

# Current trends and age-based differences of unintentional injury in Japanese children

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## Summary

Unintentional injury in children is a worldwide public health problem, as it increases the health burden and is a leading cause of death among children. It is important to understand the differences between different age groups of children in regard to unintentional injury, in order to effectively implement child safety education. The present study aimed to determine the current trends of unintentional injury in children, and to identify the differences between different age groups of children with regard to unintentional injury. We identified 1,521 children who attended an 18-month health checkup (18-month group), and 1,368 children who attended a 36-month health checkup (36-month group), between January 1, 2014 and December 31, 2014. The rate of hospital visits associated with unintentional injury was 10.6% (161/1,521) in the 18-month group, and 13.1% (180/1,368) in the 36-month group. In both groups, present/past illness was associated with hospital visits, and in the 36-month group, hospital visits were more common in boys than in girls. The number of unintentional injuries that occurred outdoors was higher in the 36-month group than in the 18-month group. Unintentional injuries resulting from accidental ingestion and falls were more common in the 18-month group, while unintentional injuries resulting from turning over were more common in the 36-month group. In conclusion, the number of hospital visits for unintentional injury might be higher, and the number of preventive actions taken by mothers might be lower, among children attending the 36-month health checkup than among those attending the 18-month health checkup.

**Keywords:** Public health, unintentional injury, child health checkup

## 1. Introduction

Unintentional injury in children is a worldwide public health problem and a leading cause of death among children, with an increasing health burden (1). Injury has been described as the physical damage that results when a human body is suddenly subjected to energy in amounts that exceed the threshold of physiologic tolerance, or damage that results from a lack of one or more vital elements, such as oxygen (2). Unintentional

injuries include injuries that are not associated with predetermined intent (3).

Recently, the mortality rate of Japanese children under 10 years of age experiencing unintentional injury has decreased; however, the reduction in hospitalization rates and outpatient treatment rates associated with unintentional injury has been moderate (4). Additionally, as well as other developed countries, unintentional injury remains a major cause of death among Japanese children (5). In Japan, the Ministry of Health, Labour and Welfare has been promoting the "Healthy Parents and Children 21" campaign, which is a national campaign to improve the health standards of mothers and children. A decrease in the mortality rate of children who experience unintentional injury is one of the evaluation indices of this campaign.

The *Maternal and Child Health Act* (Act No. 141 of 1965) requires all municipalities to conduct health checkups at healthcare centers for children aged 18-23

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months (18-month health checkup) and children aged 36-47 months (36-month health checkup); the mean response rate for these health checkups is over 90% (6). A previous study from Japan suggested that the number of hospital visits for unintentional injury in children might be reduced when safety education is provided to parents/guardians as part of health-maintenance guidance (7). The 18-month and 36-month health checkups are important opportunities for public healthcare providers to assess the current trends of unintentional injury in children, and to provide child safety education to families in the community. However, no study has presented municipal health checkup data on unintentional injuries in Japanese children. An understanding of the current state of unintentional injuries in children in the community is important to aid public health efforts directed at improving knowledge regarding child-based unintentional injury prevention.

Previous studies have shown that the type of unintentional injury differs according to the age of the child (8,9), therefore, it is important to understand the differences between different age groups of children in regard to unintentional injury, in order to effectively implement child safety education during child health checkups. The present study aimed to determine the current trends of unintentional injury in children, and to identify differences between different age groups of children in regard to unintentional injury.

## 2. Methods

### 2.1. Definition of unintentional injury

Unintentional injury was defined as injury not associated with predetermined intent. Only unintentional injury requiring a hospital visit was evaluated in this study.

### 2.2. Design and data collection

We used a child health checkup database, managed by the municipal government of the Tokyo metropolitan area, Japan. In addition, this municipal government subsidizes medical expenses for children, as with other many municipal governments of the Tokyo metropolitan area.

The child health checkup database includes data from health checkups of children aged 18-23 months (18-month health checkup) and 36-47 months (36-month health checkup), in addition to data from mother-child questionnaires completed by mothers or other caregivers present for the health checkups. In the present study, unintentional injury was the outcome of interest and it was compared between the 18-month health checkup and 36-month health checkup. Some items were partially different between the two health checkups (e.g., items of child developmental status and child daily lifestyle), and therefore, only items common to both health checkups

were extracted from the child health checkup database and were compared. Demographic data of the mothers or families, such as age, employment status, economic status, and family structure, were not recorded in the child health checkup database, and therefore, were not evaluated.

### 2.3. Subjects

We identified children who attended the 18-month health checkup or 36-month health checkup between January 1, 2014 and December 31, 2014. A total of 1,535 children attended the 18-month health checkup, and of these children, 14 were excluded owing to the lack of an answer to indicate the presence or absence of previous unintentional injury. Additionally, 1,387 children attended the 36-month health checkup, and of these children, 19 were excluded owing to the lack of an answer regarding previous unintentional injury. Thus, the study included 1,521 children who attended the 18-month health checkup (18-month group), and 1,368 children who attended the 36-month health checkup (36-month group).

### 2.4. Ethical considerations

This study was approved by the Ethics Review Board of the University of Tokyo (No. 10754).

### 2.5. Variables

#### 2.5.1. Individual variables

Variables evaluated included child age, sex, present/past illness (yes or no), use of nursery (yes or no), and frequency of playing outside (almost always or sometimes/rarely). Furthermore, a family-based variable for implementation of injury prevention actions at home (yes or no) was also included.

#### 2.5.2. Variables of unintentional injury

The variables of unintentional injury were age at hospital visit (0-11 months, 12-23 months, 24-35 months, or 36-47 months), location where the unintentional injury occurred (indoors or outdoors), and cause of the unintentional injury (drowning, accidental ingestion, burn, fall, turning over, cut, getting caught in something, or other). In the 18-month group, unintentional injury was assessed between 0 and 18 months of age, and in the 36-month group, unintentional injury was assessed after 18 months of age up to the 36-month health checkup.

### 2.6. Statistical analysis

Descriptive statistics were used to detail subject

characteristics in the 18-month and 36-month groups. Continuous variables were described using the mean and standard deviation (SD), while categorical variables were described as number (*n*) and percentage of total. Logistic regression analysis was performed to investigate the associations between individual variables and unintentional injury in each group. Additionally, logistic regression analysis was also performed to compare the variables of unintentional injury between the groups. The criterion for statistical significance was set at  $p < 0.05$ . IBM-SPSS ver. 23.0 was used for all statistical analyses.

### 3. Results and Discussion

#### 3.1. General characteristics

The demographic characteristics of the 18-month and 36-month groups are presented in Table 1. The mean age of the children in the 18-month group was 19.0 months (SD, 1.1; range, 18-23), and the mean age of the children in the 36-month group was 37.2 months (SD, 1.8; range, 36-47). Children were more likely to attend nursery school and play outside, and families were less likely to implement injury prevention actions in the 36-month group, than in the 18-month group. A previous study showed that the level of physical activity in children increases with age (10); therefore, the risk of unintentional injury might also increase with age. Additionally, parent awareness of child safety might decrease as the child gets older in the Japanese population (11, 12). The results of the present study suggest that child safety education for family members

should be provided repeatedly from soon after the birth of the child.

#### 3.2. Hospital visits for unintentional injury

The number of hospital visits for unintentional injury among the 18-month and 36-month groups are presented in Table 1. The rate of hospital visits associated with unintentional injury was 10.6% (161/1521 children) in the 18-month group, and 13.1% (180/1368 children) in the 36-month group; the number of children who had hospital visits was greater in the 36-month group than in the 18-month group. The rate of hospital visits associated with unintentional injury in the 18-month group in the present study was similar to the rate reported previously (13). However, the rate of hospital visits associated with unintentional injury in the 36-month group was lower in the present study than in a previous study from Japan (14). This difference may have been the result of the previous study, which included unintentional injury that occurred from birth to the age of 3 years.

#### 3.3. Associations between individual variables and unintentional injury

The associations between individual variables and unintentional injury in each group are presented in Table 2. In both groups, present/past illness was associated with an increase in the number of hospital visits. A previous study reported that mothers who were worried about the health of their children from prior experience were more likely to visit the hospital after an unintentional injury (13); similar results were obtained in the present study.

**Table 1. Subjects' characteristics in the 18-month and 36-month groups (*n* = 2,889)**

Items	Total (%)	Child health checkup group		<i>p</i>
		18-month group ( <i>n</i> = 1,521) <i>n</i> (%)	36-month group ( <i>n</i> = 1,368) <i>n</i> (%)	
Sex				0.168
Male	1,453 (50.3)	746 (49.0)	707 (51.7)	
Female	1,436 (49.7)	775 (51.0)	661 (48.3)	
Nursery school attendance				< 0.001
No	812 (37.2)	469 (43.1)	343 (31.3)	
Yes	1,371 (62.8)	619 (56.9)	752 (68.7)	
Frequency of playing outside				0.102
Sometimes/rarely	1,037 (36.1)	523 (34.7)	514 (37.7)	
Almost everyday	1,836 (63.9)	985 (65.3)	851 (62.3)	
History of present/past illness				0.868
No	2,492 (86.9)	1,308 (86.8)	1,184 (87.1)	
Yes	375 (13.1)	199 (13.2)	176 (12.9)	
Hospital visits for unintentional injuries				0.033
No	2,548 (88.2)	1,360 (89.4)	1,188 (86.9)	
Yes	341 (11.8)	161 (10.6)	180 (13.1)	
Implementation of unintentional injury preventive behavior at home				< 0.001
No	175 (6.6)	43 (3.2)	132 (10.2)	
Yes	2,473 (93.4)	1,308 (96.8)	1,165 (89.8)	

Note: Missing data were excluded from this analysis.

**Table 2. The associations between individual variables and unintentional injury according to checkup groups (n = 2,889)**

Items	18-month group (n = 1,521)				36-month group (n = 1,368)					
	Hospital visits for unintentional injuries		OR	95 % CI	p	Hospital visits for unintentional injuries		OR	95 % CI	p
	No (ref.)	Yes				No (ref.)	Yes			
Sex			0.92	(0.66-1.27)	0.613			0.72	(0.52-0.98)	0.038
Male (ref.)	664 (48.8)	82 (50.9)				601 (50.6)	106 (58.9)			
Female	696 (51.2)	79 (49.1)				587 (49.4)	74 (41.1)			
Nursery school attendance			0.95	(0.65-1.40)	0.804			0.90	(0.62-1.30)	0.573
No (ref.)	416 (43.0)	53 (44.2)				294 (31.0)	49 (33.3)			
Yes	552 (57.0)	67 (55.8)				654 (69.0)	98 (66.7)			
Frequency of playing outside			0.93	(0.66-1.30)	0.659			1.05	(0.76-1.45)	0.769
Sometimes/rarely (ref.)	465 (34.5)	58 (36.3)				448 (37.9)	66 (36.7)			
Almost everyday	883 (65.5)	102 (63.8)				737 (62.1)	114 (63.3)			
History of present/past illness			2.04	(1.35-3.07)	0.001			1.67	(1.10-2.53)	0.016
No (ref.)	118 (87.8)	124 (78.0)				104 (87.9)	144 (81.4)			
Yes	164 (12.2)	35 (22.0)				143 (12.1)	33 (18.6)			
Implementation of unintentional injury preventive behavior at home			1.69	(0.52-5.53)	0.387			1.28	(0.72-2.29)	0.398
No (ref.)	40 (3.3)	3 (2.0)				118 (10.5)	14 (8.3)			
Yes	116 (96.7)	147 (98.0)				101 (89.5)	154 (91.7)			

Note: Missing data were excluded from this analysis. OR, odds ratio; CI, confidential interval.

**Table 3. Comparison of variables for unintentional injury according to health checkup groups (n = 366)**

Items	Total (%)	Health checkup groups		OR	95% CI	p
		18-month group	36-month group			
Age at hospital visit						
0-12 months	59 (16.0)	59 (35.5)	0 (0.0)			
13-24 months	226 (61.2)	107 (64.5)	119 (58.6)			
25-36 months	70 (19.0)	0 (0.0)	70 (34.5)			
36-47 months	14 (3.8)	0 (0.0)	14 (6.9)			
Location where unintentional injury happened				1.72	(1.09 - 2.72)	0.022
Indoor (ref.)	253 (69.5)	127 (75.6)	126 (64.3)			
Outdoor	111 (30.5)	41 (24.4)	70 (35.7)			
Type of unintentional injury						
Drowning†						0.251
No	363 (99.2)	172 (100)	191 (98.5)			
Yes	3 (0.8)	0 (0)	3 (1.5)			
Accidental ingestion				0.26	(0.82 - 0.81)	0.020
No (ref.)	349 (99.2)	159 (92.4)	190 (97.9)			
Yes	17 (4.6)	13 (7.6)	4 (2.1)			
Burn				0.53	(0.28 - 0.99)	0.046
No (ref.)	320 (87.4)	144 (83.7)	176 (90.7)			
Yes	46 (12.6)	28 (16.3)	18 (9.3)			
Fall				0.30	(0.16 - 0.55)	< 0.001
No (ref.)	307 (83.9)	130 (75.6)	177 (91.2)			
Yes	59 (16.1)	42 (24.4)	17 (8.8)			
Turning over				2.50	(1.53 - 4.09)	< 0.001
No (ref.)	269 (73.5)	142 (82.6)	127 (65.5)			
Yes	97 (26.5)	30 (17.4)	67 (34.5)			
Cut				1.62	(0.98 - 2.68)	0.060
No (ref.)	284 (77.6)	141 (82.0)	143 (73.7)			
Yes	82 (22.4)	31 (18.0)	51 (26.3)			
Getting caught in something				1.14	(0.50 - 2.58)	0.756
No (ref.)	341 (93.2)	161 (93.6)	180 (92.8)			
Yes	25 (6.8)	11 (6.4)	14 (7.2)			
Other				1.05	(0.53 - 2.07)	0.893
No (ref.)	329 (89.9)	155 (90.1)	174 (89.7)			
Yes	37 (10.1)	17 (9.9)	20 (10.3)			

Note: Missing data were excluded from this analysis. OR, odds ratio; CI, confidential interval. 18-month group = reference group. †: Result of Chi-squared.

These results suggest that the care of the children and sensitive personality of mothers or other caregivers after previous illness or injury in children might influence the absolute rate of hospital visits for unintentional injury.

In the 36-month group, hospital visits were more common in boys than girls, while in the 18-month group, no differences were noted according to sex. These results are similar to those of a previous study (15). This previous study suggested that the sex differences might have resulted from biological factors, exposure opportunities, sex-based socialization, and cognition of the children (15). The finding that the presence of sex differences in regard to hospital visits for unintentional injury might be influenced by the age of the children is consistent with the information presented in the WHO plan of action (9).

### 3.4. Comparisons of the variables of unintentional injury

Comparisons of the variables of unintentional injury between the groups are presented in Table 3. There were 366 cases of unintentional injury, from a total of 341 children. Seven children had 3 hospital visits (18-month group, 2; 36-month group, 5), and 39 children had 2 hospital visits (18-month group, 14; 36-month group, 25). The number of unintentional injuries that occurred outdoors was higher in the 36-month group than in the 18-month group. This result might indirectly support the finding that the play area expands with age (10).

Unintentional injuries resulting from accidental ingestion and falls were more common in the 18-month group than in the 36-month group, while unintentional injuries resulting from turning over were more common in the 36-month group than in the 18-month group. These results show that child development might influence some causes of unintentional injury, and this is consistent with the findings of a previous study (8). Therefore, child safety education for parents/caregivers in health checkup settings should include information on child development.

### 3.5. Limitations

The present study has some limitations. First, the health checkup database did not include fatal unintentional injuries; therefore, the factors related to severe unintentional injuries could not be evaluated in this study. Second, socioeconomic status of the family might have influenced the rate of hospital visits for unintentional injury. However, the health checkup database has an insufficient scope for evaluation of socioeconomic status. Third, the participants were from a single municipality in the Tokyo metropolitan area; thus, it might be difficult to generalize our findings. Finally, the cross-sectional nature of the study did not allow assessment of causal relationships among the study variables. Nonetheless, the present study is one of

the few studies to describe the current status of hospital visits for unintentional injury among children aged 18-23 months and those aged 36-47 months in Japan.

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