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The problem of preventable public health: Evaluation of demographic characteristics of patients followed up and treated for corrosive esophagitis

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Abstract

Objective: This study aims to evaluate the demographic characteristics of patients treated for corrosive esophagitis, highlighting key risk factors and the importance of immediate endoscopic evaluation.

Materials and methods: Retrospective demographic data of 340 (age, gender, number of siblings, maternal education level, region of incidence, type of treatment) patients with corrosive esophagitis who were followed up and treated and between the ages of 0 and 18 was examined. All patients had endoscopies 24-36 hours after exposure to stage their esophagitis, and the Zargar classification was applied for this staging.

Results: Corrosive esophagitis was shown to occur equally in both sexes. Patients were mainly exposed to 27.94% bleach, 15% air conditioner cleaner, and 12.64% sink cleaner. Pre-kindergarten age group had the highest exposure rate (40.58%), while rural residents had the highest exposure rate (64.12). Mothers with primary school education level were 55.2%. In 42.64% of the patients, the number of siblings in the household was 4 or more. 71.87% of patients had Stage 2A or below, while 25.29% had esophageal dilatation.

Conclusions: This study highlights the urgent need for preventive measures and education to reduce corrosive esophagitis, especially in vulnerable populations. Stricter regulations and targeted interventions are essential for effective prevention.

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Introduction

The illness known as Corrosive Esophagitis (CO), which arises from unintentional consumption of corrosive chemicals, is widespread in society. Considering its occurrence and consequences, it is still a serious cause of mortality and morbidity in developing countries. Even though it is a condition that may be prevented, once it happens, it can have terrible consequences for both the parents and the exposed child (1).

In many developed countries, written and visual education programs are applied to families. It is reported that the frequency of corrosive oesophageal burn decreases by 75% by taking protective measures in packaging and storage and introducing various legal restrictions on the free sale of strong corrosive substances (1-3). The first known legal regulation regarding corrosive agents was made by the Federal Government of the United States in 1927 (4).

Preferring cheap and poor quality products due to the country's insufficient socioeconomic level, parents not being conscious enough about education, having many children in the household and not being able to show sufficient sensitivity and attention to children increases the rate of such exposures (4).

Accidental exposure is frequent in early life because of children's natural curiosity and energy. The use of corrosive substances for suicide is increasingly common during adolescence and adulthood. 20-40% of corrosive ingestions result in esophageal damage (5,6).

The degree of esophageal damage varies depending on whether the ingested substance is acid, base or alkaline and the amount of the ingested substance. Alkaline substances cause liquefaction necrosis, whereas acidic corrosive substances cause coagulation necrosis. Deep tissue damage of alkaline substances is more evident than acidic substances. Acid-containing substances have a rather superficial corrosive impact (5,7).

This study aims to evaluate the demographic characteristics of patients treated for corrosive esophagitis, highlighting key risk factors and the importance of immediate endoscopic evaluation.

Materials and methods

In our study, the demographic data of 340 patients between the ages of 0-18 (age, gender, number of siblings, mother's education level, region where the cases occurred, type of treatment) who were followed up and treated for corrosive esophagitis in the department of pediatric surgery at Harran University Research and Application Hospital between January 2012 and December 2021 were retrospectively examined. Within 24 to 36 hours of the patient's admission to our hospital due to corrosive exposure, an endoscopic evaluation was conducted. Under operating room conditions, sedation was applied with intravenous Midazolam 0.1-0.3 mg/kg and endoscopy was performed. Endoscopy was performed with a 5mm diameter STORZ pediatric endoscopy device (Figure 1). Endoscopic findings were performed according to the Zargar classification (7). According to this classification; Stage 0: normal, Stage I: superficial mucosal edema and hyperemia, Stage IIA: superficial ulcers, erosions and exudates, Stage IIB: deep focal or circular ulcers, Stage IIIA: transmural ulcers with focal necrosis, Stage IIIB: diffuse necrosis was evaluated. All patients were subsequently included in the study. The flow chart is given in Figure 2.

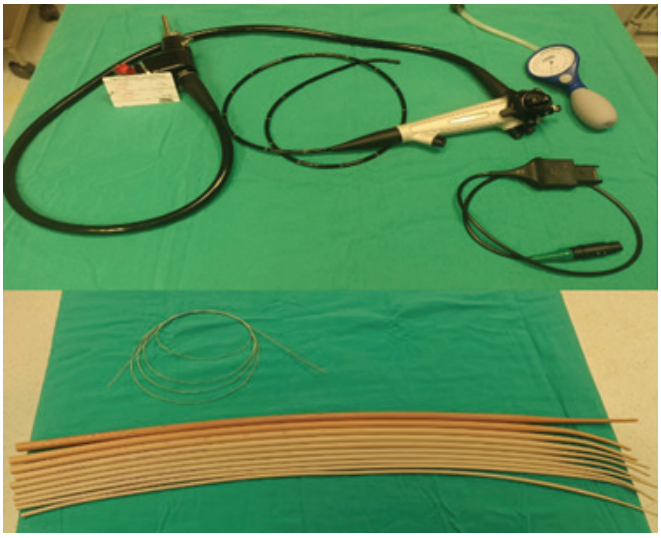

Figure 1: Endoscope and dilatators

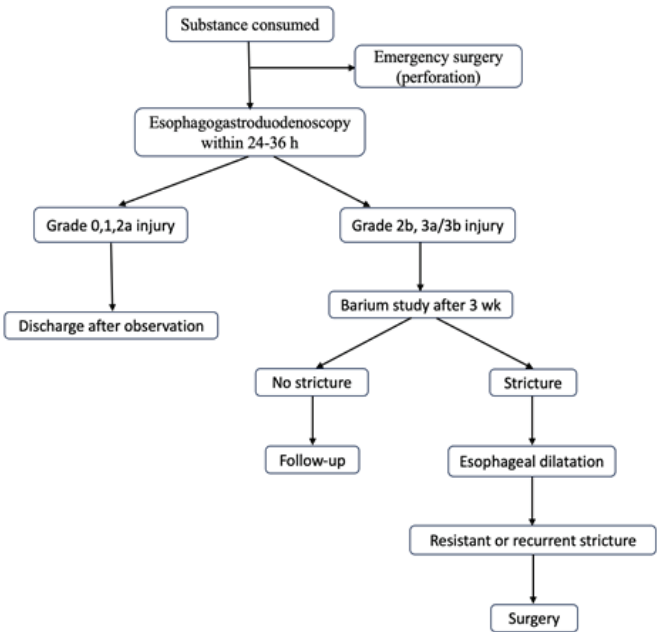

Figure 2: Flow chart

Statistical analysis

SPSS 25.0 (IBM Corporation, Armonk, New York, United States) program was used to analyze the variables. When comparing categorical variables, the results of the Pearson-Chi-Square and Fisher-Freeman-Holton tests were tested using the Monte Carlo Simulation technique, and the comparison of column ratios was expressed using Benjamini-Hochberg corrected p-values. While quantitative variables were expressed as mean (standard deviation) and Median (Minimum / Maximum) in the tables, categorical variables were shown as n(%). A p value of less than 0.05 was deemed significant when examining variables at a 95% confidence level.

Results

Of the 340 patients included in the study, 145 were female (51.47%) and 165 were male (48.53%). The patients had no additional health problems. For both girls and boys, bleach exposure accounted for the

Table 1: Comparison of corrosive substances consumed according to gender

	Gender	
	Female	**Male**
p=0.797	**n (%)**	**n (%)**
Type of Substance Consumed		
Unknown	12 (6.9)	10 (6.1)
Dishwashing liquid	7 (4.0)	8 (4.8)
Bleach	42 (24.0)	53 (32.1)
Eating donkey cucumber	2 (1.1)	2 (1.2)
Eating limescale remover	7 (4.0)	3 (1.8)
Air conditioner cleaner	26 (14.9)	25 (15.2)
Sink cleaner	23 (13.1)	20 (12.1)
Polisher	19 (10.9)	10 (6.1)
Wart medicine	3 (1.7)	1 (0.6)
Vinegar water	0 (0.0)	1 (0.6)
Shampoo	4 (2.3)	4 (2.4)
Thinner	2 (1.1)	5 (3.0)
Muriatic acid	17 (9.7)	13 (7.9)
Oil solvent	5 (2.9)	5 (3.0)
Surface cleaner	6 (3.4)	5 (3.0)

Table 2: Comparison of Substances consumed according to age group

	Age group			
	Pre-kindergarten	**Kindergarten**	**Primary school**	**≥ Secondary school**
p=0.884 ssx	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Unknown	10 (7.2)	5 (5.7)	6 (7.3)	1 (3.0)
Dishwashing liquid	7 (5.1)	2 (2.3)	3 (3.7)	3 (9.1)
Bleach	42 (30.4)	23 (26.4)	22 (26.8)	8 (24.2)
Eating donkey cucumber	2 (1.4)	0 (0.0)	2 (2.4)	0 (0.0)
Eating limescale remover	4 (2.9)	1 (1.1)	4 (4.9)	1 (3.0)
Air conditioner cleaner	14 (10.1)	18 (20.7)	15 (18.3)	4 (12.1)
Sink cleaner	18 (13.0)	12 (13.8)	7 (8.5)	6 (18.2)
Polisher	10 (7.2)	11 (12.6)	7 (8.5)	1 (3.0)
Wart medicine	2 (1.4)	2 (2.3)	0 (0.0)	0 (0.0)
Vinegar water	1 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)
Shampoo	3 (2.2)	2 (2.3)	2 (2.4)	1 (3.0)
Thinner	4 (2.9)	0 (0.0)	2 (2.4)	1 (3.0)
Muriatic acid	10 (7.2)	7 (8.0)	8 (9.8)	5 (15.2)
Oil solvent	5 (3.6)	3 (3.4)	1 (1.2)	1 (3.0)
Surface cleaner	6 (4.3)	1 (1.1)	3 (3.7)	1 (3.0)

Table 3: Comparison of esophageal burn degree according to age group

	Pre-kindergarten	**Kindergarten**	**Primary school**	**≥Secondary school**	**p-value**
	n (%)	**n (%)**	**n (%)**	**n (%)**	0.781
Esophagitis stage					
Stage 0	47 (34.1)	26 (29.9)	22 (26.8)	11 (33.3)	
Stage I	39 (28.3)	19 (21.8)	18 (22.0)	6 (18.2)	
Stage IIA	24 (17.4)	13 (14.9)	14 (17.1)	6 (18.2)	
Stage IIB	10 (7.2)	7 (8.0)	8 (9.8)	3 (9.1)	
Stage IIIA	9 (6.5)	8 (9.2)	7 (8.5)	3 (9.1)	
Stage IIIB	9 (6.5)	14 (16.1)	13 (15.9)	4 (12.1)	
Treatment					0.317
Surgical	2 (1.4)	2 (2.3)	5 (6.1)	1 (3.0)	
Dilatation	30 (21.7)	25 (28.7)	20 (24.4)	11 (33.3)	
Conservative	106 (76.8)	60 (69.0)	57 (69.5)	21 (63.6)	

Table 4: Comparison of the region where the cases exist and the substances consumed

	The region	
p=0.503	**Rural area**	**City center**
	n (%)	**n (%)**
Type of substance consumed		
Unknown	13 (6.0)	9 (7.4)
Dishwashing liquid	7 (3.2)	8 (6.6)
Bleach	66 (30.3)	29 (23.8)
Eating donkey cucumber	2 (0.9)	2 (1.6)
Eating limescale remover	6 (2.8)	4 (3.3)
Air conditioner cleaner	31 (14.2)	20 (16.4)
Sink cleaner	28 (12.8)	15 (12.3)
Polisher	17 (7.8)	12 (9.8)
Wart medicine	2 (0.9)	2 (1.6)
Vinegar water	1 (0.5)	0 (0.0)
Shampoo	8 (3.7)	0 (0.0)
Thinner	3 (1.4)	4 (3.3)
Muriatic acid	21 (9.6)	9 (7.4)
Oil solvent	7 (3.2)	3 (2.5)
Surface cleaner	6 (2.8)	5 (4.1)

majority of cases. In our study, bleach was observed in 27.94% of 340 cases, air conditioner cleaner in 15%, sink cleaner in 12.64%, spirit salt in 8.82%, rinse aid in 8.52%, and corrosive substance exposures other than these in 27.05% (**Table 1**). 138 (40.58%) of the cases were at pre-kindergarten level, 87 (25.58%) at kindergarten level, 82 at primary school (24.11%) and 33 (9.70%) at secondary school level or above (**Table 2**).

Of the 340 cases included in our study; Stage 0 in 31%, Stage I in 24.11%, Stage IIA in 16.76%, Stage IIB in 8.23%, Stage IIIA in 7.94%, Stage IIIB CO in 11.76% has been found. 29.62% of stage IIIA CO cases and 35% of stage IIIB CO cases were seen in the kindergarten age group. 71.76% of 340 cases were monitored conservatively. Esophageal dilatation was applied to 25.29% of them at least once, and surgical treatment was applied to 2.94% of them because their esophagus was not suitable for dilatation or was unresponsive to esophageal dilatation treatment. While conservative monitoring was most frequently applied in the pre-kindergarten age group (76.8%), dilatation treatment (25.29%) was most frequently applied in the nursery age group. Surgical treatment was applied most frequently in the primary school age group (2.94%). 5 of 10 patients who underwent surgical treatment are in the primary school age group. In terms of gender, there was no difference in the degree of esophageal burn, the need for surgery or rigid esophageal dilatation (**Table 3**).

While 218 (64.12%) cases were found in rural areas, this number was 122 (35.88%) in those who settled in the city center. Whereas 30.3% of the 218 CO cases in rural areas were exposed to bleach, the rate of bleach-related CO in 122 cases seen in central settlements was 23.8% (**Table 4**).

The percentage of CO according to the education level of the mother was 55.2% at primary school, 42.64% at secondary school, and 2.05% at college level. While exposure to bleach was most common in cases whose mothers had primary and secondary

Table 5: Comparison of the corrosive substances consumed according to the education level of the mother

	The education level of the mother		
	Primary school ed.	**Secondary school ed.**	**College education**
p=0.833	**n (%)**	**n (%)**	**n (%)**
Type of substance consumed			
Unknown	12 (6.4)	9 (6.2)	1 (14.3)
Dishwashing liquid	9 (4.8)	5 (3.4)	1 (14.3)
Bleach	57 (30.3)	37 (25.5)	1 (14.3)
Eating donkey cucumber	3 (1.6)	1 (0.7)	0 (0.0)
Eating limescale remover	5 (2.7)	5 (3.4)	0 (0.0)
Air conditioner cleaner	30 (16.0)	19 (13.1)	2 (28.6)
Sink cleaner	23 (12.2)	19 (13.1)	1 (14.3)
Polisher	13 (6.9)	16 (11.0)	0 (0.0)
Wart medicine	4 (2.1)	0 (0.0)	0 (0.0)
Vinegar water	0 (0.0)	1 (0.7)	0 (0.0)
Shampoo	5 (2.7)	3 (2.1)	0 (0.0)
Thinner	4 (2.1)	3 (2.1)	0 (0.0)
Muriatic acid	12 (6.4)	17 (11.7)	1 (14.3)
Oil solvent	5 (2.7)	5 (3.4)	0 (0.0)
Surface cleaner	6 (3.2)	5 (3.4)	0 (0.0)

Table 6: Comparison of the number of siblings in the household in terms of consuming corrosive substances

	The number of siblings			
	1	**2**	**3**	**≥4**
p=0.220	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Type of substance consumed				
Unknown	0 (0.0)	10 (10.5)	3 (4.5)	9 (6.2)
Dishwashing Liquid	1 (3.0)	3 (3.2)	2 (3.0)	9 (6.2)
Bleach	16 (48.5)	19 (20.0)	23 (34.3)	37 (25.5)
Eating donkey cucumber	1 (3.0)	3 (3.2)	0 (0.0)	0 (0.0)
Eating limescale remover	0 (0.0)	4 (4.2)	2 (3.0)	4 (2.8)
Air conditioner cleaner	6 (18.2)	15 (15.8)	9 (13.4)	21 (14.5)
Sink cleaner	6 (18.2)	13 (13.7)	6 (9.0)	18 (12.4)
Polisher	1 (3.0)	8 (8.4)	4 (6.0)	16 (11.0)
Wart medicine	0 (0.0)	1 (1.1)	2 (3.0)	1 (0.7)
Vinegar water	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.7)
Shampoo	0 (0.0)	0 (0.0)	3 (4.5)	5 (3.4)
Thinner	0 (0.0)	1 (1.1)	3 (4.5)	3 (2.1)
Muriatic acid	1 (3.0)	13 (13.7)	5 (7.5)	11 (7.6)
Oil solvent	0 (0.0)	2 (2.1)	1 (1.5)	7 (4.8)
Surface cleaner	1 (3.0)	3 (3.2)	4 (6.0)	3 (2.1)

school education levels, the number of cases was 2 in children whose mothers had a college education. Nevertheless, exposure to air conditioner cleaning fluid was the most common percentage among children of mothers with college education (**Table 5**).

While the number of siblings living in the same house was 4 or more in 42.64% - of 340 cases included in the study- the number of siblings was 3 in 19.7%, 2 in 27.94%, and 1 in 9.7% (**Table 6**).

Rupture of the trachea and esophagus is one of the most serious complications of substance consumption. In our study, trachea and esophagus rupture occurred in one patient (**Figure 3**).

Figure 3: Esophagus and trachea rupture after drinking sink cleaner

Discussion

In developing countries, corrosive esophagitis continues to be a major cause of morbidity and mortality. Parents play an important role in these exposures. Unconscious and uneducated parents store these corrosive sunstances in places where they are easily accessible and in materials that are utilized on a daily basis without considering the potential consequences of potential exposure to them (1,2,8-10). In our study, we found that these substances are found in plastic cola bottles, water bottles, etc. and therefore we often come across stories that children drink these substances thinking they are cola or water. The fact that the education level is in the background in our region raises the possibility of exposure to corrosive substances. Increasing maternal education level is very important to pay attention to the warnings on the packaging of cleaning materials that have a corrosive effect and in terms of storage conditions. In addition, uneducated parents increase the existing damage by using methods such as inducing vomiting after exposure, feeding yoghurt, etc. In our study, the percentage of CO according to the education level of the mother was 55.2% at primary school, 42.64% at secondary school, and 2.05% at college level. While bleach exposure was most common in cases whose mother's education level was at primary and secondary school level; the number of cases in children of mothers with a college education is 2. Despite this, it is noteworthy that the children of mothers with a college education are most frequently exposed to air conditioning cleaning fluid as a percentage.

Cleaning that must be done with serious corrosive substances and by specialists (air conditioning, heater core, rust removal, etc.) are done by parents due to financial inadequacies and it causes these substances to be drunk unconsciously by children during cleaning. In our study, a 15% rate of CO was found due to air conditioning cleaner. While cleaning with this substance, which has a serious corrosive effect, should be done by professionals, parents undertake this cleaning themselves.

Parents do not devote enough time and effort to their children in households with many kids and in areas with insufficient birth control. Growing children who are left unattended can tamper with the cupboards and come into contact with these substances. In our study, the number of siblings in the household was 4 or more in 42.64% of the patients who were followed up and treated due to CO. In two cases, two siblings in the same household drank sink cleaner orally at the same time. While the older of the two siblings had hyperemia in the mouth, swelling of the lips, inability to swallow secretions and hypersalivation, the other brother had swelling only on the lips.

In our study, there were significantly more cases of exposure to corrosive substances among rural-dwelling families than among urban-dwelling families. In contrast to the 122 cases (35.88%) discovered in the city center, 218 (64.12%) cases were discovered in the rural area.

In Stage 0 and Stage I cases, there is no significant difference in percentage between those living in rural areas (52.3%) and those living in the city center (60.7%); and it was noteworthy that Stage IIA esophagitis was observed in 20.2% of people in rural areas. Despite this, there was no discernible difference between the two regions' populations' rates of treatment and lengths of follow-up.

Both histological damage and functional impairment to the esophagus follow oral consumption of corrosive substances. When these substances are consumed in concentrated form, they can lead to death. Since alkaline substances are tasteless and odorless, they can be consumed in higher amounts because they stimulate protective reflexes less than acidic substances.

One of the points discussed in the management of corrosive substance exposure is the inconsistency between symptoms and the severity of injury. The absence of symptoms does not literally indicate the absence of oesophageal damage. According to some authors, a combination of two or more symptoms may inform us of an oesophageal injury, but it has also been reported that a single symptom or its combination cannot guarantee the definitive diagnosis of oesophageal damage.In a series of 473 paediatric cases, oesophageal lesions were identified in 61% of cases without oral lesions (8).

In experimental studies, it has been reported that as the alkali concentration taken increases, the depth of the damage caused increases. Up to 3.8% NaOH submucosa, muscle layer at concentration of 10-17%, above 22% transmural necrosis was shown to occur (9,11,12). Acids, on the other hand, cause coagulation necrosis. The resulting fibrosis is quite harsh (8). Acids cause significant damage to the pyloric part of the stomach and stomach more than the oesophagus. Oesophageal damage is mostly limited to the mucous layer. The columnar epithelium of the stomach is more resistant to alkaline substances, while more sensitive to acids (10).

Even if patients do not experience any symptoms after consuming corrosive substances, esophageal injury may nonetheless happen. Symptoms and signs of patients are not a safe criterion to show the degree of damage in esophageal corrosion. Therefore, upper gastrointestinal endoscopy is the gold standard in corrosive esophagitis (13). Upper gastrointestinal system endoscopy is guiding in both diagnosis and treatment as it can provide information about the depth and length of the damage.

However, there are differences of opinion on the issue of performing endoscopy in the acute period. Endoscopies performed in the first 6 hours may cause errors in the staging of esophagitis. Endoscopy to be performed within 24-36 hours after consuming a corrosive substance is important both in determining the degree of burn in the esophagus and in planning subsequent treatment. A group of researchers recommend that endoscopy be performed approximately 2-3 weeks after consumption of corrosive substances (14). All patients in our study underwent endoscopy in the first 24-36 hours. 31.17% of 340 cases who underwent endoscopy were evaluated as Stage 0 and no damage to the esophagus was found. Stage I in 24.11%, Stage IIA in 16.76%, Stage IIB in 8.23%, Stage IIIA in 7.94%, Stage IIIB esophageal burn in 11.76% have been found.

Savary bougies are believed to be more dependable and successful than balloon dilators in consolidated strictures, despite studies not conclusively demonstrating the superiority of balloon dilatation and Savary bougies in esophageal dilatations. In addition, Savary plugs provide the operator with the advantage of feeling the resistance to dilatation under his hands (15). 244 (71.76%) of the 344 patients who were a part of the study were followed conservatively after endoscopy. 86 of the cases (25.29%) underwent esophageal dilatation sessions with Savary bougies three weeks after endoscopy. Surgical treatment was applied to the other 10 cases (2.94%).

In 2015 in the results of the World Emergency Surgery Consensus Conference published in the World Journal of Emergency Surgery, according to CO Zargar staging, patients with severe (Stage IIIB) esophagogastric injuries are evaluated for surgery, while patients with low-grade injuries (≤ Stage IIIA) are recommended nonoperative treatment (15). In our study, the percentage of Stage IIIB cases is 11.76% and only 25% of these Stage IIIB cases underwent surgical treatment. The remaining 75% of Stage IIIB cases were treated with esophageal dilatation.

Cleaning detergents preferred in households with low socioeconomic levels are mostly called 'under the counter' products and lack warning labels and protective packaging. In the Law No. 5996 of the Constitution of the Republic of Turkey, there is an article stating that 'Forty-five thousand six hundred and twenty-four Turkish Liras administrative fine is imposed on the owners of laboratories operating without the approval of the Ministry'. However, considering the possible mortality and morbidities, it is obvious that these penalties are insufficient in terms of deterrence.

Insufficient legal regulations also play an important role in these exposures. Although no parent wants their children to be exposed to these corrosive substances and their possible bad consequences, this should be constitutionally considered as 'child abuse'. In the Law No. 5237 of the Constitution of the Republic of Türkiye,

the article 22 includes 'No punishment is given if the legal consequence of the negligent offense exclusively results with injury of the offender either in person, rights or reputation in such a way not to require imposition of punishment; in case of intentional negligence, the punishment to be imposed may be abated from one half to one sixth' and parents are not punished for the possible situation according to this article.

Limitations

Several limitations must be acknowledged. The retrospective design relies on existing records, which may lack comprehensive details and introduce bias. The single-center nature limits the generalizability of findings to other settings. Additionally, the absence of long-term follow-up data restricts insights into chronic outcomes. Variability in endoscopic evaluations and potential selection bias further impact the study's consistency. Unmeasured confounding factors and the broad categorization of substances also constrain the depth of analysis.

Conclusions

This study highlights the urgent need for preventive measures and education to reduce corrosive esophagitis, especially in vulnerable populations. Stricter regulations and targeted interventions are essential for effective prevention.

Conflict of interest: The authors report no conflict of interest.

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Ethical approval: (This study was approved by Harran University IRB with no 22- 13.12.2021)

Informed consent

Written informed consent was obtained from all individual participants and/or their gaurdians.

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Peer-review

Externally. Evaluated by independent reviewers working in at least two different institutions appointed by the field editor.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Contributions

Research concept and design: MC, MED,

Data analysis and interpretation: MC, MED

Collection and/or assembly of data: MC, MEB

Writing the article: MC, MED, MEB

Critical revision of the article: MC, MEB

Final approval of the article: MC, MED, MEB

All authors read and approved the final version of the manuscript.

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