Changing Pattern of Acute Alcohol Intoxications in Children

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Background: In many countries, the number of children hospitalized for alcohol intoxication is increasing. This study analyzed changes in the number of hospitalizations for alcohol intoxication in children aged 0–18 years at the Department of Pediatrics, University Hospital of Split, from 2008 to 2015.

Material/Methods: Data were collected retrospectively from hospital medical records. Risk groups were classified according to sex, age, drinking habits, and possible benefits of early psychological or psychiatric interventions. Children were divided into 4 age groups: 0–5 years, 6–9 years, 10–13 years, and 14–18 years. Statistics 12.00 was used for statistical analyses, with *P*-value <0.05 considered as statistically significant.

Results: Out of 24 651 hospitalized children, 488 were treated for acute intoxication: 36.40% were girls and 63.60% were boys. Among them, 272 children (55.74%) were acutely intoxicated with alcohol, with the average age of 15.95 years and the average blood alcohol concentration of 2.00%. The proportion of children hospitalized for alcohol intoxication decreased from 1.33% in 2008 to 0.75% in 2015. Alcohol intoxications occurred in most cases outside children's homes (92.42%, *P*=0.001), and on weekends and holidays (81.62%). Among all intoxicated children, 17 children (6.25%) were positive for drugs. A total of 51.29% of children received psychological support (58.59% of girls and 47.09% of boys).

Conclusions: In this study, the number of children hospitalized for alcohol intoxication decreased, possibly as a result of preventive, educational, and psychotherapeutic measures or changing drinking habits. Acute alcohol intoxication was most common in the group of children aged 14 to 18 years, and a significant number of these children were positive for drugs, thus, further preventive interventions should be provided.

MeSH Keywords: Adolescent • Alcohol Drinking • Alcoholic Intoxication • Child • Drug Users • Risk Factors

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Background

Alcohol has been used for thousands of years in many different scenarios: for religious purposes, in medicine and social interactions, and as a nutritive substance. To reduce its consumption in the 20th century, it was prohibited in many countries by numerous preventive measures [1].

Intoxication is a clinical condition of a sudden or gradual threat to one or more organic systems that is caused by contact with toxic substances. It can be acute or chronic and it is usually accidental. Alcohol intoxication is one of the most common causes of poisoning. A blood alcohol concentration (BAC) of 0.20–1.50 mg/g is considered mild alcohol intoxication; 1.51–2.50 mg/g moderate intoxication, and >2.50 mg/g severe intoxication [2]. Alcohol intoxication in children is sometimes characterized by coma and vomiting. Coma in children occurs at lower blood alcohol concentration than in adults and children have higher risk of hypoglycemia and hypothermia [3].

Drinking in children in most cases is occasional and happens during puberty. Children usually enjoy alcohol under the influence of peers, believing that drinking will make them feel better and more relaxed [4], or "to have more fun at a party" [5], or to experiment, or because of problems in human relations or in their family, or as an attempted suicide [3].

There are various risk factors for drinking in children including parents especially a father [6] or other relative who often consumes alcohol as these adults are usually a social role model and children often follow their parent's behavior and develop a similar drinking pattern through observational learning, deviant peer affiliations, and an elevated alcohol tolerance; or when there is less parental supervising and strictness [7], or poor parental insight into children´s activities during their leisure time, and less parental control and fewer rules [6]. More girls reported coping motives than boys [5,8], and more often drink alcohol when they were depressed or to cheer up when they have problems, often leading to binge drinking [5].

Alcohol intoxication in adolescents, especially accompanied with drug consumption is often connected with traffic accidents [9], trauma [10], or sexual violence [11]. Alcohol consumption, as well as use of marijuana in children may interrupt brain development leading to cognitive impairment. Heavy alcohol use during adolescence is related to accelerated decreases in gray matter and attenuated increases in white matter volume [12].

Children who were hospitalized due to acute alcohol intoxication are at greater risk for alcohol dependence and alcohol abuse, binge drinking, smoking and illicit substance use [7], as well as delinquent behaviors [13].

According to ESPAD (European School Survey Project on Alcohol and Other Drugs) data, the highest prevalence of alcohol drinking is in the Czech Republic and Denmark and lowest in Iceland and Nordic and Balkan countries. From 1995 to 2011, the largest increase of alcohol use was in Croatia with a decrease in Iceland and Sweden [14]. In Croatia, 80% of boys and girls tasted alcohol before the age of 15 years [15]. In most countries, except Iceland, Latvia, and Sweden, the incidence of drinking is reported to be higher in boys than girls [14].

A number of studies have shown an increase in the number of children hospitalized for alcohol intoxication [16–25], while only a few studies have shown a decreasing trend [26]. A Croatian study, from 1997 to 2007, showed an alarming increase in the number of hospitalizations for alcohol intoxication in children, from 0.3% to 1.7% of all hospitalizations, especially among girls and in the adolescent group [27]. Another Croatian study also showed an increasing number of children with alcohol consumption, especially in high schools, both for boys and girls, as well as binge drinking [28].

The aim of this study was to examine the number of hospitalizations for alcohol intoxications in children aged 0–18 years old seen at the Department of Pediatrics, University Hospital of Split from January 1, 2008 to December 31, 2015. As the University Hospital of Split is the only clinical hospital center in Split-Dalmatia County (approximately 455 000 residents), we could presume that all serious cases were treated at University Hospital of Split and the data are representative of the Dalmatian region.

We also wanted to determine changes in the number of hospitalizations by year, as well as the different risk groups for drunkenness by age and sex, drinking habits, and interventions by psychologists or psychiatrics, as well as to compare the results from 1997 to 2007 in the same department.

Material and Methods

Patients

Children aged 0–18 years old who were hospitalized at the Department of Pediatrics, University Hospital of Split from January 1, 2008 to December 31, 2015 were included in our study. From the total number of 24 651 children who were hospitalized during that period, we included 488 who were hospitalized for acute intoxication (272 for alcohol and 216 for other causes of intoxication). All children were admitted to the hospital through our receiving department. After extensive clinical examination, blood and urine samples were taken to measure the blood alcohol concentration and detect the possible presence of drugs or medications. All children with symptoms of

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Table 1. Comparison of children hospitalized due to alcohol intoxications at the Department of Pediatrics, University Hospital of Split from January 1, 2008 to December 31, 2015, by age and sex.

Year	Age group												All age groups			Number of all hospitalizations
	0–5 years			6–9 years			10–13 years			14–18 years						
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	
2008	0	0	0	0	0	0	2	1	1	42	23	19	44	24	20	3303
2009	0	0	0	0	0	0	6	4	2	49	34	15	55	38	17	3414
2010	0	0	0	0	0	0	1	0	1	37	22	15	38	22	16	3395
2011	0	0	0	0	0	0	4	4	0	33	21	12	37	25	12	3315
2012	0	0	0	0	0	0	3	1	2	36	24	12	39	25	14	3192
2013	0	0	0	0	0	0	1	0	1	25	17	8	26	17	9	2891
2014	0	0	0	1	0	1	0	0	0	13	8	5	14	8	6	2621
2015	0	0	0	0	0	0	1	1	0	18	13	5	19	14	5	2520
Total	**0**	**0**	**0**	**1**	**0**	**1**	**18**	**11**	**7**	**253**	**162**	**91**	**272**	**173**	**99**	**24651**

Table 2. Comparison of children hospitalized due to non-alcohol intoxications at the Department of Pediatrics, University Hospital of Split from January 1, 2008 to December 31, 2015, by age and sex.

Year	Age group												All age groups			Number of all hospitalizations
	0–5 years			6–9 years			10–13 years			14–18 years						
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	
2008	11	3	8	6	2	4	1	0	1	9	2	7	27	7	20	3303
2009	10	5	5	2	1	1	0	0	0	5	1	4	17	7	10	3414
2010	14	9	5	2	1	1	2	1	1	5	1	4	23	12	11	3395
2011	18	7	11	3	2	1	2	1	1	13	3	10	36	13	23	3315
2012	16	7	9	2	1	1	2	1	1	23	7	16	43	16	27	3192
2013	8	4	4	2	2	0	2	1	1	13	0	13	25	7	18	2891
2014	10	5	5	0	0	0	0	0	0	6	2	4	16	7	9	2621
2015	15	7	8	1	1	0	4	2	2	9	2	7	29	12	17	2520
Total	**102**	**47**	**55**	**18**	**10**	**8**	**13**	**6**	**7**	**83**	**18**	**65**	**216**	**81**	**135**	**24651**

acute intoxication such as vomiting, consciousness disorders or general clinical disorders, or anamnestic data of ingestion of a toxic substance were received for hospital treatment. The admission policy was not changed during the observed period. The study was approved by the Ethical Committee of the University Hospital of Split and procedures were followed in accordance with the Helsinki Declaration of 1964 as revised in 2013.

Data collection

The data of children hospitalized for acute intoxication (n=488) were collected from medical records and medical histories at the Department of Pediatrics, University Hospital of Split. After identifying children with acute alcohol intoxication, we collected data on age, sex, alcohol blood concentration, location of intoxication (at home or outside the home), month and day of intoxication (working days or weekends and holidays), type of drinks (shots, wine/beer, or mixed drinks), presence of injuries, presence of other drugs or medications, and interventions by psychologists or psychiatrics. Children were divided into 4 age groups: 0–5 years (preschool), 6–9 years (elementary school, 1st–4th grade), 10–13 years (elementary school, 5th–8th grade) and 14–18 years (high school) (Tables 1, 2).

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Statistical analyses

We used Statistics 12.00 (Statsoft producer) software for statistical analyses. We also used methods of graphic and tables display, chi-square test, and exponential trend models. Empirical F value was used for statistical significance testing of the model. Numeric variables were shown with mean and standard deviation. Z-test was used for comparison of 2 proportions and χ^2 test was used for detecting the association between 2 categorical variables. *P* value <0.05 was considered as statistically significant. For trend displays we used the exponential trend model where the parameter β1<1.00 indicated declining tendency.

Results

Sample characteristics and types of intoxications

During the period from January 1, 2008 to December 31, 2015, 24 651 children were hospitalized at the Department of Pediatrics, University Hospital of Split; 488 admissions were due to various intoxications. Among them, 272 children (55.74%; CI 95%: 51.33–60.14%) were hospitalized for alcohol intoxications (Table 1), and 216 children (44.26%) were hospitalized due to various other intoxications (Table 2).

Among the 216 children (44.26%) who were hospitalized due to various other intoxications, 141 children were intoxicated with different groups of medications such as anti-inflammatory drugs (paracetamol, ibuprofen, diclofenac), antipsychotics (benzodiazepines, risperidone, olanzapine, haloperidol, buprenorphine/naloxone, etc.), antiepileptics, various antihypertensives, anticoagulants (warfarin), iron supplements, metoclopramide, and oxymetazoline. Forty children were intoxicated with various chemicals (antimycotic chemicals for dogs, naphthalene, oil, petrol, manganese, acetone, detergents, acids, alkali, volatile oil, hair colors), 11 children with non-medical drugs (cannabis, nicotine, amphetamine), 11 children with carbon monoxide, 10 children with poisons (insecticides, organophosphates, rodenticides), 2 children with plants, including mushrooms, and 1 child with drugs and medications intoxication (Figure 1).

The average age of children hospitalized for acute alcohol intoxication was 15.95±1.51 years. The youngest patient was 7.17 years old and the oldest patient was 18.18 years old. The most numerous group consisted of adolescents 14–18 years old (93.2%). Girls were affected in 36.40% of cases (n=99), and boys in 63.60% of cases (n=173). The average blood alcohol concentration was 2.003±0.585 mg/g (minimum 0.20 and maximum 4.00 mg/g).

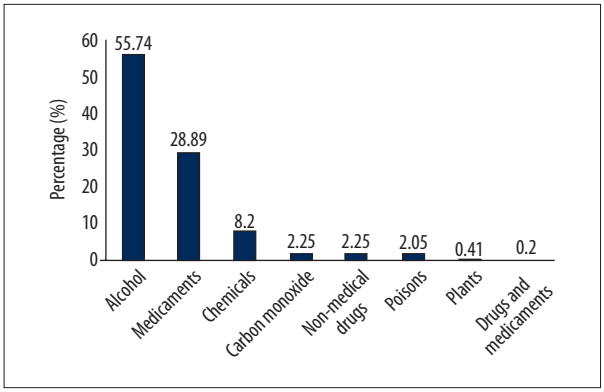

Figure 1. Percentages of various causes of intoxication in children hospitalized at the Department of Pediatrics, University Hospital of Split from January 1, 2008 to December 31, 2015 (n=488).

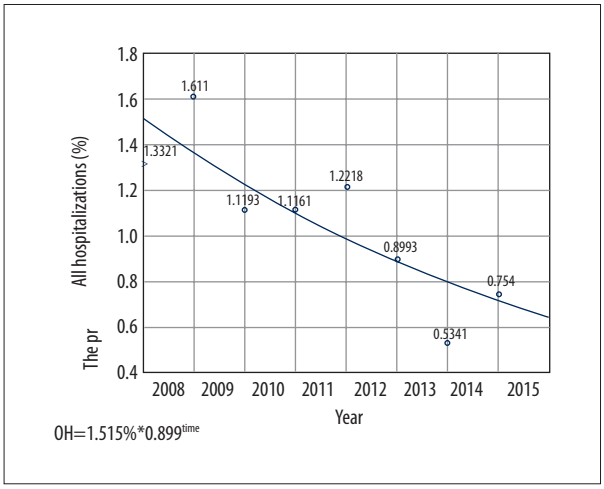

Figure 2. Estimated trend model of proportion of alcohol intoxications among all hospitalizations at the Department of Pediatrics, University Hospital of Split. The estimated model explains 97.68% (R^2=97.68%) changes of percentages of hospitalizations for alcohol intoxications from all hospitalizations. It is a representative model and it is statistically signigicant.

Changes in the number of hospitalizations for acute alcohol intoxication in children from 2008 to 2015

During the study period, the proportion of hospitalizations due to alcohol intoxications among all hospitalizations for various reasons, deceased from 1.33% in the first to 0.75% in the last year. The trend of the proportion of alcohol intoxication among all hospitalizations was estimated by exponential trend (Figure 2).

The proportion of alcohol intoxications among all intoxications was significantly lower in the last 2 years of research compared to the first 2 years (*P*=0.00107, χ^2 test). The highest proportion

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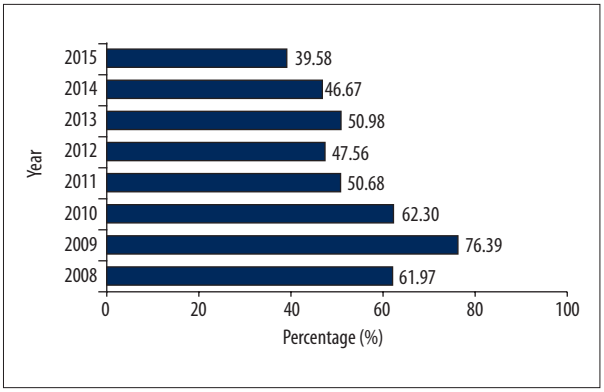

Figure 3. The proportion of alcohol intoxications among all intoxications in children hospitalized at the Department of Pediatrics, University Hospital of Split in a period from January 1, 2008 to December 31, 2015, by year.

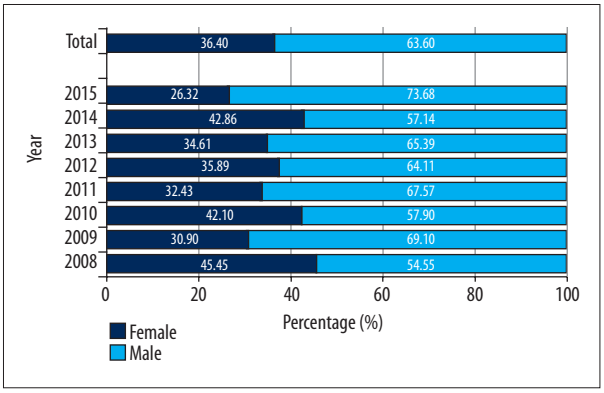

Figure 4. Gender distribution of children hospitalized for alcohol in intoxications at the Department of Pediatrics, University Hospital of Split, from January 1, 2008 to December 31, 2015, total in examined period and for each year of research separately.

of alcohol intoxications was found in 2009 (76.39%), and the lowest in 2015 (39.58%) (Figure 3).

Changes of gender distribution of children hospitalized for acute alcohol intoxication from 2008 to 2015

There were more hospitalized boys than girls for alcohol intoxication in every observed year. Moreover, in the last year of our research the reduction in the proportion of girls was highly noticeable (26.32% from all children intoxicated with alcohol) compared to the first year of the study when that number was 45.45% (Figure 4). During the observed period from 2008 to 2015, the gender representation was not significantly changed (P=0.75797, χ^2 test).

Table 3. Structure of other drugs use in children with acute alcohol intoxication (n=272) at the Department of Pediatrics, University Hospital of Split in period from January 1, 2008 to December 31, 2015.

Addictive substances in urine	Number of children	Structure (%)
No	247	90.81
Opiates	1	0.37
Cannabis	10	3.67
Unknown	7	2.57
Amphetamine	1	0.37
Barbiturate, benzodiazepines	5	1.84
False positive (red bull)	1	0.37
Total	**272**	**100.00**

Drug use and injuries in children hospitalized for alcohol intoxication

Out of 272 patients with alcohol intoxication, 247 patients (90.81%) were negative for addictive substances (medical and non-medical drugs) in urine samples, while 17 patients (6.25%) were positive to addictive substances in urine samples and 7 patients (2.57%) had no data about drug use available (Table 3). There were 12 children (4.41%) who were positive for non-medical drugs. Compared by sex, there was no significant difference in drug use among boys and girls (P=0.3728, z-test). Out of 173 boys, 157 (90.75%) were negative for addictive substances in urine samples, as well as 91 out of 99 girls (91.91%).

Out of 272 children, 30 (11.03%) had body injury acquired for drunkenness.

Drinking habits in intoxicated children

In most cases (81.62%), children got intoxicated with alcohol on weekends (Fridays, Saturdays, and Sundays) and holidays. In 92.42% of cases (P<0.001), they drank outside of their homes, in many different locations (park, beach, disco club, cafe bar, etc.).

Alcohol use was higher in August (n=37, 13.60%) and January (n=32, 11.76%) and lower in November (n=13, 4.78%), (Figure 5). Children usually (58.71%) drank different kind of strong alcoholic drinks: 31.61% drank mixed drinks (shots with juice, cola, Red Bull, wine, or beer) and 9.68% drank beer or wine.

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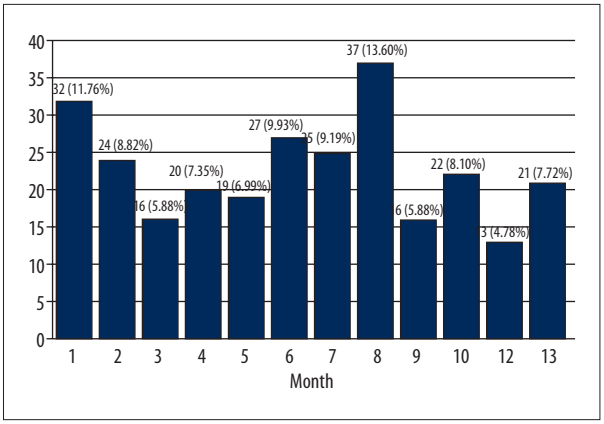

Figure 5. A number and percentage of children hospitalized for acute alcohol intoxication at the Department of Pediatrics, University Hospital of Split (n=272) from January 1, 2008 to December 31, 2015, shown by every month of the year.

Table 4. Gender comparison of children with alcohol intoxication in a need for psychological intervention at the Department of Pediatrics, University Hospital of Split from 2008 to 2015, shown separately for each year.

Year	Psychological support Number (percentage)	
	Male	Female
2008	15 (62.50%)	11 (55.00%)
2009	13 (34.21%)	11 (64.71%)
2010	7 (31.82%)	9 (56.25%)
2011	13 (52.00%)	7 (58.33%)
2012	14 (56.00%)	10 (71.43%)
2013	11 (68.75%)	7 (77.78%)
2014	3 (37.50%)	1 (16.67%)
2015	5 (35.71%)	2 (40.00%)

The intervention of psychologist or psychiatrist

An intervention by a psychologist or psychiatrist was conducted for 51.29% of patients. Girls more often received a psychological intervention (58.59%) compared to boys (47.09%) (P=0.0341, z-test). In 2014 and 2015, interventions were received less often by boys as well as girls. In other years, most girls (over 50%) received psychological support. In 2013, interventions were conducted for 77.78% of girls and 68.75% of boys (Table 4). In one case, there was a first sexual contact with drunkenness, 2 children got intoxicated with alcohol for suicidal attempts, for 6 children there was repeat hospitalization for drunkenness, and for 2 children was earlier intoxicated with medications.

Discussion

Our investigation showed a decrease in the number of children hospitalizations for acute alcohol intoxication at the University Hospital of Split between 2008 and 2015 compared to an early period from 1997 to 2007 [27].

Types of intoxication in children

There are various causes of acute intoxications in children and the most common causes of poisoning have changed over the years. In a Turkish study, children were more frequently (78.1%) accidentally intoxicated with drugs, while alcohol intoxication was ranked in the seventh place, with a frequency less than 5% [29]. In 2 Polish studies, alcohol was considered the first (49.9%) and second (24.4%) cause of poisoning [30,31]. In our study, alcohol was also the most common cause of poisoning with 55.74% of intoxicated children, while drugs were in second place (28.89%). This proportion of alcohol intoxications is higher than in the previous Croatian study where it was 40.2%, while drugs were in second place (36.9%) [27]. In the present study, there were less intoxications with other chemicals, and more intoxications with non-medical drugs (2.25% versus 0.3%). There were also more children with concomitant alcohol and non-medical drug intoxication (4.41% versus 2.9%). Some other studies reported similar results [30,31].

Prevalence of hospitalizations for acute alcohol intoxication in children

Although some studies showed an increasing trend in frequency of alcohol consumption in children [32,33] as well as an increase in hospitalizations for alcohol intoxication [16–25], including a previous Croatian study [27], our new study from 2008 to 2015 conducted at the same hospital resulted in a completely different result showing a significant decrease in the number of alcohol intoxications treated in hospital. Based on these results, we predict an annual decrease in alcohol intoxications in children by 10.10% (Figure 2). A decreasing trend is probably a result of intensively provided preventive, educational and psychological measures which have significantly increased the public awareness of the severity of underage drinking and reduced the accessibility of alcoholic drinks to youths. A Russian study also reported a decrease in the number of hospitalizations for alcohol intoxication in children [26].

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Gender and age distribution of alcohol consumption in children

Boys usually drink more than girls [18,19,23] as was seen in our study (63.60% for boys versus 36.40% for girls), while in a study from Bitunjac and Saraga [27], the proportion of boys was 71.1%. A number of studies found an increasing number of girls who were hospitalized for alcohol intoxication [21,22,27,32,34], and some found that young females get intoxicated with alcohol as often as young males [35,36], while other studies found the highest alcohol consumption was in girls [31,33].

A Dutch study showed that the average age of adolescents admitted to hospital with alcohol intoxication increased from 15.3 years in 2007 to 15.7 years in 2009 [16]. In our study, the average age of children who got intoxicated with alcohol increased to 15.95 years, compared with 14.01 years from the previous Croatian study [27]. In other studies [17,18,25,30,36], the average age was lower. In our study, the most numerous group consisted of youths from 14 to 18 years (92%).

Drinking habits in children (types of drinks, places, and time) and acquired injuries

The most common type of alcohol in our study were shots (58.71%), while beer or wine use was found in only 9.68% of cases, which was similar to some other studies [18,36], but different from some studies where beer was the most prevalent alcoholic drink [16,33]. Spirit drinkers seem to be more likely to use cigarettes and drugs and are more frequently drunk than beer/wine drinkers [37].

Considering the place of drinking, in our study children usually drunk outside their homes (92.42%), similarly to results of other studies [18,33,38].

When analyzing the time of year for alcohol intoxication, a Polish study showed a significant drop in the frequency of all types of poisoning in the summer holiday months (July and August) and an increased frequency, mainly with alcohol, in the school period [30]. Contrarily, in our study, alcohol use in children was most often in August (13.60%) and January (11.76%) and the lowest was in November (4.78%). This is probably a result of a different distribution of leisure time and school obligations between these months. During August, children are on their school break, often meet with their friends in open spaces, stay out later, and may be "trying to fulfill the last days of break and to relax" before the beginning of the school semester in September. The largest number of intoxications in January happens on New Year Eve´s celebrations.

The largest number of alcohol intoxications (81.62%) happened during weekends and holidays when children were off school, as was found in other studies and other European countries [18,27,28,30,35].

In our study, 11.03% of children had body injuries due to loss of conciseness, similar to a Turkish study where that proportion was 7% [17], while a significantly higher proportion (34%) was reported in a Canadian study [36].

Preventive measures

Psychosocial intervention on the morning after hospitalization for acute alcohol intoxication results in a lower alcohol use for 4 weeks after, and lower binge drinking frequency, but only in girls [39]. Another study showed that children hospitalized for acute alcohol intoxication who received a booster session did not increase episodic heavy drinking in a period of 11–25 months after hospitalization [40]. Our study showed that 51.29% of children received interventions from a psychologist or psychiatric, most frequently the day after hospitalization or a few weeks later. Support was more often provided to girls (58.59%) compared to boys (47.09%). In a German study, 17 out of 173 patients had mental disorders or psychosocial problems and were in psychological or psychiatric treatment [19]. In a previous Croatian study, the proportion of children in need of a psychological or psychiatric intervention increased from 5.9% to 30.5% [27]. With minimal parental supervision during the time when peer interactions are at their highest significance, early maturing girls are at higher risk for a dramatic increase in drinking problems [41]. These findings indicate that an earlier and more frequent psychological intervention could be the reason for a decreasing trend in alcohol intoxications in young people.

Prevalence of drunkenness and drinking in different countries might be a result of substantially different laws between these countries [42,43].

Limitations of the study

The limitations of this study include lack of data of places where drinking occurred, types and quantities of drinks, and other drugs use, so we did an analysis of the available data. We had no data on the reasons and circumstances which lead to alcohol intoxication. The number of children intoxicated with alcohol is possibly higher than we recorded, because some of them were treated at home.

Conclusions

In conclusion, there was a significant decline in the number of hospitalizations for acute alcohol intoxication in children ($P<0.001$). This might be a result of better preventive

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and educational measures in schools and media campaigns, or the result of changing attitudes to alcohol drinking among youths. A high number of psychological treatments, more provided in girls than boys, could also be a reason for this declining trend or the small number of recurrences. Since most of intoxications happen in public places ($P<0.001$), to further reduce these risky behaviors, implementation of stricter laws and preventive measures are needed. In addition, prohibition of alcohol sales to youths should be better conducted and supervised. We also found an increase in non-medical drug usage indicating a need for a stricter legal procedure to ban the sale of drugs to minors and better school area supervision.

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