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PREVALENCE AND RISK FACTORS OF TRAUMATIC DENTAL INJURIES IN GREEK CHILDREN AND ADOLESCENTS. A NATIONAL CROSS-SECTIONAL STUDY.

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Preface

This master thesis was written as part of my three-year postgraduate course in Paediatric Dentistry and was assigned to me by the former Chair of the Department of Paediatric Dentistry, Assoc. Prof. Katerina Kavvadia. The thesis is based on data from a national survey conducted in Greece, on TDI prevalence and risk indicators in our country. The results could be a useful guide for public and private dental health services for prevention and management of trauma emergencies.

I would first like to acknowledge Dr Kavvadia, for providing me this excellent project. A huge "thank you" goes to my Supervisor, Assistant Professor Andreas Agouropoulos, for his valuable and tireless guidance and assistance through each stage of the procedure. His expertise and thorough editing was invaluable in formulating the research questions and process the data. His constant patience and the fact that he was always there when I needed him, seemed to be endless.

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I treasure all the moments with my colleagues for the wonderful collaboration we had, and for their love and support throughout all the difficult but beautiful days we spent together.

Last but not least, I cannot thank enough my whole family: my parents for their enormous help these 3.5 years as they were always there for me. Finally, I could not have completed this dissertation without the encouragement and every day support of my dear husband and my 3 beloved kids that had to tolerate a mother even less unusual than what she used to be.

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Introduction

Dental trauma is a painful experience that can impair orofacial function, negatively affecting growth, occlusion and aesthetics. A severe dental trauma, unlike a chronic condition, causes immediate and unexpected pain. Apart from the obvious economic cost, it can initiate a series of socio-economic consequences affecting the quality of life and can possibly lead to absence from school or work, sleep disturbances and changes in the daily schedule. Furthermore, when referring to children, they may experience stress from their peers' behavior and inability to participate in school activities such as sports and music. Subsequently, long-term monitoring is necessary, particularly in patients with a developing dentition. The psychological and social impact of dental trauma is generally recognized as having consequences that may affect social contact, emotional balance and well-being of the child. *(Arhakis et al 2017)*

Traumatic dental injuries (TDIs) are also a public health problem and one of the main reasons for dental emergencies. This condition would rank fifth if it was included in the list of the main chronic diseases and injuries by the Global Burden Diseases study of 2015, and it is the second most frequent oral disease after dental caries *(Petty et al 2018).* Furthermore, it tends to be one of the most prevalent oral pathologies in children and adolescents *(World Health Organization 2019).* It is estimated that 17–50% of adolescents and adults experience dental trauma to one or more permanent teeth and 9–40% of children experience trauma in their primary dentition and evidence suggests that traumatic injuries can have negative impact on the oral health-related quality of life of young patients and their families *(Zaror et al* 2018). *Lam (2016)* has reported that one third of primary and one fourth of permanent dentition sustain a TDI during childhood. The wide range in reported prevalence of TDIs is likely due to variation in the studied populations and sample characteristics, study design, and injury diagnosis and classification *(Born et al 2019).* Table 2 shows the prevalence of TDI in different countries and it is obvious that the percentages of TDI vary significantly between different countries, but also between studies conducted in the same country.

A systematic review and meta -analysis of studies was conducted in the area of Latin America and Caribbean by the United Nations Children's Fund (UNICEF), on the prevalence and biological factors of dental trauma in adolescents (mainly 12- year-olds).

The studies included had different results when different criteria were used for evaluating dental trauma. On the other hand, prevalence of dental trauma did not tend to show sudden changes over time, despite criteria used. Results showed that prevalence of dental trauma after 2000s tended to decrease over time. Approximately 15–20% of the adolescents in Latin American and Caribbean countries have shown some type of dental trauma in permanent teeth.

Different age groups encounter TDIs as a result of variable behaviors. While preschool children sustain TDIs usually through falls, school age children typically have TDIs due to sports or interpersonal violence. Adolescents and young adults also commonly encounter TDIs from interpersonal violence, alcohol consumption and motor vehicle accidents, with adults having a higher prevalence of dental trauma compared to children and adolescents *(Arraj et al 2019).*

Classification of dental injuries

Dental injuries have been classified according to a variety of factors, such as etiology, anatomy, pathology or therapeutic considerations.

Numerous classification systems have been proposed for traumatic dental injuries. *(Pagadala & Tadikonda 2015).* Some of these systems are virtually non-applicable in epidemiological studies, because of some particular characteristics, i.e.radiographic examination as part of the clinical examination, diagnosis of root fractures, pulp vitality and sinus tracts. Furthermore, some of them include many broad terms, detailed terms, or very controversial ones. In 1950, paediatric dentist G.E. Ellis was the first to promote a universal classification of dental injuries

The Ellis classification has been used by various authors for recording dental trauma. This system is a simplified classification which groups many injuries and allows for subjective interpretation by including broad terms such as ‘simple’ or ‘extensive’ fractures. Injuries to the alveolar socket and fractures of the mandible and maxilla are not classified here. *(Bastone et al 2000).* Ellis’ classification system is the most suitable for epidemiologic studies, however, some changes might be needed *(Feliciano & Caldas 2006).* A systematic review of the diagnostic classifications used in the literature, by *Feliciano and Caldas in 2006*, showed that the most frequently used classification system was Andreasen’s (32%).

Table 1 shows the most commonly used classifications both in prospective and cross-sectional studies.

Andreasen	World HealthOrganisation	Garcia-Godoy	Ellis
Crown infraction. Incomplete fracture of the enamel	Fracture of enamel of tooth	Enamel crack	Simple fracture of the crown, involving little or no dentine
Uncomplicated crown fracture. A fracture confined to the enamel or dentine but not exposing the pulp	Fracture of crown without pulpal involvement	Enamel fracture	Extensive fracture of the crown, involving considerable dentine, but not the dental pulp
Complicated crown fracture.A fracture involving enamel and dentine, and exposing the pulp.	Fracture of crown with pulpal involvement	Enamel-dentine fracture without pulp exposure	Extensive fracture of the crown, involving considerable dentine and exposing dental pulp
Uncomplicated crown-root fracture. A fracture involving enamel,dentine, cementum, not exposing the pulp	Fracture of root of tooth	Enamel-dentine fracture with pulp exposure	The traumatized tooth that becomes non-vital,with or without loss of crown structure
Complicated crown-root fracture. A fracture involving enamel, dentine and cementum, and exposing the pulp	Fracture of crown and root of tooth	Enamel-dentine-cementum fracture without pulp exposure	Total tooth loss
Root fracture.A fracture involving dentine, cementum, and the pulp	Fracture of tooth, unspecified	Enamel-dentine-cementum fracture with pulp exposure	Fracture of the root, with or without loss of crown structure
Concussion. Injury without abnormal loosening or displacement but with marked reaction to percussion	Luxation of tooth	Root fracture	Displacement of tooth, without fracture of crown or root
Subluxation (loosening). Injury with abnormal loosening but without displacement of the tooth	Intrusion or extrusion of tooth	Concussion	Fracture of the crown *en masse* and its replacement
Intrusive luxation (central dislocation)	Avulsion of tooth	Luxation	
Extrusive luxation (peripheral dislocation, partial avulsion)	Other injuries including laceration of oral soft tissues	Lateral displacement	
Lateral luxation		Intrusion	
Exarticulation (complete luxation)		Extrusion	
Comminution of alveolar socket		Avulsion	
Fractures of facial or lingual alveolar socket wall			
Fractures of alveolar process with and without involvement of the socket			
Fractures of the mandible or maxilla with and without involvement of the tooth socket			
Laceration of gingiva or oral mucosa			
Contusion of gingiva or oral mucosa			
Abrasion of gingiva or oral mucosa			

Table 1. Classifications of dental trauma *(from Bastone et al 2000)*

Aetiology and predisposing factors of TDI

The high prevalence of TDIs and their negative impact on quality of life have dictated the need to identify etiologic factors. It is common ground that dental trauma etiology is multifactorial and complex. Glendor suggested that the three main etiologic factors of dental trauma can be grouped in the domains of “human behavior,” which generally includes risk-taking behaviors, conditions such as attention-deficit/hyperactivity disorder, and others; “environmental determinants,” where in more contextual parameters, such as material deprivation, or an “unsafe” environment are included; and “oral factors,” including increased overjet with protrusion, lip incompetence, and other intraoral and

extraoral factors *(Glendor 2009).* This triad is certainly not an all-inclusive list but offers a helpful categorization of all postulated risk factors for dental trauma. Additional risk factors that do not necessarily fall into one of these three categories, but might also increase the risk of TDIs are body mass index (BMI),gender, presence of illness, learning difficulties, physical limitations, inappropriate use of teeth, and oral piercings *(Zaleckiene et al 2014)*. *Table*2 exhibits information from worldwide studies about etiological factors of dental trauma from 2000 onwards.

A review of the literature reveals that several predisposing risk factors/indicators for TDI have been studied; however, few are well established. It appears that gender, age and history of previous trauma are important predisposing factors which increase the risk of dental trauma. A number of studies also confirm the relationship between overjet and lip incompetence and the tendency to sustain dental injuries.*(Bastone et al 2000)*

*Goettems et al (2016),*detected a positive association of obesity and dental trauma, but data could not allow a conclusion to a causal relationship in their systematic review. However, they pointed out that there is low evidence currently present, as only 13 studies could be included, and there is a need for studies with more robust design.

A systematic review and meta-analysis about TDI in children and adolescents published in 2015, found variations between different geographical areas. Prevalence in the population was estimated 17,5%, being higher in boys. Furthermore, enamel fracture was the most frequent type of dental trauma *(Aghdash et al2015).*

Primary dentition

Except the clinical consequences of TDIs to the primary dentition, negative economic, social, and psychological impacts have also been well documented. Additionally, a potential sequelae to the developing successors includes hypoplastic defects, root dilacerations, and other enamel or developmental disturbances that are not seen until months or years after the injury, when the permanent teeth erupt. *(Freire-Maia et al 2015, Born et al 2019)*

A community –based cohort study on preschool children of low income families aged 3-4 years, in North Carolina examined the prevalence, socio-demographic correlates, and clinical predictors of traumatic dental injuries (TDIs) in the primary dentition. Prevalence was 47% and 8% of trauma cases were characterized “severe”(pulp exposure, tooth displacement, discolored or necrotic tooth, or tooth loss).

Overjet and lip incompetence were strong risk factors for TDIs in the primary dentition. Each added millimeter of overjet was associated with 40% increased likelihood of severe dental trauma. Children with increased overjet (>3 mm) were 3.8 times as likely to have experienced severe TDI compared with those with ≤3 mm *(Born et al 2019).*

Additionally, a recent systematic review investigating the correlation of overjet and dental trauma found that children 0-6 years old were at increased risk for TDIs when overjetwas ≥3mm, while the overjet threshold for children with mixed or permanent dentition (12year-old's) was set at equal or greater than 5mm *(Arraj et al 2019).* Furthermore, behavioral factors, such as breastfeeding, bottle-feeding, and pacifier use, have been suggested to be associated with TDI in primary dentition *(Feldens et al 2016).*

Dental injuries mainly involve front teeth, with maxillary central incisors being reported as the most affected teeth *(Glendor2009).* Nevertheless, the most significant predisposing factor of dental trauma in primary as well as in permanent dentition is increased overjet *(Arraj et al 2019).*

Permanent dentition

TDI studies indicate that male gender, child age, inadequate lip coverage, anterior open bite, caries in the permanent dentition, overweight, a previous history of TDI, tongue piercing, the use of alcoholic beverages and participation in sports are associated with a greater chance of suffering TDI *(Magno et al 2020).* Regarding gender, historically, boys are more prone to TDI than girls but recent studies show that the increased involvement of girls in sporting activities may lead to a decline in gender differences *(Zaleckiene et al 2014, Glendor 2009)*. There are also psychosocial factors—those related to stressful events or environments—which have not been explored fully in relation to TDI *(Glendor 2009, Sideri et al 2018).*

In addition, a population –based study conducted in Brazil, revealed that families of adolescents 11-14 y/o with TDI involving the dentine or dentine/ pulp are more likely to report a negative impact on quality of life than families of adolescents who had no signs of TDI. The results demonstrate that severe untreated TDI in adolescents could be an important source of family distress *(Bendo et al 2014).*

The association between dental trauma and socioeconomic indicators remains unclear *(Oldin et al, 2015, Correa-Faria et al 2015, Elkhadem&Wanees2015, Bendo et al 2009).*

Studies in different regions are useful in addressing the prevalence, incidence and associated factors of dental trauma. They can help to identify groups and individuals at risk in areas with similar geographic, cultural, and socioeconomic characteristics, considering it could reflect similar aspects concerning dental trauma trends. Therefore, this can contribute to the development of preventive health strategies and organization of dental services for emergency, restorative, rehabilitation and follow-up care of the individuals who suffered the traumatic injury.

A review of the literature reveals that there is limited information about TDI in Greece regarding both prevalence and associated risk factors in children and adolescents *(Oulis & Berdousis 1996, Lygidakis et al 1998, Vanderas & Papagiannoulis 1999).* The samples in the studies conducted more than 20 years ago, were also limited and non -representative. Therefore, generalized data on TDI could not be drawn, while there was no information in relation to specific predisposing factors. *Baxevanos et al (2017),* performed a cross-sectional study in an urban group of 13–16-year-old Greek adolescents to examine the association of psychosocial factors and TDI and reported that high TDI prevalence was observed in males, non-firstborn children, or those frequently engaged in physical activity. Most of the participants in the study that suffered from TDI had low socioeconomic status and parental support.

Table 2. Prevalence/types/factors of TDIs in different countries in children of various age ranges. (M: male/ F: female)

AUTHOR	Country	SampleSize	Age (years)	Criteria	TDI Prevalence	Remarks
Todero et al 2018	South Brazil	537	8-10	Andreasen and Andreasen(except categories with radiographs)/ Cortes, Marcenes and Sheiham	22%	Higher among children who: woke three to four times per night (PR = 3.30; 95% CI:2.47-4.39), fell asleep in parental bed (PR = 1.41; 95% CI: 1.09-1.83), were not in a good mood on waking up in the morning (PR = 1.30; 95% CI: 1.02-1.65),became sleepy while sitting and/or studying (PR = 1.57; 95% CI: 1.09-2.24)and while watching TV (PR = 1.41; 95% CI: 1.0005-1.97) and those who had bad dreams (PR = 1.35; 95% CI: 1.04-1.76
Baxevanos et al 2017	Greece	531	13-16	Modified Ellis and Davey classification	15,8%	Adolescents with high TDI prevalence were males, non-firstborn/ frequently engaged in physical activity. Personal and mother's Sense of Coherence were low and reported low parental support
Born et al 2019	North Carolina, USA	1546	2-5	Modified Ellis and Davey classification	47%	75% of TDI were enamel fractures, 4% were "severe"(tooth loss or necrosis) Overjet and lip incompetence were strong risk factors for TDIs in primary dentition. Each added millimeter of overjet was associated with 40% increased likelihood of severe dental trauma, corresponding to an absolute 1 p.p. approximate probability increase. Children with overjet >3 mm were 3.8 times as likely to experience severe TDI compared with those with <3 mm.
Bratteberg et al, 2018	Norway	2055	16	mild, moderate, severe	16,4%	Maxillary central incisors most affected (64.7%), Boys more prone to injury than girls Mild=88.4%, moderate=6.1% and severe=5.5%. Peak age for TDI was 8-10years
Ain et al 2016	India	1600	12	Ellis and Davey classification of fractures (1970)	9,3%	Higher prevalence of TDI was found in children with incisal overjet ≥ 3 mm and those with incompetent lip closure. Academic performance of children showed significant association with TDIs to anterior teeth.
Freire-maia et al 2018	Brazil	1201	8-10	Adreasen	14%	Prevalence of TDI in the permanent dentition is higher when enamel fractures are included. Boys, older children, individuals whose families had a lower income and parents/ caregivers with a lower level of education and individuals with an overjet > 3 mm more likely to have other trauma/trauma sequelae
Dame´-Teixeira et al 2013	Brazil	1528	12	Children´s Dental Health Survey Criteria	34,79%	Enamel fracture = 24.37%, severe trauma = 10.43% Male and schoolchildren from low socioeconomic status more likely to present at least one tooth with TDI, whereas students attending 7th grade (advanced students) were less likely to experience TDI. Students ofmid-high, mid-low and low socioeconomic status were more likely to have mild trauma when compared with schoolchildren of high socioeconomic status
Francisco 2013	Brazil	765	9-14	O'Brien	16.5%	Boys:2.03-times higher risk of crown fracture than do girls, while children with an overjet size > 3 mm were 1.78 times most likely to have TDIs. Children with inadequate lip coverage were 2.18 times more likelyto suffer TDIs than children whose lip coverage was

						adequate. TDIs: 66% enamel, 27% enamel-dentin ,5% enamel cracks ,2% fracture with pulp involvement, 26% of traumatized teeth were restored
Naile et al 2013	South Brazil	1528	12	Children's Dental Health Survey criteria	34.79%	24.37% Enamel only, 9.43% enamel dentine without pulp, 0.52% enamel dentine with pulp 0.11% tooth loss,M>F
Schatz et al 2013	Switzerland	1900	6-13		14.3%	Prevalence higher in boys than girls. Most injuries (91.2%) involved the upper front teeth; 87.2% of all injuries were hard tissue injuries (enamel or dentin fractures), and 12.8% only subluxation and luxation injuries. Children with an overjet of 6 mm or more had 4 times higher risk of suffering trauma
Marilia et al 2012	Brazil	504	2-6	Andreasen	40%	Overjet >3 mm > trauma moderate/severe malocclusion had more trauma
Gupta et al, 2011	India	1059	4-15	Modified Ellis Classification	4,15%	Prevalence of dental trauma higher in boys, 95.45% of injuries were to maxillary anterior teeth. Maxillary central incisor was the most commonly affected tooth. Enamel with dentin fracture with pulp exposure was the main type of TDI (43.1%). Majority of TDIs were untreated (97.7 %).
Piovesanetal, 2011	Brazil	792	12	Children's Dental Health Survey UK	9,7%	Crown fracture of enamel only (94.5), enamel and dentin (4.4), Crown fracture involving pulp (1.1) Maxillary central incisors : most frequently traumatized teeth/ No association of child oral health-related quality of life and socioeconomic factors with TDI.
Alon et al 2010	Palestine	804	6thGrade	UK surveys	17.7%	M>F, Enamel/ Dentine fractures 41%, All injuries 42.5%, 89% incisors effected 5% received treatment, OJ> 5mm with incompetent lip > trauma
Ravishankar et al 2010	India	1020	12		15.1%	The prevalence of TDI was higher in boys. Maxillary incisors were commonly injured, involving mainly enamel fracture. Children with excessive overjet and inadequate lip coverage more likely to have TDI
Altun et al 2009	Turkey	4956	6-12	WHO classification	9.5%	Enamel fracture (44.6%). Boys suffered more often a dental hard tissue and pulp injury than girls, whereas there was no difference in gender in the distribution of periodontal injuries. Children with increased overjet were 2.19 times more likely to have dental injuries than other children. TDIs are highest among children 6 and 8-10yrs old
Adekoya-Sofowora et al 2009	Nigeria	415	12	Garcia-Godoy's classification	12.8	No gender differences. Enamel fractures: 9.9% Enamel- dentine fracture: 4.8%
Naidooetal 2009	South Africa	1665	11-13	Modified Ellis classification	6.4%	Home and school most common place of TDI 5.7% occurred at the street. Enamel fractures: 69.1%, Untreated dental trauma: 85.4%Boys had an almost 2.5 (95% CI: 1.59, 3.69) times higher probability of having a TDI than girls. Highest prevalence in 12 year olds and in the high socio-economic status group.
Fakhruddin et al 2008	Ontario	2422	12-14	Dental Tauma Index	11.4%	Untreated enamel fractures: 63.7% No diference between males and females Children with caries history had more TDIs compared to caries free. Family income, mother's level of education, familycomposition, or government social support recipient were associated with the occurrence of dental injuries

Soriano et al 2007	Brazil	1046	12	Andreasen	10.5%	Public schools> Private schools, M>F Overjet>5 mm >trauma
Malikaewet al 2006	Thailand	2725	11-13	Cortes 2000	35%	Males had TDI levels approximately twice as high as females (25.2%)TDIs more common amongst children living in more disadvantaged households with less educated parents. Children with an overjet greater than 5mm were also more likely to have TDI Enamel fracture was the major type of TDI.
Granville-Garcia et al 2006	Brazil	2651	1-5	English classification	36.8%	58.1% enamel fractures, trauma increases with age ,M>F
Locker D 2005	Canada	3010	13-14	Trauma Index	18.5%	M>F, Decayed teeth had more trauma
Schulman 2004	USA	15364	8-50	Scale developed by the National Institute of Dental and Craniofacial Research	23.45%	Males and children with increased overjet had more trauma Trauma to incisors is more prevalent but mostly limited to enamel
Skaare et al 2003	Norway	1275	7-18	WHO Classification	1,8-2%	M>F* No differences between right or left central
Al Majed 2001	Saudi Arabia	354 862	5-6 12-14	UK NationalSurvey	33% 5-6yo 34% 12-14yo	5-6yrs old: 71% enamel, 13% tooth loss, 7% enamel dentine, 5% discoloration , 4% pulp invol. 12-14 yrs:74% enamel, 15% enamel dentine, 5% pulp involvement, 3% tooth loss, 0.4% discoloration
Cortes et al 2001	Brazil	3702	9-14	UK Child Oral Health Survey.	9yo 8% 12yo 13.6% 14yo 16.1%	High SES> Low SES M>F Children with OJ> 5mm were 1.37 times (95% CI½1.06–1.80) more likely to have TDI. Children with adequate lip coverage were 0.56 times (95% CI½0.44–0.72) less likely to have dental trauma
Naidoo et al 2009	South Africa	1655	11-13	Modified Ellis'sclassification	6.4%	M>F, Enamel fracture: 69.1%, Untreated: 85.4% Home and school most common place of TDI 5.7% occurred at the street.
Vanderas & Papagiannouli s 1999	Greece	195	10-12	Enamelfractures and infractions	16,6%	Higher incidence of dentofacial injuries in boys 11,5%TDis in boys/ 5% in girls

Aim

The aim of this study was to assess the prevalence and severity of TDI and its association with socio-demographic (gender, residency status, parental education) and personal/behavioral (overjet, BMI, smoking, alcohol consumption and mouth piercing) risk indicators in a representative sample of 5,12 and 15-year-old Greek children and adolescents.

Materials and methods

Study design

The data on TDI were obtained as part of a national pathfinder survey (cross-sectional study) aimed to investigate the oral health of Greek children and adolescents. The study was conducted with the collaboration of the Dental school of the National and Kapodistrian University of Athens, the Aristotle University of Thessaloniki and the Hellenic Dental Association. It has been approved from the Ministry of Health and the Ethics Committee of the National and Kapodistrian University of Athens (414/22.05.2019). Data were collected between October 2013 and June 2014 at the schools of the specific areas, all over Greece.

Settings and participants

The sample was selected according to the guidelines proposed for pathfinder surveys by the World Health Organization using stratified cluster sampling, which achieves inclusion of population groups, which may have different frequency of TDIs *(WHO, 1997).* The sampling was performed exclusively on children and adolescents in three age groups: 5, 12, 15 years old, according to the following inclusion criteria: 1) Written parental consent, 2) Greek citizenship, 3) healthy. The study population included population from urban and rural areas. According to a previous national epidemiologicalresearch *(Oulis 2015),* study groups were selected from 11 prefectures, 6 on the mainland and 5 on islands. In the prefectures of Attica and Thessaloniki (where most of the population of the country inhabits) a sample of population was selected from three urban areas, while for each of the other prefectures sampling was performed in an urban area (capital area) and in a rural area of the prefecture. Therefore, the study was carried out in 15 sampling locations characterized as urban and 9 locations characterized as rural. The collection of the sample was carried out by random selection of public schools in the chosen sampling locations.

Data collection

The data were collected from questionnaires and clinical examination. Before clinical examination, a letter explaining the purpose of the study, an informed consent and a questionnaire on demographic and socioeconomic characteristics were sent to the parents/ legal guardians. The questionnaire included questions on gender, age, parents' highest level of educational attainment and perception about their child's oral health. Furthermore, adolescents in the 12 and 15yo groups, answered a separate questionnaire on their dental history and personal habits like alcohol consumption, smoking, mouth piercing and perception about their oral health.

All children with informed consent were examined it the classrooms with artificial light, a mirror and a WHO periodontal probe. All participants were examined by 10 calibrated dentists using sterilized instruments, gauzes and disposable gloves and masks. Examiners participated in a 5-hour calibration session against a gold examiner, until a level of above 0.85 inter and intra- examiner agreement was achieved.

To record dental trauma, *Ellis and Davey (1970)* classification was used, modified by *Naidoo et al 2009*. Briefly, the presence or absence of the following were recorded: a) enamel fracture, b) enamel-dentin fracture c) crown fracture with pulp involvement, d) crown discoloration, e) fistula, f) composite resin build-up. All teeth in the dentition were examined. Overjet was recorded during maximum intercuspation using the periodontal probe and was classified in the following categories: for 5y/o not increased (0-2mm) or increased (≥3mm) and for 12 & 15 y/o not increased (0-3mm) or increased (≥3mm). In the latter age groups the permanent molar relationship was recorded according to Angle classification. Presence of piercing intraorally or on the lips was also recorded by the examiner. Furthermore, weight (kg) and height(m) were recorded for the children living in Attica only and the BMI was calculated for each child (kg/m2). Children were classified as underweight, normal, overweight and obese using the national reference growth curves.

Statistical analysis

Statistical analysis of data was realized using the STATA statistical package. Statistical significance threshold was defined in $p<0.05$. At first, descriptive analysis of epidemiological data took place with common presentation methods of univariate

statistics of the variables under examination, in all the sample, as well as in the different population subgroups. More specifically, frequency, mean, and standard deviation of every variable were presented, as well as the percentage that it represents in all the sample (valid percent).

Finally, multifactorial analysis was performed to study the simultaneous correlation of a number of variables with parameters of oral health using specific statistical models. (negative binomial regression models, fraction allogit regression models, ordinal logistic regression models).

Results

The sample consisted of 3.455 children which were divided into 3 age groups as follows: 1222 5-year-old children, 1102 12-year-old children and 1131 15-year-old children. *Table 3* presents the demographic characteristics of the sample, overjet, Angle classification and habits for the three age groups. Regarding BMI, this was recorded in N=141 5 y/o, N=166 12y/o and N= 150 15y/o children who lived in the area of Attica and overweight/obese were 22%, 32% and 23% of the participants, respectively.

Regarding demographic data, it was found that for the 5 y/o group, mothers with lower level of education had children more prone to dental injuries, while for the older age groups trauma was more prevalent in boys. Furthermore, for the older groups, children with worse perception of their oral health, had experienced more TDIs *(Table 3)*. In all age groups TDIs were recorded only in upper and lower incisors and there were no injuries in the canines or the molars.

The total prevalence of TDI in the 3 age groups studied was 12,23%. For the 5year-old group the prevalence of dental trauma was 12.5% and the distribution of the different TDIs is presented in *Table 4*. The most prevalent TDI was enamel fracture and the most affected teeth were the upper central incisors. Statistically significantly more upper teeth were traumatized compared to lower ones ($p<0.001$). In the multivariate model, the maternal level of education and increased overjet retained their significance for the occurrence of TDI *(Table 5).*

For the 12-year-old group the prevalence of dental trauma was 12.7% and the distribution of the different TDIs is presented in *Table* 4. The most prevalent TDI was enamel fracture and the most affected teeth were the upper central incisors as well. Statistically significantly more upper teeth were traumatized compared to the lower ones ($p<0.001$). In the multivariate model, male gender was identified as a risk indicator of TDI occurrence *(Table 6)*.

Finally, for the 15year-old group the prevalence of dental trauma was 11.5% and the distribution of the different TDIs is presented in *Table 4*. The most prevalent TDI was enamel fracture and the most affected teeth were the upper central incisors. Statistically significant more upper teeth were traumatized compared to the lower ones ($p<0.001$). In the univariate analysis, smoking was a risk indicator for dental trauma ($p=0,008$), but in

the multivariate analysis, only perception of oral health, has given statically significant results (p=0,02)*(Table 7).*

Table 3. TDI prevalence according to demographic, socioeconomic and physical characteristics and habits for the 3 age groups (percentages %) and statistical differences

Parameters		**Age groups**								
		5yo (N=1222)			12 yo(N=1102)			15 yo(N=1131)		
		Presencedental trauma								
		Yes	No	P value	Yes	No	P value	Yes	No	P value
Gender	Male	64(10.8%)	531(89.2%)	0.171	64(11.6%)	490(88.4%)	0.026*	63(11.8%)	469(88.2%)	0,003
	Female	53(8.5%)	574(91.5%)		41(7.6%)	500(92.4%)		40(6.7%)	559(93.3%)	
Population	Urban	65(8.6%)	694(91.4%)	0.124	72(9.9%)	652(90.1%)	0.612	67(9.2%)	659(90.8%)	0,849
	Rural	52(11.2%)	411(88.8%)		34(9.0%)	344((91.0%)		36(8.9%)	369(91.1%)	
Maternal levelof education	Secondary	18(19.1%)	76(80.9%)	0.004*	22(10.0%)	198(90.0%)	0.591	17(8.6%)	181(91.4%)	0,186
	High school	66(8.5%)	708(91.5%)		54(10.1%)	479(89.9%)		58(10.7%)	485(89.3%)	
	University or higher	33(9.6%)	309(90.4%)		28(8.1%)	316(91.9%)		28(7.2%)	360(92.8%)	
Paternal level of education	Secondary	23(11.9%)	170(88.1%)	0.453	22(8.5%)	237(91.5%)	0.786	25(9.8%)	231(90.2%)	0.712
	High school	66(8.9%)	672(91.1%)		51(10%)	457(90.0%)		47(9.4%)	452(90.6%)	
	University or higher	27(9.9%)	245(90.1%)		31(9.4%)	299(90.6%)		30(8.1%)	342(91.9%)	
Perception about oral health	Excellent	17(8.5%)	183(91.5%)	0.917	20(6.3%)	300(93.8%)	0,047	22(6.8%)	300(93.2%)	0.006*
	Very good	52(9.4%)	500(90.6%)							
	Good	37(10.7%)	309(89.3%)		54(10.8%)	446(89.2%)		44(8.1%)	500(91.9%)	
	Average	10(10.1%)	89(89.9%)		32(11.5%)	246(88.5%)		37(14%)	227(86%)	
	Poor	1(14.3%)	6(85.7%)							
Overjet	Not increased	56(7.4%)	704(92.6%)	0.001*	98(9.5%)	935(90.5%)	0.537	100(9.2%)	990((90.8%)	0,788
	Increased	61(1.2%)	400(86.8%)		8(11.8%)	60(88.2%)		3(7.9%)	35(92.1%)	
Angle classification	Class I				46(8.5%)	498(91.5%)	0.428	47(7.9%)	545(92.1%)	0.355
	Class II				49(10.7%)	407(89.3%)		42(10.5%)	358(89.5%)	
	Class III				11(10.9%)	90(89.1%)		14(10.1%)	125(89.9%)	
Smoking	Yes							17(16.2%)	88(83.8%)	0.008*
	No							86(8.4%)	938(91.6%)	
Alcohol consumption	Yes							47(10.1%)	419(89.9%)	0.424
	No							56(8.5%)	604(91.5%)	
Piercing	Yes							2(8.3%)	22(91.7%)	0.894
	No							101(9.1%)	1006(90.9%)	
BMI (Attica)		5yo(N=141)			12yo (N= 150)			15yo (N=166)		
	Underweight	15.4	84.6	0.665	33.3	66.7	0.084	0.00	100.0	0.415
	Normal	8.2	91.8		14.1	85.9		13.1	86.9	
	Overweight	10.0	90.0		13.9	86.1		6.5	93.5	
	Obese	18.2	91.8		41.7	58.3		0.00	100.0	

Table 4. Distribution of types of TDIs and affected teeth, among the traumatized teeth for the three age groups

	Age groups		
	5yo (N=151)	**12yo (N=140)**	**15yo (N=130)**
Type of TDI (%)			
enamel fracture	49.7	60.7	53.07
enamel-dentin fracture	20.53	13.57	13.85
crown fracture with pulp involvement	0.66		
crown discoloration	24.5		0.77
fistula	1.32		
composite resin build-up	3.31	25.7	32.31
Type of teeth (%)			
Upper central incisors	83.44	80	79.23
Upper lateral incisors	11.92	7.86	12.31
Lower central incisors	3.97	10.71	6.92
Lower lateral incisors	0,66	1.43	1.54

Table 5. Multivariate logistic regression model of TDI indicators in 5-year-old children.

Factor	OddsRatio	95% C.I.	p-value
Population			
Urban*	1		
Rural	1.29	(0.80, 2.08)	0.289
Gender			
Male*	1		
Female	0.75	(0.50, 1.14)	0.177
Paternal level of education			
Secondary*	1		
High School	0.86	(0.47, 1.56)	0.621
University or higher	0.97	(0.47, 2.03)	0.941
Maternal level of education			
Secondary*	1		
High School	0.34	(0.17, 0.68)	0.002*
University or higher	0.38	(0.18, 0.84)	0.016*
Overjet			
Not increased*	1		
Increased	2.08	(1.37, 3.15)	0.001*
Perception about oral health			
Excellent*	1		
Very good	1.05	(0.57, 1.92)	0.886
Good	1.09	(0.57, 2.11)	0.794
Average	0.83	(0.33, 2.08)	0.699
Poor	1.78	(0.17, 19.08)	0.632

Table 6. Multivariate logistic regression model of TDI indicators in 12-year-old children.

Factor	OddsRatio	95% C.I.	p-value
Population			
Urban*	1		
Rural	0.98	(0.58, 1.66)	0.934
Fender			
Male*	1		
Female	0.60	(0.39, 0.93)	0.023*
Paternal level of Education			
Secondary*	1		
High School	1.52	(0.83, 2.79)	0.177
University or higjer	1.76	(0.82, 3.80)	0.150
Unknown	7.83	(0.07, 929.84)	0.398
Maternal level of education			
Secondary*	1		
High School	1.04	(0.56, 1.95)	0.902
Ανώτατη	0.65	(0.28, 1.48)	0.300
Unknown	1.49	(0.01, 185.09)	0.872
Overjet			
<=6mm*	1		
>6mm	1.14	(0.48, 2.75)	0.763
Angle classification			
Class I angle*	1		
Class II angle	1.07	(0.67, 1.72)	0.766
Class III angle	0.88	(0.39, 1.96)	0.752
Perception about oral health			
Poor/Average*	1		
Good	1.08	(0.65, 1.81)	0.760
Very good/Excellent	0.72	(0.37, 1.40)	0.337

Table 7.Multivariate logistic regression model of TDI indicators in 15-year- old adolescents

Factor	OddsRatio	95% C.I.	p-value
Population			
Urban*	1		
Rural	0.82	(0.49, 1.37)	0.459
Gender			
Male*	1		
Female	0.59	(0.38, 0.93)	0.021*
Paternal level of education			
Secondary*	1		
High School	0.94	(0.52, 1.71)	0.846
University or higher	0.93	(0.45, 1.92)	0.852
Maternal level of education			
Secondary*	1		
High School	1.37	(0.72, 2.62)	0.343
University or higher	0.82	(0.37, 1.81)	0.618
Overjet			
<=6mm*	1		
>6mm	0.77	(0.22, 2.75)	0.690
Angle classification			
Class I angle*	1		
Class II angle	1.19	(0.75, 1.90)	0.466
Class III angle	0.88	(0.43, 1.80)	0.734
Perception about oral health			
Poor/Average*	1		
Good	0.54	(0.32, 0.91)	0.020*
Very good/Excellent	0.57	(0.30, 1.08)	0.086
Smoking			
No*	1		
Yes	1.85	(0.97, 3.53)	0.062
Alcohol consumption			
No*	1		
Yes	0.92	(0.56, 1.50)	0.739
Piercing			
No*	1		
Yes	0.62	(0.12, 3.22)	0.567

Discussion

In the present study, children and adolescents 5, 12 and 15 years old, from Greece participated and the total TDI prevalence was found 12.2%. For the 5y/o group the prevalence of dental trauma was 12.5%, for the 12 y/o group 12, 7% and for the 15 y/o group 11,5%. In every age group examined, the most prevalent TDI was enamel fracture and the most affected teeth were the upper central incisors.Regarding risk indicators for the 5y/o group, maternal level of education and increased overjet significantly correlated with the occurrence of TDI, for the 12 y/o group, male gender was identified as a risk indicator, while male gender and worse perception of oral health were found to be the significant risk indicators in the 15y/o group.

To ensure high external validity, ten trained calibrated dentists with standardized methods participated in the clinical examination of the children. Stratified cluster sampling was chosen as the collection sample technique to permit representation of every social level, while overcoming cost and time problems in a scattered population like that of Greece. As a result, urban and rural areas of Greece were equally represented, in relation to their number of inhabitants, and the sample was representative of the Greek population. Another strength of our study was the investigation of specific age ranges and dentition stages, thus reducing age-related statistical heterogeneity, while providing evidence which is clinically translatable. Age and dentition specific risk estimates for TDI are important, to identify at-risk patients in a timely manner, counsel them about the aetiology and complications related to TDIs and inform them about appropriate preventive measures. This can also consequently decrease the need for emergency dental treatment.

The data from the present study show that the prevalence of dental trauma in children and adolescents was 12%. This percentage seems to be relatively low compared to results from population-based studies from all over the world *(Francisco et al 2013, Teixeira et al 2013, Bratteberg et al 2018).* However, these variations are common in trauma studies and reflect not only regional differences, environmental variations and socio-economic, behavioral and cultural diversities but also the lack of standardization in methods and classifications presented in the literature.In our case, the Ellis classification modified by Naidoo (2009) was preferred over others, as it is usually applied for epidemiological

surveys and can be compared with previous studies performed all over the world. Additionally, it is simple and broadly used in trauma studies and the standardization of the examiners is easier.

A recent meta -analysis by *Azami-Aghdasgh et al (2015)* found an overall trauma prevalence of 17,5%, with higher frequency in America compared to Asia or Europe which was attributed to the sports activities of youth. Furthermore, another interesting finding was that in regions where fluoride concentration of water is low, resulting in lower fluoride content in teeth, higher incidence of dental trauma is reported. In Greece there is no water fluoridation, but this does not seem to significantly affect the occurrence of dental trauma.

The prevalence of TDI for the 5-year-olds was 12, 4%, for the 12 -year-olds 12, 7 % and for 15-year-olds adolescents 11,5%, showing a slight decrease as children grow up, a finding that is in agreement with the relevant literature. *Cardoso et al (2002), Bratteberg (2018) and Oldin et al (2015)*, also found that the peak of TDIs in children are in the 8-10 y/o group while similar results have been previously reported for Greek children *(Oulis & Berdouses 1996)*. This can be explained by the fact that by this age, permanent incisors have fully erupted and are susceptible to trauma, especially in children with increased overjet. In the older ages, many of these children might undergo orthodontic treatment and consequently the risk of trauma is reduced. Additionally, at early ages children are usually more energetic,careless and risky in comparison to adolescents, features that can lead to falls and more TDIs. Furthermore, growing children need to adjust newly earned skills to the changing dimensions of their bodies. Growth is expressed first in the long bones and then in the muscles,which leads to a temporary decrease in flexibility. This loss of flexibility may be why participation in sports is the mostfrequent cause of injuries in children *(Pinkham & Kohn 1991)*.

Enamel fracture was found to be the most common type of TDI and central incisors were the most frequently traumatized teeth as reported in the majority of epidemiological studies in the literature *(Francisco et al 2013, Azami-Aghdash 2015, Bratteberg et al 2018, Eltair et al 2019*). This can be easily explained by the fact that these teeth are frequently protruding and may have insufficient coverage by the lips especially in Class II malocclusion cases. In a 5-year retrospective study of clinical records from 1-18 years old

Greek patients *(Agouropoulos et al 2021),* the most prevalent trauma was fracture injuries for the permanent and luxation injuries for the primary teeth. As aforementioned, in our study it was not possible to detect luxation injuries because radiographs could not be taken, so the types of TDI recorded were restricted to crown injuries with the exception of discoloration in primary teeth and fistula which could be the result of a luxation injury. The same Greek retrospective study reported that TDI affected boys more than girls and children aged 5, 7, and 11 years old had the most injuries, in agreement to the findings of the present study.

Risk indicators

Maternal education, increased overjet, male gender and perception of oral health, were identified as risk indicators in the multivariate models. Regarding low mothers' education as a risk indicator for trauma in the 5 yrs old children, this could be related to the parenting style in the family, since it is known that -for preschool children -maternal characteristics are correlated with oral health status. In our study, most of the socioeconomic data were not found to be important risk indicators for the occurrence of trauma. *Correa-Farria et al (2015)* had a similar conclusion in their meta-analysis on primary dentition but this is a controversial issue in the literaturefor the different age groups *(Fakhruddin et al 2006, Freire-Maia et al 2018)*. A recent study by *Bonfandini et al* found that university education of mothers, was associated with higher incidence of dentin/pulp trauma and they attributed it to higher socioeconomic status of these families that have greater access to high-risk conditions and unsafe environments, which increase the risk for TDI. In addition, more educated mothers are more often absent from home due to job-related demands, decreasing closeness and care for their children, which may ultimately lead to an increased exposure to risk factors for dental trauma.

In this same 5-years-old age group, increased overjet appeared as a predisposing factor, (p=0,001) in accordance with the systematic review of *Feldens et al 2016* on risk factors in primary dentition*. Born et al 2018*, also found overjet ≥3mm to be a strong risk factor for primary dentition. Many studies referring to permanent teeth also report overjet as a significant risk factor as proclination of anterior permanent teeth, leads to an inadequate lip coverage*(Marcenes et al 1999, Ain et al 2016*). In some studies, the overjet > 3–3.5 mm is defined as protrusion *(Francisco et al 2013, Ain et al 2016, Freire-Maia et al 2018*), but

in others, it is considered when overjet is> 5.0 mm *(Marcenes et al 1999)*. Such differences in the explanation of increased overjet makes it difficult to compare the results of various studies. A recent meta-analysis of *Arraj et al 2019*, has set the threshold of overjet as a risk factor for dental trauma for primary teeth at ≥3mm and for permanent teeth at ≥5mm. In our case, increased overjet for permanent teeth was set at ≥5mm and the results for the groups of 12 and 15 y/o adolescents were not statistically significant. This variation may be explained when considering that in these ages many children have already completed orthodontic treatment. Most surveys referring to overjet, were conducted in countries like Brazil and India. Therefore, the socioeconomic status and consequently the dental care of children in these countries could be lower and orthodontic assessment might be delayed, as well as the treatment of the exposing front teeth to trauma. On the contrary, in Greece, counseling for orthodontic treatment is usually done at an early age and orthodontic treatment is completed in early adolescence.

In the two older age groups, the number of boys presenting with a TDI were statistically significant higher than girls, and this seems to be a universal finding. This is mainly due to boys' behavior which is naturally riskier, as they participate more in contact sports, aggressive games and risk-taking behaviours according to social environment competitive activities, which increase the risk for accidents *(Glendor 2009, Francisco et al 2013 Teixeira et al 2013)*. Additionally, the fact that boys had suffered more traumatic injuries may be also explained by cultural factors *(Marcenes et al 1999,)* which has been also verified in other studies in the Greek population *(Agouropoulos et al 2021, Baxevanos et al 2016, Vanderas and Papagiannoulis 1999, Oulis and Berdousis 1996).* Nevertheless, it has been suggested that the gap between the genders is reducing, as girls participate more and more in risky sports and activities and are equally exposed to accidents and violence *(Teixeira et al 2013, Eltair et al 2019).*

Older children and adolescents that have a strong self-image perception, probably recognize that having a dental trauma (mainly fracture), leads to worse oral health. This is in accordance to the studies that show that TDIs –especially untreated ones- affect quality of life *(Cortes et al 2001, Lee and Divaris 2009*) and probably explain the finding that adolescents with TDI had worse perception about their oral health. An interesting finding in the adolescent group was the association between smoking and increased prevalence

of TDIs in the bivariate correlations. Smoking, together with alcohol consumption in this age group, probably relates to specific life styles that put individuals to increased risk of trauma because of frequent engagement to fights and accidents, low self-esteem, lack of behavioral skills and increased risk of using other drugs. In respect to intraoral and perioral piercing, this study did not find an association with prevalence of dental trauma, probably because of the few cases with piercing. In the literature, piercing has been correlated with local and systemic adverse effects and increased risk of enamel trauma, gingival trauma, periodontal recession together with other health problems (bleeding, swelling, hematoma, nerve damage, abscess, blood-borne infections etc*) (Plessa & Pepelassi 2012,Hennequin-Hoenderdos et al 2016).*

As far as correlation between BMI and dental trauma is concerned, this was recorded in only one region, no causal relationship was established and that is again is accordance with the systematic review of *Goettems and al (2014)* which showed that nutritional status and physical activity cannot be established as a risk factors for dental trauma. Probably obese children might not be so exposed to dental trauma because they tend to stay on their own and play mostly at home. Furthermore, they might possibly avoid playing sports and engage in risky activities and may be calmer and more careful.

A shortcoming of the design of our study is that traumatic dental injuries have probably been underestimated as in the reporting of TDI we could not collect data on crown-root fracture with/out pulp exposure, root fracture, or alveolar fracture as well as luxation injuries. These require radiographic examination, which could not be performed. Additionally, information obtained from questionnaires are subjective and cannot be validated. Cross-sectional studies are a type of observational study design that investigate exposure and outcome as a snapshot in time, and thus can help infer relationships between a disease and other variables. Due to their inherent nature, when compared with experimental designs, observational studies are more at risk of the influence of confounding factors and different sources of bias that are unavoidable. Although a causality between the risk-indicators assessed and presence of dental trauma cannot be established, the representative wide country sample allows us to have valid enough results that could be used for developing school and parent information campaigns, to prevent dental traumas all over the country, in the future. The systematic review of *Lopez*

et al (2019) showed that uncomplicated TDIs did not have negative impact on quality of life, whereas severe dental injuries affect everyday life of all the family because of the need to search for dental care urgently, causes stress and affect esthetics and social life *(Lopez et al 2019, Bendo et al 2014).* Therefore, organized preventive oral health strategies and emergency services for children and adolescents with TDIs, based on actual needs, are very important.

Some of the risk indicators studied like increased overjet, are modifiable, meaning that they can be controlled or altered in some way and the risk for TDI can be reduced. Interceptive orthodontic treatment can be done in order to reduce overjet, thus helping to minimize the risk for TDI in those individuals. Furthermore, mouthguards can also help reduce TDI occurrence during sports. Treatment options to prevent TDI should also take into consideration a patient's age, dentition status, as well as their behavioral and socioeconomic situation. Therefore, interceptive orthodontic treatment to prevent TDI cannot be provided for children in the primary dentition. If a child in the primary dentition presents with an increased overjet, the parents/caregivers should be counseled about the risk of TDI and its consequences. If a habit (eg. thumb sucking) is identified as an etiological factor for the increased overjet, then they should also be advised to discontinue it. Applying such approach could help identify more precisely patients at increased risk of TDI who may benefit from preventive measures, thus avoiding the possible negative consequences related to occurrence and management of TDI.

In conclusion, within the limitations of this study it was found that:

- TDI prevalence was **12,5%** for 5-year-old group, **12,7%** for 12-year-old group and **11, 7%** for 15-year-old group.
- In all age groups the most prevalent type of trauma was **enamel fracture** and the most frequently traumatized teeth were **upper central incisors.**
- In the 5-year-old group **maternal education** and **increased overjet** were the two significant TDI risk indicators.
- In the 12 and 15-year-old groups, **male gender** was the significant TDI risk indicator and additionally, in the 15 year-old group the **perception about oral health.**
- Socioeconomic factors may not be important risk indicators in the Greek population, with the exception of maternal education for the younger children.

- In older children and adolescents, TDI seem to affect the child's perception about his/her oral health.
- Smoking habits seem to be related with TDI in older adolescents.
- Our findings, in general, are in agreement with the international literature, regarding the risk indicators.

Summary

Traumatic dental injuries (TDI) are a public health problem and one of the main reasons for dental emergencies. Trauma studies in different regions are useful to identify groups and individuals at risk and contribute to the development of health strategies. The aim of this study was to assess the prevalence of TDIs and its association with socio-demographic and personal/behavioral risk indicators, in a national representative sample of 5,12- and 15-year-old Greek children and adolescents.

Materials and methods

The sample was selected according to the guidelines proposed for pathfinder surveys by the World Health Organization using stratified cluster sampling. The sampling was performed exclusively on children and adolescents in three age groups 5, 12, 15 years old according to the following inclusion criteria: 1) Written parental consent, 2) Greek citizenship, 3) healthy. The study population included samples from urban and rural areas. Collection of the sample was carried out by random selection of public schools in the proposed sampling locations.

Demographic data were collected from questionnaires answered by the parents/ legal guardians, while adolescents in the 12 and 15yo groups, answered a separate questionnaire on their dental history and personal habits like alcohol consumption, smoking and mouth piercing and perception about their oral health. All children with informed consent were examined in classrooms with artificial light, a mirror and a WHO periodontal probe. All participants were examined by 10 calibrated dentists and recorded dental trauma as: a) enamel fracture, b) enamel-dentin fracture c) crown fracture with pulp involvement, d) crown discoloration, e) fistula, f) composite resin build-up. All teeth in the dentition were examined. Overjet was recorded during maximum intercuspation using the periodontal probe in all children and in the 12& 15 yo age groups the permanent molar relationship was recorded according to Angle classification. Presence of piercing intraorally or on the lips was also recorded. Furthermore, weight and height were recorded for the children living in Attica only and the BMI was calculated for each child. Children were classified as underweight, normal, overweight, obese using the national reference growth curves.

Descriptive statistics (frequency, mean, and standard deviation, valid percents) took place, while multifactorial analysis was performed to study the simultaneous correlation of a number of variables with parameters of oral health using specific statistical models (negative binomial, fraction allogit and ordinal logistic regression models). Statistical significance was set to $p<0.05$.

Results

The sample consisted of 3.455 children, 1222 children 5 years old, 1102 children 12 years old and 1131 children 15 years old. For the 5yo group the prevalence of dental trauma was 12,5%. The most prevalent TDI was enamel fracture and the most affected teeth were upper central incisors. Statistically significant more upper teeth were traumatized compared to lower ones ($p<0.001$). Children with increased overjet were 2.08 times more likely to suffer traumatic dental injury compared to counterparts with normal overjet. Furthermore, mothers' low educational level was significantly correlated with increased trauma prevalence in young children. For the 12yo and 15 yo groups the prevalence of TDI was 13% and 11,5% respectively, the most prevalent TDI was enamel fractures and upper central incisors were the most affected teeth($p\leq 0,001$) in both age groups.Additionally, boys had experienced dental trauma significantly more frequent than girls (12yo: p=0,025, 15yo:p=0,003). In the 15yo teenage group, smokers were 1.85 times more likely to have suffered TDI than non-smoking peers while those with dental trauma were conscious that their oral health condition was worse compared to their counterparts with no TDI(p=0,008).The rest of the demographic and personal data, including the BMI, were not significantly correlated with the presence of TDIs.

Conclusions

Overall, around 1 in 10 children in each age group had suffered a TDI, the upper central incisors were the most frequently traumatized teeth, and enamel fractures was the most frequent type of trauma. Identified risk indicators were male gender, increased overjet, maternal education level and smoking, but were not the same across the three age groups. Interestingly enough, 15yo adolescents seem to be more self-conscious and acknowledge TDI as an oral health problem. The large and country-wide representative

sample was a big strength of this study, while a significant weakness was the limitationtoidentifyluxation injuries due to the study design.

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