Caries prevalence and need for dental care in 13–18-year-olds in the Municipality of Milan, Italy.

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Objective: To assess the relationship between caries prevalence and toothbrushing and dietary habits in adolescents in the city of Milan (Italy). ***Research Design***: The study consisted of a cross-sectional survey using clustering samples. DMFT was recorded following the WHO guidelines by three calibrated examiners. A dental health questionnaire was completed by the subjects to assess their toothbrushing and oral hygiene habits. Univariate and multivariate analysis were performed. ***Participants***: A sample of 1,333 students (age-range 13-18 years, 648 males and 685 females) was studied. The students came from three secondary schools located in different socio-economic and cultural areas of the city. ***Results***: Caries experience (DMFT>0) was 59.11%. A significant linear trend ($p<0.01$) was observed for DT>0 among the three different schools selected. The mean DMFT was 1.94 ± 2.46 and difference observed in DT, FT and DMFT among the three schools was statistically significant ($p<0.05$). Eating snacks more than once a day provided a significantly higher odds ratio for DMFT>0 and for DT>0 (OR=5.24, $p<0.001$ and OR= 1.46, $p=0.01$ respectively). ***Conclusions***: A significant trend between caries experience and socioeconomic status was observed: adolescents, attending school in a low-socio-economic areas, showed higher caries prevalence and higher levels of untreated caries than their counterparts attending schools located in medium-high socio-economic areas.

Key words: Caries epidemiology, dmft index, cross-sectional study, adolescents, Italy.

Introduction

The prevalence of dental caries in children living in developed countries has decreased over the last few decades and the number of caries-free subjects has increased. Recent data on dental caries in the permanent dentition have indicated that there is a plateau of this decline in many industrialized countries (Marthaler, 2004). Although a decline in caries levels has been noted in adolescents, caries experience remains still high in many European countries: caries prevalence in Spain being 82% (Salas-Wadge, 1994), 94.6% in Latvia (Bjarnason *et al.*, 1995) and 52.9% in Portugal (de Almeida *et al.*, 2003).

So far, only few studies have been reported in the literature on oral status in adolescents, although those are a crucial target age group in caries epidemiology; adolescents take care of their dental hygiene personally and their dental care is often not continuous,.

In 1996, The World Health Organisation has reported a study on the oral health status in 12-year-old Italian children; the study reported a DMFT value of 2.1. Since than, no new data, at national level, has been reported.

In Italy no national preventive programmes against caries are in place and oral health services are provided mainly by private dental practitioners. Thus, it is not surprising that, even if a reduction of dental caries experience has occurred, caries prevalence remains still high in Italy compared to other European countries (Brambilla *et al.*, 1999; Arcella *et al.*, 2002; Campus *et al.*, 2001; Campus *et al.*, 2005).

The reasons for the decline in caries prevalence are various and complex; the most crucial are the widespread use of fluoridated toothpastes (Moynihan and Petersen, 2004) and the acquired knowledge of oral hygiene produced by mass-media. This is especially true in countries, like Italy, where no school-based preventive programmes were established (Friel *et al.*, 2002)

The correlation between a low socioeconomic status and poor health has been well established: the lower the socioeconomic status, the worse the health, including caries (Okullo *et al.*, 2004). Indeed, socioeconomic conditions could be indicative of different levels of exposure to caries risk factors, such as greater consumption of cariogenic food and soft drink (high frequency of sugar intake) and poor oral hygiene habits.

Many studies have found a significant association between the frequency of sugar intake and dental caries (Bratthall, 1996; Moynihan and Petersen, 2004; Okullo *et al.*, 2004). Sugar is present in many snacks; thus, the frequency of intake of these products is correlated with caries development.

Oral hygiene is a cornerstone of the oral health and caries prevention. Toothbrushing is the most important commonly performed oral self-care practice, and it plays a key role in oral health maintenance.

The aim of this survey was to describe the occurrence of dental caries in a representative sample of Italian adolescents (aged 13-18) living in Milan. In addition, using a standardized questionnaire, to collect data on adolescents

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oral hygiene and dietary habits, the study intends to correlate the questionnaire results with the clinical data observed in the same group of adolescents.

Materials and Methods

The survey was carried out as a cross-sectional study from November 2003 to February 2004. Data on the total number of residents in Milan from five selected age groups (13-18 year-olds) was derived from the National Statistical Institute (ISTAT, 2004) (48,697 total; a mean number in each group of 8,282.8). The concentration of fluoride in tap water of this area is low (0.2 ppm of F) (Brambilla *et al.*, 1999).

Sample size was calculated on the basis of previous studies of Italian children. As reported above, no data are present in the literature about caries prevalence in Italian adolescents. Thus, the data on 12-years old children previously reported (Campus *et al.*, 2001; Campus *et al.*, 2005) has been taken as a reference. The theoretical sample size would have been of 1,572 adolescents.

The city of Milan was divided into different areas on the basis of the property price and this information was used as proxy of socio-economic indicator. Three high grade schools located in three areas were selected: *school A*, located in the city centre with houses at a mean price of Euro 6,500 per square meter; *school B*, located in the south-west area with houses at a mean price of Euro 2,750 square meter; *school C*, located in the north area at a mean price of Euro 2,400 per square meter.

School children were recruited using systematic cluster sampling. Each class was identified as a cluster and compiled into a list. The first cluster was randomly chosen, while the others were selected at the systematic interval of three classes. The number of subjects in each class was approximately the same. 1,624 subjects were recruited for the study.

The data were collected by dental examination and by a dental health questionnaire. Parents or guardians were informed by leaflet, explaining the aim of the study and requesting their children's' participation. Only adolescents with their parents signed consent were enrolled as participants (1,376 subjects). Forty one of them were absent on the school day of the clinical examination and two refused it; hence, the study reports data on 1,333 subjects (685 girls and 648 boys). The subjects were then categorized on the basis of school class attendance and age range. Three age groups were set: group 1 (539 subjects aged 14-15 years); group 2 (480 subjects aged 16-17 years), and group 3 (314 subjects aged 17-18 years).

A simplified highly structured questionnaire was compiled by the authors before the begin of the study. The questionnaire was pre-tested for control of reliability and validity. The questionnaire, investigated oral hygiene habits and snacks habits.

Clinical examinations were carried out at school under standardised conditions (Bolin *et al.*, 1995). Calibration of the examiners was carried out before the study. Three examiners were calibrated to assess caries at dentinal level: 30 adolescents (14 males and 16 females) were visited and revisited after 72 hours. The Cohen-Kappa was used to evaluate the examiners' inter and intra-reproducibility. Inter examiners agreement (Cohen's Kappa)

for decayed teeth was 0.8±0.3 (range 0.79 - 0.84), while intra-examiners agreements was 0.7±0.2.

DMFT index was recorded following the WHO oral heath recommendations (WHO, 2003). Each subject was examined at school by one examiner using: a plane mirror (Hahnenkratt, Königsbach, Germany) and the WHO CPI ballpoint probe (Asa-Dental, Milan, Italy), under optimal light conditions and air-drying when necessary.

No bitewing radiographs or fibre-optic trans-illumination were used.

Processing and analysis of data were carried out by means of the Statistical Data Analysis (STATA SE® 8.2). Caries experience and prevalence were calculated by the number of subjects with DMFT>0 and DT>0 respectively. The caries prevalence was measured by the number of subjects with DMFT>0 and DT>0 respectively compared to the whole sample. Caries experience, percentage of caries experience, high caries level experience as the percentage of subjects with DMFT≥4 were compared to the whole sample, stratified by age and class attended. Descriptive statistics were performed. Frequency distributions and mean DMFT were calculated for the univariate and bivariate analyses. The statistical evaluation of a quantitative variable among groups was carried out using one-way ANOVA.

Odds ratios (ORs) were calculated using as reference the group with the most favourable exposure level namely (school A as medium-high socio-economic status, toothbrushing more than twice a day, no snack/daily). Differences in proportion among groups regarding qualitative variables and clinical data were tested using χ^2 test. The multivariate analysis comprised logistic regression model using a dependent variable caries experience DMFT>0.

Results

Caries experience (DMFT>0) was 59.1% (from 52.6 % in school A to 72.1% in school C). Caries experience, need for dental care (DT>0), and high caries level (DMFT≥4), across age groups and type of school are shown in Table 1. A significant linear trend was observed both for need of dental care (DT>0) and high caries level (DMFT≥4), among the three different schools (p<0.001 and p=0.02, respectively). The higher the socio-economic level of the area the school was located, the lower was the caries prevalence. The caries distribution pattern was highly skewed. The mean DMFT was 1.9±2.5 ranging from 1.6 in school A to 2.6 in school C (Table 2). Mean SIC was 4.8±2.2 and it was similar in the three schools. The differences observed in DT, FT and DMFT among school type were statistically significant (Anova one-way p<0.05).

As shown in Figure 1, the teeth most affected were the molars; contrary to expectations, the percentage of decayed second molars was higher than that of the first molars.

The association between toothbrushing frequency and frequency of snacks and caries prevalence or caries experience is showed in Table 3. A significant linear effect was observed between frequency of toothbrushing and need for dental care (p<0.001). Those subjects brushing their teeth less than twice a day showed caries

Table 1. Caries experience (DMFT>0) and need for dental care (DT>0) in the examined sample are reported by gender, age groups, and schools.

Caries experience (DMFT>0)		
Gender	*DMFT=0* *% (n)*	*DMFT>0* *% (n)*	
Males	19.9 (266)	28.7 (382)	
Females	20.9 (279)	30.5 (406)	
Age groups	*DMFT=0* *% (n)*	*DMFT>0* *% (n)*	*O.R. ($_{95\%}$ C.I.)*
14-15 years old	48.2 (260)	51.8 (279)	-
16-17 years old	37.9 (182)	62.1 (298)	1.5 (1.4 -2.0)
>17 years old	32.5 (103)	67.5 (211)	1.9 (1.6-2.7)
χ^2 for trend 20.99 p<0.01			
Schools	*DMFT=0* *% (n)*	*DMFT>0* *% (n)*	*O.R. ($_{95\%}$ C.I.)*
School A	47.4 (261)	52.6 (289)	-
School B	41.5 (200)	58.5 (282)	1.3 (1.2 -1.7)
School C	27.9 (84)	72.1 (217)	2.3 (2.0 -3.3)
χ^2 for trend 29.06 p<0.0001			

Need for Dental Care (DT>0)		
Gender	*DT=0* *% (n)*	*DT>0* *% (n)*	
Males	33.8 (450)	14.8 (198)	
Females	36.7 (489)	14.7 (196)	
Age groups	*DT=0* *% (n)*	*DT>0* *% (n)*	*O.R. ($_{95\%}$ C.I.)*
14-15 years old	74.0 (399)	26.0 (140)	-
16-17 years old	67.5 (324)	32.5 (156)	0.7 (0.4-0.9)
>17 years old	68.8 (216)	31.2 (98)	0.8 (0.6-0.9)
χ^2 for trend 3.58 p=0.058			
Schools	*DT=0* *% (n)*	*DT>0* *% (n)*	*O.R. ($_{95\%}$ C.I.)*
School A	78.0 (429)	22.0 (121)	-
School B	67.2 (324)	32.8 (158)	1.7 (1.3-2.3)
School C	61.8 (186)	38.2 (115)	2.2 (1.6-3.0)
χ^2 for trend 27.26 p<0.0001			

High Caries level (DMFT≥4)		
Gender	*DMFT<4* *% (n)*	*DMFT≥4* *% (n)*	
Males	38.1 (508)	11.7 (156)	
Females	39.7 (529)	10.5 (140)	
Age groups	*DMFT<4* *% (n)*	*DMFT≥4* *% (n)*	*O.R. ($_{95\%}$ C.I.)*
14-15 years old	33.6 (445)	7.1 (194)	-
16-17 years old	28.1 (372)	8.1 (108)	1.4 (1.0-1.9)
>17 years old	16.2 (215)	6.9 (981)	1.5 (1.5-3.0)
χ^2 for trend 19.75 p<0.001			
Schools	*DMFT<4* *% (n)*	*DMFT≥4* *% (n)*	*O.R. ($_{95\%}$ C.I.)*
School A	34.3 (457)	7.0 (93)	-
School B	28.0 (374)	8.1 (108)	2.1 (1.2-3.7)
School C	15.5 (206)	7.1 (95)	2.0 (1.0-3.8)
χ^2 for trend 5.08 p=0.02			

Table 2. Descriptive statistics, mean ± SD of DMFT and indices components reported by school type.

|	Subjects	DT mean±SD	MT mean±SD	FT mean±SD	DMFT mean±SD	SIC mean±SD
Total sample	1333	0.6±1.30	0.0±0.2	1.3±2.0	1.9±2.5	4.8±2.2
School A	550	0.4±1.1	0.0±0.1	1.1±1.9	1.6±2.2	4.8±2.1
School B	482	0.7±1.4	0.0±0.1	1.3±2.1	2.0±2.6	4.9±2.9
School C	301	0.8±1.1	0.1±0.4	1.7±2.3	2.6±2.7	4.7±2.5
Anova one-way		p<0.001	p>0.05	p<0.01	p<0.001	p=0.07

Table 3. Caries experience and need for dental care, stratified by daily frequency of toothbrushing and snacks are reported as percent (count), odds ratio (OR) for each category.

a-daily frequency of toothbrushing

Brushing frequency	DMFT=0 % (n)	DMFT>0 % (n)	Odds Ratio	DT=0 % (n)	DT>0 % (n)	Odds ratio
> twice a day	19.1 (254)	28.0 (373)	-	36.4 (485)	10.6 (142)	-
twice a day	14.7 (196)	21.4 (285)	1.0 (0.6-1.5)	24.9 (332)	11.2 (149)	1.5 (1.1-2.5)
< twice a day	7.1 (95)	9.7 (130)	0.9 (0.4-2.4)	9.2 (122)	7.7 (103)	2.9 (1.8-4.2)

χ^2 for trend=0.16 p=0.69 χ^2 for trend=41.83 p<0.001

b-daily frequency of snack

Snack frequency	DMFT=0 % (n)	DMFT>0 % (n)	Odds ratio	DT=0 % (n)	DT>0 % (n)	Odds ratio
No snack	17.0 (227)	10.8 (144)	-	20.9 (278)	6.9 (92)	-
Once a day	14.6 (194)	17.4 (232)	1.9 (1.0-2.3)	22.5 (300)	9.5 (127)	1.3 (1.0-1.7)
> Once a day	9.3 (124)	30.9 (412)	5.2 (2.4-7.8)	27.1 (361)	13.1 (175)	1.5 (1.2-1.9)

χ^2 for trend=135.50 p<0.001 χ^2 for trend=6.24 p=0.01
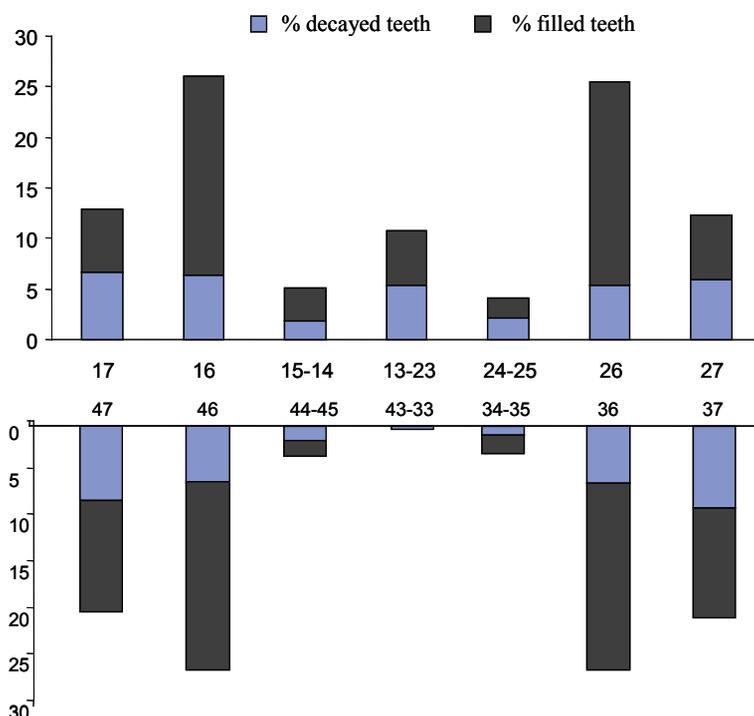
Figure 1. *Percentage of decayed and filled teeth for tooth type.*

prevalence almost three times higher than those brushing twice a day or more. Eating snacks more than once a day resulted in a significantly higher odds ratio both for caries experience and prevalence rate (OR=5.2, p<0.001 and OR= 1.5, p=0.01 respectively).

Significant odds ratios were also observed for subjects in school C with worse toothbrushing .and snacking habits, and caries prevalence or experience (p<0.01) (data not in tables). The comparison between brushing frequency and snack eating is described in Table 4. The results from regression analysis of dental caries experience (DMFT>0) are summarised in Table 5. The only covariate significantly associated with the dependent variable is the type of school attended. Adolescents attending school C had an odds ratio four times higher for caries experience compared to those attending school A.

Discussion

World wide, dental caries is the most common chronic disease (Petersen and Lennon, 2004). Data on caries experience among Italian schoolchildren are scarce and often limited to samples not representative of the entire population. No surveillance system has been established so far, and oral health services are mainly provided by private dental practitioners. Thus, oral health care is mainly financed in the form of direct payments by the patient or, for a minor part, by public or private insurance schemes, and no data on oral health status are collected during this process.

Public dental health services are limited; there are only few National Health Service dentists and over the past 20 years, preventive oral health care services have not been included in the National Health Care schemes. (Brambilla *et al.*, 1999; Arcella *et al.*, 2002; Campus *et al.*, 2001; Campus *et al.*, 2005). In few Italian regions (i.e. Veneto and Tuscany), caries preventive programmes have been carried out but disease prevalence remains still high.

Thus, the purpose of this survey was to provide data on oral health status and to verify the related socio-behavioural factors in a sample of Italian adolescents living in Milan. This study was aimed to help planning oral health programmes and to establish a baseline for evaluation of future preventive interventions towards this target group. The sample size was sufficiently large to calculate parameters on dental caries experience and disease prevalence rates.

The caries experience showed a level of disease comparable to other European countries. In England and Wales, 49% of 14-year-old children had evidence of caries experience (Pitts et al., 2004). However, in developing countries, higher levels of caries disease are commonly found. In Uganda, a total of 80% of students (age range 13-19 years) with positive caries experience was reported (Seibert et al., 2004), while in Ethiopia the caries experience ranged from 45 to 61% depending on the concentration of fluoride in drinking water (Wond-wossen et al., 2004). In the United States, in a group of American-African adolescents, 73% had either decayed, missing or filled teeth (Brathall, 1996). Recently, the

Table 4. Relationship between toothbrushing habits and snacking in the whole sample. Data are reported as number of subjects and percentage. Furthermore the mean DMFT for each stratum is reported.

| | | *Brushing frequency* | | |
		More than twice a day *% (n)* *mean DMFT*	*Twice a day* *% (n)* *mean DMFT*	*Less than twice a day* *% (n)* *mean DMFT*
Snacks	None	18.0 (240) 1.6	6.3 (84) 1.8	3.5 (47) 2.5
	Once a day	14.8 (197) 1.7	14.0 (186) 1.9	3.2 (43) 2.1
	> than once a day	14.3 (190) 1.7	15.8 (211) 2.3	10.1 (135)2.5

Table 5. Multivariate logistic analysis for caries experience (DMFT>0) in Milan adolescents.

Caries experience	Odds Ratio	p-value	95%C.I.
Males	1.2	0.231	0.9 -1.6
Tooth-brushing frequency (Less than twice a day)	1.1	0.352	0.9 -1.5
School B	1.8	0.02	1.1-2.9
School C	4.7	<0.001	1.6-3.1
Snacks (more than once a day)	1.1	0.057	0.9-1.2

Log likelihood = -576.67   p<0.001

CDC Surveillance Summary on oral health of the US population, reports that 49.6% of adolescents aged 12-15 years, had caries experience in their permanent teeth (Beltran-Aguilar et al., 2005).

Statistically significant associations were observed in DMFT, subgroups (DT and FT) and socio-economical status. Subjects attending the school located in a high-socio-economic area of the city (school A) showed a DMFT lower than subjects attending school in a medium-socio-economic area (school B) or in a low-social-economic area (school C). Opposite results were found when considering high level of caries (DMFT≥4) among school type. The mean SIC was similar in the three schools, probably due to high caries prevalence in examined group .

Most of the adolescents reported brushing their teeth two or more times a day and a significant association between caries experience and frequency of toothbrushing was evident. A total of 82% of caries free (DMFT=0) adolescents and 87% of subjects with DT=0 reported to use the toothbrush twice or more daily.

Data support the evidence that sugars and starch are undoubtedly the most important dietary factor in the development of dental caries (Moynihan and Petersen, 2004). Since sugar is widely available in many kinds of snacks, the frequency of intake of this kind of food is correlated with caries development. In the present survey, the majority of caries free adolescents (DMFT=0) did not eat snacks at all, and others claimed eating snacks just once a day. Marthaler (1994) evaluated trends in the prevalence of dental caries and concluded that, even when preventive measures such as use of fluoride toothpaste are provided, a relationship between sugar intake and caries is still present. Where there is adequate exposure to fluoride, sugar consumption is a moderate risk factor for caries; the restriction of sugar consumption still plays a crucial rule in caries prevention (WHO 2003; Petersen and Lennon, 2004).

Data from the present epidemiological survey showed that Italian adolescents still have high caries prevalence; therefore the planning and the creation of preventive programmes is necessary. Moreover in our sample, the caries distribution was highly skewed, and this relates to the role of socio economic factors in caries prevalence, despite the high availability and use of fluoride toothpaste. We propose to follow the WHO Oral Health indications (WHO, 2003) to identify the mechanisms needed to improve and promote oral health and to implement community-based programmes, especially focused on disadvantages groups.

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