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Beatriz de Moura Carmo

School injuries in children who resort to the pediatric emergency department: an epidemiologic 3-year retrospective study

Acidentes escolares em crianças que recorrem ao serviço de urgência pediátrica: um estudo epidemiológico retrospetivo de 3 anos

março, 2018

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Pediatria

TÍTULO DISSERTAÇÃO/~~MONOGRAFIA~~ (riscar o que não interessa)

School injuries in children who resort to the pediatric emergency department: an epidemiologic 3-year retrospective study

ORIENTADOR

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“Try to leave this world a little better than you found it.”
R. Baden-Powell

Aos meus Professores

School injuries in children who resort to the pediatric emergency department: an epidemiologic 3-year retrospective study

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Abstract

Objective: The goal of this study was to describe the epidemiology of school injuries evaluated in a 3-year period at the São João Hospital Center – Pediatric Emergency Department (SJHC-PED) in Porto, Portugal (volume ~ 79,000 patients/year), as well as to clarify if the emergency department software system (JOne) is suitable as a school injury surveillance system.

Methods: A 3-year (2014-2016) retrospective review of the electronic clinical data collected from the JOne, was carried out among children aged 3 to 17 years who were classified by the SJHC-PED's reception staff as having sustained a "school injury".

Results: A total of 20325 cases were analyzed. The injury rate was 48.4:1000 students per year. Severe cases accounted for 19.4% of all cases. Musculoskeletal complaint was triage's most frequent main complaint (69.2%), and 65.9% of patients were discharged by the orthopedics medical specialty. Correct/valid principal diagnosis coding, using the International Classification of Diseases, Ninth Revision, Clinical Modification, was registered in 56.1% of all the emergency episodes.

Conclusion: Our results support clinical perception concerning the burden of school injuries in the SJHC-PED. The JOne is an important source of information. Although, it proved to be an insufficient tool for the surveillance of school injuries. Altogether our findings reinforce the need of an articulated strategy between health and educational services to report and prevent school injuries.

Key Words: schools; wounds and injuries; epidemiology; pediatrics; emergency service, hospital

Introduction

School is widely accepted as a “safe space” by the general population, since it is perceived as a supervised environment for the transmission of knowledge and skills acquisition.[1] At school, children (“every human being with less than 18 years old”[2]) engage in several activities that range from traditional classroom learning, to the practice of sports. During these activities, they may also be involved in many hazardous situations that take place in the school setting.

The child’s typical risk-taking behavior combined with peer and surrounding interaction within a supervised or non-supervised area, transform the school in an environment prone to injury. [3-5] Furthermore, the time of risk exposure is high, considering that children spend around 25%, up to 50% of their daytime at school, five days per week.[6, 7]

Injury in children is considered a major health problem and numerous organizations worldwide have focused their efforts in reducing child associated injury mortality and morbidity.[8, 9] An injury surveillance system is an essential instrument by which reliable information is collected and analyzed to produce a statistical overview of the injury problematic. This data could be utilized to plan and monitor effective prevention strategies, in a local, regional or national context.[9, 10]

According to the Child Safety Report Card, published by the European Child Safety Alliance, Eurosafe in 2012, childhood injury in Portugal was still a leading cause of death. Although some good initiatives and projects were implemented, more actions are required to improve the overall child safety in Portugal. This report also highlighted the need to establish an integrated injury surveillance system to allow the study of injuries and the development of evidence-based prevention strategies.[11, 12]

School injuries are not related to a high risk of fatal injuries, however they are a major cause for disability, and socio-economic burden. Although previous evidence support that the school environment offers privilege circumstances to ensure effective injury prevention measures, school injuries still account for a significant proportion of the pediatric injuries. [4, 13] More, prevent the school injuries will also help in the development of healthy and safe habits among children, which ultimately leads to a more productive and safe school.[14]

Multiple international studies have already described injury patterns associated with school injuries, and effective prevention strategies, supported by school injury surveillance systems, were defined.[5, 15-17] These studies also showed that injury rate and injury specific patterns tend to vary from country to country, and even from school to school.[5, 18]

In Portugal there is no centralized data regarding school injuries. So far, all the implemented studies described school injuries from a local perspective and for a short-time period. Thus, this precludes the monitoring of the school injuries, as well as the proper evaluation of the prevention strategies.

The necessary data to create an injury surveillance system can be collected from the information made available in the clinical and administrative records of a Pediatric Emergency Department (PED).[19] In the São João Hospital Center – Pediatric Emergency Department (SJHC-PED; Porto, Portugal) all the clinical and administrative data, regarding emergency episodes, is registered in the JOne software system. The system was built with the main purpose of allowing the registration and consultation of the clinical information in the PED. The software, entirely developed by the SJHC professionals,

undergoes through regular updates to better fulfill the needs from both medical professionals and patients. [20, 21]

Within the clinical staff of the SJHC-PED, the current perception is that school injuries are a considerable burden to the PED. Thus, the aim of this study was to describe the epidemiology of school injuries evaluated in a 3-year period at the SJHC-PED. More, we intend to clarify if the JOne software system is suitable as a school injury surveillance system. To our knowledge, this is the first study to describe the epidemiology of school injuries in the SJHC- PED. This constitutes an important topic of discussion within the national public health system, because the medical assistance to a school injury must be provided by a public health institution in order to be entitled to the school insurance. [22]

Methods

Design and Setting

A retrospective electronic chart review was conducted during a 3-year period (from January 1st 2014 till December 31st 2016) at SJHC-PED, in Porto, Portugal.

The São João Hospital Center (SJHC) is an urban, university-affiliated hospital with a catchment area of approximately 800 thousand inhabitants. The SJHC-PED is a metropolitan PED that serves 5 cities from the Oporto district (Porto, Maia, Valongo, Matosinhos and Gondomar) and receives more than 79,000 visits per year, from an estimated population of over 130,000 children. The SJHC-PED is the only public PED of this region. [21, 23]

This study was approved by the hospital's ethical commission.

Patients

All the pediatric patients aged 3 to 17 years who were admitted in the reception desk of the PED with a "school injury" were included in this study. An emergency episode is labeled as a school injury whenever the child or his responsible adult (parent/family member or the school staff accompanying the child) state at the reception desk that the cause of attendance to the PED is an injury sustained during an activity under the school's responsibility, as defined by the Portuguese legislation.[22]

Data collection and analysis

All the data used in this analysis was automatically exported from the JOne system to a spreadsheet, meaning, the cases were not individually checked.

The number of annual emergency episodes in the SJHC-PED was obtained from an official document published by the SJHC.[23] The number of students per year (2014, 2015 and 2016) grouped by academic level and city was obtained from the online database PORDATA and used to calculate the injury rate.[24]

To this study the following variables were considered: age, sex, date and hour of the emergency episode, time spent in the PED, wait time to consultation, medical discharge specialty, principal diagnosis, triage score, triage main complaint, hospitalization, requirement of medical analyses, radiologic exams or medical treatment, and patient origin (walk-in, with a referral from other health center or brought in by emergency vehicles).

Age was grouped according to the academic level: kindergarten [3,6[years, 1st cycle [6,10[, 2nd cycle [10,12[, 3rd cycle [12,15[, and high school [15,18[.

Triage variables analyzed included triage score according to the Paediatric Canadian Triage and Acuity Scale (PaedCTAS), and triage main complaint, which is registered by triage nurses who integrate the patient's complaint into an organ system or a medical specialty. Triage score was also categorized into severe (Level I – Red, Level II – Orange and Level III – Yellow) and non-severe cases (Level IV – Green and Level V – Blue).[25, 26]

The JOne software system utilizes the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) tabular list of diseases and injuries to code the principal diagnosis of an emergency episode. Emergency doctors can select the diagnosis from a list provided by the JOne, based on the ICD-9-CM tabular index. The principal diagnoses codes where grouped into two variables: ICD-9-CM chapters and injury type. To evaluate correct/valid coding we further categorize the ICD-9-CM principal diagnoses codes into: Supplementary classification of external causes of injury and poisoning (all diagnoses with a code correspondence to that specific chapter), diagnoses without ICD-9-CM coding (all the principal diagnoses that presented a written diagnoses recorded in the system, but no correspondence to an ICD-9-CM code), insufficient coding (the diagnoses that have not been coded to the full number of digits required by the guidelines) and correct/valid coding (codes with the full number of digits required by the guidelines). [27]

All data was systematized and analyzed using the SPSS 25 (Armonk, NY: IBM Corp). Descriptive statistics were computed for all variables.

Results

A total of 20325 emergency episodes were registered by the reception staff as “school injury” from January 2014 till December 2016, representing 8.4% of the total 240763 cases treated in the PED for the 3 years.

The injury rate calculated was 48.4/1000 students for the total of the three years. The injury rate increased every year: in 2014 the rate was 47.8/1000; 2015 was 48.2/1000, and in 2016 was 49.2/1000 students.

The age group with the higher percentage of injuries was the [12,15[(30,3%). The group with the highest incidence rate was the [10,12[. Kindergarten group presented the lowest frequency and incidence rate from all groups. [Table 1]

The boy:girl ratio was1.2:1 (10979/9346). Boys are more frequently injured than girls in all the age groups, except in the older group from 15 to 18 years old, when girls invert this trend. [Figure 1]

More than 90% of patients were walk-ins (94.1%), 3.2% were referenced from other health centers and 2.4% were brought in by emergency vehicles.

When considering the triage score, a higher frequency of injuries, 78.4% (15932), were screened as Level IV – Green, followed by Level III – Yellow with 18.6% (3772), and Level V – Blue with 1.9% (385). Only 3 cases were classified as Level I – Red, and 172 cases as Level II – Orange. The severe cases accounted for 19.4% (3947) of all cases. When considering this data by age group, the ratio non-severe:severe for the three older age groups ([10,18[) is similar, approximately 5.4:1, while the [6,10[group presented 2.6:1, and the group [3,6[showed a non-severe to severe ratio of 1.9:1. Boys suffered a higher proportion of injuries classified as severe when compared to girls (Boys – 3.3:1, and Girls – 5.7:1 non-severe:severe). [Figure 2]

The most reported triage main complaint was the musculoskeletal (69.2%). The neurologic/CNS complaint accounted for 10.7%, the dermatologic for 8.0%, and the ophtalmologic/otolaryngologic to 7.7% of the cases.

Approximately seventy-one percent of the injured students required radiologic exams (71.2%), and 74.4% received medical treatment in the PED. Only 0.9% required medical analysis.

Regarding ICD-9-CM diagnosis, 72.9% of the diagnosis were coded in Chapter 17 “Injury and Poisoning” and 17.0% were coded in Chapter 13 “Musculoskeletal System and Connective Tissue”. Only two Chapters did not have corresponding codes: Chapter 11 “Complications of Pregnancy, Childbirth and Puerperium” and Chapter 15 “Certain Conditions Originating in the Perinatal Period”. Chapters 1 - “Infectious and Parasitic Diseases”, 2 - “Neoplasms”, 3 - “Endocrine, Nutritional and Metabolic Diseases, and Immunity Disorders”, 4 - “Diseases of the Blood and Blood-Forming Organs”, 7 - “Diseases of the Circulatory System”, and 14 - “Congenital Anomalies” were the chapters with the lowest frequency of coded diagnoses (a total of 62 coded diagnosis).

Contusion with intact skin surface was the most frequent injury (30.8%), fractures accounted for 6.0% of all injuries. Sprains and strains were diagnosed in 10.4% of cases, while open wound was diagnosed in 10.1% of cases.

Correct/valid coding was performed in 56.1% of cases. Incorrect coding included diagnosis with no ICD-9-CM code correspondence (2.4%), Supplementary classification of external causes of injury and poisoning (0.2%), and diagnosis with insufficient number of digits to a correct/valid coding – insufficient codding (39.9%). [Table 2]

Orthopedics and pediatric surgery were the most common medical discharge specialties, accounting for 65.9% and 21.0% of all the school injuries discharges, respectively.

Hospitalization was necessary in 1.4% of cases (275), from those 41.5% (114) were diagnosed as fractures in the PED.

A greater proportion of the visits to the PED were registered in the months of October (14.7%), November (13.4%) and May (12.6%). December, September and June recorded a similar frequency attendance (6.7%, 5.5% and 4.8%, respectively), the same was observed to February, March, January and April (10.9%, 10.5%, 10.4% and 9.7%, respectively). July and August combined, recorded the lowest percentage of visits (0.9%).

Tuesday, Wednesday and Friday registered a similar attendance frequency (19.9%, 19.3% and 19.4%, respectively). The highest percentage of injuries occurred on Thursday (22.0%), and the lowest on Monday (17.2%). Two percent of the visits occurred on weekends (2.2%; Saturday and Sunday).

The majority of patients resorted to the PED between 09h and 19h (87.2%). Between 19h to 09h, 12.8% of patients were admitted to the PED.

The mean time spent in the PED was 103 minutes (1h43m), and the mean waiting time to consultation was 34 minutes. Considering each month, the mean time spent in the PED is rather similar, although July and August, comparing to the other months, had had the smallest mean time spent in the PED [Figure 3]. October, November and December are the months with the higher waiting time to consultation, while July and August presented the smallest waiting time. [Figure 4]

Discussion

Overall, our results support the clinical perception concerning the burden of school injuries in the SJHC-PED. Further, the JOne system is an important source of information, but the data collected from it does not suffices to the surveillance and monitoring of the school injuries[10]. Our findings reinforce that is mandatory to create an articulated strategy between health and educational services to report and prevent the school injuries.

The results from this study also highlighted that the injury rate at the SJHC-PED is higher than those previously reported, when considering the hospital as a data source (48.4:1000 students per year).[5, 28] This discrepancy may be justified by the lack of school nurses in Portugal, since the Portuguese school system does not contemplate school nurses as a part of the School Health Program.[29] Thus, all the school injuries and diseases that occurs within the school responsibility are brought to an emergency department for evaluation. An alternative explanation is that the PED is commonly used as a primary care facility, that is, people resort directly to the PED without previous evaluation from the primary care providers. Supporting this assumption is the low percentage of cases referred from other health centers (3.2%). More, the low percentage of severe injuries presenting to the PED (19.4%) and the low rate of hospitalization (1.4%) also reinforce the previous assumption. These findings are not surprising since the first evaluation of the injured child is performed by the school staff with no medical expertise, meaning that the decision to transport the child to the PED is based on common sense. Therefore, a large amount of injuries probably did not need a medical assessment in a PED, and could be treated in the school grounds using general care measures, or in a primary care provider. Furthermore, during the three years considered in this study, the injury rate showed an increasing trend that may be related to social issues or to architectural changes made to the Portuguese schools during the last decade. In spite of that, to further evaluate this topic a deepen analysis should be considered.

Some other variables from this study can further clarify the burden of school injuries in the SJHC-PED. The monthly rate of school injuries presents a seasonal distribution, reflecting the discrepancy between school days and holidays. More, most of the emergency episodes occurred during the week within the school schedule (09h to 19h). Weekend visits or visits between 19h to 09h can be explained by parents bringing their children to the PED after the school schedule. Ideally, the child should be brought for evaluation immediately after the injury, but in some cases complaints may manifest later. Furthermore, the waiting time to consultation during the months of October, November and December (when the school injury rate is also higher), highlighted the overload of the emergency departments during the autumn/winter period. Thus, it is not surprising that the waiting time to consultation is higher than in other seasons.

In the SJHC-PED, the most reported triage main complaint is the musculoskeletal (69.2%), and orthopedics is the most requested medical specialty in the injury context (65.9%). Despite that, the current organization of the SJHC-PED is not suitable to respond to such demand, because children with a musculoskeletal complaint are first seen by a pediatric surgeon, then they do the radiologic exams, and finally they are seen by an orthopedic specialist within the adult emergency department. So, the current procedure seems to contribute to a higher burden of the emergency department.

Regarding the demographic variables, our results are similar to those from the review study of Laflamme and Menckel,[5] that is, boys have a higher injury rate than girls, and the difference decrease across the development. In accordance to our results, this review study also show that preadolescents are generally the group with the highest injury rate, although the evidence concerning the association between injury rate and age group vary in different directions depending on the school or region. Different studies use several definitions of injury severity, which makes comparisons difficult.[18] Our reults point that boys and younger students suffer a higher proportion of severe injuries, probably due to the more risk-taking behavior associated with boys, and to the different stages of physical development of children.[3, 8]

Concerning the JOne system and, as previously referred, it was not designed with the main purpose of injury surveillance.[20] However, it allows the direct download of the data without consulting the individual charts, which is considered an important feature of an injury surveillance system.[10] Currently, JOne already collects important data for injury surveillance, such as the PaedsCTAS triage score. PaedsCTAS is a suitable indicator for monitoring the injury severity through the JOne system in the PED because: 1) is a validated injury severity proxy measure, and 2) all the emergency episodes go through the triage process.[26] Another valid indicator for the injury surveillance program is the principal diagnosis, coded by the ICD-9-CM.[27] Our analysis revealed that only 56.1% of the principal diagnosis were correctly coded according to the ICD-9-CM, because the current system allows the selection of an incorrect diagnosis. Simple updates to the system might improve the number of valid diagnosis, namely the system should not allow that doctors select a principal diagnosis from the “Supplementary Classification of External Causes of Injury and Poisoning”. The “E codes” should never be recorded as a principal diagnosis.[27] A new sub-label entry for the event of injury can be made available in order to record the cause, the intent and the place where the injury occurred through the “E codes”. More, the JOne should be updated so that only the diagnosis codes with the maximum subdivision are accepted, that is, those that have been coded to the full number of digits required.

An alternative and more informative approach to the previous referred problems may be the creation of an injury specific form (within the JOne system) that would allow to record and collect data, considered fundamental to construct a good injury surveillance system, as defined by the World Health Organization.[10] Thus, injury emergency episodes will be labeled by doctors, and not by the reception staff, which will reduce the current subjectivity within the labeling procedure. The current subjectivity of this procedure is obvious for example in some cases that at first are classified as school injuries by reception staff, and then were diagnosed as belonging to the ICD-9-CM Chapter 1 “Infectious and parasitic diseases”, clearly not related with injuries.

To conclude, our results suggest that the school injuries account for a significant burden in the SJHC-PED, and that the current routines of the pediatric orthopedic service should be revised and improved, in order to allow an efficient patient care. A screening test criteria must be defined to facilitate the decision of the school staff regarding the reference of the child to the primary or the tertiary health facility. More, JOne has the potential to be a childhood injury surveillance system, because it is allocated to a PED that receives most of the pediatric patients with injury-related complaints within the Oporto region.[19, 23] Further, it allows for a practical and direct download of data without an individual patient chart review. However, some updates must be done to grant the recording of more detailed injury-specific data, so that the JOne could work as an injury

surveillance system. In the specific case of school injury surveillance, we perceived JOne system as an incomplete tool to its study. To accomplish this baseline, a centralized dataset is mandatory, and it should combine information provided from both the school and the PED.[30] This is important because it is known that some injuries sustained at school may not need emergency care, but they should also be accounted and prevented.[31] More, injury rate and injury associated features vary from school to school, so it is important to have a system that allows for schools to be individually evaluated.[5] This assumes that some data can only be recorded by the school staff, so that variables regarding the student, the school environment and the school community and surroundings, involved in the injury event sequence, can also be evaluated.[5, 16] This approach will allow the adjustment of the prevention programs to better fulfill the needs of each school, and its shortcomings regarding injury specific proneness.[32, 33] Altogether, these findings reinforce the importance of an articulated strategy between health and educational services regarding the reporting and prevention of school injuries, which can be partially accomplished through an online form shared between the schools and the PED.

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Figure Captions:

Figure 1. Number of school injuries by age group and sex.
Figure 2. Number of school injuries by age group and injury severity.
Figure 3. Mean time spent in the Pediatric Emergency Department (PED) by months.
Figure 4. Mean waiting time to consultation by months.

Table 1.

Descriptive statistics of the school injuries for each age group.

Age group	Frequency	Percent	Injury rate
[3,6[	1115	5.5	17.6/1000
[6,10[	4944	24.3	51.1/1000
[10,12[	4354	21.4	77.3/1000
[12,15[	6167	30.3	67.9/1000
[15,18[	3745	18.4	33.7/1000
Total	20325	100.0	

Table 2.

Incorrect Coding of the school injurie's principal diagnoses.

	Frequency	Percent	Valid Percent
Supplementary Classification of External Causes of Injury and Poisoning	49	.2	.2
Diagnosis with no coding match	489	2.4	2.4
Insufficient coding	8107	39.9	40.4
Correct/valid coding	11399	56.1	56.9
Total	20044	98.6	100.0
Missing	281	1.4	
Total	20325	100.0	

Figure 1

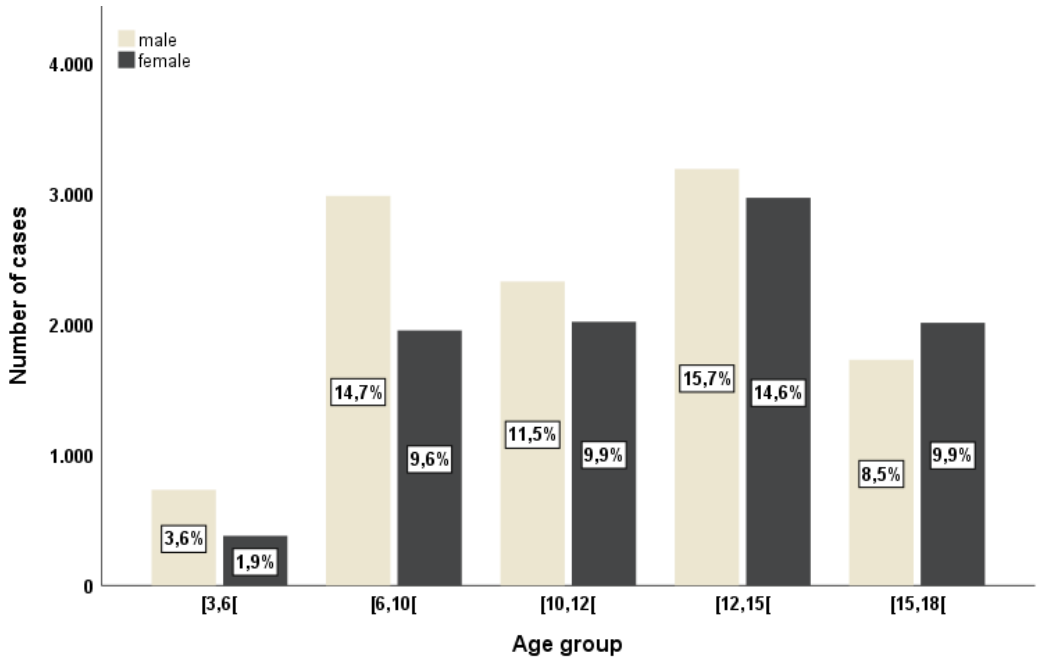

male
female
4.000
3.000
2.000
1.000
0
Number of cases
3,6%
1,9%
14,7%
9,6%
11,5%
9,9%
15,7%
14,6%
8,5%
9,9%
[3,6[
[6,10[
[10,12[
[12,15[
[15,18[
Age group

Figure 2

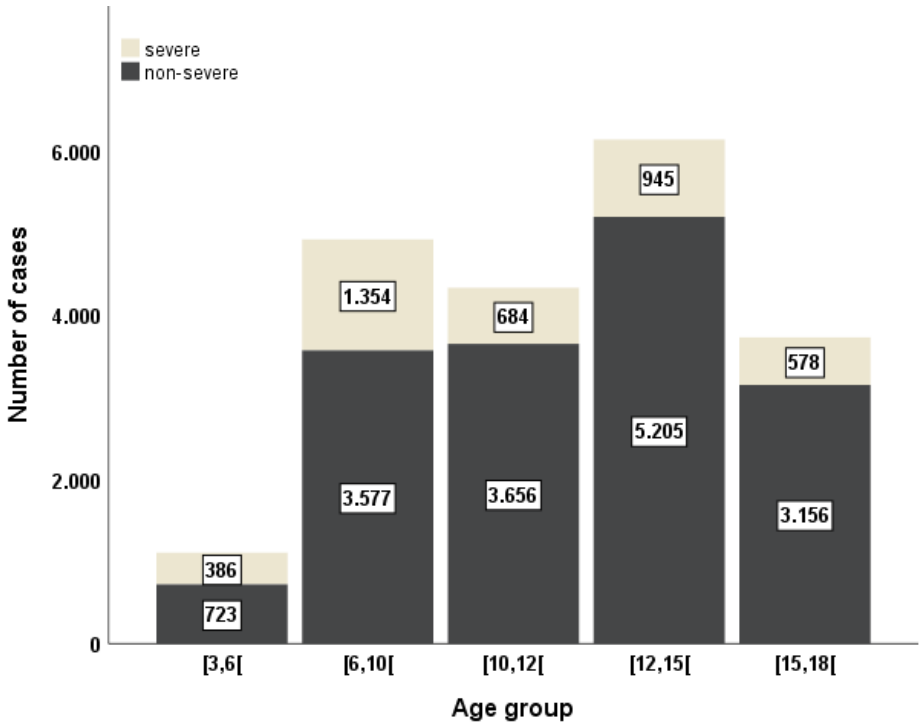

severe
non-severe
Number of cases
6.000
4.000
2.000
0
386
723
1.354
3.577
684
3.656
945
5.205
578
3.156
[3,6[
[6,10[
[10,12[
[12,15[
[15,18[
Age group

Figure 3

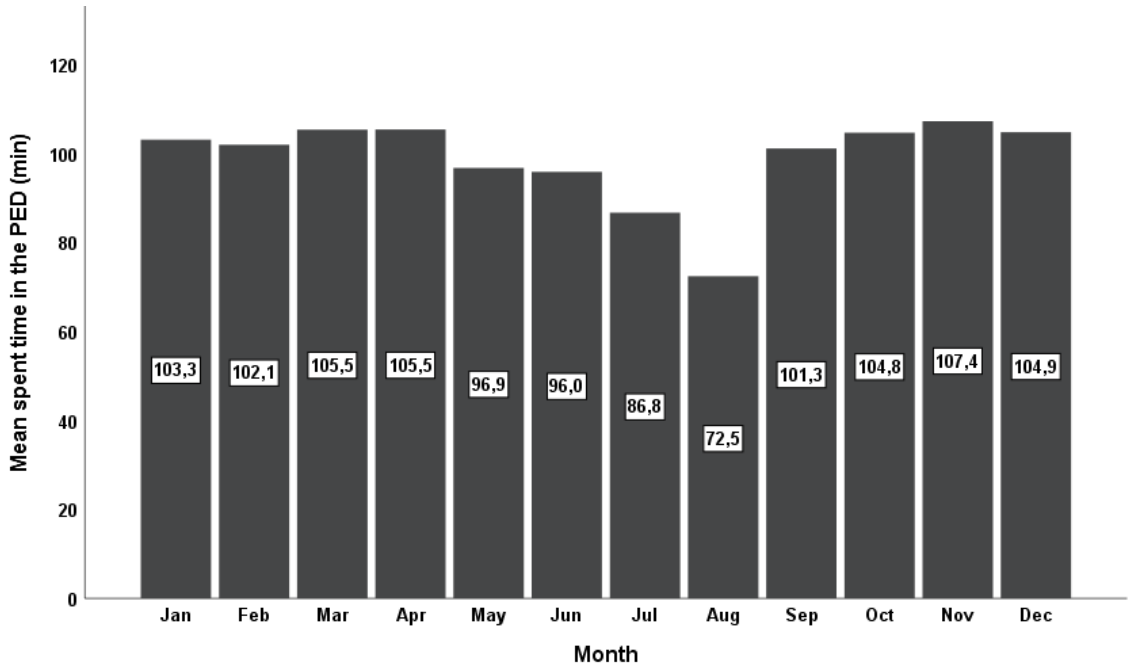
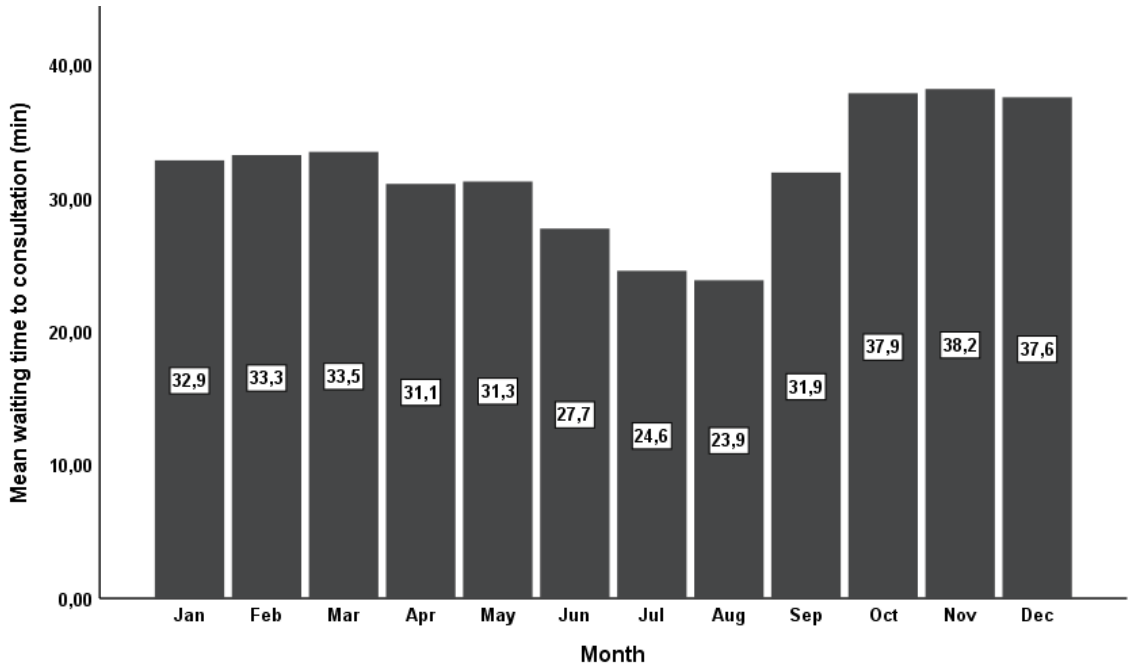

Mean spent time in the PED (min)
120
100
80
60
40
20
0
103,3
102,1
105,5
105,5
96,9
96,0
86,8
72,5
101,3
104,8
107,4
104,9
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

Figure 4


Mean waiting time to consultation (min)
40,00
30,00
20,00
10,00
0,00
32,9
33,3
33,5
31,1
31,3
27,7
24,6
23,9
31,9
37,9
38,2
37,6
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

Agradecimentos

Em primeiro lugar gostaria de agradecer ao Professor Doutor Luís de Almeida Santos, que tenho o prazer de conhecer desde a infância, por ter aceite orientar esta dissertação e me ter envolvido nesta temática. Agradeço a sua total disponibilidade e apoio em todas as fases deste trabalho e a forma como fomentava as discussões levando a que eu quisesse ir mais longe. Não posso deixar de referir o quanto admiro e reconheço a vastíssima experiência clínica e o conhecimento científico aliados à capacidade de encontrar soluções, procurando construir "um mundo melhor" para as crianças.

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ANEXOS

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1. Journal Article

Schuh S, Coates AL, Binnie R, et al. Efficacy of oral dexamethasone in outpatients with acute bronchiolitis. J. Pediatr. 2002;140:27-32.

2. Book chapter

Perron CE. Pain-scrotal. In: Fleisher GR, Ludwig S, eds, *Textbook of Pediatric Emergency Medicine*. 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2000:473-481.

3. Entire book

Monti PM, Colby SM, O'Leary TA, eds. *Adolescents, Alcohol, and Substance Abuse: Reaching Teens Through Brief Interventions*. New York, NY: Guilford Press; 2001.

4. Software

Epi Info [computer program]. Version 6. Atlanta, GA: Centers for Disease Control and Prevention; 1994.

5. Online journal

Harrison CL, Schmidt PQ, Jones JD. Aspirin compared with acetaminophen for relief of headache. *Online J Curr Clin Trials* [serial on-line]. January 2, 1992; doc 1.

6. Database

CANCERNET-PDQ[database online].Bethesda,MD:National Cancer Institute; 1996. Updated March 29, 1996.

7. World Wide Web

US Department of Health and Human Services. Methamphetamine: abuse and addiction.

National Institute on Drug Abuse Research Web site. Available at: http://www.nida.nih.gov/researchreports/methamp. Accessed August 13, 2001.

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