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Suicide attempt and self-harm among hospitalized children in Japan: A nationwide inpatient database study

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Abstract: This study aims to delineate the characteristics and clinical trajectories of suicide attempts and self-harm, and its gender and age differences among children. This nationwide retrospective cross-sectional study utilized data extracted from the Japanese Diagnosis Procedure Combination inpatient database spanning 2016 to 2017. Children aged 7-17 years admitted to acute care hospitals for suicide attempts and self-harm, were identified. Patient characteristics included age, gender, suicide method, and comorbid psychiatric disorders. Trajectory information included the duration of hospital stay, admission ward, psychiatric/psychological interventions, in-hospital mortality, and healthcare expenditure. Data analysis encompassed 1,704 children hospitalized for suicide attempts and self-harm. Among these, 49.4% were junior high school age, 69.0% for female, and 28.4% for underweight. Overdose emerged as the most prevalent method for suicide attempts and self-harm (49.9%). Notably, 66.0% did not receive a diagnosis of any mental illness, and 56.3% did not undergo psychiatric/psychological care during their hospitalization. Boys were more likely to use high-lethality suicide methods, such as hanging ($p < 0.001$), and die during hospitalization ($p < 0.001$). Conversely, girls were more likely to use low-lethality suicide methods, such as drug overdose ($p < 0.001$), and receive psychiatric/psychological intervention during hospitalization ($p = 0.015$). Children aged 7-12 years were more likely to use high-lethality suicide methods, such as hanging ($p < 0.001$), and be diagnosed with attention-deficit/hyperactivity disorder ($p < 0.001$) and less likely to receive psychiatric/psychological intervention ($p = 0.005$) compared with other age groups. These findings suggest the importance of developing gender and age sensitive health policies, systems, and interventions to prevent child suicide.

Keywords: acute care hospital, children, Japan, self-harm, suicide, suicide attempt, nationwide inpatient data

Introduction

Child suicide poses a significant global health concern. Among adolescents aged 15-17 years, the average global suicide rate stands at 7.4 per 100,000 (*1*). Notably, Japan reports a crude suicide rate of 16.1 per 100,000 across all age groups, surpassing rates in other developed countries such as the United States, France, the United Kingdom, and Germany (*2*). In Japan, the number of suicides among children aged 7-18 years reached 514 in 2022, marking a historic high, with a majority being adolescents (*3*). Suicide ranks as the third leading cause of death among 10-14 year-olds and the primary cause among 15-19 year-olds in Japan, while globally, it ranks fourth among 10-29 year-olds (*2,4*). Additionally, previous studies focusing on a larger population of Japanese adolescents and young adults (n = 1,540 to 2,974) found a lifetime prevalence of self-harm at approximately10%, surpassing the global rate of 6.2% (*5,6*).

Studies underscore the association of suicide attempts and self-harm among children with various factors including internalizing psychopathology, depression, anxiety, externalizing psychopathology, attention-deficit

hyperactivity disorder (ADHD), psychosis, family conflict and dysfunction, family psychopathology, lower self-esteem, parental support, peer support, bullying, and child maltreatment (*7,8*). While a Japanese study in 2020 (*9*) explored suicide attempts and self-harm among adults, shedding light on demographic trends, method of suicide attempt or self-harm, suicide completion rates, and lack of psychiatric/psychological interventions, its focus excluded children. Consequently, there remains a significant gap in understanding the characteristics and clinical trajectories of suicide attempts and self-harm among this demographic.

Additionally, previous studies indicated that the rate of suicides, type of suicidal behaviors, and its associated factors may differ between genders. Studies reported that females were more likely to commit self-harm, such as cutting a wrist, and self-poisoning; furthermore, it was associated with their internalizing behaviors, such as depression and suicidal ideation (*10-14*). Conversely, males were more likely to attempt suicide possibly owing to their externalizing behaviors, such as physical and verbal aggression and hostility (*13-15*). However, findings regarding gender and age differences have been inconsistent (*16,17*). Furthermore, whether gender differences exist in the rate, methods, demographics, and clinical trajectories – such as treatments of self-harm and self-attempt – especially in childhood remains unclear.

In addition, the characteristics and clinical trajectory among children who committed self-harm and suicide attempt may differ depending on age groups. Systematic reviews indicated that children's suicidality, especially self-harm, were common from the age of 12 years onwards, especially among girls (*13*). Reasons for rapid increase of self-harm during puberty may include depressive symptoms, alcohol misuse, substance abuse, and onset of sexual activity. Furthermore, risk-taking behaviors and emotional symptoms may be associated with their neurodevelopmental vulnerability, such as underdevelopment of the cortical brain region (*7,13,18-20*). However, limited studies have examined self-harm and suicide attempts among children younger than 12 years. Furthermore, differences in the characteristics and clinical trajectory have not been elucidated among the age groups of 7-12 (elementary), 13-15 (junior high), and 16-17 years old (senior high).

This study aims to address this gap by identifying the characteristics and clinical trajectories associated with suicide attempts and self-harm among hospitalized children aged 7-17 years, and its gender and age differences leveraging data from a nationwide inpatient database in Japan.

Participants and Methods

Study design

This nationwide retrospective cross-sectional study was conducted from 2016 to 2017, utilizing the Japanese Diagnosis Procedure Combination inpatient database. The 2016-2017 database was used as the provision of data on suicide attempts and data on self-harm were compulsorily provided only during this period.

Data source

The nationwide inpatient database encompasses data gathered from approximately 1,600 acute-care hospitals across Japan, encompassing around seven million inpatients annually, which accounts for approximately 50% of inpatients admitted to Japanese academic and community hospitals (*21*). This comprehensive database comprises discharge abstracts and administrative claims data, providing insights into patient demographics such as age and gender, alongside diagnoses categorized utilizing the International Classification of Diseases Tenth Revision codes, medications, procedures, and various clinical data, including levels of consciousness and activities of daily living. Studies have indicated a moderately high accuracy in primary diagnoses and a very high accuracy in recorded procedures within this database (*22,23*).

Information on suicide attempts and self-harm

Between 2016 and 2017, the database included information on whether patients had engaged in suicide attempts or self-harm, as well as the specific method employed, for all hospitalized patients admitted to acute-care hospitals. Suicide methods encompassed *i*) hanging, *ii*) jumping from a height, *iii*) poisoning, *iv*) drug overdose, *v*) cutting or piercing excluding wrist cutting, *vi*) wrist cutting, *vii*) other methods, and *viii*) unspecified methods. In cases where healthcare professionals did not identify any suicide attempts upon admission, they assigned the code *ix*) indicating none.

Participants

We identified children aged 7-17 years, admitted to acute-care hospitals in Japan for the first time for suicide attempts or self-harm between 2016 and 2017. Children coded as 7 (others) or 8 (unspecified) were excluded owing to the low reliability of the data concerning child suicide.

Variables

Patient characteristics encompassed age, gender, body height, body weight, current pregnancy status, smoking index, prior admission within one year to the same hospital, ambulance utilization, emergency admission, forced admission by a licensed psychiatrist, level of consciousness upon admission utilizing the Japan Coma Scale, comorbid psychiatric disorders, and suicide

methods. Comorbid psychiatric disorders included mood disorders (such as depressive disorder and bipolar affective disorder), anxiety disorders (including generalized anxiety disorder, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, and dissociative disorder), somatoform disorder, eating disorder, ADHD, schizophrenia, and personality disorder.

Clinical trajectory information comprised length of hospital stay, admission ward (categorized into psychiatry, emergency medicine, and intensive care unit), physical interventions (such as mechanical ventilation, blood transfusion, closed heart massage, counter shock, gastric lavage, and vasopressor utilization), psychiatric/psychological interventions (including inpatient psychotherapy, cognitive therapy/cognitive behavioral therapy, inpatient group psychotherapy, psychiatric occupational therapy, psychiatric discharge guidance, and antidepressants utilization), non-psychiatric/psychological intervention, in-hospital mortality, mortality within 24 hours post-admission, discharge destination (home, another hospital/clinic, or social welfare facility), Japan Coma Scale assessment at discharge, and total healthcare costs (with the conversion rate of 1 dollar = 105 yen for the years 2016 and 2017).

Statistical analyses

Descriptive statistics for all the variables are presented. The median and interquartile range (IQR) are presented for numerical variables, while numbers and percentages are presented for categorical variables. Subsequently, Wilcoxon rank-sum tests and chi-squared tests were performed for numerical and categorical variables, respectively, to compare all the variables between the genders and age groups: 7-12 years old (Elementary), 13-15 years old (Junior high), and 16-17 years old (Senior high). If patients were hospitalized again between 2016 and 2017, information from the first admission, concerning suicide attempts or self-harm, was collected. All analyses were performed utilizing Stata version 17 software (StataCorp, College Station, TX, USA). A p-value < 0.05 was considered statistically significant.

Ethical considerations

This study was approved by the Institutional Review Board of the University of Tokyo (No. 3501-(5)). All information collected from the database was kept anonymous.

Results

Characteristics of suicide attempt and self-harm among hospitalized children

A total of 1,704 children aged 7-17 years, were identified concerning being hospitalized with regards to suicide attempts and self-harm for the first time from 2016 to 2017 (n = 862 in 2016; n = 842 in 2017) (Table 1 and Table 2). The median age of the children was 15 years (IQR, 14-16), while 90.2% of them were adolescents (49.4% comprising junior high school age and 40.8% senior high school age, respectively). Overall, 69.0% were female, while 28.4% were classified as being underweight (exhibiting a body mass index < 18.5 kg/m^2). In relation to the route and type of admission selected, half the children utilized ambulances, 65% experienced emergency admissions, and 10% experienced forced hospitalization approved by a licensed psychiatrist. Overall, 17.5% were in a coma at the time of admission; 17.3% were going through depression; 0.8% were diagnosed with post-traumatic stress disorder, 3.1% with dissociative disorder, 2.8% with a bipolar affective disorder, 2.5% with somatoform disorder, 2.2% with an eating disorder, and 1.3% with a personality disorder. Regarding suicide attempts or self-harm, drug overdose was the most common (49.9%), followed by jumping from a height (22.3%), hanging (13.3%), wrist cutting (8.0%), cutting or piercing without wrist cutting (3.2%), and poisoning (3.2%).

Furthermore, girls (n = 1,176) were more likely to be older; underweight (BMI < 18.5); use ambulances; be less in a coma; diagnosed with psychiatric disorders such as depression and bipolar affective, panic, dissociative, somatoform, eating, and personality disorders; and forcedly admitted by a licensed psychiatrist than boys (n = 528). Moreover, Boys were more likely to use high-lethality suicide methods, such as hanging, jumping from a height, poisoning, and cutting or piercing without wrist cutting, than girls who were more likely to use low-lethality suicide methods, such as drug overdose and wrist cutting.

Clinical trajectory of suicide attempt and self-harm among hospitalized children

The median length of hospitalization was four days (IQR, 2-14 days) (Table 3 and Table 4). Overall, 19.0% of children were hospitalized in a psychiatric ward, 17.1% in an intensive care unit, and 31.0% in an intermediate intensive care unit. Regarding procedures and medications, 12.2% of children received mechanical ventilation, 6.0% received blood transfusion, 9.6% received gastric lavage, 11.4% utilized vasopressors, 41.8% received psychotherapy, 6.5% utilized antidepressants, 5.1% received psychiatric discharge guidance, and 3.9% received psychiatric occupational therapy during hospitalization. A total of 959 (56.3%) children did not receive psychiatric/psychological treatment. The in-hospital mortality rate was 9%, of which 7.3% passed on within 24 hours post-admission. Most children (87.4%) were classified as having a clear consciousness at the time of discharge, and 79.1% returned home after discharge. Their median total

Table 1. Characteristics of hospitalized children due to suicide attempt and self-harm: Gender and age comparisons (*n* = 1,704)

Variables	Total *n* = 1,704 *n* (%)	Girls *n* = 1,176 *n* (%)	Boys *n* = 528 *n* (%)	*p* value
Age (years old)				
7-12: Elementary	166 (9.7)	88 (7.5)	78 (14.8)	< 0.001
13-15: Junior high	842 (49.4)	587 (49.9)	255 (48.3)	
16-17: Senior high	696 (40.8)	501 (42.6)	195 (36.9)	
Female	1176 (69.0)	NA	NA	NA
Body mass index ((kg/m^2)				
< 18.5	398 (23.4)	252 (21.4)	146 (27.7)	< 0.001
18.5-24.9	871 (51.1)	658 (55.1)	223 (42.2)	
25.0-29.9	92 (5.4)	64 (5.4)	28 (5.3)	
≥ 30.0	39 (2.3)	30 (2.6)	9 (1.7)	
Current pregnancy	4 (0.2)	4 (0.2)	0 (0.0)	0.007
Smoking status				
Current/ ex-smokers	38 (2.2)	26 (2.2)	12 (2.3)	0.86
Ambulance use	1,116 (65.5)	728 (61.9)	388 (73.5)	< 0.001
Emergency admission	1,542 (90.4)	1,063 (90.4)	479 (90.7)	0.83
Forced admission by a licensed psychiatrist	186 (10.9)	149 (12.7)	37 (7.0)	< 0.001
Japan Coma Scale at admission				
Clear	892 (52.3)	629 (53.5)	263 (49.8)	< 0.001
Dizziness	352 (20.7)	274 (23.3)	78 (14.8)	
Somnolence	162 (9.5)	109 (9.3)	53 (10.0)	
Coma	298 (17.5)	164 (13.9)	134 (25.4)	
Comorbid psychiatric disorders				
Mood disorder				
Depressive disorder	295 (17.3)	226 (19.2)	69 (13.1)	0.002
Bipolar affective disorder	48 (2.8)	41 (3.5)	7 (1.3)	0.013
Anxiety disorder				
Generalized anxiety disorder	40 (2.3)	32 (2.7)	8 (1.5)	0.13
Post-traumatic stress disorder	14 (0.8)	12 (1.0)	2 (0.4)	0.17
Obsessive-compulsive disorder	9 (0.5)	7 (0.6)	2 (0.4)	0.57
Panic disorder	14 (0.8)	14 (1.2)	0 (0.0)	0.012
Dissociative disorder	53 (3.1)	48 (4.1)	5 (0.9)	< 0.001
Somatoform disorder	43 (2.5)	36 (3.1)	7 (1.3)	0.035
Eating disorder	37 (2.2)	36 (3.1)	1 (0.2)	< 0.001
Attention deficit hyper activity disorder	32 (1.9)	19 (1.6)	13 (2.5)	0.23
Schizophrenia	1 (0.1)	1 (0.1)	0 (0.0)	0.50
Personality disorder	23 (1.3)	22 (1.9)	1 (0.2)	0.005
Non-diagnosis of any psychiatric disorders	1,125 (66.0)	721 (61.3)	404 (76.5)	< 0.001
Methods of suicide attempt and self-harm				
Hanging	226 (13.3)	86 (7.3)	140 (26.6)	< 0.001
Jumping from a height	380 (22.3)	211 (17.9)	169 (32.1)	
Poisoning	55 (3.2)	32 (2.7)	23 (4.4)	
Drug overdose	850 (49.9)	696 (59.2)	154 (29.2)	
Cutting or piercing without wrist cutting	55 (3.2)	32 (2.7)	23 (4.4)	
Wrist cutting	137 (8.0)	119 (10.1)	18 (3.4)	

healthcare cost during hospitalization was 2,792 dollars (IQR, 1,551 to 6,816).

Gender comparisons

As shown in Table 3, boys were more likely to be hospitalized in an intensive care unit ($p < 0.001$); receive physical interventions ($p < 0.001$), such as mechanical ventilation ($p < 0.001$), blood transfusion ($p < 0.001$), closed heart massage ($p < 0.001$), counter shock ($p = 0.006$), and vasopressor use ($p < 0.001$); die during hospitalization ($p < 0.001$) or within 24 hours after admission ($p < 0.001$); be in a coma ($p < 0.001$); and have more healthcare cost than girls ($p < 0.001$). However, girls were more likely to be hospitalized in a psychiatric ward ($p < 0.001$); receive psychiatric/ psychological interventions ($p = 0.015$), which included inpatient psychotherapy ($p = 0.015$), psychiatric discharge guidance ($p = 0.009$), and antidepressant use ($p = 0.009$), and be discharged to home than boys ($p < 0.001$).

Age-group comparisons

As shown in Table 2 and Table 4, children < 12 years were more likely to be underweight ($p < 0.001$), use high-lethality suicide methods, such as hanging and jumping from a height ($p < 0.001$), have a clearer conscious level ($p < 0.001$), and use vasopressor ($p = 0.036$). They were less likely to use an ambulance service ($p < 0.001$), have

Table 2. Characteristics of hospitalized children due to suicide attempt and self-harm: Age comparisons (*n* = 1,704)

Variables	7-12 years old *n* = 166 *n* (%)	13-15 years old *n* = 842 *n* (%)	16-17 years old *n* = 696 *n* (%)	*p* value
Age (years old)				
7-12: Elementary	NA	NA	NA	NA
13-15: Junior high	NA	NA	NA	NA
16-17: Senior high	NA	NA	NA	NA
Female	88 (53.0)	587 (69.7)	501 (72.0)	< 0.001
Body mass index ((kg/m^2)				
< 18.5	74 (44.6)	193 (22.9)	131 (18.8)	< 0.001
18.5-24.9	55 (33.1)	426 (50.6)	390 (56.0)	
25.0-29.9	7 (4.2)	43 (5.1)	42 (6.0)	
≥ 30.0	2 (1.2)	18 (19.2)	19 (2.7)	
Current pregnancy	0 (0.0)	0 (0.0)	4 (0.6)	0.011
Smoking status				
Current/ ex-smokers	0 (0.0)	9 (1.1)	29 (4.2)	< 0.001
Ambulance use	87 (52.1)	556 (66.0)	473 (70.0)	< 0.001
Emergency admission	130 (78.3)	776 (92.2)	636 (91.4)	< 0.001
Forced admission by a licensed psychiatrist	15 (9.0)	92 (10.9)	79 (11.4)	0.335
Japan Coma Scale at admission				
Clear	111 (66.9)	460 (54.6)	321 (46.1)	< 0.001
Dizziness	19 (11.5)	167 (19.8)	166 (23.9)	
Somnolence	12 (7.2)	73 (8.7)	77 (11.1)	
Coma	24 (14.5)	142 (16.9)	132 (19.0)	
Comorbid psychiatric disorders				
Mood disorder	19 (11.5)	167 (19.8)	194 (22.9)	< 0.001
Depressive disorder	15 (9.0)	133 (15.8)	147 (21.2)	< 0.001
Bipolar affective disorder	2 (1.2)	18 (2.1)	22 (3.2)	< 0.001
Anxiety disorder				
Generalized anxiety disorder	1 (0.6)	19 (2.6)	20 (2.9)	0.215
Post-traumatic stress disorder	1 (0.6)	6 (0.7)	7 (1.0)	0.775
Obsessive-compulsive disorder	3 (1.8)	3 (0.4)	3 (0.4)	0.056
Panic disorder	0 (0.0)	3 (0.4)	11 (1.6)	0.014
Dissociative disorder	2 (1.2)	28 (3.3)	23 (3.3)	0.033
Somatoform disorder	7 (4.2)	24 (3.0)	12 (1.7)	0.013
Eating disorder	3 (1.8)	17 (2.0)	17 (2.2)	0.804
Attention deficit hyper activity disorder	9 (5.4)	16 (1.9)	7 (1.0)	< 0.001
Schizophrenia	0 (0.0)	0 (0.0)	1 (0.1)	0.485
Personality disorder	0 (0.0)	11 (1.3)	12 (1.7)	0.221
Non-diagnosis of any psychiatric disorders	126 (75.9)	575 (68.3)	424 (60.9)	< 0.001
Methods of suicide attempt and self-harm				
Hanging	54 (32.5)	105 (12.5)	67 (9.6)	< 0.001
Jumping from a height	43 (25.9)	198 (23.5)	139 (20.0)	
Poisoning	3 (1.7)	33 (3.9)	19 (2,7)	
Drug overdose	40 (24.0)	407 (48.3)	403 (57.9)	
Cutting or piercing without wrist cutting	3 (1.8)	34 (4.0)	18 (2.6)	
Wrist cutting	23 (13.8)	64 (7.6)	50 (7.2)	

emergency admission ($p < 0.001$), be diagnosed with a mental illness ($p < 0.001$), except ADHD ($p < 0.001$), and receive any psychiatric/psychological interventions ($p < 0.001$). In contrast, children > 13 years were more likely to be girls ($p < 0.001$), use lower-lethality suicide methods, such as drug overdose ($p < 0.001$), use an ambulance service ($p < 0.001$), be diagnosed with a mental illness ($p < 0.001$), particularly, depressive ($p < 0.001$), bipolar affective ($p < 0.001$), panic ($p = 0.014$), dissociative ($p = 0.033$), and somatoform disorders ($p = 0.013$), be hospitalized in a psychiatric ward ($p < 0.001$), receive psychiatric/psychological interventions ($p < 0.001$), particularly inpatient psychotherapy ($p < 0.001$)), and be transferred to another hospital after discharge ($p = 0.046$). Children aged 16-17 years exhibited the highest proportions of current pregnancy and smoking ($p < 0.001$), ambulance use ($p < 0.001$), diagnosed with a mental illness ($p < 0.001$), and receiving psychiatric/psychological interventions ($p < 0.001$), which included inpatient psychotherapy ($p < 0.001$) and antidepressant use ($p < 0.001$).

Discussion

This study, utilizing the Japanese nationwide inpatient database spanning 2016 to 2017, represents the first endeavor to unveil the characteristics of children hospitalized aged 7-17 years owing to suicide attempts and self-harm, along with tracing their clinical trajectory from admission to discharge. Although previous studies

Table 3. Clinical trajectory of suicide attempts among hospitalized children: Gender comparisons (*n* = 1,704)

Variables	Total *n* = 1,704 *n* (%)	Girls *n* = 1,176 *n* (%)	Boys *n* = 528 *n* (%)	*p* value
Length of hospitalization, days, median (IQR)	4 (2-14)	4 (2-13)	4 (2-15)	0.43
Admission ward				
Psychiatry	324 (19.0)	255 (21.7)	69 (13.1)	< 0.001
Intensive care unit	292 (17.1)	156 (13.3)	136 (25.8)	< 0.001
Intermediate intensive care unit	529 (31.0)	372 (31.6)	157 (29.7)	0.43
Physical interventions		35 (3.0)	67 (12.7)	< 0.001
Mechanical ventilation	208 (12.2)	96 (8.2)	112 (21.2)	< 0.001
Blood transfusion	102 (6.0)	54 (4.6)	48 (9.1)	< 0.001
Closed heart massage	102 (6.0)	35 (3.0)	67 (12.7)	< 0.001
Counter shock	16 (0.9)	6 (0.5)	10 (1.9)	0.006
Gastric lavage	163 (9.6)	133 (11.3)	30 (5.7)	< 0.001
Vasopressor use	195 (11.4)	92 (7.8)	103 (19.5)	< 0.001
Psychiatric/psychological interventions				
Inpatient psychotherapy	713 (41.8)	515 (43.8)	198 (37.5)	0.015
Cognitive therapy/cognitive behavioral therapy	0 (0.0)	0 (0.0)	0 (0.0)	NA
Inpatient group psychotherapy	24 (1.4)	20 (1.7)	4 (0.8)	0.13
Psychiatric occupational therapy	67 (3.9)	48 (4.1)	19 (3.6)	0.64
Psychiatric discharge guidance	87 (5.1)	71 (6.0)	16 (3.0)	0.009
Antidepressants use	111 (6.5)	89 (7.6)	22 (4.2)	0.009
Non-psychiatric/psychological intervention	959 (56.3)	515 (43.8)	198 (37.5)	0.015
Death during hospitalization	151 (8.9)	54 (4.6)	97 (18.4)	< 0.001
Death within 24 hours after admission	123 (7.3)	40 (3.4)	83 (15.7)	< 0.001
Discharge destination				
Home	1,347 (79.1)	978 (83.2)	369 (69.9)	< 0.001
Another hospital/clinic	183 (10.7)	128 (10.9)	55 (10.4)	
Social welfare facility	18 (1.1)	12 (1.0)	6 (1.1)	
Japan Coma Scale at discharge				
Clear	1,490 (87.4)	1,078 (91.7)	412 (78.0)	< 0.001
Dizziness	52 (3.1)	36 (3.1)	16 (3.0)	
Somnolence	5 (0.3)	5 (0.4)	0 (0.0)	
Coma	6 (0.4)	3 (0.3)	3 (0.6)	
Total healthcare cost, dollars, median (IQR)	293,240 (162,860-715,660)	278,270 (154,900-649,320)	332,685 (179,195-862,250)	< 0.001

IQR, inter quartile range. The conversion rate of 1 dollar = 105 yen for the years 2016 and 2017.

in Japan reported suicide attempts and self-harm among older persons hospitalized aged 29-60 years and those in the community aged 16-49 years (*5,9*) and suicide ideation and attempts among children aged 13-18 years, no studies have included hospitalized children with a younger age group (*24*). The findings bear significant implications for health policies, healthcare systems, and clinical practices aimed at preventing child suicide considering genders and age groups.

Overall tendency

First, this study sheds light on the demographic profile of children hospitalized for suicide attempts and self-harm. A systematic review has highlighted a rapid surge in the prevalence of self-harm during early teenage years (*13*). This escalation may be as a result of specific neurodevelopmental vulnerabilities, such as serotonin imbalance, alongside personality traits such as perfectionism and impulsivity and cognitive vulnerabilities such as impaired social problem-solving abilities. The confluence of these vulnerabilities among early adolescents precipitates an upsurge in self-destructive behaviors, especially in the prevalence of adverse social events and circumstances in both early and recent life (*e.g.*, bullying, interpersonal difficulties, parental illness or loss, strained family relationships, physical punishment, and instances of child abuse and neglect) (*7,8,13*). Additionally, the percentage of female individuals in this study (70%) exceeded that observed among adults hospitalized for similar reasons in Japan (61.0%) (*9*). Consequently, female individuals in early adolescence may face heightened risk of engaging in suicide attempts and self-harm.

Notably, this study exhibited a higher prevalence of being underweight among the children examined. In Japan, the prevalence of being underweight among young female individuals aged 20-29 years ranks highest among developed countries (*25*). Studies (*26,27*) have linked being underweight with mental health issues such as depression and suicidal ideation, which can directly elevate the risk of suicide. Being underweight is a significant clinical indicator of eating disorders, such as anorexia nervosa, among adolescents (*28,29*), indicating

Table 4. Clinical trajectory of suicide attempts among hospitalized children: Age comparisons (*n* = 1,704)

Variables	7-12 years old *n* = 166 *n* (%)	13-15 years old *n* = 842 *n* (%)	16-17 years old *n* = 696 *n* (%)	*p* value
Length of hospitalization, days, median (IQR)	5 (2-12)	4 (2-12)	3 (2-12)	0.17
Admission ward				
Psychiatry	19 (10.8)	158 (18.8)	148 (21.3)	< 0.001
Intensive care unit	36 (21.7)	151 (17.9)	105 (15.1)	0.088
Intermediate intensive care unit	27 (16.3)	256 (30.4)	246 (35.3)	< 0.001
Physical interventions				
Mechanical ventilation	23 (13.9)	111 (13.2)	74 (10.5)	0.249
Blood transfusion	10 (6.0)	49 (5.8)	43 (6.2)	0.957
Closed heart massage	11 (6.8)	62 (7.4)	29 (4.2)	0.029
Counter shock	1 (0.6)	10 (1.2)	6 (0.7)	0.569
Gastric lavage	4 (2.4)	85 (10.1)	74 (10.6)	0.004
Vasopressor use	26 (15.6)	104 (12.4)	65 (9.3)	0.036
Psychiatric/psychological interventions				
Inpatient psychotherapy	46 (27.7)	350 (41.6)	317 (45.6)	< 0.001
Cognitive therapy/cognitive behavioral therapy	0 (0.0)	0 (0.0)	0 (0.0)	NA
Inpatient group psychotherapy	2 (1.2)	13 (1.5)	9 (1.3)	0.892
Psychiatric occupational therapy	5 (3.0)	33 (3.9)	29 (4.2)	0.789
Psychiatric discharge guidance	6 (3.6)	49 (5.8)	32 (4.6)	0.365
Antidepressants use	5 (3.0)	45 (5.3)	71 (8.8)	< 0.001
Non-psychiatric/psychological intervention	118 (71.1)	481 (57.1)	360 (51.7)	< 0.001
Death during hospitalization	18 (10.8)	90 (10.7)	43 (6.2)	0.005
Death within 24 hours after admission	10 (6.0)	75 (8.9)	38 (5.5)	0.097
Discharge destination				
Home	136 (81.9)	658 (77.0)	563 (80.9)	0.046
Another hospital/clinic	11 (6.6)	91 (10.8)	81 (11.6)	
Social welfare facility	1 (0.6)	11 (1.3)	6 (0.9)	
Japan Coma Scale at discharge				
Clear	145 (87.4)	728 (86.5)	617 (88.7)	
Dizziness	2 (1.2)	19 (2.3)	31 (4.5)	
Somnolence	0 (0.0)	1 (0.1)	4 (0.6)	
Coma	1 (0.6)	4 (0.5)	1 (0.1)	0.004
Total healthcare cost, dollars, median (IQR)	351,750 (184,670- 861,270)	302,500 (160,470- 785,620)	268110 (163,470- 622,760)	0.165

IQR, inter quartile range; The conversion rate of 1 dollar = 105 yen for the years 2016 and 2017.

that being underweight may be a crucial and useful screening indicator for detecting a high-risk population for child suicide attempts as well as self-harm earlier in clinical, school, and community settings.

In this study, the proportions of being in a coma at admissions, intensive physical interventions, and mortality within 24 hours were lower than those reported in a prior study on adults (*9*). The methods of suicide attempts and self-harm among children in this study were similar to those utilized for adults in a prior study (*9*). A systematic review (*13*) exhibited that methods of self-harm, such as self-cutting, jumping from a height, and self-batteries, were heterogeneous among children. However, this study could not identify diverse and unique methods for reducing fatal self-destruction.

Additionally, this study exhibited that 66% of children were not diagnosed with any mental illness, and 56% did not receive any psychiatric/psychological interventions during hospitalization. In contrast, a prior study exhibited lower proportions: 38% of adults were not diagnosed with any mental illness, and 51% did not receive any psychiatric/psychological interventions (*9*). This may be as a result of the severe shortage of child psychiatric hospitals and healthcare professionals with sufficient skills and knowledge in child psychiatry in Japan. (*2,30,31*).

Finally, the length of hospitalization and total healthcare costs owing to child suicide attempts and self-harm were somewhat higher than those among adult patients (*9*). One conceivable reason for this is that the cost may include additional medical costs for pediatric patients as they utilize special equipment and a higher number of healthcare professionals (*32*). Additionally, the shorter length of hospitalization among children may be as a result of their lower rate of death within 24 hours post-admission as opposed to adults.

Gender differences

This study showed that methods of suicidal behaviors differed between the genders. Girls were more likely to use low-lethality methods, such as self-poisoning and wrist cutting, which indicated self-harm; conversely, boys were more likely to use high-lethality methods, such

as hanging and jumping from a height, which indicated suicide attempts. These results were consistent with those of previous studies that girls tended to have suicidal ideation and conduct self-harm using a low-lethality method (*7,13,33,34*). A longitudinal study reported the trajectories of internalizing and externalizing behaviors by genders (*14*) and demonstrated that girls had increased internalizing behaviors, such as depressive symptoms, toward age 10 and continued to maintain these behaviors until age 17. However, externalizing behaviors, such as aggression, were higher in boys than in girls at age 5, which continued till age 17. Thus, differences in behavioral tendencies between girls and boys, especially during adolescence, could directly influence differences in their suicidal behaviors. Moreover, differences in their suicidal behavior may directly result in significant differences in their status during hospital admission and subsequent medical interventions and healthcare costs. Boys were more likely to receive more physical interventions and have higher healthcare costs.

Additionally, the rates of psychiatric diagnosis and treatment differed significantly between boys and girls. Previous studies demonstrated that depression was higher in adolescent girls and mediated the relationship between individual negative life events (*e.g.*, victimization of childhood abuse, bullying, suicidal ideation) and behaviors (*10,12,35*). This suggested that girls may be more likely to manifest their distress owing to negative life events as psychiatric symptoms than men, which may lead to higher rates of psychiatric diagnosis and psychiatric/psychological treatments.

Age differences

This study revealed that 9.7% of children hospitalized due to suicide attempt or self-harm were preadolescent children < 12 years old. They were more likely to use higher-lethality suicide methods, such as hanging and jumping from a height. Results of the higher proportion of low-lethality suicide methods were consistent with those in previous studies (*7,13*). A meta-analysis revealed that suicide death among pre-adolescents was rare, being approximately 1 in 1 million children compared with 3.8 in 100,000 adolescents (*36*). However, a recent systematic and meta-analytic review revealed that approximately 17.0% of pre-adolescents with suicidal ideation attempted suicide (*13*). The results of this study provide evidence to question the view that pre-adolescents do not experience suicidal thoughts and engaged in suicidal behaviors owing to the underdevelopment of their cognitive capacity (*37,38*). Furthermore, this study suggests the necessity of paying attentions to suicidality among pre-adolescents.

In addition, pre-adolescent children and adolescents who committed self-harm and suicide attempt were more likely to be diagnosed with ADHD and mood disorders, such as depression, respectively. This result was consistent with that of a previous meta-analysis, which revealed that ADHD was a strong and unique clinical factor of suicidal ideation among pre-adolescents (*7*). This high level of impulsivity and hyperactivity may be associated with their high-lethality suicidal behaviors. In addition, particular neurodevelopmental vulnerability among pre-adolescents may be related to their more direct suicidal behaviors. Owing to limited research on pre-adolescent suicide, further research should accumulate evidence on their suicidality and its related factors.

The disparities in access to psychiatric/psychological healthcare services between the age groups should also be highlighted. This study revealed that 71.1% of pre-adolescents did not receive any psychiatric/psychological interventions during hospitalization. Furthermore, this proportion was significantly higher than that in adolescents (57.1%). This may be due to the difficulty of diagnosing mental illness among younger children. In general, children's psychiatric symptoms manifest differently from those of adults, and many symptoms are not visible and are recognized as normal during development (*39*). Thus, only 10-20% of children with mental health problems meet the criteria for a specific psychological disorder, and the majority do not receive healthcare services (*39*). In particular, mental symptoms among children aged < 12 years may be more invisible owing to their immaturity in linguistic, cognitive, and intellectual development, than those in adolescents. This may be associated with the disparities in psychiatric/psychological healthcare service's depending on age groups.

Future implications

This study provides valuable evidence for developing effective policies and systems for suicide prevention in children from genders and age groups. At present, the Japanese government considers the prevention of child suicide a national priority as the number of child suicides is at a historical high as of 2022 (*3*). In 2023, the Japanese government released a plan to strengthen measures against child suicide (*3*), and the results of this study will be useful evidence regarding promoting the measures proposed by government. This study highlights the importance of attentiveness toward being underweight as a potential predicting factor for child suicidality. Psychological screening has been recommended to identify children at high risk of suicide in educational and clinical settings. However, a recent systematic review (*40*) concluded that the benefit and harm of such screening remained uncertain, especially for children and adolescents. Use of being underweight as an indicator for screening the risk of child suicide attempts and self-harm may be feasible and acceptable for frontline providers owing to its less invasive and stigma-free approach. In addition, this study suggests

the necessity of developing age- and gender-sensitive policies and interventions to effectively prevent child suicidality. This study revealed that boys and pre-adolescents tended to commit higher-lethality suicide attempts, while girls and adolescents tended to commit lower-lethality suicide attempts. Previous studies have indicated that psychopathology that lead to suicidal behaviors may differ based on gender and developmental stages (*7,13*). Thus, careful attention, interventions, and policies for the prevention of suicidality among children based age groups and gender are crucial.

Additionally, this study reported that the majority of children hospitalized due to suicide attempt and self-harm did not receive psychological treatment or interventions during hospitalization. These results indicate the importance of enhancing psychiatric/psychological treatments and psychosocial interventions. A meta-analysis examined the efficacy of psychosocial interventions for children with suicidal behaviors and demonstrated that psychosocial interventions, such as dialectical behavior, cognitive-behavioral, and mentalization-based therapies, reduced their suicidality (*41*). To provide sufficient psychiatric/psychological healthcare services for children hospitalized due to suicide attempt and self-harm, a policy to increase child psychiatric hospitals and healthcare professionals with sufficient skills and knowledge in child psychopathology is urgently required in Japan. This could directly contribute to preventing their relapse of and death due to suicidal behaviors. Furthermore, this study indicated gender and age inequality in psychiatric/psychological health service utilization for children hospitalized due to self-harm and suicide attempt. Hence, this should be an important warning to healthcare professionals. Furthermore, a policy to increase psychiatric/psychological interventions, especially for boys and pre-adolescents, is necessary.

Strengths and limitations

To the best of our knowledge, this study was the first to identify the number, characteristics, and clinical trajectory of hospitalized children of various ages from 7-17 years due to suicide attempts and self-harm *via* a nationwide inpatient database. Children with high suicidality are one of the most difficult populations to approach owing to ethical issues, such as higher physical and psychological burdens and consent age for study. This study reported the actual situations of such children *via* a nationwide inpatient database, without any additional burden on the children. These findings should be used to develop an effective healthcare policy and system to prevent child suicide in Japan and also worldwide.

This study had some limitations. First, this study included only patients who had attempted suicide or self-harm and were hospitalized in acute care hospitals. Consequently, it did not include non-hospitalized patients or those who passed on prior to admission. Second, owing to the lack of rigorous terminology and definitions in this database, the recorded information on suicide attempts and self-harm did not necessarily follow the definition of "deliberate self-harm" (*42*). Third, owing to the limitations encountered concerning collecting longitudinal data utilizing the database, we could not identify the long-term trajectory of suicide attempts and self-harm, including repeated suicide attempts and mortality. Further studies collecting long-term longitudinal data are necessary. Fourth, the database did not include information on victimization through violence, social support from parents, or self-esteem, which are reportedly correlated to suicide attempts (*7*). Finally, this study used only the 2016-2017 database as only this period was available for accessing information on suicide attempt and self-harm for all hospitalized patients. Thus, we could not identify longitudinal changes in the number and related factors of children hospitalized due to suicide attempt and self-harm. However, previous research reported that the number of child suicides increased during the COVID-19 pandemic (*43*).

Conclusion

This study utilized data from the Japanese nationwide inpatient database spanning 2016 to 2017, examining the characteristics of 1,704 children hospitalized owing to suicide attempts and self-harm, alongside tracing their clinical trajectory from admission. This study's findings serve as valuable evidence to inform the development of effective changes in health policies, healthcare systems, and interventions aimed at preventing child suicide considering genders and age.

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