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# Dental fear and caries in 6–12 year old children in Greece. Determination of dental fear cut-off points

**ABSTRACT**

***Aim*** *To present: the normative data on dental fear and caries status; the dental fear cut-off points of young children in the city of Thessaloniki, Greece.*
***Methods*** *Study Design: This is a cross-sectional study with two independent study groups. A first representative sample consisted of 1484 children from 15 primary public schools of Thessaloniki. A second sample consisted of 195 randomly selected age-matched children, all patients of the Postgraduate Paediatric Dental Clinic of Aristotle University of Thessaloniki. First sample: In order to select data on dental fear and caries, dental examination took place in the classroom with disposable mirrors and a penlight. All the children completed the Dental Subscale of the Children's Fear Survey Schedule (CFSS-DS). Second sample: In order to define the cut-off points of the CFSS-DS, dental treatment of the 195 children was performed at the University Clinic. Children's dental fear was assessed using the CFSS-DS and their behaviour during dental treatment was observed by one calibrated examiner using the Venham scale. Statistics: Statistical analysis of the data was performed with IBM SPSS Statistics 20 at a statistical significance level of p<0.05.*
***Results*** *First sample: The mean CFSS-DS score was 27.1±10.8. Age was significantly (p<0.05) related to dental fear. Mean differences between boys and girls were not significant. Caries was not correlated with dental fear. Second sample: CFSS-DS< 33 was defined as 'no dental fear', scores 33-37 as 'borderline' and scores > 37 as 'dental fear'. In the first sample, 84.6% of the children did not suffer from dental fear (CFSS-DS<33).*
***Conclusion*** *Dental fear was correlated to age and not to caries and gender. The dental fear cut-off point for the CFSS-DS was estimated at 37 for 6-12 year old children (33-37 borderlines).*

***Keywords*** *Caries; Cut-off points; Dental fear; Prevalence.*

## Introduction

Dental fear (also called dental phobia and dental anxiety) is the fear of the dentist/dentistry and of receiving dental care. Dental phobia is not frequently used, since this term is proposed for people who feel that their fears are excessive and cannot be easily managed [Bracha et al., 2006]. Dental fear and dental anxiety have been used interchangeably in the international literature to describe the overwhelming discomfort that people (children and adults) experience in the different dental situations [Klingberg et al., 1994]. The prevalence of childhood dental fear varies considerably in the international literature ranging from 3% to 43% in different populations and age groups [Klingberg et al., 1994; ten Berge et al., 2002; Wogelius et al., 2003; Lee et al., 2007; Mendoza-Mendoza et al., 2015]. This variation may be due to several parameters, such as the selection of the patient populations, methodological variables and different cultural parameters.

It is generally reported that childhood fears tend to decrease as the child grows older [Klingberg et al., 1994; Muris et al., 2003]. Peak fear scores were found to occur at various ages, indicating that the general tendency for fear to decrease may not be linear over time [ten Berge et al., 2002]. Childhood fears are often related to developmental changes and the nature of each fear seems to be related to the child's age [Prins et al., 1997]. As a result, for a pre-school child, separation fear is one important fear, whereas at a later age (from 8 years old) social fears and fear of injury become more prominent [ten Berge et al., 2002]. All the above could explain why younger children are expected to have dental fear when visiting a dentist for the first time. During a dental visit, children may be separated from the mother while also having a limited understanding of the dental procedure, or possibly associating these facts with other age-appropriate fears [ten Berge et al., 2002]. In most children, this fear will probably decrease with successive visits to the dentist and after becoming accustomed to the

dental situation [Veerkamp, 1994].

What makes dental fear a serious problem for the paediatric dentist is its potential link with dental behavioral management problems (DBMP), although the fact that a child exhibits DBMP is not a firm predictor that they will report a high level of dental fear [Klaassen et al., 2002; Klingberg et al., 2007]. However, it is useful for the dentist to know the level of the child's dental fear before beginning dental treatment [Klaassen et al., 2002]. Nowadays there are many tools available to the dentist to assess the child's dental fear, with CFSS-DS being the most commonly used.

Generally, dental fear is measured according to cut-off points on validated self-reported scales [Armfield, 2011]. In many studies the researchers have used the mean score (±SD) or the median score on the CFSS-DS as a cut-off point, but the use of these measures of central tendency can bias conclusions, as the researchers predetermine the percentage of the population who will be categorised as dentally fearful [Oliveira et al., 2015]. A cut-off point is a point on a continuous measure that acts as a categorical boundary, ideally providing an intuitive interpretation of scores above and below that point [Oliveira et al., 2015]. It is important to use a quantitative diagnostic test to determine the cut-off point on a continuous scale that would best enable dentists to identify fearful individuals [Oliveira et al., 2015]. Dental fear cut-off points are already defined in several countries, but they have never been defined for Greek children.

Though the dental profession stresses the need of preventive visits to the dentist, dental caries is among the main reasons for a child's first visit to the dentist. The relationship of dental fear to caries is controversial among researchers. Some studies have shown that children with higher dmfs scores have lower dental fear [Nicolas et al., 2010; Gustaffson et al., 2010; Soares et al., 2015], while others have shown that children with more dental caries have higher levels of dental fear [Esa et al., 2014; Viswanath et al., 2015]. This difference is probably due to the previous dental experience of the children in the different samples [Nicolas et al., 2010; Gustaffson et al., 2010; Esa et al., 2014].

There are no previous Greek epidemiological studies based on a representative sample about the prevalence of childhood dental fear in relation to dental caries. Consequently, the aims of this study were: to present the normative data on dental fear and caries status; to define the dental fear cut-off points of 6-12 year old children in Thessaloniki, Greece.

## Materials and Methods

### *Ethical Approval-Permissions*

The Ethics Committee of the Dental Faculty, Aristotle University of Thessaloniki, Greece, gave approval for the study. Permission to visit the schools and perform dental examination was given by the Ministry of Education of Greece. Parents were given an informative leaflet about the procedure and gave written consent before their child was examined and included in the study.

### *Sample calculation for school children*

To optimise cost and use of time factors, a single stage stratified clustered sampling method was applied to a sample population of 39,448 elementary school students as follows. The sample size was calculated using the formula $N=z0.025/d^2$. The relative precision of the estimation of the population's statistics (means or proportions) was set at d=4% and a confidence level of 95% was used (corresponding to z0.025=1.96). This formula produced a figure of 1,230 children for N, but based on a minimum attrition rate of 50% in previous studies, it was decided to initially include at least N=3,000 pupils in the sample. The city of Thessaloniki was divided into 3 sampling areas: 20% of the child population lives in the eastern area (higher socio-economic status), from where 3 schools were selected using a simple random sampling method. Similarly, 6 schools were chosen from the city centre (which has 30% of the child population, but where the schools are smaller) and 6 schools from the western area (lower socio-economic status), which houses 50% of the relevant student population.

### *Procedure for the normative data collection*

During the period from September 2013 to February 2014, one calibrated examiner (VB) with two assistants visited the selected schools. All dental examinations were performed under artificial classroom light, with single-use dental mirrors (Steriblue; Prodentis, France) and a penlight, by the same examiner (VB). One assistant filled in the dental records for every child.

The examination included recording dental caries, using the dmfs and DMFS indices. In the occlusal and smooth surfaces only the cavitated lesions were recorded. Caries on proximal surfaces was recorded only if it was so extensive that it had resulted in a shadow under the occlusal surface or if it was already cavitated. To assess their dental fear, every child completed the Greek version of the Dental Subscale of the Children's Fear Survey Schedule (CFSS-DS) [Arapostathis et al., 2008]. A second trained assistant was present to assist in cases of questions or problems on the questionnaire, especially with the younger children.

### *Child dental fear cut-off points*
### *Sample and procedure*

In order to define the dental fear cut-off points, data on the children's dental fear and behaviour during treatment were needed. For this purpose, a separate group of 195 children (6-12 years old), all patients in the Postgraduate Paediatric Dental Clinic of Aristotle University of Thessaloniki, was randomly selected in a continuous fashion, during the same time period. Their data on dental fear were determined using the CFSS-DS and their behaviour during dental treatment, using the Venham scale [Venham et al., 1980]. The person (VB) who rated

the behaviour of every child was not aware of the child's CFSS-DS rating.

### Measures

The dental fear level of the children was assessed using the CFSS-DS, tested for reliability and validity in Greek [Arapostathis et al., 2008]. The CFSS-DS consists of 15 items relating to different aspects of dental treatment; possible scores range from 1 (not afraid at all) to 5 (very afraid). Total scores range from 15 to 75, while higher scores reveal more dental fear. The CFSS-DS was developed to provide an instrument for assessing dental fear in children; it is a revised form of the fear survey schedule for children (FSS-FC) including specific dental fear items (afraid of the dentist, the injection etc) (Fig. 1).

The Venham (modified) scale was used by the parents and the dentist to rate the behaviour of the children, during dental treatment. The scale consists of 6 points: 1) Relaxed (smiling, willing, able to converse, displays behaviour desired by the dentist); 2) Uneasy (concerned, may protest briefly to indicate discomfort, hands remain down or partially raised. Tense facial expression. Capable of co-operation); 3) Tense (tone of voice, questions and answers reflect anxiety. Child still complies with request to co-operate); 4) Reluctant (Pronounced verbal protest, crying. Using hands to stop treatment. Treatment proceeds with difficulty); 5) Resistance (General crying, body movements sometimes needing physical restraint. Protest disrupts procedure); 6) Out of contact or untreatable (Hard loud swearing, screaming unable to listen, trying to escape. Physical restraint required). The score for any particular child can range from 1 to 6. The scale has an established reliability and validity [Venham et al., 1980].

### Statistics

Statistical analysis of the data based on multilevel models with schools at level 1 and children at level 2 and was performed with IBM SPSS Statistics 20 at a statistical significance level of $p<0.05$. Linear Mixed Models (algorithm MIXED) was used to associate CFSS-DS with the factors: area, gender and age. The analysis of dmfs and DMFS was done using the Generalized Estimating Equations or GEE (algorithm GENLIN) using the Negative Binomial distribution for the outcome variable with a log link function. Hence, the results are interpreted by means of Risk Ratios (RR) which are the estimated exponential coefficients of the GEE models. The same statistical model was also used to associate dmfs/DMFS and their parameters with CFSS-DS as the independent variable. Comparisons between dmfs and DMFS according to gender and area were done with the Generalized Linear Mixed model (algorithm GENLINMIXED). Pair-wise comparisons were performed with the Bonferroni adjustment method. The estimation of the dental fear cut-off points were based on a ROC analysis that was combined with a method given in ten Berge et al. [2002].

## Results

The 15 chosen schools had a total of 3,340 students (1,737 boys) and 1,540 of these children participated in the study. Due to incorrectly filled in questionnaires, 1,484 (96.4%) were included in the final statistical analysis. Of the 1,484 children, 48.3% were boys (8.5±1.8 years old) and 51.7% were girls (8.6±1.8 years old). Concerning the area, 295 (19.9%) of them were from the eastern part of the city, 444 (29.9%) from the city centre and 745 (50.2%) from the western areas of Thessaloniki. Accordingly, the sample is consistent with the true distribution of the target population in each area ($\chi^2$ (2) = 0.026, p=0.987).

### Child dental fear cut-off points

Taking the Venham ratings of 4-6 (reluctant, resistance

| | | Not afraid at all | Very little afraid | Moderate afraid | Afraid enough | Very much afraid |
|---|---|---|---|---|---|---|
| 1 | The dentist | 1 | 2 | 3 | 4 | 5 |
| 2 | The doctor | 1 | 2 | 3 | 4 | 5 |
| 3 | The injection | 1 | 2 | 3 | 4 | 5 |
| 4 | Having his/ her mouth examined | 1 | 2 | 3 | 4 | 5 |
| 5 | Opening his/her mouth | 1 | 2 | 3 | 4 | 5 |
| 6 | Someone unknown to touch it | 1 | 2 | 3 | 4 | 5 |
| 7 | Someone unknown to look at it | 1 | 2 | 3 | 4 | 5 |
| 8 | The dentist drilling his/her tooth | 1 | 2 | 3 | 4 | 5 |
| 9 | Seeing the dentist drilling teeth | 1 | 2 | 3 | 4 | 5 |
| 10 | The sound of the drilling | 1 | 2 | 3 | 4 | 5 |
| 11 | Putting tools in his/her mouth | 1 | 2 | 3 | 4 | 5 |
| 12 | Feeling that he/ she will chock | 1 | 2 | 3 | 4 | 5 |
| 13 | Going to the hospital | 1 | 2 | 3 | 4 | 5 |
| 14 | People in white coats | 1 | 2 | 3 | 4 | 5 |
| 15 | The nurse cleaning his/her teeth | 1 | 2 | 3 | 4 | 5 |

FIG. 1 The CFSS-DS questionnaire for children aged 4-12 years )in English language).

and out of contact or untreatable) as those defining the uncooperative population, the area under the ROC curve is AUC=0.743, 95%CI: 0.612–0.874 (p=0.010), which means that it is statistically significant. Using the results of the ROC analysis to define the dental fear cut-off points, equal weight to sensitivity and specificity and two different methods were used. The first method [Kummar et al., 2011] used the maximum of the square of the distance between the point (0, 1) on the upper left hand corner of ROC space and any point on ROC curve i.e. $(1\text{-sensitivity})^2+(1\text{-specificity})^2$ and gave a cut-off point equal to 37.5 (sensitivity=60%, specificity=75%). The second method used the intersection between the line specified by the values of sensitivity and the line specified by the values of sensitivity (Fig. 2) and gave a cut-off point equal to 32.5 (sensitivity=70%, specificity=59%). According to ten Berge et al. [2002], a score of 3 in the Venham scale is assumed to reflect a distinct level of dental fear in children, while ratings of 4 and higher reflect extreme dental fear. Of the 195 children from the Postgraduate Clinic, 162 (83.1%) were rated below 3, with a mean CFSS-DS total score of 30.5, 23 (11.8%) were rated 3 and so found to be on the borderline with mean CFSS-DS total score 33.9 and 10 (5.1%) were rated as 4 and 5, with mean CFSS-DS total score 37.7. Accordingly, a CFSS-DS total score below 33 was defined as 'non-clinical range' (no behavioural problems or very low possibility of behavioural problems), scores 33 to 37 as 'borderline range' (some possibility of behavioural problems) and scores of 37 and higher as 'clinical range' (high possibility of behavioural problems). In Table 1, the mean CFSS-DS total scores for all distinct levels of the dentist's ratings in the Venham scale are shown. Remarkably, the previous estimated ranges are very close to those produced by the use of the ROC analysis.

## Dental fear

Descriptive statistics about CFSS-DS and age according to area and gender are shown in Table 2. The mean CFSS-DS score was 27.1±10.8. Gender was not correlated with dental fear. Age was statistically significantly related to CFSS-DS score through a quadratic equation that exhibits a local maximum at the age of 9.7 years (Fig. 3, Table 3). After that age, the CFSS-DS score (dental fear) tends to decrease.

Based on the calculated cutting points, the sample collected from the schools (1,484 students) was divided according to their dental fear. As a result, 84.6% (n=1,255) of those school children had scores below 33 ('non-clinical range'), 11.8% (n=175) had scores 33 to 37 ('borderline range') and 3.6% (n=54) of the children had scores of 37 and higher ('clinical range'). There was no statistically significant difference between these three groups concerning age and gender.

## Caries

The overall mean dmfs score was 3.4±5.9. Significant differences were observed between the different city areas (p=0.031). In detail, western areas (lower socio-economic status) showed greater values (mean=3.7±5.9) than eastern areas (higher socio-economic status) (mean=2.9±5) (p=0.011), while the city center (medium socio-economic status) value lay in between and did not differ (significantly) from the other two regions (mean=3.3±6.9). The caries-free children were found to be 45.4% (674/1,484). The overall mean DMFS score was 0.6±1.5. Significant differences were observed between the three areas of the city. The city centre area (mean=0.7±1.4) showed greater DMFS values than eastern area (mean=0.6±1.7) (p=0.002) and western area (mean=0.6±1.5) (p=0.001).

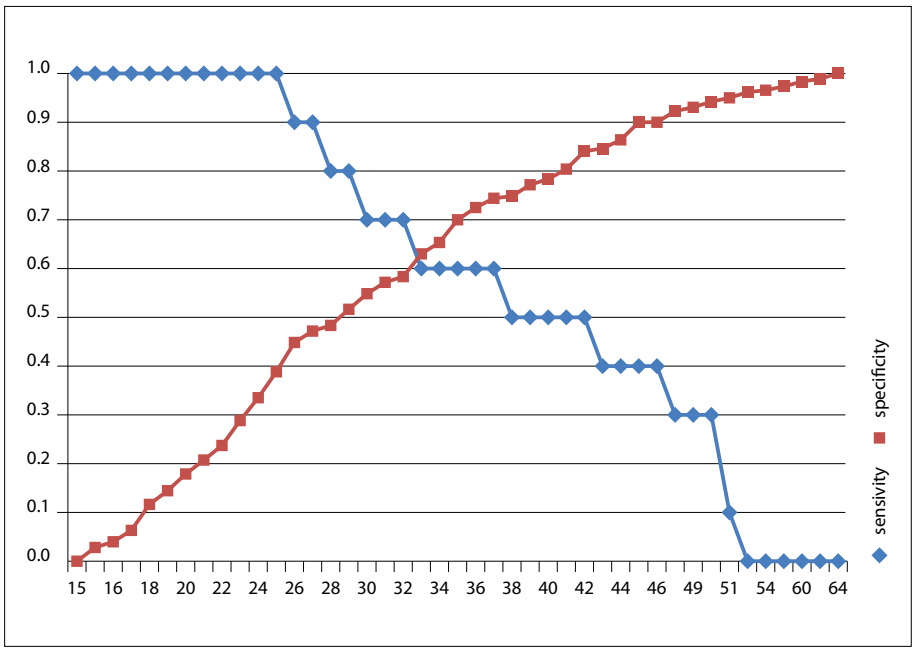



FIG. 2 Sensitivity and specificity values from ROC analysis of clinical fear ratings and CFSS-DS total score.

| Rating | N | % | Mean CFSS-DS score |
|---|---|---|---|
| 1 | 109 | 55.9 | 30.4 |
| 2 | 53 | 27.2 | 30.6 |
| 3 | 23 | 11.8 | 33.9 |
| 4 | 7 | 3.6 | 37.7 |
| 5 | 3 | 1.5 | 45.7 |
| 6 | 0 | 0 | 0 |

TABLE 1 Dentists' clinical behaviour ratings and related mean CFSS-DS total scores for the 195 Postgraduate Clinic patients.

| Area | Boy | | | Girl | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Age | CFSS-DS (SD) | N | Age | CFSS-DS (SD) | N | Age | CFSS-DS (SD) |
| East | 134 | 8.6 (1.6) | 25.0 (9.8) | 161 | 8.7 (1.6) | 25.9 (9.7) | 295 | 8.7 (1.6) | 25.5 (9.7) |
| Centre | 207 | 8.4 (1.8) | 26.2 (10.2) | 237 | 8.4 (1.8) | 27.3 (11.4) | 444 | 8.4 (1.8) | 26.8 (10.9) |
| West | 376 | 8.5 (1.9) | 26.5 (10.9) | 369 | 8.5 (1.8) | 29.2 (11.0) | 745 | 8.5 (1.8) | 27.8 (11.1) |
| Total | 717 | 8.5 (1.8) | 26.1 (10.5) | 767 | 8.6 (1.8) | 27.9 (10.9) | 1434 | 8.5 (1.8) | 27.1 (10.8) |

TABLE 2 Descriptive statistics regarding CFSS-DS and age according to area and gender for the school children.

| Parameter | Estimate | SE | df | t | p-value | 95% Confidence Interval | | Significance at p<0.05 (bold) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound | |
| Intercept | 6.384 | 6.853 | 1473.908 | 0.932 | 0.352 | -7.059 | 19.828 | |
| Age | 4.533 | 1.625 | 1480.359 | 2.79 | 0.005 | 1.346 | 7.72 | |
| Age2 | -0.233 | 0.093 | 1480.342 | -2.499 | 0.013 | -0.416 | -0.05 | |

TABLE 3 Estimated parameters of the quadratic equation between age and CFSS-DS.

### *Dental caries in relation to dental fear*

DMFS/dmfs and CFSS-DS were not found to be correlated. Although no statistically significant association was found between d and m with the CFSS-DS, a statistically significant negative association was observed between f and CFSS-DS (p=0.010) (children with more filled tooth surfaces in their primary teeth have less dental fear).

## Discussion

The present study showed that 84.6% of the primary school children do not suffer from dental fear and as a result they do not present dental behavioural management problems (DBMP) or have very little potential to present them [Klingberg et al., 1994; ten Berge et al., 2002]. In the present study, the cut-off points of the different dental fear groups (low, borderline and high) were defined, using two methods relating to the reported dental fear and child behaviour. CFSS-DS scores of 37 and higher (3.6% of the children) were found to represent high levels of dental fear which can lead to serious BMP during dental treatment [Klingberg et al., 1994; ten Berge et al., 2002]. In addition to this somewhat strict cut-off point, a borderline area for dental fear was set at scores between 33 and 37. Children with CFSS-DS scores in this range (11.8%) also suffer from some degree of dental fear or may be at risk for developing it [ten Berge et al., 2002]. This group of children seems to be of special interest for the paediatric dentist, since the development of dental fear may be prevented by providing extra attention and guidance during dental treatment [ten Berge et al., 2002]. However, it should be taken into consideration that for some of these children, the expression of dental fear may depend on specific circumstances and on temperamental factors [Klingberg et al., 1998; ten Berge et al., 2002]. In other words, fearful children may not always be uncooperative during dental treatment and vice versa [Klingberg et al., 1998; ten Berge et al., 2002]. As a result, while the CFSS-DS seems to give a good indication of a child's likelihood of showing "fear behaviour" during treatment, situational and temperamental factors such as shyness, aggressiveness or the child's psychological functioning may be decisive in the expression of a child's dental fear [ten Berge et al., 2002; Versloot et al., 2008]. An age effect was found in the present study, which reported that dental fear seems to decrease with increasing age and this is in agreement with previous studies [Klingberg et al., 1994; Raadal et al., 1995; Klingberg et al., 1998]. This reported decrease in dental fear may represent a developmental change in children, since increasing age is related to the development of cognitive abilities and a change in the expression of fears, including dental fear [Klingberg et al., 1994; Raadal et al., 1995; Versloot et al., 2008]. As a result, this may

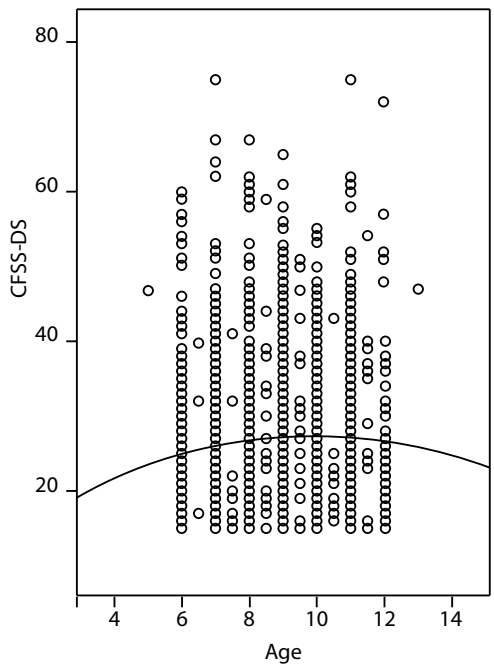



FIG. 3 Graph of the relation between age and CFSS-DS total score.

lead to a decrease in inappropriate behaviour during dental treatment [Prins et al., 1997; ten Berge et al., 2002]. Socioeconomic status and gender were not found to be related with dental fear in this study, while some previous researchers agree with these findings but others do not [Raadal et al., 1995; ten Berge et al., 2002; Arapostathis et al., 2008; Klaassen et al., 2002], stressing the need for further research.

Dental caries was found in more than half (54.6%) of the examined children. Significant differences were found between caries and the different parts of the city. In this study, children from western city areas (lower socioeconomic status) had significantly more caries than the other two areas (city center and eastern areas). This finding is in agreement with previous studies in which the existence of dental caries in children seems to be related to the socioeconomic status of the parents [Kallestal and Wall, 2002; Elfrink et al., 2010; Boka et al., 2013].

When dental fear was compared with dental caries in primary and permanent teeth, no large statistically significant correlations were found. When comparing dental fear and each component of the DMFS and the dmfs, negative correlations were found between dental fear and the number of filled primary tooth surfaces (f). This may be because of the familiarity of children, since restoration means exposure and helps to reduce/prevent dental fear. This finding is in agreement with previous studies, which showed that children, who had never been to the dentist, were much more anxious than children who had been [Nicolas et al., 2010; Gustaffson et al., 2010; Soares et al., 2015].

A possible limitation of this study was that children were not asked about their previous dental experience, since a previous negative dental experience can affect their dental fear [Locker et al., 2001b; Versloot et al., 2008; Tong et al., 2014]. Another limitation of this study was that dental caries was only inspected by the screening in the classroom. The use of a professional light, the use of x-rays and the possibility of drying the tooth surfaces could affect these results.

## Conclusion

This is the first epidemiological study in the Greek population, about child dental fear and cut-off points based on a representative sample. The present cut-off points can be used in future studies, in other Greek cities, in order to explore child dental fear of the whole country. The results of the present study indicate that there is an open area for further research on the relation between dental fear and experience.

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