

# Prevalence of dental caries in 5-year-old Greek children and the use of dental services: evaluation of socioeconomic, behavioural factors and living conditions

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**Objectives:** To assess dental caries and use of dental services experience in 5-year-old children attending public kindergartens in Attica, Greece and to examine the influence of certain socioeconomic factors and living conditions as well as dental behaviours and attitudes. **Methods:** In this cross-sectional study, a random and stratified sample of 605 Greek children was examined using decayed, missing, filled tooth surfaces and simplified debris indices. The use of dental services was measured by children's dental visits (any dental visit up to the age of 5 years). Care Index was also calculated. Risk indicators were assessed by a questionnaire. Zero-inflated Poisson and Logistic Regression Analysis were generated to test statistical significant associations. **Results:** The prevalence of dental caries was 16.5%. Care Index was 32% and dental visits were reported for the 84% of the children. Medium Socio-Economic Level (SEL) was associated with no detectable caries. High SEL was related to decreased decayed, missing, filled teeth values, while female gender and rented houses had the opposite effect. The age of the mother (35–39 years) and the higher SEL were related to higher levels of dental services use. **Conclusions:** It is suggested that there are differences in the experience of dental caries and use of dental services among preschool children in Attica, which are related to demographic, socioeconomic factors and living conditions. Dental public polices should focus on groups with specific characteristics in order to improve oral health levels of disease-susceptible populations.

**Key words:** *Cross-sectional study, dental caries, dental services use, preschool children, living conditions, socioeconomic indicators*

## INTRODUCTION

The influence of socio-economic factors and living conditions on the oral health status of individuals and populations has been documented over the recent decades<sup>1</sup>. Despite the recent substantial decline in the prevalence of dental caries in developed countries<sup>2</sup>, it still remains a public health problem within underprivileged sections of the population, especially among preschool children. Several studies have demonstrated positive associations with certain socioeconomic factors, such as social gradient, family income and maternal education level<sup>3,4</sup>. Low rates of dental attendance are evident among disadvantaged preschool children in various countries<sup>5–8</sup>.

In Greece, several epidemiological studies have highlighted the association of dental caries and dental services utilisation with socio-economic factors in various populations. However, the scientific evidence

regarding preschool children is rather limited. From the most recent national oral health survey conducted in 2002–2003<sup>9</sup>, it was observed that 43% of 5-year old children experienced dental caries, with differences found according to geographic areas, level of urbanisation and parental educational level. However, there are no published data regarding the impact of their living standards, dental behaviours and attitudes on their oral health and use of dental services.

The purpose of this study was to examine the prevalence and severity of dental caries as well as the use of dental services in a sample of 5-year-old children attending public kindergartens in the Athens metropolitan area. Furthermore, we attempted a comprehensive investigation of their possible associations with certain socio-economic factors and living conditions related to the Greek society in addition to dental behaviours and attitudes.

## METHODS

In this cross-sectional study, which was carried out during the years 2009–2011, a random representative cluster sample of 605 children was selected from public kindergartens in Attica, Greece. The sample size was defined using the results of a previous study on Attica Greek children<sup>9</sup>. For the selection of the kindergartens, the 120 municipalities of the prefecture of Attica, which is the most densely populated prefecture of Greece, were stratified into three area-based income clusters that were representative of the socio-economic structure of the country's population, according to the mean annual family income of the residents<sup>10</sup>. These income bands were: high ( $\geq 25,000\text{€}$ ) medium (16,000–24,999€) and low ( $\leq 15,999\text{€}$ ). A total of 13 municipalities were randomly selected and 35 public kindergartens were chosen (using a random numbers generator) without replacement from the total list of the kindergartens of the selected municipalities. Once a kindergarten was selected, all children of that kindergarten were included. The Ethical Committee of the University of Athens Dental School and the Ministry of Education gave their approval for the study, while the head teachers of the selected kindergartens were informed by mail. The study was conducted in full accordance with the World Medical Association Declaration of Helsinki. Because of the large number of refusals observed in similar studies<sup>11,12</sup> and high rates of school absences that were expected during the winter season, 1294 children were given a consent form and a questionnaire to be completed by their parents. A total of 744 parents agreed to participate in the study and 633 returned completed questionnaires. As the present study focused on the oral health of Greek children, 82 children of non-Greek origin were excluded, although they were examined. A total of 605 Greek children who were present in the schools the assigned days of dental examination formed the study sample. Parental questionnaire and child dental examination data was available for 524 children and these comprised the final data set for statistical analysis.

The children were examined in their school settings, under artificial light (Darey lamp), using a mouth mirror and the World Health Organisation (WHO) periodontal probe. All examinations were performed by the same examiner (MM), who recorded dental caries experience as well as the oral hygiene level. Dental caries was recorded using WHO standardised criteria and was measured by the decayed, missing, filled tooth surfaces (dmfs) index<sup>13</sup>. Oral hygiene was recorded using the Simplified Debris Index (DI-s)<sup>14</sup>. The Care Index<sup>15</sup> was used to describe the level of restorative care (the number of filled teeth divided by

the number of obviously decayed, missing and filled teeth and multiplied by 100%).

The questionnaire consisted of a combination of open and closed-ended questions regarding demographic and socioeconomic data, oral hygiene and dietary habits and oral health behaviours and attitudes (Table 1). The use of dental services was measured by children's dental visits (any dental visit up to the age of 5 years). In order to avoid self-report bias in the socio-economic classification of the participants, area-based annual income<sup>10</sup> was used as a marker of socio-economic level (SEL).

Intra-examiner reproducibility for dental caries after re-examination of 5% of the sample 1 month later was assessed by Kappa statistic at child level and was found to be 0.94.

Statistical analysis was carried out using STATA v.12 (StataCorp LP, College Station, TX, USA). Descriptive statistics were performed for the scale variables and frequency distributions were provided for categorical factors. As dmfs scores were non-normal, showing considerable skewness and overdispersion with excess zero counts, a zero-inflated Poisson (ZIP) regression analysis was performed<sup>16</sup>. The zero-inflated Poisson regression consists of two separate models: a logit (binary) model for the 'certain zero' cases predicting whether or not a child would have no caries and a Poisson model estimating the counts (expected dmfs values) for those children who are not certain zeros. These two processes are finally combined into a final regression model. Use of dental services was studied with binary logistic regression analysis (1 = use 0 = other).

For the purposes of the statistical analysis categorical variables with low number of cases in their subgroups ( $< 5\%$ ) were excluded in order to obtain stable statistical models. Missing data were handled using list-wise deletion (case complete analysis). In the finalised data set all variables were initially tested in univariate analysis and those significantly associated with the outcome ( $P \leq 0.10$ ) were fitted in a multivariate regression model of main effects (predictive effect of each variable when the rest of the variables in the model were held constant). In order to find the most parsimonious set of explanatory variables that are most effective in predicting the dependent variable a stepwise backward logistic regression analysis was performed. As ZIP regression does not support stepwise procedure, the final model resulted after consequent removal of non-significant variables and model fit assessment was based on Bayesian information criterion (BIC)<sup>17</sup>, where the model with the smaller value of BIC was considered as preferable. In addition, a Vuong test was used to compare the ZIP model with the standard Poisson having the specified predictors and Wald test ascertained the overall fit of the predictors. Adjusted standard errors for clusters

**Table 1** Distribution (%) of explanatory variables included in the questionnaire

		%
<b>Social factors</b>		
Gender	Boy	51.15
	Girl	48.85
Maternal age	< 35 years	22.87
	35–39 years	43.52
	≤ 40 years	33.60
Paternal age	≤ 40 years	46.92
	> 40 years	53.08
Family status	Two-parent family	94.47
	Single-parent family	5.53
Living with older persons	No	90.29
	Yes	9.71
Maternal education	Secondary (≤ 13 years)	45.19
	Undergraduate	39.45
	Postgraduate	15.36
Paternal education	Secondary (≤ 13 years)	51.20
	Undergraduate	32.27
	Postgraduate	16.53
Maternal occupational status	Unemployed	26.82
	Employed	73.18
Paternal employment status	Employee	64.50
	Self-employed	35.50
Order of child's birth	1st	48.82
	2nd	41.57
	≥ 3	9.61
No of children in the family	1	15.43
	2	63.33
	≥ 3	21.24
<b>Economic factors</b>		
Monthly family income	Low (≤ 15,999€)	21.26
	Medium (16,000–24,999€)	52.21
	High (≥ 25,000€)	26.53
Area-based annual income (measure of Socioeconomic level)	Low (4505–13,499€)	30.53
	Medium (13,500–23,399€)	35.69
	High (23,400–29,700€)	33.78
Consumer loans	No	73.51
	Yes	26.49
Difficulties in facing family needs with family income	Great difficulty	16.84
	Difficulty	35.52
	No difficulty	47.64
Economic difficulties during child's birth	No	81.19
	Yes	18.81
<b>Living conditions</b>		
Type of residence	Detached house	29.19
	Apartment	70.81
Size of residence	< 90 m <sup>2</sup>	29.45
	90–119 m <sup>2</sup>	33.26
	≥ 120 m <sup>2</sup>	37.29
Overcrowding*	> 1	54
House tenure	Private	81.49
	Rented	18.51
Private car	No	4.67
	Yes	95.33
Dish-washer	No	11.42
	Yes	88.58
Internet connection	No	15.11
	Yes	84.89
<b>Oral health behaviours</b>		
Fluoride use at home <sup>†</sup>	Never	89.7
	Rare	9.1
	Daily	1.2
Topical fluoride applications	Never	63.15
	Once	21.69
	Regularly	15.16

**Table 1** continued

		%
Frequency of tooth brushing	Rare	20.65
	Once a day	50.48
	≥ twice a day	28.87
Sugar consumption <sup>‡</sup>	Once a week	9.54
	2–3 times a week	43.70
	Daily	46.76
Consumption of commercial fruit juices	> 3 times a week	41
<b>Oral health attitudes</b>		
Dental Visits	No	16.47
	Yes	83.56
Use of dental insurance	No	77.07
	Yes	22.93
Reason of first dental visit	Prevention	92.01
	Treatment	7.99
Frequency of mother's dental visits	Rare	19.03
	Once a year	51.07
	> Once a year	29.90
Reason of mother's dental visits	Check up	20.12
	Scaling	33.40
	Treatment	46.48

\*Number of persons/number of main rooms: value > 1 suggests overcrowding.

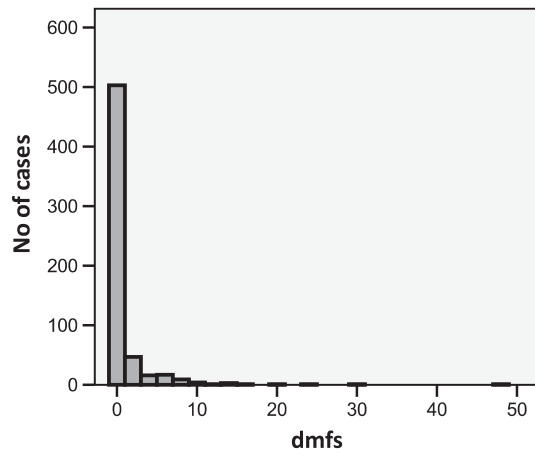
<sup>†</sup>Except fluoride toothpaste.

<sup>‡</sup>Solid sugary foods.

by school (cluster standard errors) were obtained to control intracorrelation [correlation of the observations (cases) within the same school]. The interpretation of regression outcomes was based on exponential regression coefficients in terms of the change in the expected value (count model) or the change in odds (logit models) of the dependent variables for a unit change in the corresponding predictor. All reported *P*-values were two-tailed with an alpha level of 0.05 and 95% confidence intervals indicating statistical significance. In this publication only the final multivariate models will be presented, along with the univariate analysis results of the variables included.

## RESULTS

The sample consisted of 306 boys (50.6%) and 299 girls (49.4%), with a mean ( $\pm$  SE) age 5.11  $\pm$  0.5 years. The socioeconomic and behavioural characteristics of the participants, as reported by their parents, are presented in *Table 1*. Almost all of the children grew up in a two-parent family environment. Approximately 50% of both mothers and fathers had received secondary education. The majority of mothers were employed and parents had a waged labour employment status. Almost half of the families had a medium monthly income (16,000–24,999€) and reported no particular difficulties in facing their family needs. Private apartments were the most common type of residence. A considerable proportion of chil-



**Figure 1.** Histogram of decayed, missing, filled tooth surfaces (dmfs) index.

dren did not brush on a daily basis, while sugar consumption was a daily habit for almost half of the children; 41% of the children consumed commercial fruit juices. Adjunctive fluoride use (excluding fluoride toothpaste) was reported for 10% of the sample population at home, while 15% of the children had regular topical fluoride applications. Dental visits were reported in 83.56% of the children (86 children had never visited the dentist by the age of 5 years). The mean age of the first dental visit was (mean  $\pm$  SE)  $3.50 \pm 0.05$  years and the main reason was prevention while only 20% of the children had visited the dentist before their 3rd year of age (data not shown).

**Table 2** Descriptive statistics of decayed, missing, filled tooth surfaces (dmfs) index in 5-year-old children

Range	0–48
Mean $\pm$ SE	$0.85 \pm 0.13$
SD	3.23
Median	0
IQR	0
Variance	10.45
Skewness	8.09

Half of the mothers reported annual dental visits year to receive dental treatment.

Descriptive statistics and distribution of dental caries according to dmfs index are presented in *Figure 1* and *Table 2*. The data were strongly right skewed and, as the variance was approximately 10 times larger than the mean, the dmfs distribution displayed signs of over-dispersion. The prevalence of dental caries was 16.5%. From these children, 75% had untreated caries and in 38% filled dental surfaces were recorded. No missing teeth were observed. The Care Index was 32%, following the socioeconomic gradation of the population. Mean DI-s score and SE was  $0.15 \pm 0.01$  (IQR = 0.17, data not shown).

The results of the statistical analysis between the dependent and explanatory variables are presented in *Tables 3 and 4*. Medium SEL had a statistical significant effect on predicting children with no caries in comparison with low SEL and children who reported frequent consumption of commercial fruit juices, who were less likely to be in the ‘certain zero’ group than

**Table 3** Zero-inflated Poisson regression analysis between dental caries (dependent variable) and explanatory variables

Explanatory variables		Univariate analysis		Multivariate analysis (final model)		
		exp(b)	P	exp(b)	SE	P
dmfs counts						
Gender	Boy*	–	–	–	–	–
	Girl	<b>1.94 (1.60–2.36)</b>	<b>0.000</b>	<b>2.33 (1.64–3.30)</b>	0.41	<b>0.000</b>
Socioeconomic level	Low*	–	–	–	–	–
	Medium	<b>0.78 (0.62–0.98)</b>	<b>0.036</b>	<b>0.63 (0.29–1.35)</b>	0.25	0.234
	High	<b>0.65 (0.51–0.83)</b>	<b>0.001</b>	<b>0.44 (0.21–0.92)</b>	0.16	<b>0.028</b>
Size of residence	< 90 m <sup>2</sup> *	–	–	–	–	–
	90–119 m <sup>2</sup>	<b>2.28 (1.74–3.02)</b>	<b>0.000</b>	<b>2.35 (0.96–5.78)</b>	1.08	0.061
	$\geq 120$ m <sup>2</sup>	<b>1.50 (1.13–1.99)</b>	<b>0.005</b>	<b>2.47 (1.14–5.33)</b>	0.97	<b>0.022</b>
House tenure	Private*	–	–	–	–	–
	Rented	<b>1.48 (1.17–1.87)</b>	<b>0.001</b>	<b>2.31 (1.09–4.93)</b>	0.89	<b>0.030</b>
Internet connection	–	<b>1.74 (1.26–2.45)</b>	<b>0.002</b>	<b>1.49 (0.91–2.44)</b>	0.37	0.114
	–	–	–	<b>0.27 (0.06–1.28)</b>	0.21	0.098
dmfs = 0						
Socioeconomic level	Low*	–	–	–	–	–
	Medium	<b>2.28 (1.29–4.02)</b>	<b>0.004</b>	<b>2.20 (1.26–5.84)</b>	0.36	<b>0.041</b>
	High	<b>1.92 (1.01–3.35)</b>	<b>0.022</b>	<b>1.55 (0.92–3.47)</b>	0.34	0.201
Commercial fruit juices consumption	–	<b>0.67 (0.28–0.72)</b>	<b>0.001</b>	<b>0.53 (0.31–0.91)</b>	0.27	<b>0.021</b>
	–	–	–	<b>3.07 (0.92–5.34)</b>	0.28	<b>0.000</b>

\*reference category, statistical significance  $P \leq 0.05$  (in bold), Wald  $\chi^2$  (7) = 55.99,  $P = 0.0000$ , Vuong test: 4.42,  $P = 0.0000$ , Bayesian information criterion (BIC) difference = 80.095. dmfs, decayed, missing, filled tooth surfaces.

**Table 4** Logistic regression analysis between use of dental services (dependent variable) and explanatory variables

Explanatory variables		Univariate analysis		Multivariate stepwise analysis		
		OR (CI 95%)	P	OR (CI 95%)	SE	P
Maternal age	< 35 years*	–	–	–	–	–
	35–39 years	<b>2.06(1.12–3.81)</b>	<b>0.021</b>	<b>1.99 (1.21–3.26)</b>	0.50	<b>0.006</b>
	≥ 40 years	1.29(0.70–2.35)	0.411	b	b	b
Frequency of tooth brushing	Rare*	–	–	–	–	–
	Once a day	<b>2.39(1.38–4.14)</b>	<b>0.002</b>	<b>2.37 (1.21–3.26)</b>	0.81	<b>0.011</b>
	≥ Twice a day	<b>3.56(1.36–4.58)</b>	<b>0.004</b>	<b>3.14 (1.30–7.60)</b>	1.41	<b>0.011</b>
Use of dental insurance		<b>2.14(1.06–4.34)</b>	<b>0.034</b>	<b>2.37(0.93–6.01)</b>	1.13	<b>0.069</b>
Size of residence	< 90 m <sup>2</sup> *	–	–	–	–	–
	90–119 m <sup>2</sup>	<b>2.86(1.45–5.66)</b>	<b>0.002</b>	<b>2.02 (0.93–6.01)</b>	0.77	<b>0.069</b>
	≥ 120 m <sup>2</sup>	1.17(0.67–2.03)	0.575	b	b	b
Internet connection		<b>3.39(1.49–8.62)</b>	<b>0.000</b>	b	b	b
Socioeconomic level	Low*	–	–	–	–	–
	Medium	<b>2.87(1.62–5.09)</b>	<b>0.000</b>	<b>2.11(1.01–4.37)</b>	0.78	<b>0.046</b>
	High	<b>2.58(1.97–4.53)</b>	<b>0.001</b>	<b>2.08(1.14–3.79)</b>	0.64	<b>0.017</b>
cons	–	–	–	0.89(0.39–2.02)	0.37	0.778

\*Reference category, statistical significance  $P \leq 0.05$  (in bold type).

LR  $\chi^2(6)=31.49$ ,  $P = 0.0000$ , Pseudo  $R^2 = 0.1005^2$ , Wald  $\chi^2(7) = 32.53$ ,  $P = 0.0000$ , Pseudo  $R^2 = 0.0999$ .

b, removed from the full model.

their counterparts. Gender, residence size and house tenure were significantly associated with severity of caries: girls, children living in houses over 120 m<sup>2</sup> or in rented houses presented higher expected dmfs counts when compared with the their reference categories, which were boys, houses under 90 m<sup>2</sup> and private residencies. High SEL predicted reduction in the expected dmfs when compared with the low SEL.

For use of dental services, the multivariate stepwise logistic regression analysis (Table 4) revealed that maternal ages of 35–39 years, as well as medium and high SELs were positively associated with dental visits compared with the reference categories, which were mothers younger than 35 years and low SEL, respectively. Tooth brushing was associated with higher likelihood of dental services use.

Comparing the results between univariate and multivariate analysis of the aforementioned variables, it is evident that gender and rented houses, as well as maternal age and frequency of tooth brushing, had stable, strong predictive effects on the number of carious dental surfaces and use of dental services, respectively. These predictive effects were independent of the presence of the other covariates in the regression models. Although a stable effect was observed for SEL in predicting the use of dental services, its relationship with experience of dental caries was influenced by the presence of other covariates and only some of their subgroups remained statistical significant after multivariate analysis. Similarly, the association between size of residence and dental caries was rather unstable as it remained significant only for the houses over 120 m<sup>2</sup>.

Dental plaque accumulation was not significantly associated with experience of caries in the multivariate model, although a univariate statistical signifi-

cance was observed in both ZIP regression equations. Finally, experience of dental caries (dmfs index) had no direct effect on the use of dental services, neither in univariate nor in multivariate analysis ( $P > 0.05$ , data not shown) and the prevalence of caries was similar in both child groups (with or without dental visits).

## DISCUSSION

The present cross-sectional study examined whether living conditions and certain socio-economic and behavioural factors and attitudes affect preschool children's experience of caries and use of dental services in Attica, Greece. The analysis of the data concerned only Greek children, because immigrant background can be considered a very strong determinant of poor dental health<sup>3,11,18,19</sup> and this would have modified the impact of the other explanatory variables in the models.

The present results revealed that the prevalence of caries in 5-year-old children has declined since the previous national pathfinder oral health survey carried out in 2003<sup>9</sup>, following, in certain respects, the epidemiological pattern of other developed countries. More specifically, caries-free Greek kindergarten children living in Athens were previously found to be 67.5%<sup>9</sup>, thus an increase of 24% in caries free children was observed. The results of our study are similar to those recorded in a more recent study in Piraeus, Greece<sup>11</sup>, where 74.8% of the 5-year-old children, during the year 2006–2007, were caries free (immigrant children were included), and in Thessaloniki, Greece<sup>20</sup>, where 79.8% of the children aged 3–5.5 years had no experience of caries. For severity of caries, the mean dmfs values decreased from 2.42 in

2003<sup>9</sup> to 0.85. Trikaliotis and co-workers<sup>20</sup>, also reported mean dmfs values ranging from 0.74 to 1.88 according to the children's weight. Furthermore, the most recent epidemiological studies from other countries report caries prevalence rates of 40%, 38% and 34% for Italian, British and Norwegian 5-year old children, respectively (immigrants included), for the years 2005–2007<sup>3,19,21</sup>.

Regarding oral health behaviours and attitudes, although a dental visit is compulsory in order for a child to be registered in the kindergarten, a total of 86 children had never visited the dentist. This, in combination with the low Care Index [found to be 32%, although there was an increase of 44% since the national pathfinder study (17%)], the moderate levels of regular tooth brushing, the limited use of fluoride and the high rates of sugar consumption create a poor and unsatisfactory profile for oral health related behaviours and dental utilisation.

The significant dental treatment needs among caries-prevalent children, found in the present study, may be attributed to the Greek oral health care system, which is primarily delivered by the private sector, with extremely low public reimbursement<sup>22</sup>. Furthermore, there are no preventive programmes on a systematic public basis, meaning that prevention is left to the parents or the individual initiatives of some public authorities, schools, dentists or dental associations. It must also be noted that there is no water fluoridation in Greece.

Consequently, the improvement in the children's oral health reported here may be attributed to overall lifestyle changes following a rapid development in the living standards, along with better nutrition and oral hygiene habits, including the effective use of fluoride toothpastes<sup>1,2</sup>.

From the results of the multivariate statistical analysis on dental caries a number of comments can be made. With regard to the gender factor, girls were associated with higher dmfs scores. According to the literature, being a girl is a strong predictor for severity of caries because they have an earlier tooth eruption<sup>23</sup>. Declerck and co-workers<sup>24</sup>, in their study of preschool children in Northern Belgium, also found that girls were 4.67 times more likely to have decayed, missing, filled teeth (dmft) value > 5. Conversely, gender was not related to the occurrence of caries and this was supported by Ferro and co-workers<sup>3</sup>. In the present study, although sugar consumption was not statistically significant because of its overall very high consumption rates, commercial fruit juices containing significant quantities of 'hidden' sugar were indeed a statistical significant predictor. Sugar-containing drinks between meals were also found to be a risk indicator for dental caries in 5-year-old children in Belgium<sup>24</sup>.

Several factors of living conditions such as housing or material resources and specifically overcrowding, house and car ownership had positive associations with caries in preschool populations. In the present study, children living in rented houses were expected to have higher dmfs values than those living in private houses. Housing tenure has been examined in detail by McIntyre and co-workers<sup>25</sup> mainly for its influence on morbidity and mortality. It has been argued that housing tenure is an income marker and has direct health-promoting effects, although the mechanism remains unknown. In Greek society, housing is considered an indicator of affluence and social approval. Thus, acquiring a house reflects, to a certain degree, an objective increase in the living standards of the last 15 years<sup>26</sup> and the urban redistribution<sup>27</sup> that resulted in the resettlement of the population in the developing suburbs of Athens. The association of size of residence with severity of caries was unexpected. It is possible that the improvement in living conditions of some population groups had no impact on the health profiles of sensitive domains of health status such as children's oral health. However, this observation should be interpreted with caution as the standard error and confidence intervals of the regression estimator were large, indicating low precision.

Mother's age and tooth brushing frequency were related with increased likelihood of dental care visits. Early motherhood may influence the mother's ability to take care of her child's oral health, whereas older mothers may have higher education levels and incomes that may lead to more responsible parenting<sup>4,6</sup>. Multivariate analysis presented no associations for the importance of paternal factors in children's oral health. As mothers are traditionally more involved in the upbringing of their children, maternal factors are expected to be more important.

Finally, socioeconomic level, as measured by an area-based indicator, was significantly associated with the prevalence and severity of caries, as well as use of dental services. According to Locker and Ford<sup>28</sup>, the socioeconomic level of the area in which individuals live has an impact on their health status and health-related behaviour, over and above that expected by their personal and household characteristics. However, the unstable nature of the association with dental caries described in the results section is not surprising as it is argued that social class markers may not have a profound impact on the experience of caries in multivariate analyses either because they act as a proxy for a range of other explanatory variables included in the model or because the variable used is not a good social class indicator for the particular data set<sup>24</sup>. Regarding dmfs values, as the prevalence of caries is low, only differentiation between groups with distinct socioeconomic differences could be

detected (high SEL *vs.* low SEL). Conversely, area-based income had a strong stable predictive effect in use of dental services. In Brazil and the USA children from low economic backgrounds have low rates of dental utilisation, as income is considered the main factor affecting dental utilisation<sup>5–8</sup>.

## LIMITATIONS

In this study a contextual variable (area-based annual income) was used as an indicator of socioeconomic level. The use of aggregated data in assessing individual characteristics for statistical inferences is related to ecological fallacy. However, contextual variables have been used in several studies and can be helpful in investigating behaviours of individuals and restrict the amount of response bias when self-reported information is requested<sup>11,28,29</sup>. In Greece, data regarding income and other socioeconomic data on a municipality or postcode basis are very limited and are based solely on self-reports. Therefore, the present study was susceptible to social desirability bias<sup>30</sup>. The participation rate in the present study was 57.67%. This moderate score is in accord with the median rates reported for cross-sectional studies when sensitive personal information is requested<sup>12</sup>. However, the response rates for questionnaire data (86.6%) can be regarded as sufficient for valid conclusions.

## CONCLUSIONS

The prevalence and severity of dental caries in Greek Attica preschool children has declined since the last epidemiological reports. However, the levels of use of dental services and oral health related behaviours were inadequate. Statistical analysis revealed differences in the experience of caries and the use of dental services in relation to socioeconomic level, demographic and maternal factors, as well as living conditions characteristic of Greek society. Oral health promotion programmes should include preventive measures, recommendations on sugar consumption and maternal education, while public health strategies should focus on community empowerment and development of accessible and responsive dental services.

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## Conflicts of Interest

None declared.

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