

Prevalence of tooth decay in deciduous and permanent teeth in a schoolchildren population: an epidemiological investigation

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Abstract

Aim: the aim of the present study was to assess the prevalence of dental caries in a population of schoolchildren in Rome (Italy) with different age ranges.

Materials and Method: the study involved n.1033 subjects, between 6 and 14 years of age, attending public schools in Rome (Italy). All the subjects included in the study were divided into three different age groups: 6 to 8 years (Group A), 9 to 11 years (Group B) and 12 to 14 years (Group C), respectively.

The Group A consisted of n. 385 patients (197 M, 188 F) with a mean age of 6.9 ± 0.8 years; the Group B consisted of n. 355 patients (188 M; 167 F) with a mean age of 10.5 ± 1.2 years; the Group C consisted of n. 293 patients (157 M; 136 F) with a mean age of 12.6 ± 0.9 years.

The subjects selected for the study were analyzed about the oral conditions by six expert examiners and the prevalence of dental caries on deciduous or permanent were calculated in each group. The Pearson Chi test was used to perform the statistical analysis. The level of significance was set at $P < 0.05$.

Results: in Group A, most participants were caries free (255 subjects). In children with caries (160 subjects), 126 presented caries on deciduous teeth and 34 on permanent teeth. Similarly, more than half of the students of Group B were caries free (226 patients) and 129 students showed caries on primary (82 patients) and permanent teeth (47 patients). Dental caries on permanent teeth was present in most of the subjects of Group C (35 subjects) and only 10 participants showed caries on primary teeth. In the same group, a good number of participants (248 subjects) were caries free.

Conclusions: dental caries is still a major public health concern in the schoolchildren population in Rome. The Results of the current study highlighted that dental screening plays an important role to improve public oral health conditions and involving the school structure means motivating teachers and parents for a good oral hygiene habit. A proper oral hygiene, especially if established at an early age, can translate into benefits in the permanent teeth that can last a lifetime if cared for properly. This underlines the importance of communication with families, which is also one of the main goals of this work.

Keywords: oral care; dental; caries; deciduous dentition; permanent dentition; growing patients; epidemiology.

Introduction

Oral health is crucial to overall quality of life (1) and its promotion plays an essential role in the general health (2,3). Oral health problems are frequently associated with many

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communities around the world, among underprivileged groups established in developed or developing countries, and dental caries is still a major oral health problem in most industrialized countries, affecting 60 ± 90 % of schoolchildren and most adults (4).

Early childhood caries (ECC) is a type of dental caries manifested on children's teeth that is represented as one of the most prevalent dental problems in this period (5); it is known that ECC can lead to pain, infection, interference during chewing, and increase the risk of new dental caries in primary and/or permanent teeth, and sometimes, worse effects on the eruption of permanent teeth. (6).

Furthermore, environmental factors such as undernutrition, genetic susceptibility, poor health status, certain eating habits, fluoride and/or vitamin D deficiency as well as excessive sugar consumption and prolonged bottle-feeding or other factors (age, gender and continent of residence of children) are powerful in causing tooth decay (7). It is noted that appropriate chewing of food is an important part of the digestive process and for proper nutrition; teeth missing through caries may hinder this. Links have been established between malnutrition/poor diet and early childhood caries (8).

Various studies reported different types of prevalence of dental caries in primary and permanent teeth in children worldwide (5).

According to the World Health Organization (WHO), in European countries tooth decay among six-year-old children varies from 20% to 90% (9-10). Approximately, a quarter of five- to six-year-old children experience tooth decay, and the percentage rises above 90% in some low- and middle-income countries, indicating dental caries is a permanent public-health problem (11). This is probably because primary teeth are sometimes thought of by parents as 'practice teeth' (12) or that caries in primary teeth can be ignored, as they will be shed, and this is untrue (13).

When the deciduous teeth begin to erupt (typically between 6 and 8 months of age), to the complete eruption of the second permanent molars, at around 12 years of age, the mouth, such as the rest of the body, is in an almost continuous state of changing ("flux") (14). Since education and oral-health prevention programs for all family members, children and parents, at all socio-economic levels are the only means to avoid dental caries (8), dentists and oral healthcare providers prioritize oral-health promotion (8) during this "flux" of growing (13).

Therefore, the aim of the present epidemiological study was to assess the prevalence of dental caries on primary and permanent teeth in a large sample of schoolchildren in Rome (Italy) with different age ranges (6 to 8 years, 9 to 11 years and 12 to 14 years). The null hypothesis is that the prevention methods currently in place are successful.

Materials and method

Study population

The study target population consisted of subjects between 6 and 14 years of age who were attending

public primary and middle schools in Rome (Italy). It was chosen a sample of growing patient belonging to public school of different areas of Rome, to include subjects of all socio-economic levels, and in mixed dentition to assess dental exchange and any alterations.

The total sample consisted of n. 1033 children (542 M, 491 F) belonging to three different educational institutions: I.C. Belforte del Chienti, I.C. Poppea Sabina, I.C. N.M. Nicolai. The total sample was collected over three schoolyears, respectively 2021/2022, 2022/23, 2023/24. A written informed consent was obtained from the parents before starting examination.

Clinical examination

The intraoral evaluation was carried out by six trained examiners (F.S., L.L., D.R.F.C., G. F., L.S., C.L.E., M.A.) A pilot study on n. 50 students was performed to ensure the accuracy of diagnosis and to standardize the procedures; no statistically significant differences were found ($P > 0.05$) between the examiners (Chi-square test of Pearson). The students of each class were randomly assigned and screened by the examiners. A research assistant observed the examiners throughout the oral examination procedures.

The students were visited in the medical room of the school on a chair placed very close to the windows to allow the natural light entering the room. The examination lasted 30 min per subject and the oral and occlusal conditions were assessed by using latex gloves.

At the end of the examination, each examiner gave children an information sheet to be given to the parents to inform them about their child needs.

The survey employed a specially prepared "guided" survey form to be followed during the visit. The form was divided into two parts:

- A questionnaire, distributed in advance to the parents and/or guardians of the children involved, with open-ended questions regarding remote history and current oral and habitual behaviors (Figure 1).
- A medical record filled out by the practitioners in charge of disease detection during the visit, consisting of forty closed-ended items and divided into five parts (extra-oral clinical examination, intraoral clinical examination, soft tissue analysis, dental formula, functional clinical examination of swallowing, breathing, phonetics) (Figure 2).

Statistical Analysis

Data were collected by Microsoft Excel (version 16.61.1; Microsoft Corporation, Redmond, Washington, USA) and elaborated by the Statistical Package for the Social Sciences Windows (version 15.0; SPSS, Chicago, Illinois, USA).

Qualitative data were analyzed using the Chi square test of Pearson, to determine if there were statistically differences in the distributions between age, gender and other variables. The variables considered were: gender, age and dental caries (deciduous vs permanent teeth). To evaluate the association between the variables examined, the Pearson Chi test was used for the significative findings of this association. The P value for statistical significance was set at $P < 0.05$.



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QUESTION FORM FOR PARENTS

Surname _____ Name _____
Date of birth _____
Place of residence _____
School _____
Class _____ Section _____

ANAMNESIS

Type of birth:
☐ Full-term ☐ Premature birth

Type of nursing:
☐ Breast-feeding ☐ Bottle-feeding

Has the child suffered from milk/lactose intolerance?
☐ Yes
☐ No

Has your son ever been to the dentist?
☐ Yes
☐ No

If yes, at what age?.....

If yes, for what?
☐ Pain
☐ Caries
☐ Check-up visit
☐ School visit
☐ Pediatrician advice

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The dentist was...
☐ Generic dentist
☐ Pediatric dentist
☐ Orthodontist
☐ I have no idea

Has your son ever been to the ENT specialist (otolaryngologist)?
☐ Yes
☐ No

Does your son have frequent colds?
☐ Yes
☐ No

Does your son have frequent earaches?
☐ Yes
☐ No

Does your son suffer from allergies?
☐ Yes
☐ No

If yes, to which ones?.....

Has your child ever undergone one of these surgeries?
☐ Adenoidectomy
☐ Tonsillectomy
☐ None

If yes, at what age?.....

Does your son assume Fluoride?
☐ Regularly
☐ Occasionally
☐ Never

Does your son suffer from specific pathologies?
☐ Yes
☐ No

If yes, which one?

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PREVIOUS/PAST ORAL HABITS

☐ None
☐ Thumb sucking
☐ Pacifier sucking
☐ Baby-bottle

Up to what age?.....

Are these oral habits still present?
☐ Yes
☐ No

If yes, how often?

☐ Only to fall asleep
☐ Only to quiet down during crying
☐ Always

☐ Other.....

BEHAVIORAL HABITS

The child normally breathes through...
☐ the mouth
☐ the nose

Does your child easily distract?
☐ Yes
☐ No

Is your child attentive in school?
☐ Yes
☐ No

Does your child breathe heavily at night?
☐ Yes
☐ No

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Does your child grind his/her teeth at night?
☐ Yes
☐ No

Does your child snore or stop breathing during sleep?
☐ Yes
☐ No

More/other to declare:

Date _____

Parents' signature _____

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Figure 1. Questionnaire for the parents/guardians.

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DATA DETECTION

Examiner: _____

Student: _____

School: ☐ elementary school ☐ secondary school

Class: _____ Class section: _____

Sex: ☐ M ☐ F

Date of birth: _____

TREATMENT NEED

At the end of the visit held today at the _____ school, we recommend:

☐ Oral hygiene instructions

☐ Dental check for decayed teeth

☐ Orthodontic visit for malocclusion

☐ Otolaryngological control

☐ Functional and/or speech evaluation

CLINICAL EXAMINATION

EXTRAORAL EXAMINATION

Face: frontal analysis

1

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☐ Symmetric ☐ Asymmetric

Cranial shape: ☐ Dolichofacial ☐ Mesofacial ☐ Brachyfacial

Face length to be performed with gauge or ruler

2

Length of the lower third of the face to be performed with gauge or ruler

Lips at rest: ☐ Competent ☐ Incompetent

Upper lip: ☐ Normal ☐ Short

3

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Lower lip: ☐ Normal ☐ Forward

Profile: ☐ Harmonic ☐ Convex ☐ Flat ☐ Concave

Nasolabial angle: ☐ Open (>110°) ☐ Normal (90°-110°) ☐ Closed (<90°)

Labio-mental fold: ☐ Normal ☐ Pronounced

INTRAORAL EXAMINATION

Oral hygiene: ☐ Poor ☐ Good

Periodontal exam: ☐ Healthy ☐ Hypertrophic

Gingival recession: ☐ Present ☐ Absent

SOFT TISSUES EXAMINATION

Gum fistula: _____

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Present ☐ Absent ☐

Lingual frenulum: ☐ Normal ☐ Short

Upper frenulum (vestibular): ☐ Hypertrophic ☐ Normal

Upper vestibular frenulum with diastema: ☐ Yes ☐ No

Lower frenulum (vestibular): ☐ Normal ☐ Short

Cleft lip and palate: ☐ Absent ☐ Present

Lingual posture: ☐ Low ☐ Normal ☐ Interposed

Tongue size: ☐ Normal ☐ Reduced ☐ Increased

Dental formula

Deciduous teeth									
53	54	53	52	51	61	62	63	64	65
8.5	8.4	8.3	8.2	8.1	7.1	7.2	7.3	7.4	7.5

Permanent teeth

17	16	15	14	13	12	21	22	23	24	25	26	27
4.7	4.6	4.5	4.4	4.3	4.2	4.1	3.1	3.2	3.3	3.4	3.5	3.6

Legend:
P = present
A = absent
C = decayed

O = filled
R = rest
F = broken

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I = infraoccluded
AI = shape anomaly

Distalities: ☐ Deciduous ☐ Mixed dentition ☐ Permanent

DMFT (less than 5 = very low 5-8.9 = low 9-13.9 = moderate more than 13.9 = high)

DMFT = DECAYED ☐ + MISSING ☐ + FILLED ☐ = 100 =

28

dmft (less than 1 = low more than 6 = high)

dmft = decayed ☐ + missing ☐ + filled ☐ = 100 =

20

Open bite: ☐ Present (overbite < 0mm) ☐ Absent (overbite > 0mm)
If so, where? ☐ Anterior ☐ Lateral ☐ Posterior

Deep bite: ☐ Present (overbite > 4mm) ☐ Absent (overbite < 4mm)

Cross bite: ☐ Present ☐ Absent
If so, where? ☐ Anterior ☐ Lateral ☐ Posterior
If so, what type? ☐ Unilateral ☐ Bilateral

Scissor bite: ☐ Present ☐ Absent
If so, which teeth?

Overjet: ☐ Normal ☐ Increased ☐ Decreased

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Distalities: ☐ Normal ☐ With diastemas ☐ Crowding

Curve class: ☐ Right ☐ Left

Abut class: ☐ Right ☐ Left

Class I ☐ Class II ☐ Class III ☐ Molar

Midline in closing: ☐ Coincident ☐ Non-coincident

FUNCTIONAL EXAMINATION

Breathing: ☐ Oral ☐ Nasal

Swallowing: ☐ Normal ☐ Atypical

Lower lip interposition: ☐ Present ☐ Absent

Perioral muscle contraction (on swallowing): ☐ Normal ☐ Contracted

Mental muscle: _____

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Phonetic defects:

☐ Gliss
☐ Fry
☐ Speech
☐ Stuck
☐ Smile
☐ Cereot
☐ Fry
☐ Pear
☐ Doctor
☐ Scissors

EPIDEMIOLOGICAL INVESTIGATION

Name and Surname: _____

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Figure 2. Dental chart.

Preventive action

During this investigation, at the end of the medical examination, each examiner gave the child an information sheet to be delivered to the parents to inform them about their child needs. Most of the children were advised to proceed with further specialist visits for dental caries: 334 subjects needed a dental examination. This action can be considered of maximum value because of two reasons: it can allow

to have a direct dialogue with the family promoting the prevention rules and behaviors at home and, more, it can be considered the third mission of UniCamillus, the University we are affiliated to, on the social territory.

Results

A total of 1033 students, aged from 6 to 14 years old, were examined all over the three school years. The final studied sample was composed of 542 Males (52%) and

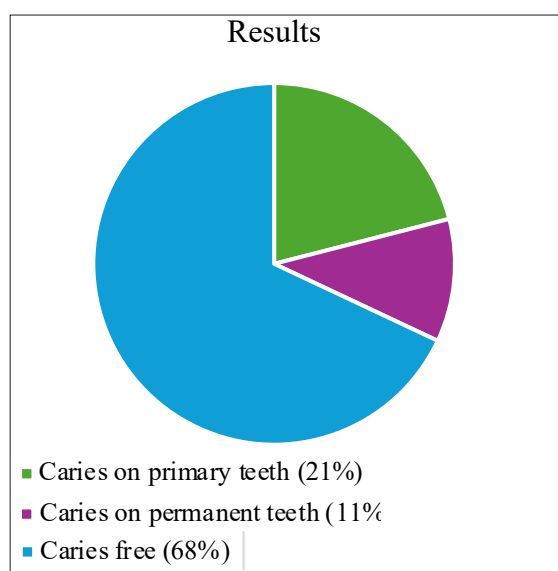
Table 1. Composition sample by age and gender (n. 1033).

Age (year) M n		Total sample			Composition sample by age		Composition sample by gender	
		F n	M + F n		M + F		Males	Females
					%		%	%
School Year 2021 - 2022								
6		20	18	38	16,9		52,6	47,4
7		20	12	32	13,7		62,5	37,5
8		23	27	50	22,1		46	54
9		20	17	37	16,4		54	46
10		5	11	16	7		31	69
11		3	2	5	2,2		60	40
12		14	6	20	8,8		70	30
13		12	14	26	11,5		46	54
14		1	2	3	1,4		33	67
Total		118	109	227	100			
School Year 2022 - 2023								
6	11		10	21	5,7	52,3		47,7
7	14		32	46	12,7	30,4		69,5
8	26		13	39	10,7	66,6		33,4
9	22		24	46	12,7	47,8		52,2
10	7		15	22	6,2	31,8		68,2
11	33		3	36	9,8	92		8
12	47		28	75	20,6	62,6		37,4
13	31		49	80	21,6	38		62
14	n.a.		n.a.	n.a.	n.a.	n.a.		n.a.
Total	191		174	365	100			
School Year 2023 - 2024								
6	21		17	38	8,7	55		45
7	37		31	68	15,7	54		46
8	25		28	53	12,5	47		53
9	39		32	71	16,3	55		45
10	33		38	71	16,3	46		54
11	26		25	51	9,5	51		49
12	29		23	52	12,2	56		44
13	16		11	27	6,4	59		41
14	7		3	10	2,4	70		30
Total	233		208	441	100			

491 Females (48%). Table 1 shows the composition of the sample according to age and gender collected in the three different school years.

Regarding the presence of dental caries on primary or permanent teeth according to age ranges, the following situation was observed (Table 2): in Group A, the vast majority of participants was caries free (255 subjects). In children with caries (160 subjects), 126 presented caries on deciduous teeth and 34 on permanent teeth. Similarly, more than half of the students of Group B were caries free (226 patients) and 129 students showed caries on primary (82 patients) and permanent teeth (47 patients). Dental caries on permanent teeth was present in most of the subjects of Group C (35 subjects) and only 10 participants showed caries on primary teeth. In the same group, a good number of participants (248 subjects) were caries free.

To evaluate the association between the variables examined, the Pearson Chi test was used for the significative findings of this correlation. In all three School Years, the following correlations were found to be statistically significant (Table 3): a poor oral hygiene with caries on primary and permanent teeth.



Graphic 1. Graphic of the Results (percentage) of dental caries on primary or permanent teeth and caries free on the total sample.

Table 2. Prevalence of Dental Caries according to age range (6 to 8, 9 to 11, 12 to 14 years).

Group	Group A (6-8y)		Group B (9-11y)		Group C (12-14y)	
Dental Caries	n	(%)	n	(%)	n	(%)
Primary teeth	126	33	82	23	10	4
Permanent teeth	34	8	47	13	35	12
Caries Free	225	59	226	64	248	84

y: years; n: number; %: percentage.

Table 3. Association among the variables by means of Pearson Chi test.

	Poor Oral Hygiene	Caries on primary teeth	Caries on permanent teeth
Caries on primary teeth	0.002*	ns	ns
Caries on permanent teeth	0.01*	ns	ns

* = significant interaction; ns = not significant.

Table 4. Distribution of Dental Caries according to gender (Male or Female) in the Group A, Group b and Group C.

Group	Group A (6-8y)		Group B (9-11y)		Group C (12-14y)	
	Gender		Gender		Gender	
Dental Caries	M	F	M	F	M	F
Primary teeth	58	68	49	33	6	4
Permanent teeth	22	12	26	21	19	16
Caries Free	109	116	112	114	134	114

The distribution of dental caries according to gender (M or F) is shown in Table 4. The Graphic 1 shows the Results, in terms of percentage of dental caries on primary (21%) or permanent (11%) teeth and caries free (68%) on the total sample.

Discussion

This cross-sectional study represents an epidemiological investigation carried out on a schoolchildren population in Rome, with the primary aim to achieve a real image about the prevalence of dental caries on primary on permanent teeth of the Roman students aged 6 to 14 years.

The study sample was evaluated to assess the oral conditions, as the prevalence of dental caries on primary or permanent teeth in three different age ranges (6 to 8, 9 to 11, 12 to 14 years).

Assuming that from the beginning of eruption of deciduous teeth and the age of 12 years with the complete eruption of the permanent dentition the mouth, such as the rest of the body, is in a continuous state of changing ("flux") (13). Since education and oral-health prevention programs for all family members, children and parents, at all socio-economic levels are the only means to avoid dental caries (9), dentists and oral healthcare providers prioritize oral-health promotion (9) during this "flux" of growing and changing (13).

In the context of oral health, primary teeth are sometimes thought of by parents as "practice teeth" (12) or that caries or problems in deciduous teeth can be ignored but this is untrue. Although the deciduous teeth remain in the mouth for a short time, they are important for many reasons, including guiding the eruption of permanent teeth and the development of speech (13). If the primary teeth are lost prematurely, for example through decay, there is the probability that the other primary or permanent teeth may drift or that unerupted permanent teeth will erupt incorrectly positioned (12) leading to crowded teeth that may be difficult to clean and possibly to experience caries (14).

In this view, caries is still a major public health concern in populations globally, despite the success of fluoride toothpastes in reducing its incidence (13).

The sample analyzed in this study showed a moderate awareness of overall oral health: the majority of children had decay-free teeth (699 subjects) and a low percentage of children had caries on deciduous and permanent teeth; specifically, the number of individuals caries free was n. 225 during in Group A, n. 226 in Group B and it was n. 248 in Group C.

Our Results are still far from the WHO goal for 2020, that is 90% of the caries-free population (15,16). However, our Results are according to the global situation: in the context of oral health, the 2016 Global Burden of Disease Study estimated that oral diseases globally affect at least 3.58 billion people, with caries of permanent teeth, being the most prevalent of all assessed conditions. Dental caries is the most prevalent chronic disease among children, and dental care is the greatest unmet healthcare need (14). Globally, it was valued that 2.4 billion people suffer from caries of permanent teeth, and 486 million children suffer from caries of primary teeth (17, 18).

In the current study dental caries on primary teeth were more frequent than on permanent teeth, except for the Group C; this is probably due to the different age range (12-14 years) of Group C, respect to the Group A (6-8 years) and Group B (9-11 years), which correspond to the final mixed dentition stage and more frequently to a complete permanent dentition stage.

Furthermore, it is known that that between primary and permanent teeth there are several important differences, although they are structurally similar (13). Physically, the enamel on primary teeth is thinner and more permeable than the enamel on permanent teeth and consequently more prone to lesion formation and progression than permanent enamel (19); the pulp chamber in primary teeth is larger relative to the crown and more attackable to caries (13, 19-21).

These differences suggest that the risk of caries increases in the primary teeth and that they are more vulnerable to caries, confirming the result of the current study, in which primary teeth showed the highest percentage of presence of dental caries respect to the permanent teeth.

In general, the relationship between incidence of caries in the primary dentition and the permanent dentition has been well-established over many years (22-28) and it is note that this relationship is likely based on diet (8), oral hygiene practices and highlights the importance of establishing a good oral and diet practices at an early age, to consent anti-caries advantages to the permanent teeth and to help them last a lifetime (13, 29).

Lastly, some limitations of the present study should be considered: the Results, not including the radiographic diagnosis in epidemiological studies of children dental caries, is likely to lead to considerable underestimation of caries occurrence, particularly with respect to the severity of caries at the interproximal sites. In addition, the students visited were preliminarily informed to obtain parental consent for the visit; therefore, the data on the level of oral hygiene are probably overestimated. It is possible that parents and children themselves, sensitized to the topic, demonstrated greater motivation and application of oral hygiene control.

Conclusions

Dental caries is still a major public health concern in the examined schoolchildren population in Rome. The Results of the current study highlighted that the dental screening plays an important role to improve public oral health conditions and involving the school structures means motivating teachers and parents for a good oral hygiene habit. Such primary preventive action can be implemented with extensive information campaigns aimed at those segments of the population showing little awareness of dental issues and oral conditions. Parents and teachers' awareness, cooperation and positive feedback in terms of oral health can improve the community awareness of bad habits in children.

The null hypothesis is that the prevention methods currently in place are successful. A proper oral hygiene, especially if established at an early age, can translate into benefits in the permanent teeth that can last

a lifetime if cared for properly. This underlines the importance of communication with families, which is also one of the main goals of this work.

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