample) had been advised by a healthcare provider to visit the dentist. Among these 21 children, 18 had been advised by paediatricians. Overall, 46.0% of the entire sample started brushing teeth after 12 months of age.

Among the 2,522 respondent parents, 8.6% ignored that their oral health could influence that of their children and 65.9% were uncertain about this statement. More than 80% of parents (i.e., 81.2%) did not perceive caries as an infective disease (data not shown in tables).

ECC prevalence in Italian children aged 0–71 months was 8.2% (9.0% in males and 7.3% in females; p=0.095). It significantly increased with age, being 2.9% in children aged 0–23 months, 6.2% in 24–47 months, and 14.7% in children aged 48–71 months (p for trend<0.001).

Table 2 shows the multivariate ORs of ECC according to selected characteristics of children. No significant relationship with ECC was observed according to sex, BMI and breastfeeding. ECC was more frequently observed among children using baby bottle with milk to fall asleep (OR 1.36, 95% CI: 1.03-1.78). Use of pacifier was unrelated to ECC, although, among users, those using pacifier with sugary substances had more frequently ECC (OR 2.49, 95% CI: 1.79–3.47). Milk consumption was inversely related (OR for high vs low consumption was 0.62, 95% CI: 0.42-0.90) and beverage consumption directly related with ECC (OR 2.29, 95% CI: 1.35–3.90), whereas no significant relationship was observed with snack consumption.

Table 3 shows the ORs of ECC according to selected parental/family characteristics. A relatively low mean age of parents was related to a higher ECC (compared to a mean age of parents <35 years, OR for 35–44 years was 0.66, 95% CI: 0.48–0.90, and OR for ≥45 years was 0.68, 95% CI: 0.44–1.07). No relationship with ECC was observed for marital status of

	N	ECC		Age of children; OR (95% CI)		
		%	OR° (95% CI)	0–23 months	24–47 months	48–71 months
Total	3,000	8.2	-			
Age (months)						
0–11	427	2.5	1^			
12–23	513	3.3	1.36 (0.63-2.98)			
24–35	478	3.2	1.38 (0.62-3.05)			
36–47	526	9.2	4.24 (2.15-8.37)			
48–59	487	12.1	5.55 (2.83-10.9)			
60–71	568	16.9	8.28 (4.29-16.0)			
p for trend			<0.001			
Sex						
Male	1,543	9.0	1^	1^	1^	1^
Female	1,457	7.3	0.80 (0.61-1.04)	0.62 (0.27-1.39)	0.60 (0.35-1.03)	0.95 (0.67-1.34)
BMI (kg/m2)*						
Underweight	771	7.3	1.04 (0.74-1.46)	1.02 (0.38-2.70)	0.91 (0.48-1.72)	1.12 (0.71-1.71)
Normal weight	1,449	8.1	1^	1^	1^	1^
Overweight	362	9.3	1.13 (0.74-1.72)	-	0.80 (0.33-1.98)	1.50 (0.91-2.47)
Obese	358	9.9	1.25 (0.83-1.90)	1.18 (0.36-3.84)	0.90 (0.37-2.18)	1.43 (0.85-2.42)
p for trend			0.361	0.748	0.889	0.191
Breastfeeding						
No	612	6.6	1^	1^	1^	1^
Yes	2,388	8.6	1.36 (0.95-1.94)	-	2.26 (1.00-5.10)	0.91 (0.60-1.39)
Duration of breastfeeding						
<12 months	1,285	7.4	1^	1^	1^	1^
≥12 months	1,103	10.0	1.16 (0.85-1.57)	0.21 (0.07-0.67)	1.36 (0.77-2.40)	1.40 (0.94-2.07)
Duration of breastfeeding during the night						
<12 months	1,296	8.0	1^	1^	1^	1^
≥12 months	1,093	9.4	1.03 (0.76-1.40)	0.18 (0.06-0.60)	1.08 (0.62-1.89)	1.29 (0.87-1.91)
Use of baby bottle with milk to fall asleep						
No	1,585	7.1	1^	1^	1^	1^
Yes	1,415	9.4	1.36 (1.03-1.78)	2.48 (1.06-5.85)	2.05 (1.20-3.52)	1.00 (0.71-1.42)
Use of baby bottle with sugary beverages						
No	2,696	6.9	1^	1^	1^	1^
Yes	304	19.7	2.87 (2.05-4.03)	5.02 (1.87-13.5)	3.98 (2.21-7.15)	2.17 (1.37-3.43)
Use of pacifier/dummy						
No	930	7.7	1.01 (0.75-1.37)	1.12 (0.48-2.61)	1.15 (0.62-2.04)	0.98 (0.66-1.44)
Yes	2,070	8.4	1^	1^	1^	1^
If yes, use of pacifier with sugary substances						
Never	1,531	5.7	1^	1^	1^	1^
Often/sometimes	539	16.1	2.49 (1.79-3.47)	5.94 (1.82-19.34)	3.53 (1.85-6.75)	1.80 (1.19-2.73)
Frequency of teeth brushing						
≥2 times/day	1,250	9.1	1^	1^	1^	1^
1 time/day	988	9.3	1.42 (1.05-1.93)	0.85 (0.27-2.74)	1.45 (0.81-2.60)	1.49 (1.02-2.17)
Never or <1 time/day	317	9.9	2.26 (1.42-3.58)	1.56 (0.49-4.93)	2.75 (1.19-6.35)	2.14 (1.09-4.23)
Not yet	445	1.9	0.62 (0.27-1.41)	0.26 (0.07-1.02)	1.19 (0.25-5.67)	1.23 (0.27-5.69)
Milk						
Never or <1/day	976	13.4	1^	1^	1^	1^
1/day	1,013	6.8	0.54 (0.39-0.74)	0.51 (0.17-1.55)	0.46 (0.24-0.87)	0.59 (0.40-0.87)
>1/day	1,010	4.6	0.62 (0.42-0.90)	0.24 (0.09-0.63)	0.65 (0.33-1.26)	0.90 (0.54-1.50)
p for trend			0.001	0.003	0.096	0.158
Beverages (not water)						
Never	805	2.8	1^	1^	1^	1^
1–2 times/week	877	7.3	1.47 (0.86-2.51)	1.08 (0.28-4.19)	1.25 (0.48-3.24)	1.43 (0.62-3.28)
3–6 times/week	602	13.7	2.59 (1.52-4.42)	6.44 (2.10-19.73)	2.02 (0.78-5.20)	2.12 (0.97-5.06)
≥1/day	716	10.8	2.29 (1.35-3.90)	2.54 (0.83-7.82)	1.68 (0.65-4.32)	2.28 (0.99-5.21)
p for trend			<0.001	0.019	0.172	0.008
Salty or sweet snacks§						
Never	513	3.3	1^	1^	1^	1^
1–6 times/week	1,271	8.7	0.90 (0.47-1.76)	0.91 (0.35-2.34)	1.04 (0.23-4.66)	0.87 (0.23-3.49)
1 time/day	827	7.3	0.74 (0.37-1.48)	0.34 (0.05-2.16)	0.63 (0.13-2.97)	0.83 (0.21-3.27)
≥2 times/day	389	15.0	1.63 (0.81-3.30)	2.72 (0.75-9.84)	1.51 (0.32-7.19)	1.61 (0.41-6.38)
p for trend			0.025	0.532	0.641	0.026
Number of snacks between meals						
<2	972	6.5	1^	1^	1^	1^
2	1,574	8.0	1.09 (0.79-1.50)	1.62 (0.62-4.20)	1.43 (0.73-2.79)	0.95 (0.63-1.42)
≥3	454	12.6	2.05 (1.38-3.06)	0.96 (0.29-3.20)	2.95 (1.37-6.33)	2.16 (1.27-3.68)
p for trend			0.002	0.927	0.007	0.023

* The sum does not add up to the total because of some missing values.
° ORs were estimated using unconditional multiple logistic regression models after adjustment for mean age of parents, marital status of parents, geographic area, monthly family income, number of siblings, sex of the child and age (in months) of the child. Estimates in bold are statistically significant at 0.05 level.
^ Reference category
§ Salty and sweet snacks included: candies, biscuits, brioches, ice cream, focaccia or pizza slice.

TABLE 2 Prevalence of early childhood caries (ECC) in the sample of 3000 children aged 0-71 months, according to selected characteristics, and corresponding odds ratios (OR) and 95% confidence intervals (CI), overall and in strata of age.

	N	ECC	
		%	OR (95% CI)
Total	3,000	8.2	-
Age group (mean age of parents)			
<35 years	852	7.9	1^
35–44 years	1,814	7.6	0.66 (0.48-0.90)
≥45 years	334	11.9	0.68 (0.44-1.07)
p for trend			0.048
Maternal age at birth*			
<30 years	639	9.2	1^
30–39 years	1,917	7.5	1.09 (0.67-1.76)
≥40 years	441	9.6	1.46 (0.72-2.94)
p for trend			0.316
Marital status			
Married	2,806	8.1	1^
Single/divorced/separated/widowed	194	9.5	1.27 (0.76-2.15)
Geographic area			
Northern Italy	1,376	9.0	1^
Central Italy	587	8.1	0.95 (0.66-1.37)
Southern Italy/slands	1,037	7.3	0.85 (0.62-1.16)
Level of education			
Low	166	7.9	1^
Intermediate	1,402	6.6	0.89 (0.48-1.66)
High	1,432	9.8	1.33 (0.71-2.49)
p for trend			0.020
Family income (€/month)			
≤€ 2000	1,146	6.5	1^
€ 2001–3000	801	7.5	1.13 (0.79-1.64)
>€ 3000	646	12.0	1.68 (1.18-2.40)
Missing	407	8.5	1.34 (0.87-2.07)
p per trend§			0.003
Number of children			
1	1,142	6.1	1^
2	1,433	8.0	1.16 (0.85-1.60)
≥3	425	14.7	2.28 (1.56-3.34)
p for trend			<0.001
Smoking habits			
Nobody in the family	1,903	6.9	1^
At least one parent	1,097	10.4	1.54 (1.17-2.03)
Frequency of tooth brushing of respondent			
>1 time/day	2,392	7.8	1^
≤1 time/day	608	9.8	1.42 (1.03-1.96)
Lifetime number of teeth with caries of respondent			
None	394	4.4	1^
1–3	1,049	7.8	1.80 (1.05-3.10)
4–6	948	8.7	1.97 (1.14-3.40)
≥7	610	10.5	2.38 (1.35-4.20)
p for trend			0.005

* The sum does not add up to the total because of some missing values.
° ORs were estimated using unconditional multiple logistic regression models after adjustment for mean age of parents, marital status of parents, geographic area, monthly family income, number of siblings, sex of the child and age (in month) of the child. Estimates in bold are statistically significant at 0.05 level.
^ Reference category.
§ Missing values excluded.

TABLE 3 Prevalence of early childhood caries (ECC) among 3,000 children aged 0–71 months, according to selected characteristics of their parents or their family, and corresponding odds ratios (OR) and 95% confidence intervals (CI).

parents and geographic area. ECC was more frequently observed in families with a high income (compared with ≤€ 2,000/month, OR for >€ 3,000/month was 1.68, 95% CI: 1.18-2.40) and a higher number of children (compared to 1, OR for ≥3 children was 2.28, 95% CI: 1.56-3.34).

The smoking habit of parents was significantly related to ECC (OR for at least one smoker vs none was 1.54, 95% CI: 1.17–2.03).

ECC was more frequent when the respondent reported a low frequency of tooth brushing (OR for ≤1 vs >1 time/day was 1.42, 95% CI: 1.03–1.96) and a high number of teeth with caries (OR for ≥7 vs 0 caries was 2.38, 95% CI: 1.35–4.20).

Discussion

This is the first survey attempting to estimate the ECC prevalence in a sample representative of Italian children aged 0–71 months, representing the target population of the ECC definition provided by the AAPD [American Academy of Pediatric Dentistry, 2016]. Our results show that, according to parents' assessment, ECC prevalence in Italian children aged 0-71 months is 8%, slightly, but not significantly, higher in males, and increases from 3% in children aged 0–23 months, to 6% at 2–3 years up to 15% in children aged 4–5 years.

Children with ECC more frequently had poorer oral hygiene, drank milk or sugary beverages from baby bottles and used a sweetened pacifier at bedtime, drank more frequently beverages other than water and had 3 or more snacks in between meals.

Parents of children with ECC were relatively young, with a high level of education and 3 or more children, they also were more frequent smokers and had poor oral hygiene with a higher number of caries.

Some findings from the descriptive analysis deserve consideration. Despite the Italian Clinical Recommendations in Odontostomatology [Italian Ministry of Health, 2017] indicate that all children should have their first dental visit between 18and 24 months of age, while almost 60% of Italian children aged 24 months or more had never visited a dentist. This is of concern and claims the need to promote early dental visits [Sanguida et al., 2019]. At least part of this concerning result is due to the lack of advice to the parents from healthcare professionals dealing with children. In our population, in fact, only less than 1% of parents reported that their children visited the dentist due to an advice from a healthcare provider, including pediatricians, pharmacists and general practitioners.

Whereas the global prevalence of ECC in low-income countries has been reported to be as high as 70%, in high-income countries the evidence suggests a prevalence lower than 20% [Anil & Anand, 2017; Congiu et al., 2014]. Studies on ECC prevalence conducted in Europe are mainly based on samples of children enrolled in kindergartens or primary care facilities, i.e., aged 3 years or more [Baggio et al., 2015; Public Health England, 2014; Stromberg et al., 2012]. Given the strong relationship between age and caries prevalence, all these surveys provide an overestimation of the real ECC prevalence. Thus, ECC prevalence was 12% in England among 3-year-old children [Public Health England, 2014; WHO, 2017b], 23% in Switzerland among children aged 3–5 years [Baggio et al., 2015], and 11% in Sweden among 3–6 years old children [Stromberg et al., 2012]. In Italy, at least three studies have been conducted to estimate ECC prevalence. Campus and colleagues, in 2004–2005 examined a representative sample of 5,538 Italian children aged 4 years, showing an ECC prevalence of 22% [Campus et al., 2009]. Nobile and colleagues in 2014 showed an ECC prevalence of 19% in a sample of 515 preschool children aged 3–5 years in southern Italy [Nobile et al., 2014]. Ferro and colleagues surveyed 2603 children from northern, central and southern Italy, showing an ECC prevalence of 17%, 24% and 35% for children aged 3, 4 and 5 years, respectively [Ferro et al., 2017]. Our estimate of 15% among 4–5-year-old children is somewhat lower compared to previous Italian estimates [Campus et al., 2009; Ferro et al., 2017; Nobile et al., 2014].

Based on the AAPD definition of ECC [American Academy of Pediatric Dentistry, 2016], the present survey provides a complete picture of current ECC over the 0–5 years age group representative of a large Country population. To our knowledge

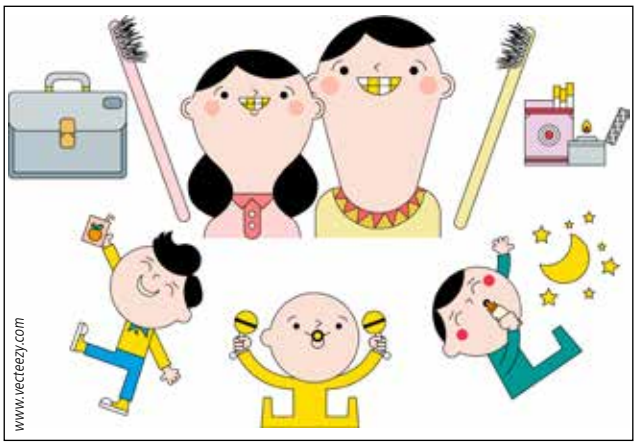

FIG. 2 Italian family at ECC risk: The research allows to identify the type of family at greater risk of ECC in their children; these families have in common young parents (<35 years-old), both smokers and with poor oral hygiene (low frequency of tooth brushing and ≥ 7 caries), belonging to middle or middle high socioeconomic status (>3000 €/month) and having a high number of children (≥ 3 children). The major risk factor for ECC in infants is the use of pacifier dipped in sugary substances, the use of baby bottle with milk before sleeping in children under the age of two, and drinking fruit juices or sugared beverages in older children.

this is the first study which considers also infants. We found that ECC occurred in a not negligible proportion of children aged 0–11 months (i.e., 3%). The relatively high prevalence of ECC in toddlers, substantially lowers the target age for future studies and preventive interventions.

In our population, we found a clear dose-response relationship between sugar consumption and ECC, confirming the current evidence [Kirthiga et al., 2019; Naidu et al., 2013; WHO, 2017b]. In particular, we found that the use of baby bottle with sugary beverages and pacifiers dipped in sugary substances is strongly related with the presence of caries, overall and consistently in various age groups, particularly among the youngest children (aged 0–23 months). Moreover, the odds of ECC increased with consumption of beverages, likely containing free sugars, as syrups, fruit juices and fruit juice concentrates. Also, increasing the number of meals and snacks in beetwen them, increased the odds of ECC among children aged 2 or more years, thus supporting the paediatric and nutrition recommendations to limit the number of meals to 5 or less [Agostoni et al., 2011; Institute of Medicine, 2007].

Widespread information is needed to increase the awareness of the public opinion on the use of the pacifier dipped in sugary substances and the consumption of beverages other than water. Today, these bad habits still affect 1 out of 5 children in Italy. We support therefore the recent US beverage recommendations to drink only water and milk for children before 6 years of age, based on scientific research reached through consensus by selected scientific societies, including the American Academy of Pediatric Dentists (Healthy Eating Research).

In our population, milk is not a determinant of ECC per se. However, the prevalence of ECC appeared to be higher, at borderline significance, among breastfed children. More importantly, the use of baby bottle with milk to fall asleep, used by almost half of children in our population, increased the prevalence of ECC. During the night the saliva flow is reduced and so also its buffering capacity, which in turn increases the oral acidity and the risk of caries [Qin et al., 2008]. Thus, the habit of drinking milk before sleeping might increase the onset of ECC.

We recommend parents to brush their children's teeth. Regular tooth brushing has been shown to have a favourable impact on dental caries [Reic et al., 2019; WHO, 2017b]. We therefore recommend frequent tooth brushing with fluoride toothpaste [WHO, 2017b]. Parents should regularly clean their baby's mouth particularly before sleep, also during infanthood, just before tooth eruption, using a moist gauze pad or a little toothbrush in order to remove residual milk and to help the baby learn how to brush and be accustomed to brushing when he/she grows up [Italian Ministry of Health, 2017].

The present work confirms findings from other studies showing that also a low frequency of tooth brushing and a high number of caries of the parents determine ECC in their children [Kirthiga et al., 2019; Naidu et al., 2013; WHO, 2017b]. This is partly due to the unfavourable habits within the family, and the transmissible nature of cavities through the plaque bacteria (e.g., Streptococcus mutants) transmitted from parents to child [WHO, 2017b], through the same cutlery or the pacifier in contact with the parent's saliva [Paglia and Colombo, 2019; WHO, 2017b]. An Israeli research conducted in 2015 showed that Streptococcus mutans can be found even in the oral cavity of infants prior to teeth eruption [Rosenblatt et al., 2015]. The mother is considered to be the important source of transmission of infection in children due to intimate contact with their children in the first two years of life, when Streptococci mutans are initially transferred. When the mother has poor oral hygiene, the concentration of bacteria is higher and more aggressive. In our study, more than 80% of respondents ignore that caries may be an infectious and transmissible disease [AAPD, 2016]. There is a need therefore to raise awareness in the general population about the possible bacterial transmission from parents to children. Having proper oral hygiene during pregnancy certainly helps to reduce the chance of transmitting the Streptococcus mutans. Instructing these mothers at high-risk of transferring cariogenic bacteria to their children improves prevention [2017].

The present work also shows that other habits of the parents influence ECC in children. In particular, we confirm that smoking parents substantially increase ECC [WHO, 2017b], at least partially due to the cariogenic effect of second-hand smoke in children [Tanaka et al., 2015]. The present study showed that parents belonging to socioeconomic middle/upper class had a proportionately higher number of children with ECC rather than lower socioeconomic classes. This finding is in contrast to previous studies where lower status of parents was associated with ECC [Chaffee et al., 2017; Tiberia et al., 2007].

Weaknesses of this study include those inherent to the design. In particular, the cross-sectional design did not allow us to infer any causal association when investigating the relationship between potential determinants and ECC. Another possible limitation is given by the assessment of ECC, obtained through self-reports by parents. This would result in an underestimation of the prevalence of caries in the study population, especially with regard to non-cavitated lesions which may be not visible to an untrained eye. However, we used selected pictures in an attempt to facilitate the parental assessment of the condition of children's mouths.

Finally, the online panel might be a source of selection bias. Actually, the sample of parents appeared to be highly educated, being only 6% the parents having a level of education below high school diploma. The strengths of our study include the online methodology of interview offered by Doxa which has

made it possible to enroll different families from various parts of Italy to obtain a large and representative sample of the Italian population of children aged 0–71 months. Moreover, to the best of our knowledge, this is the first study on ECC considering infants (<24 months).

In conclusion, the present large and representative survey shows that ECC might be frequent not only in children, but also among infants. Our study, quantifying the role of a number of potential factors, confirms that ECC is highly determined by several unfavourable lifestyle habits of both the parents and their children (Fig. 2). Moreover, Italian parents of children aged less than 6 years still have a limited knowledge on the possible determinants of ECC, frequently fall into bad behaviours, causing ECC to their children and too rarely have access to a paediatric dentist. Given the harmful consequences of ECC and its high economic burden information campaigns and intervention programmes are needed to inform parents on simple good practices that have the potential to highly prevent early caries in their children. Parents should be recommended to improve the oral hygiene of their children, also when infants, to avoid using baby bottles with sugary beverages, baby bottles with milk to fall asleep, sweetened pacifier, and to ban consumption of sweet beverages. Parents should also be aware that cavities have a strong infective component. Thus, to prevent ECC in their children they should improve their own oral hygiene to avoid the possible passages of bacteria contaminated saliva from parents to children.

Finally, parents should be aware of the unhealthy consequences of exposing their children to smoke, which also include the increased risk of early caries.

With regard to oral prevention, Italian paediatricians are currently not doing enough. They should in fact play a crucial role not only for intercepting oral disease from the early stages of life, but also to educate and inform parents on the good practices of oral disease prevention and proper oral hygiene.

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