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Impact of Suspected Child Abuse in Health Outcomes in 10 years - a Population - based cohort study

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PROLOGUE

In the current era, marked by profound changes and challenges, the search for knowledge and understanding was the motive behind this master's thesis in the field of healthcare. The realization of this research project is an analogy to the "paths of de life". At the start of the journey, you can't fully guess what lies ahead. We just know where we are, where we want to go and we choose those we want to have by our side, to accompany us and help us overcome the difficulties. This journey requires ambition, persistence, and resilience. It is full of obstacles, which are overcome step by step. It is a path of knowledge, of scientific discovery, and of ourselves. When we reach the end of the road, we realize what we have built and gained along the way, and we discover the beginning of so many others ... The journey will continue!

Many thanks to those who have walked with me:

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To my friends, thank you for your patience and for brightening my path.

Na presente era marcada por profundas mudanças e desafios a busca pelo conhecimento e compreensão são o motivo para a realização desta tese na área dos Cuidados de Saúde.

A concretização deste projeto de investigação é uma analogia aos "caminhos da vida". No início do percurso não se adivinha totalmente o que encontraremos pela frente. Limitamo-nos a saber onde estamos, onde pretendemos chegar e escolhemos aqueles que queremos ter ao nosso lado, para nos acompanhar e ajudar a superar as dificuldades. Este percurso exige ambição e é regado de persistência, e resiliência. É recheado de obstáculos, que se contornam passo a passo. É um caminho de conhecimento de descoberta científica e de nós mesmos. À chegada ao final do caminho, percebemos o que construímos e ganhamos nesse trajeto, e descobrimos o início de tantos outros ... O caminho irá continuar!

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Aqueles que passam por nós não vão sós, não nos deixam sós.

Deixam um pouco de si e levam um pouco de nós."

Antoine de Saint-Exuperry

Impact of suspected child abuse in health outcomes in 10 years - a population-based cohort study

Impacto da suspeita de violência infantil nos outcomes em saúde em 10 anos – estudo cohort de base populacional

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Abstract

Background: Child abuse includes active forms of violence against the physical and psychological integrity of the child, as well as forms of deprivation, omission, or neglect. It is a serious social problem and can lead to physical disorders such as traumatic injuries, chronic illnesses, and mental health problems. Violence against children can also compromise their development and growth, affecting them, their families, and society.

This study intends to identify some complications associated with violence in children. The main goal is to analyse associated health problems in children suspected to be victims of violence, through electronic health records (EHR) analysis.

Methods: A retrospective cohort study of children suspected of being victims of violence, aged from birth to eighteen years, followed at the Unidade Local de Saúde de Matosinhos (ULSM), between January 1, 2012, to December 31, 2022, using electronic health records. Through these electronic records, we estimated the likelihood of health outcomes occurring in these children, 10 years after the episode of violence, namely traumatic injuries, mental disorders, and somatic diseases and health risk factors.

Results: We identified 11.009 children suspected of violence, with a predominance of males (54.04%). The most prevalent health outcomes associated were fractures (24.09%), metabolic syndrome (14.92%), anxiolytic consumption (14.42%), and obesity (10.15%).

In this study, the majority of children suspected of being victims of violence were at least 1.5 times more likely to have a health outcome, than other children. Difference stood out in the following outcomes: fractures (HR = 1.91, 95% CI = [1.72, 2.11]), major psychiatric disorders (HR = 3.79, 95% CI = [3.42, 4.19]), and obesity (HR = 2.00, 95% CI = [1.81, 2.21]), independent of age or sex.

Conclusions: This study can infer that children who are suspected of being victims of violence are more prone to develop health outcomes associated with this episode. Most of the health outcomes examined from the categories of traumatic injuries, mental disorders and somatic diseases were more than twice as likely to occur in this population than in a non-violent population. The likelihood of health outcomes increases with age and the time to onset is shorter for children suspected of being victims of

violence. These findings highlight the importance of early identification and prevention of exposure to violence in children.

Our results emphasise the crucial role of health professionals in identifying and reporting situations of violence and in educating individuals about their health.

Keywords: child abuse; child mistreatment, child maltreatment, child neglect, violence; health outcomes, childhood.

1. Introduction

Child abuse is a worldwide issue that knows no geographical or cultural boundaries [1]. It encompasses not only active forms of violence against a child's integrity, as physical and psychological, but also instances of omission, deprivation, or neglect. Refers to all intentional and unintentional harm, any non-accidental action or omission perpetrated by parents, caregivers, or others which threatens the safety and dignity of the child [2-4].

Child maltreatment encompasses all intentional and unintentional harm to children and adolescents and includes exposure to physical violence, psychological violence, sexual abuse, or neglect [5].

Violence in a child's life can have detrimental effects on their growth and development, affecting their biopsychosocial and emotional well-being. Such experiences can cause long-lasting harm that may hinder their overall progress [2-4,6].

Exposure to violence can cause physical problems, including traumatic injuries and chronic illnesses, as well as mental and intellectual problems. It can also affect children's quality of life and social wellbeing, increasing morbidity and mortality [1,6].

Accurate estimates of violence are difficult to obtain [1]. WHO estimates that globally, approximately one in two children, or about 1 billion children worldwide, have been exposed to violence in 2014 [7]. The United States' National Child Abuse and Neglect Data System (NCANDS) recorded 618,000 cases of child abuse in 2020 [8]. In 2022, the Portuguese Association for Victim Support (APAV) provided assistance to around 2,600 children and young people who had suffered from violence in Portugal [9].

Violence in children acts as an early life stressor, promoting changes in the structure and physiology of the brain that disrupt the homeostasis of systems and impact multiple functions of the organism, with negative consequences for various body functions. One of the ways it works is through interference in the inflammatory response and hormonal changes caused by chronic hyperactivation of the hypothalamic-pituitary-adrenal axis, which disrupts the production of cortisol and its receptors. This dysfunction can contribute to a pro-inflammatory state and acts as an inducer of both physical and psychological illnesses, and can also act as a trigger for genetic diseases. In this way, child abuse can lead to negative health outcomes and may trigger the development of illnesses such as depression, rheumatoid arthritis [10-12]. Moreover, this violence can be related with pathologies, namely, hypercholesterolemia, stroke, high blood pressure, diabetes, neoplasia, depression, and anxiety disorder [10]. Additionally, it can promote health risk behaviors, such as substance abuse, suicide attempts, smoking, self-harm, premature sexual activity, having multiple sexual partners, and seeking an abortion [10-12].

Health services were the institutions that identified the greatest range of abuse forms, highlighting the crucial role health professionals play in detecting child abuse [4]. In Portugal, according to National Health Authority (*Direção Geral da Saúde - DGS*), the detection of the risk of maltreatment should be a parameter assessed in all medical or nursing consultations for Child Health Surveillance (*Vigilância de Saúde da Criança*). Clinical information on this parameter should be recorded in the SCLINICO® (primary healthcare informatic system), specifically in the child and adolescent health module (*Saúde Infantil e*

Juvenil), in a specific area (Family Risk Assessment (ARF) (*Avaliação de Risco Familiar*). In secondary healthcare or other situations, this information should be recorded in the child's clinical file [13].

This study intends to identify health outcomes associated with suspicion of violence in children using electronic health records (EHR) in a 10 year follow-up period.

2. Materials and Methods

Study design

We conducted a retrospective, observational, and analytical cohort study using secondary data analysis of electronic health records (EHR) and health registry data of children who were ULSM users and suspected victims of violence.

This study was performed at the Unidade Local de Saúde de Matosinhos (ULSM), which provides primary, secondary, and tertiary health care to an urban population of approximately 176.774 inhabitants, through 14 primary care centres and 1 hospital.

The detection of "risk of child abuse" must be evaluated in all child health surveillance visits, both medical and nursing. In the Portuguese National Health Service (SNS), children and adolescents under the age of 18 are invited for child health surveillance at key times (0, 1, 2, 4, 6, 9, 12, 15, 18 months, and 2, 3, 4, 5, 6/7, 8, 10, 12-13, 15-18 years), according to the surveillance schedule established by the National Health Authority.

The "risk of child abuse" parameter must be registered in the child and adolescent health module (*Saúde Infantil e Juvenil (SIJ)*) of the SClinico® software, in the specific registration area - Family Risk Assessment (*Avaliação de Risco Familiar (ARF)*), and in hospital care or by professionals without access, it is recommended to record it in the child/adolescent's clinical file.

The study analyses associated health outcomes in children after clinical suspicion of being victims of violence, through analysis of ULSM electronic health records. The case cohort included all children and adolescents aged 0-18 years, suspected of being victims of violence, who had visited the ULSM service between 1 January 2012 and 31 December 2022. The index visit was defined as the child assessment in which the health professional documented in clinical file terms that equate the child as a suspected victim of violence. These terms related to violence may have been written by any health professional, in the context of any clinical activity, both in primary health care and in hospital.

The inclusion criteria for this study were: a) age less than or equal to 18 years, b) be documented in the clinical notes terms related to violence, that raise suspicions about violence, c) had at least one consultation at the ULSM in the 365 days prior to the suspected violent episode, d) had at least 365 days of follow-up after index date. Exclusion criteria were not applied in this study.

This study and data access were approved by the ULSM Health Ethics Committee. Data processing and analysis were performed by analytical programs developed for this purpose and sent for execution at ULSM servers. No data was extracted outside the ULSM and there was no direct access by the researchers. As an additional security level and in accordance with the Health Insurance Portability and Accountability Act (HIPAA), the processed data were de-identified by the ULSM Information Technology Department prior to running the analysis code.

2.2 Cohort definition

At least one of the codes presented, or one of the regular expressions is present in the EHR of the patient. These definitions presented in Table 1, were also used before in past publications on the same database [14,15].

Table 1- Codes and regular expressions searched for in EHR

ICD-9	995.5 Child maltreatment syndrome UMLS Athena 995.81 Adult physical abuse UMLS Athena 995.82 Adult emotional/ psychological abuse UMLS Athena 995.80 Adult maltreatment, unspecified UMLS Athena 995.84 Adult neglect (nutritional) UMLS Athena 995.81 Adult physical abuse UMLS Athena 995.83 Adult sexual abuse UMLS Athena 995.85 Other adult abuse and neglect UMLS Athena
ICD-10	T76 Adult and child abuse, neglect and other maltreatment,
ICPC-2	Z12 No description available UMLS Athena Z13 No description available UMLS Athena Clinical notes regular expressions (at least one match): "[Aa]mea[çc]a", "[Ii]nsult", "[Hh]umilh", "[Dd]estru", "[Pp]erseg", "[Oo]brigada a", "[Pp]r[aa]tica[s]* sex", "[Bb]ofet", "[Ss]apatad", "[Cc]hapad", "[Mm]urr", "[Ss]oco", "[Pp]ancad", "[Pp]edrad", "[Ff]acad", "[Es]sfaquead", "[Dd]ispar", "[Bb]alead", "[Pp]ontap", "[Pp]aulad", "[Ee]mpurr", "[Ee]stalad", "[Aa]pert[ãa]o", "[Aa]pert[õo]es", "[Bb]at[e]", "[Aa]gress", "[Aa]gred", "[Ee]sgana", "[Ss]ufoc", "[Ee]strang", "[Aa]bandon", (agress viol[eê] maus tratos maus-tratos) (suspei v[íi]tim alega comportamen).*(abus viol[eê] maus agress)

2.2 Key variable definition

In this study, the variables were defined using a set of keywords selected by the researchers, based on the most common terms used to describe these situations in the clinical setting of the ULSM, and later they were included in the analytical code for processing (Table1). Data on variables were classified using the International Classification of Diseases (ICD-9 and ICD-10); International Classification of Primary Care (ICPC-2);

Variables included were: a) gender; b) age; c) traumatic injuries; d) mental disorders; e) general health conditions and health risk factors.

As categorical variables, in the group of traumatic injuries (c), we reported: c1) fractures; c2) dislocations; c3) open wounds; c4) superficial injuries; c5) crush injuries; c6) burns; c7) poisonings; c8) death. For mental disorders (d) we selected: d1) major psychiatric disorders; d2) chronic pain; d3) headache; d4) sleep disorders; d5) eating disorders; d6) memory disorders; d7) suicidal ideation; d8) psychosocial stress; d9) post-traumatic stress disorder; d10) smoking; d11) alcohol abuse; d12) drug abuse; d13) psychotropic drug use: sedatives, antidepressants, anxiolytics and antipsychotics. For general health conditions and health risk factors (e) the categorical variables were: e1) type 2 diabetes mellitus; e2) hypertension; e3) hypercholesterolemia; e4) metabolic syndrome; e5) obesity; e6) early heart disease; e7) asthma; e8) chronic kidney disease (CKD); e9) cancer; e10) non-alcoholic fatty liver disease; e11) chronic inflammatory disorder, e12) unspecified illness.

2.3 Exposure and outcome definitions

Exposure was stipulated as the moment of clinical suspicion of an episode of child violence. The outcome of interest was defined as the attainment of health outcomes associated with the identification of a child abuse situation; among them, for example, the occurrence of fractures, open wounds, major psychiatric disorders, sleep disorders, hypertension and type 2 diabetes, according to their clinical definition, up to 3600 days after exposure.

Time at risk was calculated from the index date (suspicion child abuse) until the development of the outcome of interest (health outcomes). Patients were censored in case of death or leaving the database.

2.4 Statistical analysis

Continuous variables, such as age, were presented by median and interquartile range (IQR), and categorical variables by absolute and relative frequencies.

To estimate the risk of developing health outcomes, we modelled the cohort using a Cox proportional hazards model adjusted at baseline for age and sex. Hazard ratios (HR) were calculated with 95% confidence intervals.

To decrease the potential for bias, we conducted PS-matching analysis using age and gender as variables to create a more equitable comparison between cohorts. This approximation of the cohorts directs the characterisation only to the individuals in table 1.

To correct for the dependent observations resulting from having children in more than one cohort at different points in time, the standard errors of the estimated hazard ratios (HR) were adjusted to account for correlations between the same child by applying the cluster method available in the Survival package. The resulting variance is what is known as the working independence variance in a generalised estimating equation. Overall, this design ensures that risk estimates are kept as conservative as possible.

3. Results

3.1 Episode and exposed patient characterization

For this study, 11,009 children suspected of violence were eligible, out of a population of 30,881 children during the study period. At the time of cohort entry, the median age was 8 years (IQR=9), there was a predominance of males (54.04%), with a slight predominance of children aged 0-3 years (n=2938; 26.69%), followed by 6-9 years (n=1870; 16.99%). 99.92% of suspected cases of violence were identified through the recording of clinical notes with text matches in EHR (Table 2).

Pre-matching, the most frequent outcomes associated with suspected violence were fractures (n=2652; 24.09%), metabolic syndrome (n=1643; 14.92%), anxiolytic consumption (n=1587; 14.42%) and obesity (n=1117; 10.15%), as described in Table 2.

Some health outcomes had no expression at all, during the study period, such as death, alcohol and drug abuse.

After matching, in 12221 patients, 6103 were eligible for the suspected violence child cohort, with males predominating with 50.38%.

Table 2- Baseline characteristics of the cohort – Child suspected to be victim of violence.

	Suspected violence child (n=11009)	Control group (n=19872)
Male	5949 (54.04)	9799 (49.31)
Female	5060 (45.96)	10073 (50.69)
Median (IQR)	8.00 (9.00)	1.00 (9.00)
Source of patients for the cohort		
Text match in EHR	11000 (99.92)	46 (0.23)
ICD-9/10 or ICPC-2 code present	9 (0.09)	0 (0.00)
Injuries, n (%)		
Fracture	2652 (24.09)	9 (0.05)
Dislocation	443 (4.02)	4 (0.02)
Open wounds	979 (8.89)	2 (0.01)
Superficial injuries	288 (2.62)	0 (0.00)
Crushing Injuries	26 (0.24)	0 (0.00)
Burns	71 (0.64)	1 (0.01)
Poisoning	478 (4.34)	0 (0.00)
Mental disorders, n (%)		
Major psychiatric disorders	669 (6.08)	30 (0.15)
Chronic pain	5 (0.05)	1 (0.01)
Headache	86 (0.78)	2 (0.01)
Sleep disorders	44 (0.40)	3 (0.02)
Eating disorders	6 (0.05)	1 (0.01)
Memory disorders	6 (0.05)	0 (0.00)
Suicidal ideation	2 (0.02)	0 (0.00)
Psychosocial stress	259 (2.35)	11 (0.06)
Post-traumatic stress disorder	1 (0.01)	0 (0.00)
Smoking	50 (0.45)	8 (0.04)
Psychotropic drug use:		
Sedative consumption	446 (4.05)	26 (0.13)
Antidepressant consumption	190 (1.73)	5 (0.03)
Anxiolytic consumption	1587 (14.42)	51 (0.26)
Antipsychotic consumption	161 (1.46)	5 (0.03)
General Health Conditions, n (%)		
Type 2 diabetes mellitus	178 (1.62)	2 (0.01)
Hypertension	12 (0.11)	1 (0.01)
Hypercholesterolemia	346 (3.14)	1 (0.01)
Metabolic syndrome	1643 (14.92)	77 (0.39)
Obesity	1117 (10.15)	997 (5.02)
Asthma	641 (5.82)	50 (0.25)
Cancer	100 (0.91)	1 (0.00)
Non-alcoholic fatty liver disease	3 (0.03)	0 (0.00)
Chronic inflammatory disorder	21 (0.19)	1 (0.01)
Unspecified illness	70 (0.64)	2 (0.01)

Legenda: Med - mediana; IQR- Interquartile range; Y- years.

Table 3- Baseline characteristics of the cohort – Child suspected to be victim of violence.

	Unmatched (n=30881)		Matched (n=12925)		Absolute Mean Difference
	Suspected violence child (n=11009)	Control group (n=19872)	Suspected violence child (n= 6 103)	Control group (n= 6 822)	
Male	5949 (54.04)	9799 (49.31)	3247 (53.20)	3437 (50.38)	0.05
Female	5060 (45.96)	10073 (50.69)	2856 (46.80)	3385 (49.62)	0.05
	8.00 (-)	1.00 (-)	11.20 (3.42)	11.36 (3.53)	0.05

Legenda: Med - Median; IQR- Interquartile range; SD- Standard deviation; Y- Years.

3.2 Health outcomes after a suspected of violence in children

When analysed at 3 600 days of follow-up, children suspected of being victims of violence were more likely to develop adverse health outcomes than other children, for most of the studied parameters.

Health outcomes were observed to occur earlier in children suspected of being victims of violence. Fractures occurred 1 110 days (d) earlier than in other children, as did poisoning (1088 d), type 2 diabetes mellitus (DM2) (1045 d) or major psychiatric disorders (879 d), among others described in Table 2.

Follow-up of children suspected of violence was generally shorter than that of other children for the analysed outcomes. Notably, major psychiatric disorders had a follow-up of 1408 days less in this cohort. A similar pattern was observed in cases of fractures (1400 d), anxiolytic consumption (1377 d), and obesity (1346 d) (Table 2).

Table 2 - Health outcomes after a suspected of violence in children up to 10 years follow-up.

	EV	PY	Ev/100PY	Follow-up (Days) Mean (P50)	Time to Event Mean (P50)	HR (95% CI)
Fracture	713	35 989	1.98	2200	1248	1.91 (1.72-2.11)
Dislocation	98	40 256	0.24	2480	1324	2.90 (2.10-3.99)
Open wounds	419	38 342	1.09	2348	1374	1.61 (1.42-1.84)
Superficial injuries	41	40 665	0.10	2498	1486	2.99 (1.78-5.02)
Crushing Injuries	6	40 877	0.01	2512	1870	0.77 (0.30-1.94)
Burns	40	40 671	0.10	2498	1119	1.84 (1.17-2.89)
Poisoning	137	40 013	0.34	2461	1486	1.67 (1.34-2.10)
Death	3	40 930	0.01	2514	2603	NA
Mental health disorders						
Major psychiatric disorders	1093	35 440	3.08	2192	1514	3.79 (3.42-4.19)
Chronic pain	50	40 773	0.12	2498	2274	3.58 (2.20-5.83)
Headache	89	40 553	0.22	2493	1435	2.53 (1.83-3.51)
Sleep disorders	85	40 613	0.21	2496	1790	3.01 (2.14-4.24)
Psychosocial stress	490	38 942	1.26	2390	1710	2.83 (2.46-3.26)
Smoking	609	38 585	1.58	2337	1689	1.08 (0.99-1.19)
Psychotropic drug use						
Sedative	722	37 100	1.95	2282	1443	2.14 (1.91-2.39)
Antidepressant	670	37 279	1.80	2321	1687	3.37 (2.97-3.82)
Anxiolytic	964	36 190	2.66	2217	1675	2.46 (2.23-2.71)
Antipsychotic	327	38 456	0.85	2422	1332	4.28 (3.47-5.29)

General Health Conditions						
Type 2 DM	478	38499	1.24	2403	1295	5.74 (4.75-6.94)
Hypertension	77	40614	0.19	2496	2081	1.60 (1.42-1.74)
Hypercholesterolemia	696	37084	1.88	2296	1437	1.57 (1.42-1.74)
Metabolic syndrome	1771	24228	7.31	1796	1417	1.83 (1.72-1.95)
Obesity	890	36356	2.45	2254	1288	2.00 (1.81-2.21)
Asthma	266	39040	0.68	2422	1154	1.81 (1.52-2.16)
Cancer	32	40684	0.08	2500	1514	1.15 (0.73-1.82)
Chronic inflammatory disorder	22	40799	0.05	2507	1660	2.99 (1.42-6.29)
Unspecified illness	39	40756	0.10	2500	1840	1.74 (1.09-2.77)

Legend: PY- Person-Years Cohort; Ev/100PY - Event Rate per Person-Year; DM- Diabetes Mellitus

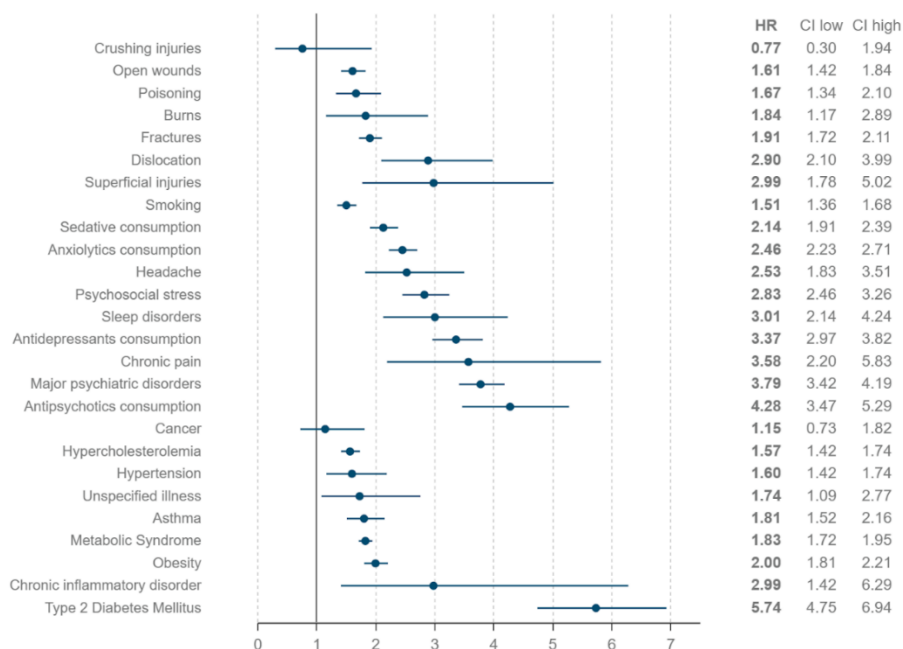
3.2.1. Traumatic injuries

Traumatic injuries were about twice as likely to occur, most commonly fractures (1.98%) and open wounds (1.09%) (Table 2).

Children suspected of being victims of violence were 1.6 and 1.9 times more likely to have open wounds and fractures, respectively, than other children (HR = 1.61, 95% CI = [1.42, 1.84], (HR=1.91,95%CI= [1.72, 2.11]). The same applies, in ascending order, to the other traumatic injuries: poisoning (HR = 1.67, 95% CI = [1.34, 2.10]), burns (HR = 1.84, 95% CI = [1.17, 2.89]), dislocation (HR = 2.90, 95% CI = [2.10, 3.99]) and superficial injuries (HR = 2.99, 95% CI = [1.78, 5.02]), as shown in Figure 1., independently of age and gender.

Likelihood of changing health outcomes after a suspected episode of violence in children, in 10 years

Values presented as hazard ratios with 95% CI



Legend: CI - Confidence Interval; HR - Hazard ratio.

Fig. 1 The health outcomes related to a suspected episode of violence in children, in 10 years. Blue filled points indicate the risk ratios, blue lines indicate the 95% confidence intervals.

3.2.2. Mental health disorders

In terms of mental health disorders, this cohort was more likely to have major psychiatric disorder (3.08%) and to used antipsychotic drugs, namely anxiolytics (2.66%), sedatives (1.95%), antidepressants (1.80%) and antipsychotics (0.85%) (Table 2).

The likelihood of children suspected of being victims of violence developing the mental disorders assessed was at least twice, compared with other children, except for smoking. They were 3.8 times more likely to develop major psychiatric disorders (HR = 3.79, 95% CI = [3.42, 4.19]) and 2.8 to develop psychosocial distress (HR = 2.83, 95% CI = [2.46, 3.26]). The likelihood of psychotropic drug use was more than double, four times higher for antipsychotics (HR = 4.28, 95% CI = [3.47, 5.29]), three times for antidepressants (HR = 3.37, 95% CI = [2.97, 3.82]) and more than two times for anxiolytics (HR = 2.46, 95% CI = [2.23, 2.71]) and sedatives (HR = 2.14, 95% CI = [1.91-2.39]), compared to the other children (Figure 1), independently of age and gender.

3.2.3. General health conditions

In the area of general health conditions and health risk factors, children suspected of violence were more likely to have metabolic syndrome (7.31%), obesity (2.45%), hypercholesterolemia (1.88%) and DM2 (1.24%) (Table 2).

The likelihood of children suspected of violence developing DM2 was 5.7 times higher than the likelihood of other children (HR = 5.74, 95% CI = [4.75, 6.94]), independently of age and gender. They had a doubled likelihood of developing obesity (HR = 2.00, 95% CI = [1.81, 2.21]), and almost twice as likely to develop the metabolic syndrome (HR = 1.83, 95% CI = [1.72, 1.95]) and asthma (HR = 1.81, 95% CI = [1.52, 2.16]) comparative to other children.

4. Discussion

In this study, we found that children suspected of being victims of violence were more likely than other children to develop adverse health outcomes for most of the parameters studied. Bibliography notes that adverse childhood experiences, such as exposure to violence, increase the risk of many health behaviours and outcomes, largely unaffected by time or social changes that have occurred [10].

We found that about a third of the children assessed were suspected by health professionals to have been victims of violence according to the EHR. Violence is an integral part of human history, and statistics on child abuse and neglect are difficult to obtain because of the variety of sources and the differing characterisations of the extent of the problem. This is partly due to legal and cultural differences in the characterisation and definition of child abuse and in the reporting and identification of cases of violence [1,7].

By analysing electronic health records, it was found that children suspected of being victims of violence were more likely than the rest of the children to have a higher probability of occurrence of the most health outcomes, in all the areas studied: traumatic injuries, mental disorders and general health conditions. These data are in line with World Health Organization (WHO) and other bibliographic [1,16-18] references that reiterate that violence can increase the risk of physical (serious injuries, chronic diseases, inflammatory diseases), mental, psychological and behavioural (depression, anxiety and suicidal behaviour) problems and can affect the quality of life and well-being of the child or in their adult life. They argue that violence can lead to a range of behaviours and negative health outcomes such as: substance abuse [19], self-harm, social problems and mental health problems such as depression [10,20].

The likelihood of the traumatic injuries studied, excluding crushing injuries, was more than 1.6 times higher in the group of children with suspected violence, with open wounds, and fractures (1.9 times higher) standing out. Obviously, the type of traumatic injury varies and is related to the type of violence perpetrated and the injuries resulting from the violence or the child's own fragility. We shouldn't forget that many situations of violence and direct injuries are not always recognised. There are various forms of violence that do not directly cause physical or immediate injuries, but have complications that are less visible to the naked eye and some of which have medium or long-term consequences. At the same time, existing data on non-fatal child abuse and neglect come from a variety of sources, many of which are based on national statistics or population-based surveys of varying scientific quality, which limits the perception of the extent of the problem. Most of the studies found are dedicated to understanding

the causal relationship, particularly in the area of cognition and chronic diseases [16]. Traumatic injuries are predominantly studied in secondary healthcare due to the higher prevalence of injuries with greater physical impact [1]. Krug et al, highlights that the musculoskeletal signs of child abuse involve several fractures at various stages, including distinctive fractures in the area of the long bones and ribs, where it is evident that the resulting trauma was not caused under normal circumstances [1]. However, data and direct comparisons using data on non-fatal violence are difficult to obtain and can be misleading [1,16].

In terms of mental disorders, children suspected of being victims of violence were at least twice as likely as other children to develop the mental disorders assessed, with the exception of smoking. Notably, children suspected of being victims of violence were 3.8 time more likely to develop major psychiatric disorders and 2.8 time more likely to develop psychosocial distress. The study also showed that they were more than twice as likely to use psychotropic medication as other children. Notably, the likelihood of taking antipsychotics more than four times, antidepressants more than three times and anxiolytics and tranquillisers twice, when child abuse suspicion. The literature associates childhood violence with mental health, highlighting depressive disorders and anxiety disorders, but also suicide and risk behaviours such as alcohol, tobacco and drug use [1,11-12]. It also addresses other risk behaviours that were not assessed in this study, such as risky sexual behaviour (early onset of sexual activity, multiple partners, abortion and sexually transmitted infections), self-injurious behaviour, victimisation and suicide attempts. Given the evidence for these outcomes, it is considered important to include them in future studies. The study of Norman et al.[16] is consistent with the findings of this study, reporting a strong association between child physical abuse and adverse mental health outcomes and risk behaviours, namely sexual and drug use. It overlaps with our study in highlighting that these mental health outcomes are twice as likely to occur. Bibliography shows that the risk of depression, suicide and some risk behaviours increases progressively with the intensity, extent and repetition of violent episodes [10,21-22]. Violence and child maltreatment are not limited to the moment, but have consequences that can last beyond childhood and have a significant negative impact on physical, psychological and social health [1,7].

Some health outcomes had no expression at all, during the study period, such as death, alcohol and drug abuse. In contrast, WHO finds consistent evidence of a strong association between child violence and alcohol consumption, chronic diseases and lifestyle risk factors [1,7]. Some studies report an increased risk of alcohol and tobacco abuse, and others even report that childhood violence increases the risk of smoking by 20 to 30 per cent and of alcoholism by 40 to 50 per cent [10]. It is thought that this difference in results may be due to the fact that in the first half of childhood the assessment of consumption is not empirically adjusted and, above all, that in the second half of childhood, there are deficiencies in the assessment of these parameters. It is important to emphasise this fact so that it is not forgotten in clinical practice.

Children who were victims of violence were at least 1.5 times more likely to develop a general health condition or risk factor, in ascending order, hypercholesterolemia, hypertension and asthma. We highlight the 5.7 times more likely to have DM2, twice as likely to have obesity, and almost twice as likely to have metabolic syndrome and asthma.

Some studies are consistent with the data obtained, linking child violence with various pathologies such as hypercholesterolemia, hypertension, diabetes, inflammatory conditions such as rheumatoid arthritis, and neoplasms [10].

At least one study conducted in a community setting has identified a correlation between exposure to violence and an elevation in the incidence of non-communicable conditions, including cardiovascular diseases, asthma, and related hospitalizations [21,24-26]. Researchers have classified violence as a risk factor for non-communicable diseases, such as cardiovascular diseases and cancer. This study has established a potential link between childhood violence and cancer. The probability of such an occurrence is 1.16, which may be attributed to the young age of the study population. It is crucial to acknowledge the impact of childhood violence on cancer incidence in children, and further research in this area is warranted. Notably, no significant correlation was observed between childhood violence

and other pathologies including liver disease, non-alcoholic fatty liver disease, memory disorders and suicide.

The study reveals that children suspected of violence received significantly shorter follow-up periods when compared to other children. Specifically, the reduction was up to 873 days for metabolic syndrome and 1408 days for major psychiatric disorders. However, children with burns showed a follow-up duration more similar to that of other children (102 days). This study highlights the importance of closely monitoring all children with active pathologies, particularly those suspected of violence. Such monitoring can help in early interventions to improve treatment outcomes.

This study highlights that health outcomes emerge earlier in children suspected of experiencing violence for most outcomes, ranging from 256 days earlier for eating disorders to 1045 days for DM2. This demonstrates the significance of the association between violence and the emergence of health outcomes. It is crucial that healthcare professionals acquire the skills to identify potential cases of child abuse and remain vigilant for their emergence.

This study confirms the negative relationship between exposure to violence and the direct and indirect effects on an individual's health. At the same time, the bibliographically proven association between a personal history of childhood violence and its impact on adult use of medical resources, such as emergency services, and mental and physical health problems, underlines the need for early identification of suspected childhood violence [20].

The present study employed a robust methodology to minimise any confounding effects of the variables under investigation. This will enable us to detect these situations at an early stage, enabling early intervention and minimising the resulting health consequences. Although the methodology is based solely on electronic record analysis, with free text based on terms and meanings ascribed by investigators, the strength of the data obtained demonstrates the need for increased attention to the issue of child violence. This is due to the implications on both current and future health of the alleged victim and the resulting economic burden. Furthermore, it leads to significant losses for the respective economies of countries due to missed workdays and a decline in investments [1].

To reduce potential bias, age and gender were used as variables in a PS-matching analysis to approach the individuals and create a more equitable comparison between cohorts.

The vast majority of suspected cases of violence were identified through text correspondence in the clinical records of patients, using Electronic Health Records (EHRs). This raises the question of the occurrence of an omission bias, one of the main limitations of the study. Simultaneously, this omission bias can be caused too by the absence of some health professionals in the clinical data collection and registration. The lack of specific codes to identify situations of violence is also a limitation and could lead to loss of records. On the other hand, the health professional is conditioned to use a very broad and generalised language, depending on the choice of the professional making the electronic record, which leads to a greater loss of information. This bias, inherent in the subject matter, conditions the under-identification and under-reporting of suspected cases of child violence. This approach may lead to an overestimation of prevalence associated with suspected cases of coding errors. Therefore, we adopted comprehensive selection criteria, avoided exclusion criteria, and utilised a double-pronged method that incorporates all relevant ICPC-2, ICD-9, and ICD-10 codes at every point of intervention for any healthcare professional while including all relevant terminology used by physicians in electronic medical records. This study did not consider the registration of the risk of child abuse, which should be addressed in future analyses.

Violence prevention is urgently needed for the development of a fairer society and to minimise this public health problem and its consequences and costs [16]. These data highlight the urgent need to adopt and sustain evidence-based interventions to reduce the high burden of violence against children [1,7]. In this sense, there needs to be a simultaneous effort by society, institutions, and the government to address the underlying causes of violence, identify pressing needs, and draw up violence prevention and response policies and programs that can be implemented, evaluated, and adjusted on a regular basis in order to minimise this problem and its consequences for children and society. On other hand, it is essential to identify situations of violence at an early stage and to provide appropriate support to

victims and their families. It is also necessary to invest in the training of health professionals to identify situations of violence, maximise their informatic skills, and improve existing clinical programs to minimise the bias of omission from the register. More specific codes could also be developed so that situations of suspected violence can be identified more consistently by all health professionals. These actions are intended to emphasise the urgency of prevention and intervention efforts, as well as the importance of support and healing for survivors.

There is an urgent need to develop measures to promote public education on child abuse, with the aim of informing the population about the types of violence, how to recognise them and what to do in the event of such a situation or the need for support.

It is considered essential to carry out a validation study of these data. For future studies, it is proposed to extend the study to other units and regions in Portugal and to research groups in other European countries, in order to carry out more robust statistical analyses to compare variables and help understand the phenomenon and guide future prevention and action. Another aspect could be to involve organisations that work more closely with child violence.

5. Conclusions

In this study, we can conclude that children suspected of being victims of violence were more likely to develop adverse health outcomes than other children for most of the parameters studied. In all areas studied - traumatic injury, mental disorders, and general health conditions, most health outcomes were higher likely to occur in children suspected of being victims of violence.

Most of the health outcomes studied were more than 1.6 times more likely to occur in this population than in a population with no exposure to violence.

Children who were suspected of violence developed health outcomes earlier. The follow-up period for these children for each of the health outcomes was also shorter than for other children without this condition.

Our results emphasise the importance of identifying situations of violence in children at an early stage and preventing their occurrence.

The role of health professionals is crucial in the early detection and signalling of situations of violence, as well as in education and awareness-raising on the issue. They also have an important role to play close to families in curbing this trend and promoting healthy family habits.

Conflicts of Interest: The authors declare no conflict of interest.

Author Contributions:

Nátalia Neves: Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Formal analysis, Supervision.

Bárbara Martins: Writing – review & editing

Teresa Magalhães: Conceptualization, Review, Supervision.

Tiago Taveira-Gomes: Conceptualization, Methodology, Software, Validation, Formal analysis, Writing - review & editing, Supervision.

All authors have read and agreed to the published version of the manuscript

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Institutional Review Board Statement

This study protocol was reviewed and approved by the ethics committee of the ULSM - Comissão de Ética da ULSM (reference number 71/CLPSI/2022 – date 21 December 2022 (original)).

Informed Consent Statement:

Not applicable

This is a database study with an eligible population in the order of thousands, in which the application of informed consent is not practicable, concerning Article 9 point (i) and point (j) of the General Data Protection Regulation which refers to “ensuring a high level of quality and safety of health care and medicinal products or medical devices, based on Union or State law” and “scientific or historical research purposes or for statistical purposes” as valid reasons for the development of this study without the need for informed consent.

Data Availability Statement: All aggregate statistical results are incorporated into the article and its online Supplementary Materials. Patient-level data used in this study are not publicly available.

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F A C C U L T A D D E D E M E D I C I N A

