Research Article

Definition of Risk Indicators for Detection of Violence and Abuse on Vulnerable People from Population-Based Databases in Emergency Department Settings: Results from a Large Case-Control Study in Italy

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Abstract

Objectives: Violence against vulnerable people is a phenomenon largely hidden and under-reported. Emergency Departments (ED) are ideal settings to identify victims of repeated abuse and maltreatment.

Availability of sets of suspicion indicators derived from large population-based databases can be useful in healthcare settings to reinforce a suspicion arising from the observation of the patient and to integrate existing sets of suspicion indicators.

Methods: The study was conducted in two Italian regions: Piedmont and Tuscany. A case-control study design was utilized. Patients of vulnerable groups (children, adult women, and older people) recorded in the ED register for assault, abuse or maltreatment occurred between 2013 and 2015 were selected as cases. Patients admitted in ED for road traffic injury in the same population groups were selected as controls. For each subject, all admissions occurred during the previous 24 months were summarized by means of indicators counting their frequency. For each group of vulnerable subjects, backward logistic regressions were implemented.

Results: Tuscany's EDs registered in each vulnerable group of population at least 4 times the number of ED- cases for violence than Piedmont. The difference could be partially explained by the adoption in Tuscan hospitals of a triage code ("pink code") explicitly concerned with the tracking of victims of relational violence. An increase in the number of ED admissions and previous admission for violence were predictive of being victim of violence. Significant predictive factors were: foreign citizenship, age class 30-49, age <1 (in the regional models), age 5-9 (in the model with both regions), mental disorders (in all groups), neoplasm or respiratory diseases (in elderly).

Discussion and conclusions: The high variability among Italian regions in violence rates can depend by both underreporting and misclassification in coding injury or disease cases. Results confirm the recurrence of violence as to the continuity characterizing maltreatment in domestic settings. The low specificity of models predictive of violence based on population-based healthcare databases implies that these models are still not sufficient alone to build effective screening tools. On the other hand, in population-based health registries the power of the sample is very high for each examined variable rendering a very accurate estimate of risk associations. Further analysis should consider the interactions among several factors, available in current registries and resulted significant in the present study.

ABBREVIATIONS

ED: Emergence Department; IDB: European Injury Database; IPV: Intimate Partner Violence; ICD: International Classification of Diseases

INTRODUCTION

Violence against vulnerable people is a highly hidden phenomenon. An Italian survey [1], estimated that the 31.5% of Italian women aged 16-70 experienced physical or sexual violence at least once in their lifetime, most of which led to injury. According to the European Injury Database (IDB) 1.8% of women admitted to Emergency Department (ED) because of injury or poisoning were victims of an intentional event [2]. The Italian IDB data [3], indicate that for women victims of violence 62% of events were secondary to relationship or relational violence respectively intended such as occurred in their ordinary context of life in family (parents, sentimental partner, relatives, care-

givers) or community (friends, acquaintances).

Scientific literature shows how women who are victims of violence seek help from healthcare services more often than women who have not been abused [4]. However, only a small fraction of victims report their assault to authorities. Given the high underreporting among victims, the burden of disease related to domestic violence and intimate partner violence (IPV) [5], still remains unclear.

Women are not the only vulnerable group exposed to abuse and maltreatment. Violence on children and elders is also widespread. The Italian Child Maltreatment study has observed a 2% prevalence of strongly suspected abuse or maltreatment with observable damage among all the children visited at paediatric ED [6]. These cases are highly underreported too [7,8].

Episodes of family violence tend to be repeated and can lead to frequent need for help from healthcare services. A systematic review revealed that at least 6% of Emergency Department patients have experienced domestic violence in the previous 12 months [9].

Many women with an admission in ED for violence had already been visited by the ED several times before the violent episode, often with traumas [10]. Victims of femicide had a significantly higher probability to have an admission to Emergency Departments when compared to controls of the same age and socioeconomic status. This suggests that femicide is in most cases preceded by episodes of physical violence that can be documented by admissions in Emergency Departments [11]. Therefore, emergency departments are ideal settings to identify victims of abuse and maltreatment, because the measure of repeated admissions is a good indicator for the continuity typical of domestic violence.

There is evidence that ED screening increases the identification of women experiencing violence and abuse [12]. However, there is insufficient evidence to show whether screening actually increases referring to local authorities or reduces violence and positively influences victims' health and wellbeing [13]. Similarly, evidence exists that systematic screening for child abuse in emergency departments is effective in increasing the detection of suspected child abuse [14].

The U.S. Preventive Services Task Force recommends screening women of childbearing age for intimate partner and domestic violence, whilst it considers the current evidence still insufficient to assess the balance of benefits and harms of screening all elderly or vulnerable adults (physically or mentally dysfunctional) for abuse and neglect [15].

Availability of sets of suspicion indicators derived from large population-based databases can be useful in healthcare settings to reinforce a suspicion arising from the observation of the patient and to integrate existing sets of suspicion indicators available from clinical practice and validated screening protocols.

Furthermore, whereas the ED admission procedures do not provide for a screening protocol on women, children and elders, an automatic procedure able to advise for patients with repeated previous admissions can be useful to alert the medical staff

about the possible continuity of violence and help them to detect victims of abuse and maltreatment [6,16].

Italian Ministry of Health project started a program in order to monitor violence against vulnerable people: women and children (REVAMP project - REpellere Vulnera Ad Mulierem et Puerum) [17]. One of the objectives therein was the identification of risk factors of domestic violence based on the analysis of repeated ED admissions. This study was a first step to define a methodology to identify patterns of admissions in ED related to violence from the analysis of healthcare population-based databases. This would be helpful to detect socio-demographic and clinical characteristics that are highly suspicious of violence. Consequently, the ED database can be used to identify patients with traits of interpersonal violence.

MATERIALS AND METHODS

The study has been conducted in two Italian regions: Piedmont (north-west of Italy with an average of 4.4 million inhabitants) and Tuscany (central Italy, around 3.7 million inhabitants). A case- control study design was utilised enrolling women (aged 15-64 years), children and adolescents (aged 0-17 years), and elders (aged 65 years or more), with at least one admission to ED during 2013-2015.

Criteria allowing the identification in healthcare databases of patients victims of violence have been identified by the epidemiological board of experts in the context of the REVAMP project. Both ED coding systems in Piedmont and Tuscany contain an identification variable of the general mechanism of injury that can assume the value of "assault". The characterization of the mechanism of injury allows the hospitals of both regions to contribute to the European Injury Database.

Another way to identify cases of violence or abuse at EDs is given by the list of ICD-IX1 diagnosis codes for abuse on adults and children or for the external causes of intentional injuries. They are reported in Appendix A.

In synthesis, patients of vulnerable groups (children, adult women, older people), recorded in the ED registers for assault, abuse or maltreatment occurred between 2013 and 2015 have been selected as cases. The last admission for violence in that period has been labelled as "index admission".

Conversely, a suitable control group should represent the general population and should not contain cases. Since some pathologies can be highly correlated with violence [18,19], it has been chosen to consider accidental (i.e. traumatic), causes of admission. Moreover, since many cases of violence can be hidden by cases of domestic injuries, only road injuries have been considered, as we did in a previous study [11]. Patients of vulnerable groups with admissions to ED for road injury occurred between 2013 and 2015 have been selected as controls. Similarly to cases, also for controls the last admission for road injury in this period has been indicated as "index admission".

· According to vulnerable groups, three series of cases and controls were studied:Children/adolescents (males and females) aged 0-17.

- Women aged 18-65
- Elders (males and females) aged 65 or more.

When we defined the control group we found that many individuals with an admission in ED for road injury had already been classified as cases of violence: 1,164 (0.88%), in Piedmont and 5,260 (3.5%), in Tuscany. These individuals were removed from the controls.

For each subject, all admissions occurred during the 24 months prior to the index admission have been selected, except for those that occurred during the 24 hours before the index admission. These admissions have been summarized by means of indicators counting their frequency.

Odds Ratios were calculated by means of a multivariate logistic regression model. In order to build each model by vulnerable group, the following variables have been taken into account: sex, age at the index admission, citizenship, number of ED admissions, number of admissions for violence, number of admissions for domestic injury and number of admissions for each big group of ICD-9 diagnosis.

Since the frequency distribution of ED admissions shows very big outliers, it has been decided to cut the observations at the 99th percentile of this distribution for each group (case/control, woman/child/elder, Piedmont/Tuscany). We can see the final number of cases and controls in Table 1.

For each group of vulnerable subjects, a backward logistic regression was implemented. The outcome variable was the belonging to the case group vs. the control one. All remaining variables were initially considered as predictors and then selected by means of backward elimination.

Initially, logistic regressions were performed separately for Piedmont and Tuscany. Once each model by region was established, all significant predictors were taken into account to model risk factors in both regions together in a new backward logistic regression.

Statistical analyses were conducted using SAS 9.2 (SAS Institute, Cary, NC). Results were considered statistically significant if the probability of erroneous refusal of the null hypothesis was p < 0.05.

RESULTS AND DISCUSSION

Let us first consider patients having an admission for violence (cases), and those with an admission for road injury (controls), of all sex and ages. If we compare their distribution for sex and age in each region, we can notice that whereas controls have a similar distribution in both regions, the number of cases in Tuscany is 5-6 times bigger than the Piedmonts' one (Figure 1). Moreover, the admissions rate ratio of violence cases for Tuscany vs. Piedmont is greater than 5 on average.

We can observe (Figure 2), a higher percentage of foreign patients in the group of the Piedmont women cases, both with respect to Piedmont controls and to Tuscany cases and controls. In both Piedmont and Tuscany, the percentage of foreign children and women is greater in cases than in controls.

When analysing the association among the considered variables and the admissions to ED for violence, backward logistic regressions allowed us to maintain only significant variables in each model. We reported odds ratios for each significant variable in each model in Tables 2-4. The group exhibiting more meaningful differences between the Piedmont and the Tuscany models is that reporting on elders.

For all models by population group and region, an increase in the number of admissions increments the probability of being victims of violence. As expected, an increase of the number of previous admissions for violence strongly affects the probability of the current admission being related to violence both for children (OR=24.025 in the common model), and for women (OR=15.910 in the common model). Surprisingly, this is not true for elders, neither in Piedmont nor in Tuscany.

Being foreigners increases the probability of being victims of violence both in children and in women, but not in a significant manner in Tuscan elders.

In the common model of both regions for children, we can see that 5-9 age group is the most at risk. However, in Piedmont age 5-9 appears to be protective with respect to age 1-4 and when separately considering the two regions age 0 seems to be exposed to the greatest risk.

By comparing the regional models of children, we can see that female gender is protective in Tuscany, whereas it is a risk factor in Piedmont.

Table 1: Distribution of cases and controls for group and region.

Piedmont N.		Tuscany N.	Piedmont yearly rate (x 10,000)	Tuscany yearly rate (x 10,000)	Admission Rate Ratio Tuscany/Piedmont
Child cases	1,205	4,965	5.84	28.81	4.9
Child controls	18,042	16,036	87.47	93.04	1.1
Woman cases	3,939	18,645	4.90	27.51	5.6
Woman controls	40,607	47,351	50.48	69.86	1.4
Elder cases	951	4,344	2.97	15.80	5.3
Elder controls	23,693	23,360	73.95	8.49	0.1
Total cases	6,095	27,954	4.58	24.84	5.4
Total controls	87,486	89,333	61.86	58.41	0.9

Table 2: Odds Ratio for factors associated with Emergency Department admission for violence among children 0-14 yrs. Piedmont and Tuscany, 2011-2015.

Children	OR (C.I. 95%)		
Factor	Piedmont (R^2=0.043)	Tuscany (R^2=0.028)	Common model (R^2=0.028)
ED admissions in the previous 24 months	1.093 (1.058-1.129)	1.135 (1.103-1.168)	1.036 (1.019-1.054)
citizenship (foreigner vs. italian)	1.805 (1.537-2.120)	1.235 (1.137-1.341)	1.633 (1.522-1.753)
sex (female vs. male)	1.404 (1.240-1.590)	0.806 (0.754-0.862)	0.938 (0.886-0.993)
age (0 vs. 1-4)	1.284 (0.915-1.802)	1.653 (1.221-2.238)	0.879 (0.715- 1.080)
age (5-9 vs 1-4)	0.910 (0.737-1.125)	1.087 (0.967-1.223)	1.129 (1.025-1.244)
age (10-17 vs 1-4)	1.240 (1.040-1.478)	0.790 (0.711-0.877)	1.054 (0.969-1.147)
ED admissions for violence in the previous 24 months	50.258 (28.131-89.788)	16.076 (11.063-23.362)	23.991 (17.578- 32.742)
ED admissions for injury or poisoning in the previous 24 months	/	0.873 (0.827-0.921)	/
ED admissions for congenital anomalies in the previous 24 months	/	0.554 (0.318-0.963)	0.601 (0.390-0.926)
ED admissions for mental disorders in the previous 24 months	1.797 (1.439-2.243)	/	1.463 (1.261-1.698)
ED admissions for diseases of the digestive system in the previous 24 months	1.241 (1.022-1.507)	/	/

Table 3: Odds Ratio for factors associated with Emergency Department admission for violence among women 15-65 yrs. Piedmont and Tuscany, 2011-2015.

Women	OR (C.I. 95%)		
Factor	Piedmont (R^2=0.061)	Tuscany (R^2=0.031)	Common model (R^2=0.060)
n. admissions	1.222 (1.198-1.247)	1.136 (1.117-1.156)	1.108 (1.095- 1.122)
age (30-49 vs. 18-29)	1.345 (1.239-1.460)	1.745 (1.670-1.824)	1.621 (1.560-1.684)
age (50-64 vs. 18-29)	0.816 (0.735-0.908)	1.585 (1.507-1.668)	1.333 (1.275-1.393)
citizenship (foreigner vs. italian)	2.534 (2.336-2.749)	1.326 (1.269-1.386)	1.666 (1.604-1.731)
ED admissions for violence in the previous 24 months	29.251 (21.261-40.244)	10.691 (9.386-12.178)	15.565 (13.799-17.556)
ED admissions for injury or poisoning in the previous 24 months	0.913 (0.861-0.968)	0.941 (0.908-0.974)	1.032 (1.002- 1.062)
ED admissions for domestic injury in the previous 24 months	1.221 (1.127-1.323)	/	0.825 (0.781- 0.872)
ED admissions for mental disorders in the previous 24 months	1.274 (1.184-1.371)	1.409 (1.312-1.514)	1.320 (1.258- 1.385)
ED admissions for musculoskeletal and connective disease in the previous 24 months	0.888 (0.819-0.961)	0.926 (0.864-0.992)	0.850 (0.809- 0.894)
ED admissions for diseases of the nervous system in the previous 24 months	0.884 (0.805-0.972)	/	/

Some groups of diagnosis appear significantly associated to ED admissions for violence: specifically, mental health diseases among women and children, neoplasm or respiratory diseases in elderly.

The analysis confirms how much the phenomenon of violence is affected by underreporting. Although the distribution of admissions for road accidents is similar among Piedmont and Tuscany, Tuscan ED register accounts for more than 5 times greater rate (per 10,000 inhabitants) of ED admissions for violence on vulnerable groups of population than Piedmont. The high variability among Italian regions in violence rates for ED-cases may depend both on underreporting and misclassification about intentionality or abuse in coding the disease causes.

Part of this difference could be explained by the adoption of the "Pink Code", a priority triage code in ED which is strictly dedicated to women and men who are suspected of being victims of violence, abuse or stalking [2]. The activation of an emergency triage code dedicated to suspected victims of violence can reduce the underreporting when based on the adoption of specific training and sensitization of the ED personnel and on definition of recognition and treatment protocols.

This case-control study provides some more information about the phenomenon of violence. First of all, it allows to estimate odds ratios for the risk factors for each group of victims. for instance, we can see how one or more ED admissions before the index one exhibits higher correlation with the risk of being

Table 4: Odds Ratio for factors associated with Emergency Department admission for violence among elders >65 yrs. Piedmont and Tuscany, 2011-2015.

| Elders	OR (C.I. 95%)		
Factor	Piedmont (R²=0.007)	Tuscany (R²=0.027)	Common model (R²=0.018)
ED admissions in the previous 24 months	1.227 (1.188-1.268)	1.300 (1.265-1.337)	1.237 (1.216- 1.258)
sex (female vs. male)	/	1.204 (1.126-1.287)	/
age (70-74 vs. 65-69)	0.947 (0.787-1.140)	/	0.907 (0.836-0.985)
age (>74 vs. 65-69)	0.816 (0.696-0.956)	/	0.899 (0.839-0.963)
citizenship (foreigner vs. italian)	1.704 (1.058-2.745)	/	1.621 (1.387- 1.896)
ED admissions for injury or poisoning in the previous 24 months	/	0.835 (0.787-0.885)	
ED admissions for domestic injury in the previous 24 months	/	1.216 (1.094-1.352)	0.864 (0.801-0932)
ED admissions for neoplasms in the previous 24 months	1.829 (1.032-3.241)	2.682 (1.679-4.286)	1.908 (1.374-2.649)
ED admissions for mental disorders in the previous 24 months	/	1.237 (1.050-1.458)	/
ED admissions for diseases of the nervous system in the previous 24 months	/	0.917 (0.847-0.992)	/
ED admissions for respiratory diseases in the previous 24 months	1.189 (1.004-1.407)	1.312 (1.179-1.461)	1.355 (1.247-1.473)
ED admissions for diseases of the blood in the previous 24 months	1.947 (1.295-2.929)		
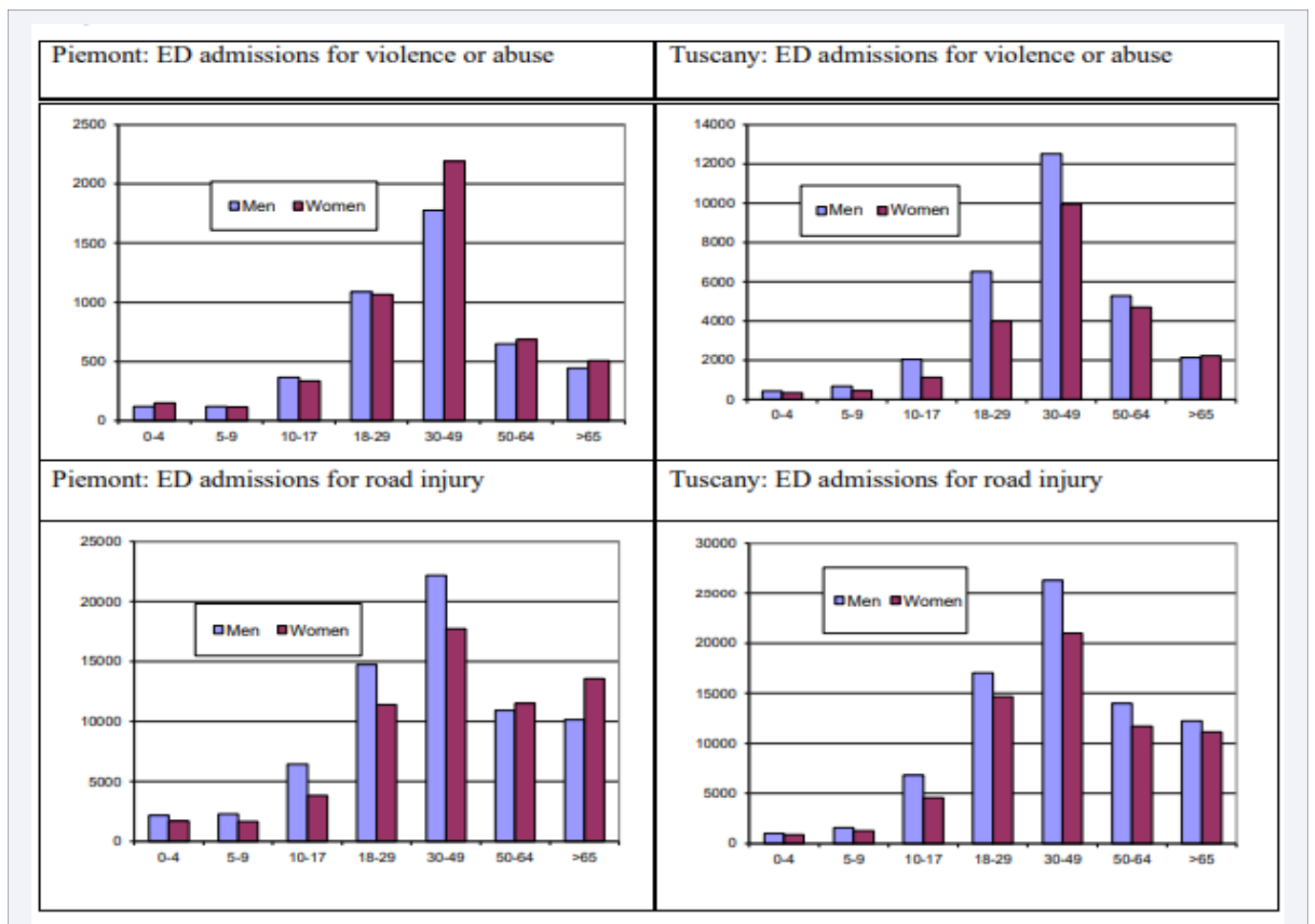
Figure 1 Sex and age distribution of cases and controls. ED admissions. Piedmont and Tuscany.

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victims with respect to the group of diagnosis of past admissions. Moreover, the statistical significance of such factors is different for each group (women, children and elders), and in some cases shows differences between Piedmont and Tuscany, probably due to the different levels of registration of violence cases.

For all models by population group and territory, an increase in the number of ED admissions causes a greater risk of being victims of violence. As expected, an increase in the number of previous admissions for violence strongly affects the probability of the current admission being related to violence both for children and for women. These results confirm the recurrence of violence as characterizing maltreatment, especially when it occurs in domestic settings.

As observed, foreign nationality is a significant risk factor for being victims of violence. It is not significant for older people in Tuscany, but it should be considered the low amount of old foreign population in Italy.

The higher risk observed for women 30-49 is coherent with the observation that among IPV victims the 36-45 age group is more likely to access the ED [20].

Concerning children, as observed, the age class 5-9 has an OR significantly higher than 1 in Tuscany and in the common model, whereas it is protective in Piedmont with respect to age 1-4. Probably the low number of children cases registered in both regions affects the measure of risks as demonstrated by the width of the confidence interval (CI), which in both regions has the lower limit below 1. Similarly, the apparently surprising observation that age group 0 is significantly at risk in Piedmont and in Tuscany respectively, but not in the common model can be explained by the numerousness of samples, which is clearly higher when considering the two regions together. Similar considerations can be made for the 10-17 age group.

Moreover, the number of admissions related to some groups of diagnosis (injury or poisoning, congenital anomalies, mental

disorders, digestive system), can have spurious correlations with age. This could be the reason of the difference in their significance in the regional models. It looks reasonable that patients suffering from some specific classes of diseases could be admitted to ED more often than other people, regardless of being victims of violence or not. For this reason, admissions for these classes of diseases appear to be significantly protective in the model. This is probably a balance for the effect of the number of admissions in general in the increase of the risk of being victims of violence.

Concerning diagnoses groups in all territorial models, mental disorders resulted as a significant risk factor for being victims of violence in women and in children. In fact, evidence in scientific literature and clinical practice indicates mental and behavioural problems as both factors of vulnerability of the person and consequences of abuse and maltreatment in a circular effect that in children can affect the development and growth process. In older people the significant diagnoses groups associated to violence in all territorial models are those of chronic diseases such as neoplasm or respiratory diseases that render the person less autonomous, more fragile and then more vulnerable to violence.

The interpretation of results can be biased by the misclassification of victims: since they are highly underreported and often inappropriately coded for the diagnoses classification, we cannot exclude the presence of cases in the group of controls. This misclassification of the outcome should be unrelated to risk factor exposure (non-differential). Non-differential misclassification of the health outcome biases the odds ratio towards the null [21].

These logistic regression models predicting violence based on the risk factors observed in population-based healthcare databases have low determination coefficients, and low specificity. This implies that such models are still not sufficient alone to build effective screening tools.
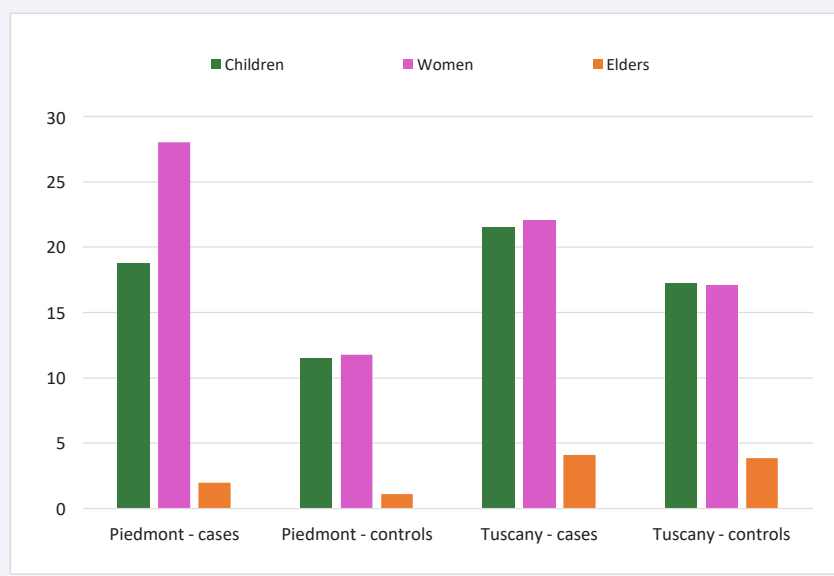

Figure 2 Percentage of foreign people in each group.

Furthermore, it is not possible to identify risk thresholds for each factor or for the model. This situation depends on the fact that in large population-based registries only a limited number of variables is available. On the contrary, in clinical practice and validation studies the definition of screening tools for relational (and relationship) violence is based on tens of variables for each prognostic dimension: anamnestic, behavioural/psychological, physical. On the other hand, in population-based health registries the power of the sample is very high for each examined variable rendering a very accurate estimate of risk associations and their strength. When considering those aspects, the results of the present study support the usefulness of considering the number of repeated admissions in ED as a suspicion index for domestic violence, together with the other suspicion indicators actually included in healthcare settings screening tools for violence on vulnerable subjects. Additionally, a contribution to a violence detection system may be provided by semantic analysis of textual ER reports data [22].

In further studies, classification models for the identification of cases of violence based on current healthcare registries will be tested and implemented.

CONCLUSION

The phenomenon of interpersonal and domestic violence is a relevant health issue. Since it is highly affected by underreporting and misclassification, healthcare specialists should be trained to make themselves responsible in dealing with potential victims, both from a physical and psychological point of view, in order to correctly detect and report cases. As an example, in Italy the activation of a specific triage code ("Pink code") in Tuscany was a first step towards a better recognition and therefore a possible better taking into care of victims.

The results of this study underline the possibility of finding patterns of admissions highly predictive of violence. In particular, the recurrence of ED admissions for victims of violence in our study resulted a significant risk factor on a large sample from population-based ED registry. New sets of suspicion indicators derived from ED registries may be useful to reinforce suspicion arising from the observation of patients in healthcare settings. Moreover, they may be added to the existing sets of indicators used in the specific screening tools for violence on vulnerable people.

Nevertheless, population-based healthcare variables models alone are not good enough as diagnostic tools. Since violence is a complex phenomenon, further analysis should consider also the effects of variables that are not available in current registries. Moreover, interactions among several factors available in current registries and resulted significant in the present study should be analysed, in order to be able to define predictive models with higher accuracy of the estimate (in terms sensibility and specificity). The presently identified risk factors, derived from population- based health databases, could be considered as appropriate variables for predictive models to be examined and tested in a future study.

Notes International classification of diseases ICD - ICD-9-CM - International Classification of Diseases, Ninth Revision, Clinical Modification (https://www.cdc.gov/nchs/icd/icd9cm.htm)

http://www.aou-careggi.toscana.it/internet/index.php?option=com_content&view=article&id=3193&Itemid=1090&lang= en

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