PREVALENCE OF TRAUMATIC DENTAL INJURIES AMONG SCHOOL CHILDREN AGE 9 -- 12 YEARS IN KHAITOUM STATE

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Dedication

To My Family
My Parents, Brothers and Sisters
For being always with me
My Husband for his continuous inspiration
My children (Ziena, Mohammed, Mahmoud and Mustafa) for their love and understanding
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Abstract

A cross-sectional epidemiological survey was conducted in 1920 school children aged 9 – 12 years in public and private schools to study the prevalence of traumatic dental injuries and its relation to age, gender and socio-economic status and the correlation between the occlusion status, the overjet, the overbite, upper lip position, and the prevalence of trauma to the anterior teeth was studied. The studied parameters were obtained through a questionnaire conducted by the investigator. Andreasen's and Andreasen's classification (1981) was adopted for diagnosing and recording dental injury. Records of occlusion and lip position were taken.

In this study the prevalence was 28.2%, 542 students sustained fracture to 633 teeth. There is no significant difference between gender prevalence wise (52% for boys, 48% for girls). School children from private schools showed a slight increase in prevalence of fractured anterior teeth than the public ones 28.8%, 27.7% respectively.

The father educational level was found to affect the prevalence of incisal trauma a significant relationship was recorded as increase in prevalence of trauma with increased educational level of the father. (P = 0.01) while the mother educational level did not show any effect on the trauma prevalence. Children from working mothers exhibited less traumatic injuries (29.7%) than children from non-working mothers (68.8%).

Maxillary central incisors were the most affected teeth (86.7%), the most common type of injury is enamel fracture (89.7%). Falls constituted the bulk of causes for traumatic dental injuries in this study (43.7%) followed by collision with an inanimate (38.7%), bicycles (2.8%) R.T.A (1.5%) , violence and fights (1.2%). Most of trauma happened at home.
(55.7%). Trauma was received once in most of the cases (81%). Four hundred ninety eight children did not consult the dentist post traumatically (94%). Pain and esthetic were the main causes of dentist consultation. Children with malocclusion class II division (I) were found to be statistically significant for incisal trauma (P = 0.04). Overbite and anterior cross bite were found to have a significant relation with dental trauma. (P = 0.03)

Great association was found between increased overjet and incisal trauma, 41.9% of school children with overjet 35 mm – 8.9 mm had incisal injury while 66.7% of those with overjet > 9 mm had traumatic injuries to the anterior teeth. (P = 0.00).

The upper lip position recorded a statistically significant relation to anterior teeth trauma. (P = 0.000)
لا يمكنني قراءة النص العربي بشكل صحيح. من فضلك تأكد من أن النص العربي مشوهًا أو غير قابل للقراءة بشكل طبيعي.
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٢٢١ (٪٦٨) في الأصابات.
1.1 Introduction

Traumatic dental injuries in children and adolescents constitutes a serious dental problem. It is considered to be second to dental caries in children prevalence wise\(^{(1,2)}\). A side from pain, discomfort and inability to eat, traumatic injuries to the anterior teeth in children has a psychological impact on both the child and parents\(^{(3)}\). These injuries start as early as the child starts to crawl, reaching a peak incidence at adolescence\(^{(4)}\). According to the previous studies, the age group 9-12 years was found to be more susceptible to trauma of the anterior teeth due to the unrestrained activities of children in this age group. At this age and during the development of the facial complex, the permanent incisor teeth are usually prominent in their position being more vulnerable to trauma\(^{(5)}\).

The prevalence of trauma in children is showing an increase in some countries from 4-14% in the period from 1922-1970\(^{(6)}\), reaching nowadays up to 30-40% in other countries\(^{(7,8)}\). It is affected by many factors including age, gender, state of occlusion and lip position as well as the socioeconomic status.
Gender difference in occurrence of trauma in children is observed after the age of 9 years. The boys were found to suffer as twice as many injuries to the permanent anterior teeth as girls\textsuperscript{(9,10)}. After this age the boys become more active and energetic, while the girls get more quiet and stoical\textsuperscript{(11,12)}. The maxillary central incisors were found to have a greater incidence of traumatic injuries (80-90\%) than the mandibular ones and because of their forward position, they are more susceptible to trauma than the laterals and canines\textsuperscript{(13)}.

There are many factors which were claimed to be predisposing to traumatic dental injuries. They include increased over jet, lip incompetence, and class II division 1 (accident prone profile) malocclusion \textsuperscript{(14,15,16)}. The latter was reported to be associated with an incidence as twice as that associated with other types of malocclusion\textsuperscript{(11,14)}.

The commonest cause of dental trauma is falls which constitutes the large bulk of trauma cases, specially before school age\textsuperscript{(11)}. At school age different kinds of athletics specially contact sports such as foot balls, basket ball and ice-hockey, they all carry danger potentiality. Collision with objects or persons, bicycles and road traffic accidents are also common causes of dental trauma\textsuperscript{(10)}. 

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Sudan is a developing country, showing a remarkable growth and development in the last few years. This is reflected on the social, cultural as well as the economical aspects of life.

Prevalence of traumatic injuries among school children in Khartoum has not been investigated since 1981\(^\text{(17)}\), a period during which social, cultural and economical changes had occurred and indeed its reflection on prevalence of trauma is expected.

For all these reasons, it was decided to carry out such an investigation in Khartoum state.

The total estimated population of Khartoum State in the year 2002 is 4,944,742. However the actual census carried in the year 1993 was 3,51,145.

The Children in age group 9-12 years are estimated to be 479,102 for the year 2002; 247,530 of them are males and 231,572 are females.

**Characteristic of Target Population**

According to the Ministry of Education, there are 1226 public schools and 143 private schools in Khartoum state.

The target population were school children aged 9-12 years in Khartoum state, which constitutes of 7 provinces (now called localities). Greater Khartoum, Khartoum north and Omdurman localities were chosen to represent Khartoum state.
1.2 Objectives

- **Main objective**

  To estimate the prevalence of traumatized anterior teeth in school children age 9-12 years in Khartoum state.

- **Specific objectives:**

  1- To determine the main etiological factors of trauma to the anterior teeth in children in relation to age, gender and socioeconomic status.

  2- To investigate the correlation between the prevalence of traumatized anterior teeth and the occlusion status and lip position.

  3- To determine whether the child received treatment or not.
1.3 Literature Review

1.3.1 Definition:

Trauma means a wound or injury it could be physical or psychic. Physical trauma applies when a wound or injury is inflicted on the body by an external force and that may lead to dystrophic changes and/or inflammatory response of the affected part\(^{(18)}\).

Traumatic dental injuries could be a result of direct or indirect trauma\(^{(19)}\). Direct trauma is when the tooth itself is struck against a playground, a table or a door. This type of trauma usually implies injuries to the anterior region. Indirect trauma is inflicted when the lower dental arch is forcibly pushed against the upper arch. It usually results in crown or crown root fracture in premolars and molars region\(^{(9)}\).

It has been presumed that a number of factors are responsible for the type of the inflicted injury, such as energy of impact, resiliency and shape of the impacting object as well as the angle of direction of the impacting object\(^{(20)}\).

In 1970 Andreasen studied the etiology and pathogenesis of traumatic injuries among 1,298 cases and showed that the causes of injuries can possibly reflect the differences in energy of impact. Cases with injuries due to fall during play, represents a trauma
type of less impact energy than those cases with injuries due to fall from a bicycle or a motor vehicle and automobile accidents. Increase in energy of the trauma impact seems to be followed by an increase in bone injuries rather than tooth fractures. The investigator showed that the difference in the resiliency of the impacting object reflects the differences in injury pattern between fight injuries and a foreign body hitting the oral structure. The former represents a blunt or padded impact leading to periodontal ligament injuries, while the latter represents a hard unelastic impact that tends to cause tooth fracture rather than periodontal ligament injury. If the lip is hit first by trauma, it may possibly act as an impact absorber reducing the chance of fracture and increasing the risk of luxation\(^9\).

Dental injuries can affect both the primary and the permanent dentition. Primary dentition trauma starts as early as when the child fall from a baby bed\(^{21}\), and increases when the child starts to walk on unsteady legs that lack motor coordination\(^{12,5}\).

Due to the resiliency of the facial bones and periodontal plasticity, most of the traumatic injuries in young children are luxation injuries specially the Intrusive type\(^{(84\%)}\)^\(^{4}\). These intrusive luxations carry the danger of damaging the permanent
successors in children. Depending on the severity, direction of displacement and the stage of development of the permanent successor, the degree of damage to the permanent tooth can vary from simple hypoplastic or hypocalcified crown to the extreme manifestation which is dilacerations of either the crown or the root\(^6\).

Previous studies gave age 1 ½ - 2 ½ years as the age of peak incidence of trauma\(^{4,10,22,23,24}\) although some studies showed that age 2-4 years children exhibited most of the traumatic injuries to their anterior teeth\(^{25-27}\).

### 1.3.2 Classification:

In 1942 Sweet studied the incidence and pattern of fractured anterior permanent teeth\(^{28}\). Five categories were used to classify dental trauma in this study:

1: Enamel injury only.

2: Enamel and dentine injury.

3: Pulpal exposure.

4: Fracture at or below the gingival margins.

5: Restorations present, trauma status not determined.

The investigator depended solely on radiographic examinations to study each case of fracture taking into consideration, opened and
closed apices. Unfortunately this was not practical in epidemiological surveys.

In 1945 Ellis was the first to promote a universal classification of dental injuries. This classification started by four categories then modified by the same author in (1948) to eight classes starting by "simple fracture of the crown involving little or no enamel" to class 8 "fracture of the crown en masse and its replacement" (2).

In 1978 the W.H.O. developed a classification for dental injuries(29) which was modified by Andreasen and Andreasen in (1990) (30). They clarified variations in the original W.H.O. categories of luxation and intrusion injuries. This classification is descriptive, easily understood and allows better understanding of the trauma injuries and it allows minimal subjective interpretation errors. More over it helps in the selection of appropriate treatment, and the design of future research projects.

It consists of four main categories:

(1) Injuries to the hard dental tissue
(2) Injuries to the periodontal tissues
(3) Injuries to the supporting bone
(4) Injuries to the gingiva or oral mucosa.

These categories are further subdivided into classes.
1. **Injuries to the hard dental tissues:**
   
i. Crown infraction
   
   ii. Uncomplicated crown fracture
   
   iii. Complicated crown fracture
   
   iv. Uncomplicated crown-root fracture.
   
   v. Complicated crown root fracture.
   
   vi. Root fracture:

2. **Injuries to the periodontal tissue:**
   
i. Concussion
   
   ii. Subluxation
   
   iii. Intrusive luxation (central dislocation)
   
   iv. Extrusive luxation (peripheral dislocation, partial avulsion)
   
   v. Lateral luxation
   
   vi. Exarticulation (complete avulsion)

3. **Injuries to the supporting bone:**
   
i. Comminution of alveolar socket.
   
   ii. Fracture of the alveolar socket
   
   iii. Fracture of the alveolar process
   
   iv. Fracture of mandible or maxilla
4. **Injuries to gingiva or oral mucosa**

   i. Laceration of gingiva or oral mucosa

   ii. Contusion of gingiva or oral mucosa

   iii. Abrasion of gingiva or oral mucosa

   This classification can be applied for both permanent and primary dentition.

   However, in 1981 Garcia Godoy published another classification that consists of ten categories, then modified by the same author in 1983\(^{31}\). This classification is also a modification of the W.H.O, however it differs only in separating the dental fractures involving the cementum more over it differs from Andreasens classification in that it is not including neither the soft tissue injuries nor the injuries to the supporting bone (Appendix 1)

1.3.3 **Epidemiology of Traumatic Dental Injuries**

   1.3.3.1 **Prevalence**

   Studies carried on prevalence of traumatic injuries among children showed marked differences. This is due to differences in the study population, criteria of selection, mode of examination and differences in local customs and traditions. Clinical records studies and hospital materials showed trauma patterns which are different from those found in epidemiological studies.
The period from 1922-1972 showed a prevalence ranging from a minimum of 4.2% \(^{(32)}\) to a maximum of 20.24% \(^{(33)}\). (Appendix 2).

In 1951 Marcus designed a case–control study comparing the prevalence of dental injuries to the anterior teeth among delinquent and non-delinquent children. He found that the prevalence of dental injuries among the control group (the non-delinquent) was 16% \(^{(34)}\). Following this period prevalence records were ranging between 8-20% \(^{(1135,36)}\). Recently, Hamilton in 1997 and Almajed reported a prevalence of 34% \(^{(7,8)}\). (Appendix 3)

\textbf{(A) Prevalence in U.S.A & South America:}

According to the preliminary results from (NHANES II phase I), 38 million American's aged 6-50 years had evidenced some sort of incisal trauma and approximately 25% of the U.S. population had at least one traumatized permanent incisor and the majority of them were in the age group 6-20 years (18%) \(^{(37)}\).

In 1979 Macko et al examined 1314 school children aged 12-15 years in Massachutes for restored and un-restored fractured anterior teeth. The sample was evenly distributed between boys and girls. The total prevalence rate was 19.1% for both gender. (24.5% for boys and 13.7% for girls)\(^{(38)}\).
In Florida, Kania et al investigated the Risk factors associated with incisor injury in an elementary school children in a sample of 3396 school children aged 9-10 years, (52% of them were boys). The prevalence was 19.2% \(^{(39)}\). While in Harris County, Texas Alonge and his colleague examined 1039 for physical evidence of trauma (47% were boys and 53% were girls). The prevalence was 4.2 %. This figure appears to be under estimated due to the fact that the study did not take into consideration any past evidence of trauma, such as discoloration, avulsion, and restored teeth \(^{(40)}\).

Battenhouse et al studied traumatic injuries to the anterior teeth in an emergency room at Pittsburgh children’s hospitals, 46% of the 1456 cases examined for emergencies were found to be due to trauma to the anterior teeth caused by falls, athletics and fighting \(^{(41)}\).

On the other hand Bhat and Li in 1979 conducted a study on consumer product–related tooth injuries in hospitals emergency rooms, showed that 75% of dental trauma treated in U.S.A hospitals were among children younger than 15 years \(^{(42)}\).

In 1979 O’Neil et al, reported that 10,346 patients were treated at university of Missouri hospital for traumatic episodes, of these 7.3% were for injuries to the oral cavity \(^{(24)}\). In another study
in Montreal children hospital, the incidence of trauma among children was studied and was found to be high in children aged 3-4 years. It is noteworthy that children of the age group 1-2 years constituted the majority of the trauma cases (66.2%)\(^{(23)}\).

In Brazil at the university of Santa Catarina pediatric clinic a study to determine factors related to the occurrence of dental trauma in permanent teeth during a period of 18 month was studied among children age 7-12 years and the incidence was 61.1% for boys and 30.9% for girls. Age 8-9 years constituted the majority of the trauma cases\(^{(43)}\).

The correlation between socio-economic status and traumatic injuries to the permanent teeth was studied in Blumeau, Brazil where 652 school children aged 12 years attending both public and private primary schools were examined. The prevalence of traumatic injuries was 58.6%. Children from mothers with higher schooling experienced more dental injuries (68.2%) in comparison to those from mothers with lower schooling (56.6%), however the father’s educational level, the family income and the employment status were not statistically significantly affecting the trauma prevalence\(^{(44)}\).

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In Chile traumatic injuries in the primary and permanent dentition in children treated from 1990-1992 at the Children's Dental Hospital Traumatology Service were analyzed. A total of 227 records from patients of the age group 2-21 years were studied. 73 patients had deciduous teeth trauma while 154 patients received injuries to the permanent dentition. A total of 357 teeth were injured, 115 primary teeth and 242 permanent dentition. The age group 10-12 years had the highest number of injuries constituting 33% of the trauma cases\(^{(45)}\).

Garcia Godoy in the Dominican Republic executed an epidemiological survey on the prevalence and distribution of traumatic injuries to the anterior teeth in both the primary and the permanent dentition. He examined 1633 children of the age group 5-14 years and found a prevalence of 10% and no significant difference between boys and girls (5% and 5.1% respectively)\(^{(46)}\). While the same investigator conducted a retrospective study in Santo Domingo in 1200 school children aged 6-17 years and found a prevalence of 12.2%\(^{(47)}\). However in another study comparing private and public schools with regard to prevalence of traumatic dental injuries by the same investigator, 1200 school children from six private and six public schools were selected, the sample was evenly distributed between gender (600 each) and the age range.
was, 7 -16 years. The overall prevalence was 18.9% and that for the private schools and the public schools was 21.3% and 16.3 % respectively. The difference between the two types of schools was in the prevalence of one type of injury namely the enamel fracture(48).

(B) Europe

Several epidemiological surveys were conducted in Europe. In the United kingdom epidemiological surveys were held since 1942 (Figure 3). In Ireland O'Mullane et al examined 2792 school children aged 12-15 years and found a prevalence was of 16% (11).

In 1983 a national survey was conducted by Todd & Dodd who examined children aged 8-15 years in the United Kingdom. The aggregate prevalence was 10 -26 % and for the age group 13- 15 years was 18% (49). However O'Brien did the same national survey in 1993 and reported a prevalence ranging between 6-17 (50) .

An investigation on dento alveolar trauma and its treatment in an adolescent population was held by Hamilton et al in 1997 the first paper discussed the prevalence and incidence of traumatic injuries as well as the adequacy of treatment received. The sample was 2022 school children aged 11- 14 years. They were examined for clinical evidence of trauma and reported a prevalence of 34%. After 15 months, 1819 students were examined for new evidence of
trauma, 4% were found to have new injuries\(^{(8)}\). In a deprived area in Newham, London, Marcenes and Murray conducted a study on traumatic injuries among 14 years old children, and reported an increase in prevalence from 23.7% at the period 1995 – 1996 to 43.8% at 1998 – 1999, and that it was higher than the overall prevalence in the United Kingdom (17%)\(^{(51)}\).

In the north west of England, concerning the aetiology of dentoalveolar injuries and factors influencing attendance for emergency care among adolescents, Blinkhorn examined 2022 school children for evidence of dental trauma, 696 children had experienced dental injuries (34%)\(^{(52)}\).

In Switzerland a fourteen years follow up study about traumatic dental injuries to the permanent dentition among 262 children aged 6-18 years in a pedodontic clinic at university of Geneva revealed a prevalence of 10.8 % with the largest number of injuries among boys between age 9 and 10 years\(^{(53)}\).

An epidemiological data was collected from the orthodontic department at the Geneva dental school from 1987 to 1990, 300 patients represented 480 dental injuries of which 252 were primary teeth 228 were permanent teeth with traumatic injuries\(^{(54)}\).
In Spain Zaragoza et al examined 4000 school children aged 6-12 years in a rural area reported a prevalence of 5.7\% \(^{(55)}\).

In Sweden epidemiological studies included both urban and rural areas. Forsberg and Tedestam examined 1635 school children aged 7-15 years in a Swedish urban area for traumatic dental injuries and reported a prevalence of 30\%. Twelve percent of the injuries had been sustained before the age of 7 years and 18\% after that age and over 75\% of the reported injuries occurred before the age of eleven years\(^{(56)}\).

On the other hand in another study carried by Joesefsson and Kardlander, patients records from all children aged 7-17 years living in a rural area (750 children) were examined. The prevalence was 11.7\%, with 88 children presenting with 152 damaged teeth. In this study the majority of the traumatic injuries occurred among boys between age group 8-12 years (75\%), while among girls 63\% of the traumatic injuries happened between the age group 7-9 years\(^{(57)}\).

Brossen and Holm studied traumatic injuries during the life span of a cohort of 16 years old children in Northern Sweden, 3007 dental records from a dental public health service were examined. Thirty five percent of the children had sustained injuries to their primary or permanent teeth, 19\% were for permanent dentition
trauma, 20% for deciduous teeth trauma and 5% sustained trauma for both deciduous and permanent dentition \(^{(58)}\).

Recently in Sweden Glendor conducted a study about the incidence, the risk, the treatment and the cost of dental trauma in children and adolescent. The material was collected from accident reports, dental files and through dental trauma forms, the investigator found that the first years of life and the first years in school were the most accident prone periods with incidence twice as high as the average incidence for all children\(^{(59)}\).

In France 2020 school children aged 6-15 years were examined for clinical evidence of dental trauma the prevalence found was 13.5% (17.5% for boys and 10.2% for girls)\(^{(60)}\).

Gabris et al in Hungary, analyzed 590 children who presented for treatment at the department of children and orthodontics in Budapest over a period of 15 years (1985-1999). The majority of these children were in the age group 7-14 years accounting for 88% of this cohort study. The ratio of the permanent teeth to the primary teeth was 90:10 and the peak of trauma incidence was found to be at the age of 10 years \(^{(61)}\).

In Rome Italy Petti and Taristani studied the Prevalence and risk factors associated with traumatic injuries among 824
school children aged 6-11 years. The prevalence was found to be 20.26% (62).

In Austria a study held by Gassener et al on dental injuries as a result of alpine skiing, 784 patients presented with skiing related facial injuries of whom 326 (41.6%) sustained injuries to 639 teeth. The age groups predominantly affected were between 7 and 32 years (63).

**(C) Australian Studies:**

As part of a large survey undertaken during the year 1982 Burton and his colleagues studied the dental needs of secondary school students in two areas of northern Sydney, were 12287 students were examined for traumatic injuries to the anterior teeth and have reported a prevalence of 6% (64). While in another study concerning the dental health of south Australian country children, children of the age group 5-13 years who presented in the clinics were examined (5,597) and the prevalence varies from 0% at age 5 years to 28.9% in the 13 years old boys (65).

**(D) Asia:**

In Malaysia, prevalence of traumatic injuries to the anterior teeth in selected population groups gave different rates. In a study of 2132 children aged 16 years the prevalence was 6.1% (66), while
in another study, 1175 children aged 7-12 years were examined and the prevalence was found to be 3.9% \[^{(67)}\].

Esa and Razak examined a sample of 1519 school children aged 12-13 years in an urban and rural area and a prevalence of 2.6% was reported \[^{(68)}\], but in a recent study in the same country Nik Hussein reported a prevalence of 4.1% of traumatic injuries to the anterior teeth among school children in a sample of 4085 children aged 16 years \[^{(69)}\].

In central Taiwan a survey about incisor traumatic injuries among 1200 second grade students of central Taiwan revealed that 16.5% of the children had a positive history of dental trauma, but the actual clinical signs and symptoms of dental trauma were found only in 3% of the examined sample (43 teeth) \[^{(70)}\].

Lastly in India Rai and Munshi examined 4500 school children aged 3-16 years in south Kanara, India and reported a prevalence of 5.29% \[^{(71)}\].

**(E) Africa and Arabic countries:**

As part of a larger epidemiological survey Nagvi et al in Benin city (Nigeria) examined school children in the first class of two secondary schools and reported a prevalence of dental trauma of 19.06% \[^{(72)}\]. Also Bode falomo in Abadan (Dakar) found a prevalence of 15.98% in a sample of 2,979 students aged 10-17 years old school children \[^{(73)}\].

In the same country Otuyemi investigated traumatic dental injuries in 12 years old Nigerian children, a total of 1016 children reported 10.9% prevalence \[^{(74)}\].
In South Africa Hargreaves and colleagues examined 1035 school children aged 11 years old for anterior teeth trauma. The reported prevalence rate was 15.4% with an evidenced trauma in the white children 21.4% followed by the black urban 13.7% and the black rural 12.9% (75).

With regard to prevalence of traumatic injuries in several Arabic countries, an epidemiological survey was conducted in Damascus Syria by Marcenes et al, where a total of 1087 children aged 9-12 years were examined and a prevalence of 5.2% at age 9 years and 11.7% at age 12 years was found (76).

In Jordan Jamani et al investigated traumatic injuries in school children aged 10-12 years and found a prevalence of 15% (77). However in a comparative study 1995 between an urban and a rural area with regard to traumatic injuries among age 10-12 years children the prevalence was 19.2% and 15.5% respectively and the overall prevalence was 17.4% (78).

In Saudi Arabia, Al Majed et al investigated the prevalence of dental trauma in 5-6 years old and 12 – 14 years old boys in Riyadh and reported a prevalence of 34% for the permanent dentition and 33% for the deciduous teeth (7).

Iraqi studies were conducted on both deciduous and permanent teeth trauma. Baghdady et al (1981) did a comparative
study between Iraq and Sudan with regard to prevalence of trauma in school children aged 6-12 years, she examined 6090 primary school children in Baghdad and found a prevalence of 7.7%\textsuperscript{(17)}. While Alsayyab et al (1992) examined 306 children aged 2-13 years and found a prevalence of 15.3%\textsuperscript{(79)}.

In Sudan the only study done was held by Baghdady et al comparing Iraq and Sudan with regard to the prevalence of dental trauma among school children where 3507 Sudanese school children aged 6-12 years showed a prevalence of 5.1% for both gender\textsuperscript{(17)}.

**Variables affecting the prevalence of traumatic injuries in children:**

**A) Age:**

Trauma can happen at any age. However the literature revealed a great disagreement about the age at which the child is more susceptible to trauma. Because of the cumulative nature of the problem, it appears that the prevalence of trauma is increasing with age. A lot of previous studies recorded the age 1.5-2.5 years as the peak range for the deciduous teeth trauma. This was justified by that it's the period during which the child learns to walk with unsteady legs and tends to play with and carry dolls and things larger than their size. However the majority of the studies showed
a remarkable decline in the prevalence rate by the child reaching age 6 years \(^{(2,4,23,24,26,27)}\).

Andreasen and Ravn found age 2-4 years as the age group more susceptible to deciduous teeth trauma \(^{(10)}\).

In another study the frequency of trauma was found to be 10.5% at age one year, 20% at age 3 years and 13.3 % at age 4-5 years then it declined to 6.7 % at age 6 years \(^{(25)}\).

The age group 1-3 years was recorded in some studies to exhibit the peak incidence of trauma amounting to 50% of the trauma cases \(^{(80)}\).

Permanent anterior teeth susceptibility to trauma was found to be between age 9 and 10 \(^{(10,11,33,36)}\). Some studies showed differences between the peak of trauma incidence in both gender. A study in Sweden showed a prevalence of 63% among girls aged 7-9 years, and showed a prevalence of 75% among the boys of the age 9-12 years \(^{(57)}\).

A study in the United Kingdom gave 6% prevalence of trauma at age 8 years, 25% at age 12 years, 19% at age 13 years then remained around 20 % \(^{(52)}\).

The range of age 8-12 years was also recorded by Sanchez et al in Mexico, age 8 years showed a prevalence of 20% of the dental injuries reported, while it is increased to 40 % by age 12 years \(^{(80)}\).
In some Arabic countries age 11-12 years showed the highest prevalence of trauma occurrence accounting for 15% (77).

Baghdady et al recorded a prevalence of 19.5% for traumatic injuries in boys at the age of 12 years compared to 16.1% for girls of the same age group in Iraq. However in Sudan the prevalence was 16.5% in boys aged 12 years compared to 3.6% in girls in the same age group (17).

In some studies the age group 13-14 years also showed a high incidence of traumatic injuries than other age group (48, 73). Zadik et al found a prevalence of 19.6% of traumatic injuries at age 13 – 14 years, followed by 11% at age 10-11 years and decreased to 8.7% in the age group 11-12 years then increased to 14.6% in the age group 12-13 years (35).

Another study gave 29% prevalence of traumatic injuries at the age of 12 years rising to 33% at the age of 14 years (49).

Caliskan et al showed that children aged 11-15 years demonstrated the highest prevalence of trauma followed by age 6-10 years with a prevalence of 34.4%, 24.5% respectively (81).

Some other studies showed that there was an increase in the prevalence of traumatic dental injuries to the anterior teeth with age without demonstrating any peak of age (35, 38).

**B) Gender:**
In the earlier studies boys were found to have a higher dental injuries frequency than girls with boys to girls ratio ranging from 2.6-2.7:1\(^2,15,17,56,82,83\). However with time the incidence of dental injuries among girls appeared to have increased with a ratio ranging from 2.3-2:1 down to 1.2:1\(^9,11,16,17,35,36,45,53,64,72,78\), 84).

Some studies showed that there was no sexual dimorphism and that the prevalence of traumatic dental injuries among boys was almost similar to that among girls. \(^4,48,74,76\).

C) **Type of occlusion**

**Anteroposterior relationship**

Angle was the first to describe malocclusion according to the anteroposterior relationship between the upper first permanent and the opposing lower first permanent tooth. He classified this relation into 3 classes, class I, class II division (1), class II division (2) and class III \(^85\).

Earlier studies claimed that there is a strong relationship between trauma occurrence and class II division (1) malocclusion in children and some of these studies suggested early orthodontic intervention and treatment to minimize such risk \(^86,87\).

Eichenbaum examined 226 children with history of trauma to the anterior teeth and found that the greater bulk of trauma
(95%) happened in a group of children with class II division (1) malocclusion and he named them as "accident prone profile" (15). O'Mullane examined 2792 school children and also found a prevalence rate of trauma 12.8% among children with Angle class II division I malocclusion and 20% had one or more injured permanent incisors injured (P < 0.001) (11).

Kania and his colleague showed that there was no significant relationship between molar Angle classification and incisor injury occurrence (39).

**Protrusion and overjet:**

The Overjet (O.J) is the horizontal distance between the maxillary and mandibular incisors. It is measured as the distance from the most prominent point on the incisal edge of the maxillary incisor to the most prominent point on the opposing mandibular incisors (88).

The degree of O.J was considered to be normal when it lies between 1-3 mm (16, 89, 90, 91) while others considered 2-4 mm to be a normal O.J value (92, 93, 94). Generally a record of 5 mm or more was considered to be an increased O.J (17, 45, 74, 95, 96) but others think that a record of 6 mm or more should be considered as an increased O.J value (7, 89, 97).
A strong and significant relationship between the occurrence of traumatic injuries to the anterior teeth and O.J measurement was found in many studies \(^{(2,5,14,15,91)}\). An O.J greater than normal creates an obvious risk of injuries to the anterior teeth when there is a normal over jet the energy of trauma received is distributed along the larger occlusal contact surface between the upper and lower teeth. In addition to that the lip acts as a shock absorber decreasing the energy rendered \(^{(17)}\).

O'Mullane examined 2792 school children aged 6-14 years to determine the relation between the prevalence of injuries to the permanent teeth and incisors protrusion and lip coverage. The author found that 25% of the protrusive group sustained traumatic injuries to one or more of the anterior teeth while 12% sustained traumatic dental injuries in the non-protrusive group \(^{(11)}\).

In another survey Jarvenin studied the relationship between incisal O.J and traumatic injuries to the upper permanent incisors. He showed that the frequency of incisor injury was 14.2% in children with normal O.J (1-3mm), 28.4% in those with increased O.J (3.1 -6 mm) and 38.6% in children with extreme O.J ( > 6 mm)\(^{(16)}\). He stated that the severity of injuries is directly proportional to the degree of overjet reporting it as 19%, 22% and
47% for the normal, the increased and the extreme overjet group respectively\textsuperscript{(16)}.

The same findings were reported by Otuyemi in which he found most of the enamel fracture types were in children with average overjet of 4.3mm, while severe types of injuries (dentin and pulp involvement or root fracture) were seen in children with mean overjet > 5 mm\textsuperscript{(74)}.

Nquen and his colleagues in a review study concluded that children with an overjet larger than 3mm are approximately twice as much at risk of injury to the anterior teeth than children with O.J less than 3mm, and the effect was less for boys than for girls in the same O.J group. They also showed that the risk of injury to the anterior teeth tends to increase with the increasing O.J value\textsuperscript{(98)}.

**Over bite:**

Smith and Bailit(1979) defined the over bite (O.B) as the vertical distance from the incisal edge of maxillary central incisors to the incisal edge of the corresponding mandibular central incisors when the dental arches are in centric occlusion \textsuperscript{(99)}.

The degree of over bite was considered to be normal when it lies between 2-4mms\textsuperscript{(92)} and a record of over bite more than 5mms was considered as a deep bite\textsuperscript{(89)}. 
The relationship between the degree of overbite and the trauma prevalence was not taken into consideration in the previous studies. However, some studies found that children with oral habits that lead to open bite were more susceptible to traumatic dental injuries than those with normal overbite\textsuperscript{100}.

**Anterior cross bite:**

According to Kinaan 1977, anterior cross bite is defined as a condition when one, two or three maxillary incisors occlude lingual to the mandibular incisors and when the four incisors were involved the condition is called reversed overjet\textsuperscript{91}.

**D) Lip position:**

Lip position was claimed to be one of the strong predisposing factors that influence the degree of trauma sustained by the anterior teeth. It usually acts as a cushion or shock absorber to the anterior teeth when the child falls or stroked by an object.

Many studies found a significant relation between the position of the lip and the incidence of fractured anterior teeth\textsuperscript{2,11,14,17,98,103,104}.

Forberg and Tedstam found that children with short upper lip, or incompetent lips and children with mouth breathing habit had increased susceptibility to traumatic dental injuries\textsuperscript{56}.
In a study of traumatic dental injuries in Nigerian children Otueymi reported 65% of children with dental injuries have inadequate lip coverage compared to 25% in a control group\(^{(74)}\).

Marcenes et al (1999) found that children with inadequate lip coverage were more likely to have experienced dental injuries than those with adequate lip coverage (\(P = 0.000\)). Children with inadequate lip coverage constituted 15% of the trauma group while those with adequate lip coverage accounted for 6.5\%(\(76\)).

In another study Marcenes et al (2001) found there was a tendency for children with inadequate lip coverage to have more dental injuries (\(P = 0.1\))\(^{(44)}\).

In another study coming from Italy Petti and Taristani found that injuries to the anterior teeth were highly significant in children with short lip (\(P = 0.0001\))\(^{(62)}\).

1.3.3.2 Etiology:

Causes of dental injuries differ from one age group to another as well as from one society to another due to differences in the local customs and climate conditions which differs from one country to another and this in turn affect the type of traditional sport activities.
Infants and toddlers sustains injury due to falls from either a baby carriage, a bed, a high chair or during early years of walking with lack of motor – coordination\(^5\). Undefined falls were recorded as a major causative factor for traumatic dental injuries to the permanent anterior teeth with a range of 60 – 85 % in the previous studies records\(^{10,17,23,24,48,60,65,73,78}\).

In some studies collision with subjects or objects comes next to falls as a cause of traumatic dental injuries in children ranging from 9 to 20\(^\%\)\(^\text{44,76}\) but in a study coming from Sweden, collision was superior to falls giving a record of 16.7% compared to 14.7% for falls\(^\text{58}\).

Contact sports were also found to be one of the causative factors in trauma cases. From reports the etiology of traumatic dental injuries due to contact sport depends on the local and traditional sports encountered in each population as well as the climatic conditions in each country which governs the type of sport played at that area.\(^\text{56}\). In Scandinavian countries, studies revealed that ice- Hockey which is the most popular sport found there is a major cause for traumatic injuries to the anterior teeth accounting for 28%, while falls and collision accounted for 25% and 8% respectively. In this study falls were recorded more in girls.
(36.7%) and sports more in boys\textsuperscript{(105)}. In warm countries different activities were found In the Dominican Republic, base ball games caused trauma injuries more in boys (86%) while roller skates was responsible for 72% trauma injuries in girls\textsuperscript{(47)}.

A comparative study in northern Sydney between two different areas showed differences with regard to incisal trauma etiology. In one area falls to concrete ground and cycling were the predominant causative factors since it is a rural area. While the other area recorded pool injuries as the main etiological factor for anterior teeth trauma due to the abundance of swimming pools in that part\textsuperscript{(65)}.

Violence was under estimated in the previous studies as one of the causes for traumatic dental injuries. Some consider falls due to pushing as a minor form of violence while others considered it as falls only. Marcenes et al found violence to constitute 43% of the trauma causes because most of the falls were due to pushing specially against the water tab and this is considered as minor form of violence\textsuperscript{(76)}.

Road traffic accidents follow in sequence, with varying ranges from one population to another but usually are less significant ranging between 2-25\%\textsuperscript{(44,55,76,106)}. The highest prevalences reported were from the hospital material since
multiple traumas are usually determined with at the emergencies in these hospitals, while the lowest prevalences were reported from epidemiological surveys \(^{(105)}\).

1.3.3.3 Location, type of injury and number of teeth involved.

According to many studies the maxillary incisors were found to be the most frequently affected teeth by traumatic injuries. This is due to their prominent position in the jaws rendering them more vulnerable to direct forces and impacts. The maxillary centrals had the high percentage of traumatic injuries ranging from 60-90% \(^{(7,35,40,46,56,74,39,106)}\) then followed by the maxillary laterals, the mandibular centrals, the mandibular laterals, and the least to suffer were the canines in both jaws \(^{(39,40,50,70,73)}\).

With regard to the commonest type of fracture affecting the anterior teeth, epidemiological data differ from clinical studies. Since simple enamel fractures are not usually worrying they were not reported in the emergency clinics but they were predominant in the epidemiological surveys \((70-90\%)\) \(^{(7,17,35,60,73)}\). While the other classes of trauma affecting more tooth structure or causing luxation, mobility or pain or even totally lost teeth are recorded in the emergency or private clinics.
Petti and Taristani found that 64% of the traumatic dental injuries were enamel fractures and 21% of these were in children who can not recall any trauma or injury rendered to their teeth\(^{(62)}\). Onetto et al reported 34% for uncomplicated fracture (enamel and dentine fracture without pulp exposure) and 21% for complicated crown fractures\(^{(46)}\). While Kaba reported a prevalence of enamel and dentin fracture without pulp exposure mounting for 53% of the trauma cases\(^{(54)}\).

In a study in Jerusalem Dan Zadik and associates found 41% of the injured teeth were enamel fracture type of injury. Enamel and dentin fracture without pulp involvement accounted for 47%, with pulp involvement 8%, totally lost teeth following trauma were 3%, and 0.6% were displaced teeth\(^{(35)}\).

Baghdady et al in a comparative study between Iraq and Sudan found enamel fractures constituted 57% of the fractured teeth in Iraqi children and 70% in Sudanese ones. Enamel and dentin fracture was 29% in Iraqi children and 21% in Sudanese ones. Complicated fractures (enamel, dentine and pulp involvement) were 12% in Iraq and 6% in Sudan. Total loss of teeth due to trauma was 2% in Iraqi children and 3% in Sudanese ones\(^{(17)}\).
In a study in England Hamilton et al found simple enamel fractures to constitute 22% while other complicated injuries constituted 12% \(^{(8)}\). Other authors gave uncomplicated fractures greatest records mounting to 55% \(^{(47,55,82)}\).

Avulsions were not commonly encountered in the previous studies specially with the permanent dentition and ranges between 0.5- 2%\(^{(59,61,62)}\).

Single tooth trauma was Invariably reported in epidemiological surveys 60-70%\(^{(4,49,64,74,82)}\), while multiple teeth injuries tend to occur in the clinical studies and hospital data\(^{(83,106)}\).

Most of the previous studies agreed that trauma happened more frequently at home with a range of 40- 50% \(^{(17,45,48,59,60)}\).

Blinkhron found a prevalence of 34% traumatic dental injuries in 2022 school children, where 33% of them happened at home while 25% happened at school\(^{(53)}\).

With regard to Socio – economic status and its correlation to the prevalence of traumatic dental injuries of the anterior teeth in children not many studies were published.

Classifying the population on Socioeconomic bases differs from one study to another. Some studies found that the prevalence of trauma was greater in the low socioeconomic classes than in the higher ones\(^{(40,52)}\). In these studies different classifications were
used for socioeconomic levels e.g. in one study, levels of deprivation were classified according to overcrowding of houses and ethnicity. In another study in U.K. Acorn classification (A classification of Residential Neighborhoods), was used. It was found that increased prevalence of trauma injuries were among Acorn class III group (working class).  

In the U.S.A, a study used free lunch received by the students to classify the schools into Socioeconomic levels. Schools with greater than 20% of children receiving free lunch were considered as low Socioeconomic level and those with less than 20% were considered as high Socioeconomic class. An inverse relationship was found between the Socioeconomic status and incisal trauma. However, another study found that the prevalence was higher among children from mothers of high education levels, while the fathers educational levels and family income were not statistically significantly affecting the prevalence of dental trauma.

1.3.3.4 Treatment Received:

A lot of literature studies had discussed the types and management of dentoalveolar injuries extensively but few of these discussed the actual appropriate treatment services provided to such traumatic injuries in children.
At the second international conference on oral trauma in Stockholm; (1990) Andreasen and Andreasen showed that traumatic dental injuries is a large, costly and serious health problem and that the treatment services to manage such problem should be taken into consideration. They showed that there are relatively few publications discussing this subject and these seem to be declining with years(105).

The extent of adequacy of treatment received was studied by Hamilton et al (1997) using both clinical and radiographic examinations for 2022 children, of these only 12.4 % had a serious type of injuries that created a definite treatment need. Teeth that received treatment were 47%, of these 59% were considered to be inadequately treated. Twenty six root canal fillings were performed, of which only 2 were acceptable. Whereas of the 140 composite fillings performed only 64 (45.7%) were acceptable(8).

Pain and dissatisfaction with appearance were the main causes of attendance for treatment in many of the studies (8,46,72).

In some countries 1-2 % only of the traumatized children received actual treatment (7,74).

In Tanzania Kahabuka et al (1998) investigated the nature of initial treatment provided by dental practitioners to children Age 1-
17 years with various types of traumatic injuries at public dental clinics. The frequently reported treatment was extraction (64%), antibiotic prescription reported by 67%, soft tissue injuries, concussion and alveolar fractures accounted for 48% of cases in which antibiotics were prescribed. The study showed that improved and standardized treatment methods should be implemented in Tanzania (106).

The interval between trauma and emergency treatment is directly related to the severity of injury and the level of dental awareness of the patient and parents. Rusmah and Meon proved that 71.4% of class III fractures involving the pulp sought treatment early, while only 5.9% of class I fracture received treatment within one week (67).

Negligence of treatment was recorded by many studies (8, 73, 76). Holland et al found 50% untreated injuries involving enamel and dentin (85). Marcenes et al found 93.1% of the traumatized teeth with untreated damage. This is mainly due to minor injuries in some untreated cases, while cases that actually need treatment were 63.2%. However, 59.8% of those with obvious injuries to the teeth were not taken to the dentist (45).

In Saudi Arabia 2% only of the damaged teeth received treatment (7).
Chapter Two

2. MATERIALS AND METHODS

2.1 Study Area:

The present epidemiological survey was conducted in Khartoum State which is made of seven localities from which the three major localities, greater Khartoum, greater Omdurman and greater Khartoum north were selected as study areas.

The total population of Khartoum state was estimated to be 4,944,472 by (2002) with boys to girls ratio of 0.98 : 1.

According to a report by the Ministry of Education (2002) the school children of the age group 9-12 years in Khartoum State were reported to be 479,102 by the year 2002), of which 231,572 were girls and 247,530 boys.

2.2 The Sample:

The sample of this cross sectional epidemiological study was selected from school children of the age group 9-12 years in Khartoum State. A total of 24 schools (12 private and 12 public schools) were selected randomly in the whole state. In each locality 8 schools, 4 public and 4 private schools were selected. These schools were chosen as 2 private and 2 public schools for boys, and 2 private and 2 public schools for the girls.
\* Sampling technique: \*

The sampling technique adopted here was the multi-stage stratified sampling techniques in which the sampling units which are the schools were randomly selected in each province and geographically located with the permission and help of the regional directorate of education in each province. The total sample was 1920 pupils in each province 640 pupils were examined (inquiry unit) half of them (320) were boys and the other half were girls. This number was distributed equally between private and public schools (160 pupils each). (Annex 1)

Each inquiry unit was further divided into 8 clusters according to the age group, each cluster consist of 40 boys and 40 girls in both schools.

In the public schools the inquiry unit randomization was obtained through a list of students for each class submitted by the school authorities, from which the 1\textsuperscript{st} student in the list was selected then every third student was chosen. In the private schools the number of the students in each class is much less than required, so the whole class was examined and completed from another private school.
The number of students examined was increased more than planned to adjust for the excluded cases due to incomplete information.

**Exclusion criteria:**

1- School children with extensive caries in the anterior teeth.

2- School children with dental anomalies in tooth structure such as amelogenesis imperfecta, dentinogenesis imperfecta, or enamel or dentin hypocalcification were excluded.

3- Discolored teeth other than for trauma (intrinsic discoloration).

4- Case sheets with incomplete or incorrect information were excluded.

**2.3 Instruments and supplies:**

The following instruments and supplies were used.

Plane mirrors (No. 4) were used for examination together with dental probe (00).

Millimeter graded vernier (No L11-975 double scale 0-12 cm x 1.0 mm - GRIFFIN) with a depth gauge (Annex 2) was used for measuring the over-jet and overbite, metric ruler was used for double check.
Containers (one for sterilized and one for the used instruments and kidney dishes for cotton pellets which are used with tweezers to clean the labial surfaces of examined teeth from any debris.

Concentrated sterilizing solution, disposable gloves and masks were used.

An indelible pencil was used to mark the measurement needed on the tooth surface.

2.4 Methods of Data Collection:

Data collection was obtained through questionnaire and clinical examination.

2.4.1 Questionnaire

The questionnaire (Appendix 4) starts by general information about name, age, gender, area of residency and telephone numbers if present. Then the student was asked whether he/she received any blow or collision that led to fracture of any of their upper or lower anterior teeth. If the answer is (yes), further questions with regard to the trauma were asked, when, where and how did the trauma occur. Then the student was asked whether he went to the dentist after the trauma, for what reason and what sort of treatment they received.
2.4.2 Clinical examination:

Clinical examination was conducted in a room predetermined by the school authorities under standardized condition following the recommendations of the W.H.O. for the year 1997.

Natural day light was utilized through a window with the student seated in a chair with a high straight back rest in an upright position and in front of the examiner.

The examination was conducted in such a way to include the following:

(1) Lip position  (2) occlusion  (3) Traumatic injuries  
(4) Treatment received (Appendix 5)

1- Lip position

It is important to examine the oral tissues particularly the lip. The lip is usually to receive the trauma first, if this is the case, it usually acts as a shock absorber or a cushion reducing the chance of fracture and increasing the risk of luxation. The upper lip was classified according to its relative position to the upper central teeth. It was recorded with the child sitting in an up right position unaware of it and the mandible in the physiological rest position. (Jackson 1962)

The following positions were recorded: (Annex 3)
Position (0)  Middle third of lower border of the upper lip is positioned above the crowns of the central incisors.

Position (1)  Lower border of the upper lip covers any part of the cervical 1/3rd of the crowns.

Position (2)  Coverage extends to any part of the middle third of the crowns.

Position (3)  Coverage is extending to any part of incisal 1/3rd.

_2- Occlusion_

(A)  Anteroposterior occlusion:

Assessment was obtained according to Angle's classification (1899). It was done by direct inspection using mouth mirror for retraction on both lateral sides of the student Jaws when he/she closing in a centric occlusion, first molar maxillary and mandibular interdigitation relationship was observed, with special consideration to the effect of tooth migration in any side for e.g. due to premature loss of second primary maxillary or mandibular molars.

The following criteria was used

1-  Class I normal anteroposterior relation of the maxillary and mandibular dental arches in which the mesiobuccal cusp of
the upper first molar occludes on the mesiobuccal groove of the opposing lower first molar (Normocclusion).

2- Class II the mandibular arch being retarded in relation to the maxillary dental arch, this is further subdivided into

a) Class II division 1 with proclination of maxillary central incisors and increased overjet.

b) Class II division 2 with retroclination of maxillary central incisors and normal overjet.

3- Class III the incisal edges of the lower incisors lie anterior to the cingulum plateau of the upper central incisors and the overjet is reduced or reversed.

(B) Overjet: (Figure 4a)

The horizontal distance between the upper and lower incisors was measured using a millimeter graduated vernier with depth gauge when the student guided to close in centric occlusion.

The measurement was up to the complete 0.1 mm using the depth gauge.

An overjet $\geq 5$ mm up to 8 mm is considered as an increased overjet, while records of $\geq 9$ mm are considered extreme overjet. (Figure 4b)

(C) Overbite:
Using Darker's pencil method (1960) was recorded by cleaning the lower incisors by a tweezers and cotton to remove any debris or extrinsic discoloration on them. The student was guided to close in centric occlusion with the occlusal plane horizontal.

A sharpened indelible pencil was used to mark the amount of vertical overlap of the upper incisors on the lower incisors. When the student opened the distance from the incisal edge of the lower incisor to the mark obtained by the indelible pencil was measured using a millimeter graded vernier up to complete 0.1 mm.

An overbite > 5 mm was regarded as a deep bite. (Figure 4c)

(D) Anterior openbite: (Figure 4d)

Defined when the lower incisors are not overlapped by the upper incisors in the vertical plane and do not occlude with them.

It was recorded for present (Yes) or not present (No).

(E) Anterior cross bite: (Figure 4e)

Defined as when one or two or three maxillary incisors occluded lingually to the mandibular incisors.

It was recorded for present (Yes) not present (No). It was assessed by inspection only.
3- **Traumatic dental injuries:**

Clinical evidence of traumatic injuries on the upper and lower anterior teeth only was recorded utilizing Andreasens classification which was adopted by the W.H.O.in 1978 (International classification of diseases application to dentistry and stomatology 1969). Clinically fractured teeth were recorded but root fractures and crown root fractures were not recorded since no radiological examination was done.

Andreasen's classification concerning the fracture to hard dental tissues:(Figure8)

1- Enamel infraction or fracture. The fracture is confined to enamel.

2- Enamel dentin fracture(E+D) this was checked using the mirror and the day light for colour changes between enamel and dentin, also the Michigan probe is used to identify the dentin lay or sound.

3- Enamel dentin and pulp(E+D+P) recorded when the pulp horns are seen or felt by the probe. The fracture is extensive, presence of fistula is also recorded.

4- Extrusive luxation
5- Intrusive luxation: The former and the later positions were recorded if there is positive history of trauma and the affected tooth position will be compared with neighbouring teeth in the same occlusal plane as well as with the opposing occluding teeth.

6- Avulsion complete loss of the tooth from its socket due to trauma was recorded.

7- Tooth discoloration was recorded only if it is post traumatic.

4- **Treatment received:**

Students who gave a history of trauma to the upper or lower anterior teeth and went to the dentist post traumatic, were asked about the kind of treatment received.

1- No treatment

2- Follow up

3- Restoration

4- Pulp therapy

5- Extraction
2.4.3 Data Processing and Statistical Analysis

Entering of data and analysis was done using SPSS. The prevalence of the examined variables was calculated for each gender, age group and type of school.

The influence of gender and age was measured separately for the examined dental trauma variables using chi-square tests. The association between the occlusion variables (type of occlusion overjet, overbite, cross-bite and lip position) and the dental trauma variables was measured using chi-square tests.

For all the previous tests a probability value was used, a level more than 0.05 was regarded as insignificant, a p-value equal to or less than 0.05 was considered as significant while values of less than 0.01 were considered highly significant.
Chapter Three

RESULTS

A Total of 1920 school children age 9-12 years were examined, the sample was evenly distributed with regard to age, gender and between private and public school in each locality.

The prevalence of traumatized children was found to be 28.2% of the total sample examined (Figure 1) 542 students had 633 fractured teeth.

Boys showed a slight increase in prevalence of fractured anterior teeth accounting for 52% (282 cases) while girls showed a prevalence accounting for 48% (260 cases) however this was not significant among all groups (p = 0.99 x 2 = 0.08 d.f = 3) (Table 1).

School children from private schools showed a slight increase in prevalence of traumatic injuries accounting for 29% (276 students), compared to a prevalence accounting for 28% (266 students) in public schools children (Table 2 and 3).

Children from fathers of high educational level showed an increase in prevalence of traumatic injuries to the anterior teeth than those from fathers of low educational level (p = 0.014 x 292 =
2.2 d.f = 1) this was significant for both gender (Table 4). While the mother educational level has no effect on the prevalence of traumatic injuries in children of both gender (p 0.7 2 = 0.62 d.f. = 2 (Table 5).

School children of working mothers showed less traumatic injuries (30%) than those of non-working mothers (69%) (Figure 2).

Maxillary anterior teeth had the greatest bulk of traumatic injuries accounting for 92% (579 tooth) while the manidublar anterior teeth constitutes 8% (53tooth). Of these fractured teeth the maxillary central incisors showed the greatest prevalence of traumatic injuries (87%); followed by the mandibular central incisors (6%) then maxillary lateral incisors (5%) followed by mandibular lateral incisors (2%) and the least affected teeth were the maxillary and mandibular canines (0.8%) (Table 6).

With regard to the etiological factors for traumatic injuries in school children; falls were the most common factors constituting 43.2% then collision with objects or inanimate (38.7%), contact sports (2.8%), bicycles (0.7%), violence or fights (1.2%), R.T.A. (1.5%) and the remaining 12% failed to remember the actual cause of fracture. With regard to falls as a causative factor between
gender, boys and girls are almost the same in occurrence of trauma (22% and 21% respectively) while with collision with objects and persons, boys showed a slight increase (21%) than girls (18%), during contact sports boys reported slightly more cases of traumatic injuries (1.7%) than girls (1.1%) (Table 7).

Most of the fractures happened at home accounting for 55.7% followed by the school play grounds accounting for 15.6%, 3.1% occurred at sport areas. The remaining 23% were divided between those who reported different places of trauma occurrence (10%) and those who do not remember the actual place in which the trauma happened (Figure 3).

With regard to the time elapsed since the trauma happened; 60% reported a period of more than one year for both gender; 26% reported a period of less than one year; and the remaining 15% failed to remember the actual time of the trauma (Figure 4). 81% of the School children sustained trauma once, 3% sustained trauma twice to their anterior teeth and 3% received trauma more than two times; while the remaining cases failed to remember. (Table 8).
Distribution of sample according to the different classes of traumatic injuries showed that simple enamel fracture was the most common type constituting 89.7% followed by enamel and dentin fracture (6.5%); enamel and dentin fracture with pulp exposure (1.7%); intrusions (0.3%); extrusions (0.8%); avulsions (0.5%) and discoloration (0.5%). The degree of dental injuries was found to be consistently increasing with age. Simple enamel fractures were common in both genders while other severe types were common in boys (Table 9).

Results of the treatment received by the child post-traumatically; revealed that 498 (94%) cases declared that they did not consult the dentist after trauma, of these 449 had simple enamel fracture (90%), the remaining 50 cases had other types of trauma classes. (Figure 5).

Of the latter; 38 cases had enamel fracture with dentine exposed, in 7 cases there was enamel and dentine fracture with pulp exposure and 2 cases had discoloration of the teeth (Figure 6).

Following trauma 32 cases consulted the dentist, of these in 14 cases the cause of consultation is pain, swelling, discoloration or
discharge, while the remaining 18 cases went for conservative treatment and check up (Figure 7).

Twenty five cases of these patients received invasive treatment including restorative treatment for 7 cases, pulp treatment for 3 cases. While 10 cases received only antibiotic and 5 cases had extraction (Table 10).

The correlation between the prevalence of trauma and state of occlusion was found to be significant with class II division (1) malocclusion (31.2%) of the trauma cases followed by class 1 (28.3%) and class 111 (29.7%) and less significant for class II division (2) constituted (10.5%), \( (p = 0.04) \times 2 = 7.859 \) d.f = 3 (Table 11).

On the other hand; a highly significant association between the prevalence of traumatic injuries and the over jet measurements was found, children with a normal overjet of less than 5mm showed a prevalence rate of 22.6% of the trauma cases while children with an increased overjet showed an increased prevalence of 42% with overjet 5-9 mm, mounting to 67% in those with >9 mm overjet \( (X_2 = 64.00, p = 0.00) \) (Table 12).
The degree of overbite appeared to show a reverse proportion with the trauma prevalence. The deeper the overbite the less the trauma occurrence \( (\chi^2 = 4.5, \ p = 0.03 \ d.f. = 1) \) (Table 13).

The anterior cross bite was found to be significantly related to anterior teeth trauma \( (\chi^2 = 9.7, \ p = 0.01 \ d.f = 1) \) (Table 14).

The upper lip condition showed a highly significant relation to traumatic dental injuries to the anterior teeth. Children with lip position 3 showed a prevalence rate of 23.5%, lip position 2 cases (28.8%) lip position 1 cases (37.4%) and lip position 0 prevalence rate increased to 66.7%. \( (\chi^2 = 18.624, \ p = 0.000) \ d.f = 3 \) (Table 15).
Table (1): Distribution of trauma according to age and gender

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Boys</th>
<th>Girls</th>
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<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
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<tr>
<td>9</td>
<td>57</td>
<td>10.5</td>
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<td>10</td>
<td>77</td>
<td>14.2</td>
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<td>11</td>
<td>70</td>
<td>12.9</td>
</tr>
<tr>
<td>12</td>
<td>78</td>
<td>14.4</td>
</tr>
<tr>
<td>Total</td>
<td>282</td>
<td>52</td>
</tr>
</tbody>
</table>

P = 0.99

Table (2): Distribution of trauma cases according to gender and type of school

<table>
<thead>
<tr>
<th>Gender</th>
<th>Type of School</th>
<th>Boys</th>
<th>Girls</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public</td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With trauma</td>
<td>135</td>
<td>28.1</td>
<td>131</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Without trauma</td>
<td>345</td>
<td>71.9</td>
<td>349</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>480</td>
<td>100</td>
<td>480</td>
<td>100</td>
</tr>
</tbody>
</table>
Table (3): Distribution of trauma according to age and type of school

<table>
<thead>
<tr>
<th>Age</th>
<th>Private</th>
<th></th>
<th>Public</th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>54</td>
<td>19.6</td>
<td>55</td>
<td>20.7</td>
<td>109</td>
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<tr>
<td>10</td>
<td>79</td>
<td>28.6</td>
<td>67</td>
<td>25.2</td>
<td>146</td>
</tr>
<tr>
<td>11</td>
<td>71</td>
<td>25.7</td>
<td>66</td>
<td>24.08</td>
<td>137</td>
</tr>
<tr>
<td>12</td>
<td>72</td>
<td>26.1</td>
<td>78</td>
<td>29.3</td>
<td>150</td>
</tr>
<tr>
<td>Total</td>
<td>276</td>
<td>100</td>
<td>266</td>
<td>100</td>
<td>542</td>
</tr>
</tbody>
</table>

P = 0.55
### Table (4): Distribution of Trauma cases according to fathers' education level

<table>
<thead>
<tr>
<th>Fathers' Education Level</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
</tr>
<tr>
<td>With trauma</td>
<td>194</td>
</tr>
<tr>
<td>Without trauma</td>
<td>543</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>737</strong></td>
</tr>
</tbody>
</table>

P = 0.01
**Table (5): Distribution of Trauma cases According to mother’s educational level**

<table>
<thead>
<tr>
<th>Mother’s Educational Level</th>
<th>Total</th>
<th>No.</th>
<th>%</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Primary</td>
<td></td>
<td>Secondary</td>
<td></td>
</tr>
<tr>
<td>With trauma</td>
<td></td>
<td>245</td>
<td>12.6</td>
<td>297</td>
<td>15</td>
</tr>
<tr>
<td>Without trauma</td>
<td></td>
<td>664</td>
<td>34.4</td>
<td>714</td>
<td>38</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>909</td>
<td>47</td>
<td>1011</td>
<td>53</td>
</tr>
</tbody>
</table>

*P* = 0.7
Table (7): Distribution of Trauma According to Cause and Gender

<table>
<thead>
<tr>
<th>Cause</th>
<th>Gender</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>Falls</td>
<td>118</td>
<td>21.8</td>
</tr>
<tr>
<td>Collision with objects or person</td>
<td>122</td>
<td>20.7</td>
</tr>
<tr>
<td>Contact sport</td>
<td>9</td>
<td>1.7</td>
</tr>
<tr>
<td>Bicycles</td>
<td>4</td>
<td>0.7</td>
</tr>
<tr>
<td>Road traffic accidents</td>
<td>5</td>
<td>0.9</td>
</tr>
<tr>
<td>Violence or fights</td>
<td>5</td>
<td>0.9</td>
</tr>
<tr>
<td>Don't remember</td>
<td>31</td>
<td>5.8</td>
</tr>
<tr>
<td>Total</td>
<td>282</td>
<td></td>
</tr>
</tbody>
</table>
## Table (8): Repetition of Trauma by Gender

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Gender</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Once</td>
<td>236</td>
<td>43.5</td>
</tr>
<tr>
<td>Twice</td>
<td>12</td>
<td>2.2</td>
</tr>
<tr>
<td>More than twice</td>
<td>10</td>
<td>1.8</td>
</tr>
<tr>
<td>Do not remember</td>
<td>24</td>
<td>4.4</td>
</tr>
<tr>
<td>Total</td>
<td>282</td>
<td>52.0</td>
</tr>
</tbody>
</table>
### Table (10): Treatment Received by Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Follow up and antibiotic</th>
<th>Restoration</th>
<th>Pulp treatment</th>
<th>Extraction</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Girls</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>25</td>
</tr>
</tbody>
</table>
### Table (11): Distribution of Traumatized Children in Relation to Antero Posterior Occlusion (Angle Classification)

<table>
<thead>
<tr>
<th>Antero posterior Occlusion</th>
<th>Class I</th>
<th>Class 2</th>
<th>Class 2</th>
<th>Class 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Div. I</td>
<td>Div. 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Without Trauma</td>
<td>1201</td>
<td>71.7</td>
<td>117</td>
<td>68.6</td>
<td>34</td>
</tr>
<tr>
<td>With Trauma</td>
<td>474</td>
<td>28.3</td>
<td>53</td>
<td>31.2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>1675</td>
<td></td>
<td>170</td>
<td></td>
<td>38</td>
</tr>
</tbody>
</table>
Table (12): Distribution of Traumatized Children in Relation to Overjet

<table>
<thead>
<tr>
<th></th>
<th>&lt; 0</th>
<th>Overjet 5-8.9mm</th>
<th>&gt; 9</th>
<th>N.R. 0-4.9</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>Without Trauma</td>
<td>1</td>
<td>100</td>
<td>1164</td>
<td>77.4</td>
</tr>
<tr>
<td>With Trauma</td>
<td>0</td>
<td>0</td>
<td>339</td>
<td>22.6</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>1503</td>
<td>317</td>
<td>15</td>
</tr>
</tbody>
</table>
Table (13): Distribution of Traumatized Children in Relation to Overbite

<table>
<thead>
<tr>
<th>Cases</th>
<th>Open bite</th>
<th>0 – 4.9 mm</th>
<th>5 mm or more</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without</td>
<td>56</td>
<td>4.1</td>
<td>1122</td>
<td>81.4</td>
</tr>
<tr>
<td>With</td>
<td>18</td>
<td>3.3</td>
<td>456</td>
<td>84.1</td>
</tr>
<tr>
<td>Total</td>
<td>74</td>
<td>1549</td>
<td>297</td>
<td>1920</td>
</tr>
</tbody>
</table>
Table (14): Distribution of Traumatized Children in Relation to Anterior Cross Bite

<table>
<thead>
<tr>
<th></th>
<th>Anterior Cross-bite</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Without Trauma</td>
<td>101</td>
<td>1272</td>
</tr>
<tr>
<td>With Trauma</td>
<td>19</td>
<td>532</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>120</td>
<td>1800</td>
</tr>
</tbody>
</table>
Table (15): Distribution of Traumatized Children in Relation to Upper Lip Position

<table>
<thead>
<tr>
<th>Upper Lip Position</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Without Trauma:
- Without: 2 (33.3), 92 (62.6), 886 (71.2), 397 (76.5), 1378 (71.8)
- With: 6 (66.7), 55 (37.4), 359 (28.8), 122 (23.5), 542 (28.2)

Total: 9, 147, 1245, 519, 1920

\[X^2 = 18.624 \quad P = 0.000 \quad \text{d.f} = 3\]
Chapter Four

DISCUSSION

The sample for this study was selected from the three major localities of Khartoum state (which consists of seven main localities), Greater Khartoum, greater Omdurman and greater Khartoum north to be more representative unlike the sample selected in 1981 by Baghdady and colleagues which was taken only from Khartoum city at that time. The sample was distributed evenly between gender as appeared according to the last national census in the year 2002 the male to female ratio was almost equal (0.9 : 1).

Ravn stated that it is a difficult task to compare one dental trauma study with another, as few epidemiological surveys are similar. They differ in methodologies, in diagnostic criteria as well as in population and sample selection. Epidemiological data differs from clinical ones.

The prevalence of trauma in this study was 28.2%, it was higher than that found by Baghdady and colleagues (5.2%) in her comparative study between Iraq and Sudan. This increase is expected due to the long time elapsed since the last study, a period during which Sudan showed a remarkable growth and
development in every aspect of life, economically, culturally and socially. The reflection of this on the style of life from a primitive to a more modern high quality of life and the change of children activities is identified.

The prevalence in this study was higher than many of the old studies, Ellis 4.2% (1948), McEwen and AL 7.5 (1967), Beck 9.4% (1968), Akpata 14.5% (1969), but there are some old studies reported higher prevalence than this study Andreasen and Ravn (1972) and Holm (1975) gave a prevalence of 30%.

The prevalence of this study was also lower than recent studies in some countries, Forsberg and Tedestam 30% in Sweden (1990), Hamilton in UK 34% (1997), Marcenes in a study in Brazil 58.6% (2001), Sanchez in Mexico 40% (1990). The prevalence in this study is lower than in Saudi Arabia. A study by Al Majed et al reported 34% prevalence of trauma among Saudi children aged 12-14 years.

While it was higher than studies carried out in some Arabic countries, in Syria Al Beiruti et al found 11.7% (1999). In Jordan, Fayyad et al 15% (1991), in Iraq, Alsayyab 15.3% (1992). It is also higher than Italy Petit and Tarsitaini (1996) 20.26%. Brossen and Holm in Sweden 20% (1997), Obrien UK 19% (1994), Kaste et al in U.S.A. 18.4% (1988
-1991), Garcia Godoy in Dominican Republic 19.4% (1981). In South Africa Hargreaves gave a prevalence lower than in this study 15.4% (1995), it is also higher than Along et al in Texas study among children in Harris country 2.4% (2001). Otuyemi et al gave a prevalence of 10.9% in Nigeria it is lower than in this result (1994), in India Rais et al 5.29% (1998), the result here is also more than in France it was 13.6% in a study by Delattre et al (1995), in Taiwan Chen et al 16.5% (1999), in Sweden in a rural area the prevalence was 11.7% (Josefsson et al (1994), Nik Hussein in Malysia gave a prevalence lower than that in this study 4.1% (2001). It is also higher than in the prevalence reported by Zaragoza etal in Spain 5.7% (1998).

With regard to age, the majority of studies in the literature showed that the risk of trauma in the permanent anterior teeth increase with age reaching a peak at 12 years then remained stable (10,15,17,34,48,61,82,85,103,108).

The result of this study has also showed that trauma is increasing with age however this increase here is in a form of burst rather than being steady. The findings showed a prevalence increasing at age 9-10 years (burst 1), remaining almost the same at age 11 and then increasing at age 12 (burst 2) especially in boys. This comes in agreement with some studies (17, 59).
In this study, the frequency of trauma in boys was slightly higher than girls (282,260 of ratio 1.1 : 1 respectively), but the difference was not significant. This is dissimilar to the previous study done by Baghdady and colleagues who reported a significant gender difference with an increased prevalence in the old age groups (2.6 : 1). The author attributed that to the more calm attitude of the Sudanese girls at this age and to the more conservative behavior adopted during puberty. This might sound logical as in this age the girls are usually involved with household activities and controlled social gatherings. However, due to the great social and cultural changes, the girls become more involved in many social activities, in sport and outdoor activities and hence vulnerable to traumatic dental injuries. Similar results of this study were shown by Otuyemi, Marceues and AlBeiruti, Garcia Godoy, Jamani and Fayyad.

The result also showed a significant increase in trauma among children of fathers with high educational level. In the majority fathers of high educational levels who invariably have good income enjoy a modern style of life in housing, furnishing and even in schooling. For example; the furniture now is changed to big and bulky designed beds made of metal increasing the risk of trauma; this was reflected obviously in this study as 65% of trauma
occurred at home. On the other hand the mother's educational level did not show a significant difference in the frequency of trauma among their children. Children from working mothers showed less trauma incidence than that of non-working mothers (29.7%, 68.5% respectively), this may be explained by that working mothers usually think of a place or a person to take care of their children during their working hours either from a person in the same house as it is common in Sudan to keep the children under the supervision of a grand mother or even a hired housekeeper. There were no many studies with regard to parents educational level, the only study done in Brazil by Marcenes et al(2001), which showed a disagreement with this result, reporting that children from mothers with higher schooling experienced more dental trauma than those with lower schooling and that father educational level is not significantly associated with dental injuries.

The result showed that maxillary incisor teeth constituted the majority of the trauma cases (91.6%) this comes in agreement with almost all of the previous and existing literature (2, 6, 15, 17, 34, 35, 64,88). The maxillary central incisors were the most affected teeth (86.7%) followed by mandibular centrals and maxillary laterals then mandibular lateral incisors and lastly were the canines. This was shown by many investigators (6,15, 48, 60, 73, 79) and it is not
unexpected as maxillary central incisors erupts earlier and hence they are at risk for a longer period than the other teeth. Over an above they are situated more frontally than the maxillary Lateral incisors and canines, they are more prone to trauma than mandibular ones as the mandibular teeth are protected by the lower lip\(^{(17)}\).

The causes of traumatic injuries in this study were falls being the major cause, followed by collision, contact sports, bicycles and the lastly violence and fights and road traffic accidents as minor causes. With similar to the majority of the studies boys being more involved in outdoor activities showed an increase in contact sports than girls\(^{(3,5,6,12,17,24,31,32,34)}\).

On the other hand Marcenes et al in Syria who found violence to be the main cause of trauma, followed by traffic accidents then collision with inanimate and objects and the least is falls. Josefson reported collision, falls then Violence 10% (1994). Most of the fractured anterior teeth surprisingly happened at home (55.7%) followed by school playground (15.6%). No significant differences were found between the gender in relation to place of trauma this is in agreement with Virgin Baghdady findings. This was also in agreement with Ravn, Chen YL 1999 and Schatz and Joho 1994 results, this is due to that children are supervised by the
teachers inside the schools and their activity is much controlled, another explanation is the change that happens in the design and architecture of the houses towards more modern styles, even the furniture, the beds design is totally different from the old ones, with high and elevated sides made of metal instead of the traditional wooden bed with flat bed sides. Most of the cases with trauma in home were due to either fall on a bed side or collision with it (29.8%).

Similar to the majority of studies tooth fractures in this study were simple enamel fractures (89.7%) (7,17,16,39,50,58,61,63,65,73,74,78,83,85), followed by enamel and dentin (6.5%), enamel, dentine and pulp exposure (1.7%), avulsion and discoloration (each 0.5%). This is expected in epidemiological studies in which enamel fractures of the simple type predominates unlike the clinical data which is obtained from emergency clinics or hospitals in which the more complicated type of fracture had the greatest bulk.

The severity of dental injuries was found to be more in boys than in girls, with the severe types of trauma almost twice in boys than in girls specially with old age groups, this is probably due to the vigorous and rough play characteristic in boys at this age unlike the girls of the same age who tend to be more calm and quiet.
The result showed that of the 498 children who did not consult a dentist after trauma, 449 children were having simple enamel fractures, but in the remaining 49 there were 38 cases with enamel and dentin fracture, 7 cases with clinically evident pulp exposures and 2 cases with discoloration and 2 with totally missed teeth. Only 32 cases reported they consulted the dentist after trauma, 22 cases were either for pain/swelling or change in colour and 10 cases only were looking for restorations.

Out of the 542 children who had dental trauma only 25 cases received actual treatment, 10 cases of these received restorative treatment (7 restorations and 3 root canal treatment) 5 cases had extraction and the remaining had symptomatic treatment. Unfortunately the removed teeth were not replaced immediately, possibly due to lack of knowledge and awareness among the dentists about the right emergency management at the right time of the traumatic injury. Moreover it appeared that there was a lack of awareness among the parents as well as the teachers about the emergency management and handling of the traumatically injured teeth and the importance of reporting immediately to the dentist.

The quality of the treatment received can not be discussed here as it was not possible to use more diagnostic tools like radiographs or pulp testing and others.
Most of the children in this study received trauma once (80.9%). Three percent of the trauma cases received trauma twice while 3.3% received trauma more than twice. Repetition of trauma in boys is greater than in girls this is in agreement with some studies\(^\text{(45,61,98,30)}\).

There was a strong relation between the prevalence of traumatic dental injuries and malocclusion specifically increased overjet and class II div I \((p=0.04, p=0.000\) respectively). This was in agreement with the findings of some of the previous studies \((11,71)\). Similar to Jarvinen findings the calculated relative risk ratio was 2:1 in the increased overjet group and 3.3:1 in the extreme overjet group. Jarvinen considered an overjet of 3 mm to be normal, >3 mm increased overjet and 6 mm as severe overjet.

The result showed a significant relation to children with overbite less than 5 mm \((X^2 = 4.5 \ P = 0.03. \ df = 1)\). This was understood as the less the vertical coverage of the upper incisors to the lower incisors the greater is the risk of trauma. The lack of contact between the upper and lower teeth results in concentration of forces to the tooth or arches receiving the trauma and hence increase the risk of trauma or damage.

The present study showed a highly significant relation ship between lip coverage and risk of trauma incidence, the result
showed that the shorter the lip coverage the greater the risk of trauma occurrence. In record (O) the children with trauma constituted 66.7%, in record (I) 37.4%, record (2) 28.8% and only 23.5% cases with record (3) received trauma. This relation was highly significant. This significance of the above mentioned relation was also reported in many previously published studies, Mcewen (1976), Korns (1991), Otuyemi (1994), and Marcenes and Albeiruti (1999). The amount of lip coverage is recorded as explained previously by the length of the lip covering the crown not by the thickness of the lips. When it is inadequate or it is raised due to protrusion of upper maxillary teeth this lip protection is lost. The claim by Bghdady and her colleagues that the low prevalence of traumatic dental injuries in the Sudanese children compared to the Iraqi counterparts is attributed to the thickness of the lips found in the Sudanese people is a mere fallacy. In fact the sample of the Sudanese children she had selected were from Khartoum state, a state most of its inhabitants do not belong to the tribes in whom the lip thickness can be observed. However if there is an anatomical feature that characterize the Sudanese in general and the Africans in particular is the so called bimaxillary protrusion. A characteristic should be associated with increase in the traumatic rather than a decrease. There for the lower prevalence of traumatic
dental injuries coated by Baghdady et al among Sudanese children could be due to the indoor life they usually favor.

CONCLUSION

- The prevalence of traumatic dental injuries among school children aged 9 - 12 years in Khartoum State was 28.2%. A total of 542 students had 633 fractured teeth.
- Differences in prevalence between boys and girls were not statistically significant, 52% in boys and 48% in girls.
- School children from private schools showed slight increase in prevalence of traumatic injuries than from public ones 28.8%, 27.7% respectively.
- The father's educational level had a significant relation to the
trauma prevalence for both gender. Children from fathers with high educational levels showed significant increase in prevalence than those from fathers of low educational level (P = 0.01).

- The mother's educational level did not show any significant relation to the trauma prevalence.
- Children from working mothers showed significantly less traumatic injuries to their anterior teeth than children from non-working mothers.
- The maxillary anterior teeth were found to constitute the bulk of fractured teeth (91.6%) while the mandibular teeth received only 8.4%. The maxillary central incisors constituted the majority of the fractured teeth 86.7%.
- Most of the trauma to the anterior teeth happened at home (55.7%) and school playground (15.6%).
- Falls constituted the greatest bulk of the etiological factors (43.2%) followed by collision with persons or objects (38.7%).
- Simple enamel fractures were the major type of trauma encountered in this survey (89.7%) followed by enamel and dentin fractures (6.5%).
- Most of the children with fractured anterior teeth did not consult the dentist post traumatically 498 cases corresponding
to 94%. While 32 cases only consulted the dentist about their trauma.

- The treatment received by these patients can not be evaluated here because only clinical evidence of trauma was recorded and no other diagnostic tools were used, Such as radiographs to decide whether the treatment is satisfactory or not.

- The main cause of attendance to the dental clinics post traumatically was pain, followed by swelling and/or discoloration and discharging fistula (43.5%).

- The study showed that children with class II division 1 and children with excessive overjet measurement were more susceptible to trauma injuries to the anterior teeth than other groups.
RECOMMENDATIONS

- The study was confined to urban children, a more comprehensive study is needed to compare the prevalence of dental trauma between the urban and the rural community.
- The socio-economic status parameters in this study were interpreted as private and public schooling to classify high and low socioeconomic classes, other parameters such as occupation or the parent's income should be taken into consideration together with the child behavior and psychology.
- Although it is difficult to prevent trauma occurrence, health educational programs to the parents; school children and school staff might help reducing the number of damaged teeth as well as dealing with emergency cases.
Educational program regarding the risk of violence in schools to reduce all types of injuries should be started. Creation of a safe environment, in housing, furniture and construction of toys.

Traumatic dental injuries is a serious public health problem and raising the awareness of the public about this matter and the importance of consulting the dentist after trauma should be instituted at least using proper examination forms for recording the trauma cases in the school health services and the emergency and private dental clinics.

Treatment received by the traumatized children seems to be insufficient compared to the high prevalence of traumatic dental injuries. This insufficiency may be due to lack of knowledge about the right emergency treatment at the right time by those dealing with the trauma cases or lack of facilities. Further investigations using more diagnostic tools such as radiographs, pulp testing should be used as well as sending questionnaires to the dental practitioners to determine the type of treatment offered by them to the traumatically injured children. Dentist population ratio should be taken into consideration.

Early orthodontic intervention might help in reducing the
trauma incidence in children with class IIdivision1 as well as those with excessive over jet records and short lip coverage.

- Children participating in organized sports are recommended to wear mouth guard.
- Bicycles and motorcycles riders should wear helmets to reduce the risk of trauma to head and neck. Children should be seated on their own seats with the seat belt fastened.
- Non accidental injuries were not included in this study. More emphasis should be applied on this subject in future studies.
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