Introduction

Childhood hand injuries constitute a significant healthcare concern, especially as children’s manual dexterity develops over time. While their motor skills progress, they do not fully mature like those of adults, making precise control challenging [1].

Despite spending much of their time in supervised, relatively safe indoor environments during the preschool years, youngsters under 6 years old are susceptible to hand trauma due to their inherent curiosity and exploratory behaviors [2]. This tendency, coupled with immature motor skills and limited perception of danger, leads to a notable peak in hand injury rates within this age group. Additionally, school-aged children and adolescents exhibit increased risk-taking behaviors, re-
sulting in another surge in hand injuries [3,4].

Children under 6 years old are mostly closely monitored by caregivers, but their natural inquisitiveness still prompts them to investigate their surroundings, including exposure to seemingly innocuous household objects that may harbor unexpected hazards. This cohort is at particular risk, as their guardians may under-estimate the potential for harm from everyday items like eyebrow razors, which have very sharp edges capable of causing severe lacerations.

Despite being closely monitored in their environment; various mechanisms can contribute to childhood hand trauma. These include burns by hot water in the kitchen, crushing injuries and fractures by falling objects or doors. Some studies suggest burns and crushing injuries are most common [5], while others highlight lacerations as predominant among younger children [6]. Despite extensive research on fingertip crushing [7-9], burns [10,11], and fractures [12,13] in pediatric hand injuries, there is a notable gap in understanding lacerations specifically.

Unlike fractures or burns, lacerations pose challenges in evaluation, as they may involve deeper structures such as tendons, nerves, or vessels, potentially requiring surgical intervention. This assessment becomes particularly problematic in children under 6 years old due to their limited ability to communicate symptoms, perform motor tests, and their small hand size, which increases the risk of overlooking injuries. Undetected lacerations can lead to permanent functional impairments. Therefore, developing targeted prevention strategies based on the epidemiology of pediatric hand lacerations, accounting for age and the objects causing injuries, is imperative. In this study, we aimed to identify the age-related hand laceration pattern and the objects that are vulnerable to causing these injuries in children under 6 years old.

**Methods**

**Ethics statement:** This study design was approved by the Institutional Review Board of Gwangmyeong Sungae General Hospital (No. KIRB-2024-N-004) and adhered to the ethical principles of the Declaration of Helsinki (2013 amendment). All participants provided written informed consent for publication, including clinical images.

We conducted a retrospective study targeting patients under 6 years old who visited the emergency department of our institution with hand lacerations between January 2016 and December 2023. Patients with injuries caused by mechanisms other than lacerations, (e.g. contusions, abrasions, burns, fractures, sprains) were excluded.

For each eligible patient, we collected demographic data including age and sex. Injury-related factors recorded were injured hand (right or left), hand dominance (dominant or nondominant), affected finger or hand region, injury location (volar, dorsolateral, or lateral side), place of injury occurrence, and the object causing the laceration. We also noted whether surgical intervention under general anesthesia was required due to suspected damage to deep structures like arteries, nerves, tendons, or ligaments. Cases treated with sedation and primary wound closure in the emergency department without deep structure involvement were classified as nonsurgical.

Age groups were defined as infants (0–1 years), toddlers (1–3 years), and preschoolers (3–6 years). This is based on significant developmental shifts, where infants transition to toddlers as they begin walking, and toddlers transition to preschoolers as they attend preschool, leading to increased fine motor skills and interactive play [14]. Comparisons were made between these groups for demographics and injury factors. Injury-causing objects were categorized into knives/blades, household structures/furnishings, household products, stationery, unknown objects, and a miscellaneous “others” group. The specific objects were also ranked by frequency of occurrence. For each injury object, we documented the number and percentage of cases requiring surgery, the types of damaged deep structures, and the average patient age.

Statistical analysis included descriptive statistics to summarize the frequency data for demographics, injury characteristics, and outcomes based on injury objects and age groups. Percentages were calculated out of the total number of patients.

**Results**

Between January 2016 and December 2023, our institution received 153 patients under the age of 6 years for hand lacerations. Of these, 82 (53.6%) were male, with an average age of 3.6 years. Most injuries occurred in toddlers (47.7%), followed by preschoolers (44.4%), and infants (7.8%) (Table 1).

Right-hand injuries slightly outnumbered left-hand injuries (51.0% vs. 49.0%), with a similar distribution between dominant and nondominant hands (51.6% vs. 48.4%). Most injuries were on the volar side (60.1%), predominantly affecting the index finger (23.5%).

Home was the primary location of injury (79.7%), followed by educational facilities (9.1%) and outdoors (7.8%). Knives/blades were the most common cause of injury (39.9%), followed by household products (20.3%) and household structures/ furnish-
Table 1. Demographic and injury-related characteristics of pediatric hand lacerations by age group

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total</th>
<th>0–1 (7.8)</th>
<th>1–3 (47.7)</th>
<th>3–6 (44.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>153 (100)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>81 (52.9)</td>
<td>6 (50.0)</td>
<td>38 (52.1)</td>
<td>37 (54.4)</td>
</tr>
<tr>
<td>Female</td>
<td>72 (47.1)</td>
<td>6 (50.0)</td>
<td>35 (47.9)</td>
<td>31 (45.6)</td>
</tr>
<tr>
<td>Dominance of the injured hand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominant</td>
<td>79 (51.6)</td>
<td>5 (41.7)</td>
<td>35 (47.9)</td>
<td>39 (57.4)</td>
</tr>
<tr>
<td>Nondominant</td>
<td>74 (48.4)</td>
<td>7 (58.3)</td>
<td>38 (52.1)</td>
<td>29 (42.6)</td>
</tr>
<tr>
<td>Injured hand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>78 (51.0)</td>
<td>6 (50.0)</td>
<td>36 (49.3)</td>
<td>36 (52.9)</td>
</tr>
<tr>
<td>Left</td>
<td>75 (49.0)</td>
<td>6 (50.0)</td>
<td>37 (50.7)</td>
<td>32 (47.1)</td>
</tr>
<tr>
<td>Injured area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand in an area other than the fingers</td>
<td>28 (18.3)</td>
<td>4 (33.3)</td>
<td>12 (16.4)</td>
<td>12 (17.6)</td>
</tr>
<tr>
<td>Thumb</td>
<td>22 (14.4)</td>
<td>2 (16.7)</td>
<td>10 (13.7)</td>
<td>10 (14.7)</td>
</tr>
<tr>
<td>Index finger</td>
<td>36 (23.5)</td>
<td>2 (16.7)</td>
<td>16 (21.9)</td>
<td>18 (26.5)</td>
</tr>
<tr>
<td>Middle finger</td>
<td>29 (19.0)</td>
<td>2 (16.7)</td>
<td>14 (19.2)</td>
<td>13 (19.1)</td>
</tr>
<tr>
<td>Ring finger</td>
<td>22 (14.4)</td>
<td>1 (8.3)</td>
<td>13 (17.8)</td>
<td>8 (11.8)</td>
</tr>
<tr>
<td>Little finger</td>
<td>16 (10.5)</td>
<td>1 (8.3)</td>
<td>8 (11.0)</td>
<td>7 (10.3)</td>
</tr>
<tr>
<td>Location of injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>127 (83.0)</td>
<td>11 (91.7)</td>
<td>65 (89.0)</td>
<td>51 (75.0)</td>
</tr>
<tr>
<td>Educational facility</td>
<td>14 (9.1)</td>
<td>0 (0)</td>
<td>2 (2.7)</td>
<td>12 (17.6)</td>
</tr>
<tr>
<td>Outdoor</td>
<td>12 (7.8)</td>
<td>1 (8.3)</td>
<td>6 (8.2)</td>
<td>5 (7.4)</td>
</tr>
<tr>
<td>Category of injury-causing object</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knives/blades</td>
<td>56 (36.6)</td>
<td>4 (33.3)</td>
<td>28 (38.4)</td>
<td>24 (35.2)</td>
</tr>
<tr>
<td>Household structures/furnishings</td>
<td>21 (13.7)</td>
<td>2 (16.7)</td>
<td>10 (13.7)</td>
<td>9 (13.2)</td>
</tr>
<tr>
<td>Household products</td>
<td>40 (26.1)</td>
<td>3 (25.0)</td>
<td>18 (24.7)</td>
<td>19 (27.9)</td>
</tr>
<tr>
<td>Stationery</td>
<td>19 (12.4)</td>
<td>0 (0)</td>
<td>8 (11.0)</td>
<td>11 (16.2)</td>
</tr>
<tr>
<td>Others</td>
<td>8 (5.3)</td>
<td>1 (8.3)</td>
<td>3 (4.1)</td>
<td>4 (5.9)</td>
</tr>
<tr>
<td>Unknown objects</td>
<td>9 (5.9)</td>
<td>2 (16.7)</td>
<td>6 (8.2)</td>
<td>1 (1.5)</td>
</tr>
</tbody>
</table>

Values are presented as number (%).

ings (16.3%).

In terms of age groups, toddlers and preschoolers had a higher proportion of male patients, with more injuries to the dominant hand in preschoolers. While injuries to the right and left hands were evenly distributed in infants, toddlers had more left-hand injuries, and preschoolers had more right-hand injuries. The most common injury site was the volar side across all age groups, with differences in specific injured parts. In infants, injuries were mostly to the hand excluding fingers, while toddlers and preschoolers commonly injured their index fingers. Home was the predominant location of injury for all age groups, with an increase in injuries at educational facilities with age.

Across all age groups, knives/blades were the primary cause of injury. Household products were more common in infants, while household structures/furnishings were prevalent in toddlers, and household products were again the leading cause in preschoolers.

Analyzing the injury-causing objects, cutter knives and broken glass were the most frequent culprits, followed by scissors and eyebrow razors. Surgical interventions under general anesthesia were required in 11.1% of cases, primarily due to injuries involving eyebrow razors. Different objects caused various types of damage, with eyebrow razors resulting in the youngest average age among patients requiring intervention (2.5 years).
Despite approximately 70% of the population being right-handed, the rate of injuries to the dominant versus non-dominant hand and to the right versus left hand was relatively equal [12,15]. This suggests that injuries in children often occur before they firmly establish a dominant hand, and these injuries frequently result from accidental occurrences rather than specific tasks using their preferred hand.

Infants aged 0 to 1 year are more prone to injuring their palms as they have not developed fine motor skills yet, making it challenging to manipulate objects with their fingers [16]. Toddlers aged 1 to 3 years and preschoolers aged 3 to 6 years frequently injure their fingers, especially the index and middle fingers, due to their ability to pick up objects more precisely with these fingers in coordination with the thumb [16]. As these children develop the ability to freely move and engage in various activities, the longer length of the index and middle fingers makes them more susceptible to injuries across diverse activities.

Upon reaching the age of 6 years, children transition from preschool to school, spending more time in educational facilities or outdoors. Consequently, while hand injuries outside the home increase among children over 6 years old, those under 6 years old predominantly sustain injuries at home [5,17,18]. This study revealed that 83 percent of hand lacerations in children under 6 years old occurred at home. It is similar to the results of the previous literature. As children begin attending kindergarten or preschool, injuries at educational facilities tend to rise. Although time spent outdoors increases with age, lacerations are less common compared to contusions or fractures resulting from sports activities or falls. The incidence rate of outdoor lacerations among children under 6 years old remains relatively low and consistent across age groups.

The objects causing injuries are primarily those easily accessible within households. Items categorized under knives/blades pose risks to both children and adults, warranting caution re-
gardless of age. However, seemingly harmless objects like vacuum cleaners and chairs, categorized under household products or furnishings, can unexpectedly cause hand lacerations in children who lack the protective hand strength and awareness to detect danger.

Equally significant as the number of injury cases caused by objects is the percentage of cases requiring surgical intervention. This indicates injuries surpassing dermal and subcutaneous layer damage, affecting deeper structures such as arteries, nerves, and tendons, potentially resulting in functional impairment. The highest percentage of such injuries was associated with eyebrow razors, primarily used by young women. Eyebrow razors are available in capping and folding types (Fig. 1). In this study, the distribution of injuries was 46.7% for the capping type and 53.3% for the folding type, showing similar frequencies and comparable risks between the two.

Eyebrow razors pose a particular hazard to children for several reasons. Their attractive design and colors targeting the fashion-conscious young female market can attract children, leading to injuries. Moreover, their user-friendly design makes it easy for children to inflict deep structural injuries upon themselves, despite safety features. Additionally, the blades may not appear particularly sharp to children, leading to underestimation of danger. Yet, what may seem minor to an adult can cause significant injuries in the smaller hands of a child.

Eyebrow razors can cause injuries to arteries, nerves, and even

Fig. 1. Eyebrow razors that feature a blade at the top with a long handle for trimming eyebrows. (A) Capping type. (B) Folding type.

Fig. 2. A 1-year-old female infant presented with a complete rupture of the flexor digitorum profundus (FDP) tendon due to an eyebrow razor injury. (A–C) Intraoperative images of FDP tendon repair. (D) Two-year follow-up images showing a full range of motion in active flexion.
flexor tendons, proving they can cause more profound injuries than other objects. With their popularization, there have been reports of increased flexor tendon ruptures among children living with female guardians [19] (Fig. 2). Moreover, patients injured by eyebrow razors had the lowest average age, indicating potential underestimation of danger by guardians. Younger children are usually kept away from sharp objects to reduce the risk of lacerations. However, incidents occur when guardians leave eyebrow razors within children’s reach under the assumption of safety, only for the child to unlock them easily and sustain a laceration.

Over the past two decades, safety regulations and improvements in product design aimed at reducing hand injury risks have significantly mitigated such risks [6]. Incorporating child-proof locking mechanisms into eyebrow razors and making such safety features a legal requirement would enhance user safety substantially. This approach should extend to other objects posing injury risks. Moreover, educating guardians about the potential dangers posed by everyday household items can significantly contribute to accident prevention [20, 21].

This study has several limitations. First, it was conducted at a single institution in Korea, so generalizing the findings to the entire population may not be appropriate due to regional and national differences in culture and environment. Second, the study did not investigate the clinical outcomes, complications, or long-term prognoses of injuries caused by each object, which would have provided a more detailed assessment of risks. Third, the study did not propose specific regulations or prevention methods to reduce hand lacerations, suggesting that further consideration is needed in this area.

Conclusion

In children under 6 years old, efforts should be concentrated on minimizing hand lacerations that occur at home. In this age group, knives and blades are the most common causes of such injuries, followed by household products. It is essential to ensure that particularly hazardous objects, such as eyebrow razors, are kept out of children’s reach, as their dangers might be underestimated. Additionally, considering legal regulations for these objects could be an effective option to further prevent pediatric hand lacerations.

ORCID

Dong Chul Lee, https://orcid.org/0000-0003-4211-6901
Yeong Wook Kim, https://orcid.org/0009-0008-4817-3652
Sung Hoon Koh, https://orcid.org/0000-0002-8094-2561
Jin Soo Kim, https://orcid.org/0000-0003-3369-2974
Si Young Roh, https://orcid.org/0000-0002-8625-6124
Kyung Jin Lee, https://orcid.org/0000-0002-9448-8291

Conflicts of interest

The authors have nothing to disclose.

Funding

None.

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