

Emergency Psychiatry in the General Hospital

The emergency room is the interface between community and health care institution. Whether through outreach or in-hospital service, the psychiatrist in the general hospital must have specialized skill and knowledge to attend the increased numbers of mentally ill, substance abusers, homeless individuals, and those with greater acuity and comorbidity than previously known. This Special Section will address those overlapping aspects of psychiatric, medicine, neurology, psychopharmacology, and psychology of essential interest to the psychiatrist who provides emergency consultation and treatment to the general hospital population.

Self-poisoning with medications in adolescents: a national register study of hospital admissions and readmissions



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ABSTRACT

Objective: To examine characteristics of hospital admissions and risk factors associated with rehospitalization for self-poisoning with medications in adolescents aged 10–19 years.

Method: This study used data from the Norwegian Patient Register from 2008 to 2011. The main outcome was hospital readmission within the observation period. A complementary log–log regression model was used to assess the effect of characteristics at index hospital admission on readmission.

Results: Of 1497 patients, 76.4% were females and 89.8% were aged 15–19 years. At their first hospital admission, about one third received a secondary psychiatric diagnosis. Females (47.5%) were registered with an E-code for intentional self-harm more often than males (33.7%), and females were more often than males discharged to further treatment (27.8% vs. 21.5%). As many as 18.4% were rehospitalized for self-poisoning with medications. Significant predictors for hospital readmission were female sex [hazard ratio (HR)=2.4, 95% confidence interval (CI) 1.7–3.6], discharge to further treatment (HR=2.3, 95% CI 1.8–2.9) and psychiatric secondary diagnoses (HR=1.5, 95% CI 1.2–1.9).

Conclusion: This national study demonstrated significant sex differences in adolescents treated in hospital for self-poisoning with medications. Psychiatric secondary diagnoses had a strong predictive effect on readmission, which indicates the importance of psychiatric/psychosocial assessment of adolescents who are admitted to hospital for self-poisoning with medications.

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1. Introduction

Adolescents who ingested a harmful dose of medications are frequently seen in acute hospital settings in Western countries [1,2]. Most of these young patients are females in their late adolescence [1,3,4]. Nonopioid analgesics, such as paracetamol, are the most common substances ingested, but benzodiazepines, antidepressants and antipsychotics are also used [3,5,6]. Significant sex differences have been found regarding suicidal intent [1], psychiatric disorders and place of discharge [7].

Usually, hospital-treated cases of adolescent self-poisoning represent either overdoses with recreational drugs or intentional self-harm [4] where the individual purposely ingests a substance in excess of the prescribed or generally recognized therapeutic dosage [8]. Both types are associated with current psychiatric problems [6,9] and increased risk of developing psychiatric disorders [10], premature death and suicide [4,11]. The risk of a fatal outcome, from poisoning or other causes, is further enhanced among those who repeat their self-poisoning behavior [12,13]. Furthermore, repeated self-poisonings represent severe psychological distress for the adolescents and their families as well as use of substantial amounts of health care resources [14]. Previous studies found that about one-third of the adolescents who were admitted to hospital for self-poisoning had a history of previous self-poisoning(s) [15] and 15%–20% were readmitted within 6–12 months for subsequent self-poisoning(s) [15,16]. However,

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these studies included only cases defined as intentional self-harm and cannot be generalized to the total population of adolescents who visit hospital for self-poisoning. Other studies found that 6%–7% were rehospitalized within one year, but these studies were completed two decades ago and limited to hospital activity data from only one city-region [11,17]. There is a lack of studies examining risk factors for hospital readmission for self-poisoning in adolescents in a national population-wide context. Targeted treatment and prevention strategies depend on updated and representative data of what characterizes those adolescents who self-poison with medications. In particular, those adolescents who repeatedly self-poison form a high-risk population yet are little studied; thus, more knowledge is needed to inform clinicians about factors associated with rehospitalization.

The current study extended the research on adolescent self-poisoning with medications by using national data from the Norwegian Patient Register (NPR) of hospital admissions from 2008 to 2011. We identified all adolescents aged 10–19 years who were admitted to hospital for acute self-poisoning with medications irrespective of the apparent purpose of their act [18]. Side effects or unanticipated reactions from medications taken correctly were not included, nor were poisonings with substances predominantly used for nonmedical reasons (such as pesticides or rodenticides) or intoxications due to addiction [19].

The aims of the study were (a) to examine the characteristics (sex, age, E-code for intentional self-harm, psychiatric disorders) and management (lengths of hospital stay and place of discharge) of hospital admissions for self-poisoning in those aged 10–19 years and (b) to examine whether or not these factors were associated with hospital readmission for self-poisoning.

2. Method

The NPR contains data on all hospital admissions and outpatient consultations in Norway. In Norway, nearly all of the hospitals are publicly funded, and all Norwegian citizens are covered by public health insurance which provides access to free medical treatment. The NPR was used to retrieve all cases of acute hospital admissions from 2008 to 2011 for individuals aged 10–19 years with a primary diagnosis of self-poisoning with medications. The primary diagnosis describes the condition that health care is mainly provided for during the hospital stay or consultation. If more than one condition is topical, the one that has required the largest proportion of medical resources is recorded as the primary diagnosis. Secondary diagnoses describe conditions that exist simultaneously with the main condition or that develop during the treatment period, and which are subjected to examination and treatment, which must be taken into account or which has consequences for the patient management [20]. Diagnostic coding was done locally by each hospital and entered into the Norwegian Patient Registry.

In the current study, self-poisoning is defined as “poisoning by drugs, medicaments and biological substances” according to the Norwegian version of the World Health Organization (WHO)’s *Tenth Revision of the International Statistical Classification of Diseases and Related Health Problems* (ICD-10). In the Norwegian classification system, these poisonings are coded as “T4n,” a generic code covering about 125 specific codes of poisonings including T36–T40, T42–T49 and T50. A supplementary classification, referred to as E-code, is intended to be used to indicate the nature of the condition [19]. From the available data, it was impossible to identify cases of poisoning that could have been inflicted on the person by others, but their numbers are negligible [21].

The period of adolescence is defined by the WHO as 10–19 years of age [22]. Previous research found differences in the hospitalization rates for self-poisoning between adolescents in early and late adolescence [1]. Thus, we separated the adolescents into two groups: 10–14 years and 15–19 years, consistent with previous literature [4,9,23].

For each adolescent, the first recorded hospital admission with a principal diagnosis of acute self-poisoning in the years 2008–2011 was termed the “index” hospital admission. An encrypted version of

patient’s Norwegian personal identification number was used to capture all repeated hospital admissions for acute self-poisoning from 2008 to 2011. Admissions that occurred within 1 day of the previous hospital admission were excluded to avoid counting transfersals between hospital departments as recurrent hospital admissions. Patients who had two or more hospital admissions from 2008 to 2011 were then counted as repeaters.

We examined index hospital admissions for self-poisoning in relation to sex and age groups, psychiatric secondary diagnoses, E-code (external cause of injury) for intentional self-harm, length of hospital stay (0 day versus 1 day +) and discharge to the home versus further treatment, including hospital psychiatric department, hospital department for treatment of drug addiction or “other” health care institution (unspecified). We then examined the bivariate association between respective sex and age groups and the following: psychiatric secondary diagnoses, E-code for intentional self-harm, length of hospital stay and place of discharge at the index hospital admission. Lastly, we examined the association of each covariate with hospital readmission in univariate and multivariate analyses.

The project used anonymous register data with no personal information that could be linked to the patients and, therefore, was not submitted to the Regional Committees for Medical and Health Research Ethics and did not require a license from the Data Inspectorate to process sensitive personal data [24].

3. Statistical considerations

Standardized incidence rates by age and sex with 95% confidence intervals (CIs) were calculated using direct standardization method and population numbers from Statistics Norway [25]. Differences in hospitalization rates between the two sexes and age groups were tested by Poisson regression and reported as incidence-rate ratios (IRR). Bivariate associations were tested using Pearson χ^2 test; P values $\leq .05$ were considered statistically significant. A complementary log–log regression was used to fit discrete-time intervals for hospital readmission for self-poisoning in the period 2008–2011, estimating hazard ratios (HRs) with 95% CIs for covariates having an effect on readmission. Information on the specific dates of hospital presentation was not available; the time variable was only available in calendar years. Therefore, the analysis time scale was calendar years from index hospital admission to readmission. The time interval was set to 0, 1, 2 or 3 years if the patient had a recurrent hospital stay in the period. A time interval of 0 meant that readmission took place in the same year as the index hospital presentation. Change of status was an event. If the patient was not readmitted in the period, time was computed to the end of the period, and status was censored (i.e., it was set to 0). Stata Survival Analysis and Epidemiological Tables Reference Manual [26] was used as a guideline to create the auxiliary variables needed to run the complementary log–log regression model. The crude and adjusted hospital readmission rates were allowed to vary from year to year over the observation period. Additionally, an offset variable was created to adjust for the fact that, on average, a patient was under risk of readmission only half a calendar year after the index admission because admission could occur at any time during the year. The analyses were carried out in STATA/IC version 13 for Windows.

Table 1

Hospitalization rate (per 100,000 persons per year) for self-poisoning with medications (primary diagnosis) in adolescents aged 10–19 years in Norway 2008–2011.

	Female hospitalization rate (95% CI)	Male hospitalization rate (95% CI)	Total hospitalization rate (95% CI)
Age group			
10–14 years old	20.4 (16.8–24.0)	4.3 (2.7–5.9)	12.1 (10.2–14.1)
15–19 years old	166.5 (156.4–176.7)	49.3 (44.0–54.7)	106.2 (100.6–111.9)
All ages	94.0 (88.6–99.4)	27.0 (24.2–29.9)	59.6 (55.6–62.6)

4. Results

From the year 2008 through 2011, 1497 patients aged 10–19 years were recorded in the Norwegian Patient Register on one or more occasion(s) with a primary diagnosis of self-poisoning with medications. These patients had in total of 2123 hospital admissions for self-poisoning with medications within this time period. There were no statistically significant differences in incident numbers of hospital admissions across the calendar years from 2008 to 2011.

The 1497 adolescents who were admitted to hospital for self-poisoning correspond to an age- and sex-standardized hospitalization rate of 59.6 per 100,000 persons per year (95% CI 55.6–62.6) for the population of this age group in Norway. Age-specific hospitalization rates for the two sexes are presented in Table 1.

Hospitalization rates were significantly higher for females than for males (IRR = 3.5 [95% CI 3.1–3.9]) and higher for 15–19 year olds than for 10–14 year olds (IRR = 8.8 [95% CI 7.4–10.3]).

4.1. Index hospital admissions for self-poisoning with medications

As presented in Table 2, about one third of the adolescents received a secondary psychiatric diagnosis at their initial hospitalization for self-poisoning, and 44.2% received an E-code for intentional self-harm. Nearly 3/4 (71.1%) of the adolescents were hospitalized for at least 1 day, and 26.3% were discharged to further treatment.

Table 3 shows clinical characteristics at index hospital admission for self-poisoning in adolescent females versus males. Females were more likely to receive an E-code for intentional self-harm at their first hospital admission. However, in 51.2% of the females and in 63.5% of the males an E-code for intentionality was not recorded, leaving the external cause unknown to the study. Affective disorders (F30–39) were more common among females, while males were more likely than females to receive diagnoses of mental and behavioral disorders due to psychoactive substance abuse (F10–19) or diagnoses of behavioral and emotional disorders with onset usually occurring during childhood and adolescence (F90–99). Males were more often discharged on the same day that they presented to the hospital for self-poisoning, and they were more likely to be discharged to their homes rather than to be discharged to further treatment.

In the two age groups, similar proportions received an E-code for intentional self-harm at their first hospitalization for self-poisoning: 42.5% of the 10–14 year olds and 44.4% of the 15–19 year olds. Only 15.7% of the 10–14 year olds received a secondary psychiatric diagnosis, while 36.0% of the 15–19 year olds did [$\chi^2(1, N=1497)=25.3, P<.001$].

Table 2

Characteristics of index hospital admissions with a primary diagnosis of self-poisoning with medications in adolescents aged 10–19 years, 2008–2011, *n* (%).

	2008 (<i>n</i> =428)	2009 (<i>n</i> =341)	2010 (<i>n</i> =325)	2011 (<i>n</i> =403)	2008–2011 Total (<i>N</i> =1497)
Sex					
Male	88 (20.6)	96 (28.2)	71 (21.8)	98 (24.3)	353 (23.6)
Female	340 (79.4)	245 (71.8)	254 (78.2)	305 (75.7)	1 144 (76.4)
Age group					
10–14 years old	27 (6.3)	24 (7.0)	46 (14.2)	56 (13.9)	153 (10.2)
15–19 years old	401 (93.7)	317 (93.0)	279 (85.8)	347 (86.1)	1 344 (89.8)
Psychiatric disorders					
No psychiatric diagnoses	298 (69.6)	213 (62.5)	213 (65.5)	265 (65.8)	989 (66.1)
Any psychiatric diagnosis	130 (30.4)	128 (37.5)	112 (34.5)	138 (34.2)	508 (33.9)
E-code					
No E-code for intentionality	232 (54.2)	202 (59.2)	171 (52.6)	205 (50.9)	810 (54.1)
Accidental	4 (0.9)	5 (1.5)	7 (2.2)	9 (2.2)	25 (1.7)
Intentional self-harm	192 (44.9)	134 (39.3)	147 (45.2)	189 (46.9)	662 (44.2)
Length of hospital stay					
0 day	131 (30.6)	90 (26.4)	103 (31.7)	109 (27.0)	433 (28.9)
≥1 day	297 (69.4)	251 (73.6)	222 (68.3)	294 (73.0)	1064 (71.1)
Place of discharge					
To home	321 (75.0)	251 (73.6)	228 (70.2)	303 (75.2)	1 103 (73.7)
To treatment	107 (25.0)	90 (26.4)	97 (29.8)	100 (24.8)	394 (26.3)

Table 3

Differences between sexes in characteristics at index hospital admission for self-poisoning with medications in adolescents aged 10–19 years, *n* (%).

	Total (<i>N</i> =1497)	Females (<i>n</i> =1144)	Males (<i>n</i> =353)	<i>P</i>
Age group				.104
10–14 years old	153 (10.2)	125 (10.9)	28 (7.9)	
15–19 years old	1 344 (89.8)	1 019 (89.1)	325 (92.1)	
E-code				<.001
No E-code for intentionality	810 (54.1)	586 (51.2)	224 (63.5)	
Accidental	25 (1.7)	15 (1.3)	10 (2.8)	
Intentional self-harm	662 (44.2)	543 (47.5)	119 (33.7)	
Psychiatric disorders				.93
No record on psychiatric diagnoses	989 (66.1)	757 (66.2)	232 (65.7)	
Any psychiatric diagnosis	508 (33.9)	387 (33.8)	121 (34.3)	
Auxiliary psychiatric diagnoses				<.001
F10–19 (due to psychoactive substance use)	109 (7.3)	67 (5.9)	42 (11.9)	
F30–39 (affective disorders)	244 (16.3)	203 (17.7)	41 (11.6)	
F40–49 (anxiety and phobia)	44 (2.9)	34 (3.0)	10 (2.8)	
F50–59 (behavioral disorders)	22 (1.5)	22 (1.9)	0	
F60–69 (personality disorders)	27 (1.8)	24 (2.1)	3 (0.8)	
F90–99 (behavioral and emotional disorders)	42 (2.8)	24 (2.1)	18 (5.1)	
Others	20 (1.3)	13 (1.1)	7 (2.0)	
Length of hospital stay				<.001
0 day	433 (28.9)	299 (26.1)	134 (38.0)	
≥1 day	1 064 (71.1)	845 (73.9)	219 (62.0)	
Place of discharge				.023
To home	1 103 (73.7)	826 (72.2)	277 (78.5)	
To treatment	394 (26.3)	318 (27.8)	76 (21.5)	

4.2. Hospital readmission for self-poisoning with medications

Nearly one fifth (18.4%, *n*=276) of the adolescents were readmitted to hospital for subsequent self-poisoning between 2008 and 2011. Eleven percent were readmitted once, 5.7% were readmitted two to four times, and 2.0% were readmitted more than five times.

Cumulative percentages of readmission to hospital for self-poisoning, for males and females whose follow-up extended up to 4 calendar years, are shown in Fig. 1. Almost eight percent (7.7%) of the females and 5.1% of the males were only readmitted within the same calendar year as their initial hospital admission. In 6.8% of the females and 1.4% of the males, rehospitalization(s) for self-poisoning occurred in the first calendar after their index hospital admission. Of the females who had their index hospital admission in 2008 (*n*=340), 31 (9.1%) were readmitted for self-poisoning(s) in the third calendar

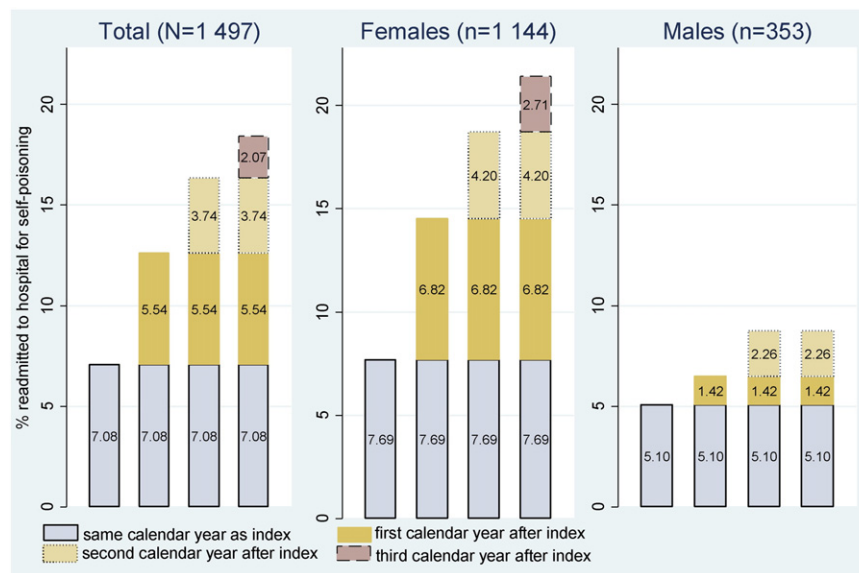


Fig. 1. Cumulative percentages of adolescents aged 10–19 years who were readmitted to hospital for self-poisoning.

year after their index admission, constituting 2.7% of the total female study population.

Table 4 presents factors associated with hospital readmissions for self-poisoning with medications as unadjusted and adjusted HRs. In bivariate and multivariate analyses, female sex, discharge to further treatment and secondary psychiatric diagnoses of anxiety and phobic disorders [F40–49], personality disorders [F60–69], and behavioral

disorders [F90–99] were significant predictors for hospital readmission for self-poisoning.

5. Discussion

To our knowledge, this is the first study that uses data covering an entire national population to examine both hospital admissions and

Table 4

Factors effect on hospital readmission for self-poisoning in adolescents aged 10–19 years using discrete-time complementary log–log regressions (N=1497), n (%) HR (95% CI).

	Readmission n=276 (18.4)	Unadjusted HR	Adjusted HR ^a	Adjusted HR ^b
Sex				
Male	31 (8.9)	Ref.	Ref.	Ref.
Female	245 (21.4)	2.6 (1.8–3.8)**	2.5 (1.7–3.7)**	2.4 (1.7–3.6)**
Age group				
10–14 years old	23 (15.0)	Ref.	Ref.	Ref.
15–19 years old	253 (18.8)	1.1 (0.7–1.7)	1.0 (0.6–1.5)	1.0 (0.6–1.5)
E-code				
No E-code for intentionality	133 (16.4)	Ref.	Ref.	Ref.
Accidental	2 (8.0)	0.5 (0.1–2.0)	0.7 (0.2–2.8)	0.7 (0.2–3.0)
Intentional self-harm	141 (21.3)	1.4 (1.1–1.7)*	1.1 (0.9–1.4)	1.1 (0.9–1.4)
Psychiatric disorder				
No record on secondary psychiatric diagnoses	153 (15.5)	Ref.	Ref.	Ref.
Any psychiatric diagnoses	123 (24.1)	1.7 (1.3–2.1)**	1.5 (1.2–1.9)**	
Secondary psychiatric diagnoses				
No record on secondary psychiatric diagnoses	153 (15.5)	Ref.		Ref.
F10–19 (due to psychoactive substance use)	18 (16.5)	1.1 (0.7–1.8)		1.1 (0.7–1.8)
F30–39 (affective disorders)	55 (22.5)	1.6 (1.2–2.2)*		1.3 (1.0–1.8)
F40–49 (anxiety and phobic disorders)	14 (31.8)	2.3 (1.4–4.0)*		2.4 (1.4–4.1)**
F50–59 (behavioral disorders)	8 (36.4)	2.8 (1.3–5.7)*		2.3 (1.1–4.7)*
F60–69 (personality disorders)	13 (48.2)	3.9 (2.2–6.8)**		2.5 (1.4–4.4)*
F90–99 (behavioral and emotional disorders)	11 (26.2)	1.7 (0.9–3.2)		2.0 (1.1–3.6)*
Other	4 (20.0)	1.3 (0.5–3.5)		1.0 (0.4–2.8)
Length of hospital stay				
0 day	72 (16.6)	Ref.	Ref.	Ref.
≥1 day	204 (19.2)	1.2 (0.9–1.6)	1.0 (0.8–1.3)	1.0 (0.8–1.3)
Place of discharge				
To home	152 (13.8)	Ref.		Ref.
To treatment	124 (31.5)	2.6 (2.0–3.3)**	2.3 (1.8–2.9)**	2.3 (1.8–2.9)**

^a Variables entered into the model: sex, E-code, psychiatric disorder, length of hospital stay, place of discharge, readmission in the same; first, second and third calendar year as index admission.

^b Variables entered into the model: sex, E-code, diagnoses of psychiatric disorders, length of hospital stay, place of discharge, readmission in the same; first, second and third calendar year as index admission.

* $P < .05$.

** $P < .001$.

readmissions for self-poisoning with medications in adolescents aged 10–19 years. The main findings of the study were that females were more likely than males to be hospitalized and rehospitalized for self-poisoning with medications. In the total sample, the proportion who was rehospitalized for self-poisoning(s) was high: 18.4%. In addition to risk of readmission being related to female sex, multivariate analyses showed it was also associated with psychiatric diagnoses.

Our reported hospitalization rates are somewhat lower than the estimates of adolescent self-poisonings from other countries, e.g., the United States, for both sexes [1]. This was to be expected since our study only included adolescents with a *primary* diagnosis of self-poisoning and hence did not allow for the contribution of self-poisoning listed as secondary diagnoses. However, the age and sex distribution of the adolescents treated in hospital for self-poisoning in our study was consistent with US data [1] and findings from regions in Australia [4] and the United Kingdom [11]. Comparisons of hospital readmission rates between studies are difficult because of differences in inclusion criteria and follow-up time. Studies based on local hospital registrations of adolescent self-poisoning in Australia and the United Kingdom found patient-based readmission rates of 10%–12% within 4–5 years after the index hospital admission [9,11]. In these two studies, no significant difference between the sexes in readmission was found, in contrast to our investigation. A study from the Oxford region of adolescent self-poisoning defined as deliberate self-harm found that 20% repeated overdose within 1 year [15]. In this region, research found a marked increase in repetition rates among female adolescents who presented to hospital following deliberate self-poisoning or self-injury during the 1990s [6]. National legislation and local prescription regimens may cause different availability to the medications that adolescents mostly used for overdoses. For example, after legislation introduced in the United Kingdom in 1998 to reduce the pack size of paracetamol sold over the counter, the use of paracetamol decreased and the size of overdoses was reduced [27]. Research found differences between nations in hospital-treated medication overdoses of undetermined [28] and suicidal [29] intent. In adolescents, service use after overdoses identified as deliberate self-harm seems to differ between regions [30], which may be linked to differences in service provision. Such observations indicate that comparison of studies of hospital readmission rates from different decades and regions is limited. International comparative studies based on ICD diagnoses of adolescents towards 10 years of age are required to compare risk of hospital readmission in different countries and time span.

In our study, females outnumbered males in hospital admission and readmission rates for self-poisoning and in cases with an E-code for intentional self-harm. In comparison, more females were hospitalized for self-poisoning with medications in the Oxford hospital region [11] and in the United States [1]; this gender difference was also found for self-poisoning with suicidal intent [1]. Rhodes et al. (2008) found that adolescent females were more likely to receive a code for intentional self-harm than their male peers when they came to a hospital in Ontario, Canada, after overdose [3]. Such findings may reflect a true difference between the sexes in the rate and intention for self-poisoning, a difference in the extent to which males and females are hospitalized after self-poisoning or a combination of these two sources of variation. Although our data cannot shed light on this, there seems to be some support for both explanations from previous studies. Adolescent females might be more inclined to overdosing by medications than adolescent males because they use prescribed drugs and over-the-counter analgesics more frequently [31]. According to some studies, females seem more often than males to resort to intentional self-harm as a way to deal with emotional pain or relational problems [6,32]. Females seem further to have a lower threshold for seeking health care services after intentional self-harm, possibly because they are more likely to perceive treatment as needed and potentially beneficial [33]. Gender differences in other psychosocial factors such as negative cognitions [34], social support [35,36]

and self-concept [33,37] might further explain some of the observed differences in rehospitalization rates between the sexes. The current study does not, however, have the data to consider such suggestions. Our study found significant sex differences in secondary psychiatric diagnoses and also found that females stayed longer in hospital and were more often discharged to further treatment than the males. Previous studies found that females are more likely to be psychiatrically hospitalized following self-poisoning [3] and deliberate self-poisoning [38] than their male peers. Probability of admission to a medical unit after self-poisoning was increased in those with current and previous intentional self-poisoning [39]. A question for further study which is clearly important for service provision and prevention is whether or not our findings of sex-differences in secondary psychiatric diagnoses and hospital management of adolescents who overdosed by medications are a reflection of true differences between the sexes in medical or psychiatric severity.

In an Australian cohort study of adolescent self-poisoning, personality disorders and nonaffective psychoses were associated with increased risk of repetition [9]. In our study, psychiatric secondary diagnoses of anxiety and phobic disorders (F40–49), personality disorders (F60–69) and behavioral disorders (F90–99) predicted self-poisoning. Compared with depression which usually remits spontaneously within a few weeks [40], these psychiatric conditions might represent a higher risk of repeated self-poisoning because they tend to be long-standing and associated with severe to extreme levels of psychosocial distress and loss of control. In studies of adolescents who use self-poisoning as a method for intentional self-harm, depression has, however, previously been identified as a key factor associated with repetition [15,16]. The current study included also cases of self-poisoning that was not defined as intentional self-harm and used a rather crude measure of depression, which could possibly explain why this disorder did not independently predict hospital readmission in multivariate analyses.

In multivariate models, the current study did not demonstrate significant difference in hospital readmission between those who were registered with an E-code for intentional self-harm and those who did not receive such an E-code. This might be due to a lack of statistical power or may suggest that, in adolescent overdoses, the lack of an E-code for intentional self-harm does not necessarily indicate different motivation or a different pattern of self-poisoning behavior than in those cases categorized as intentional self-harm. Previous research suggests that nearly all teenage cases coded as self-poisoning in the ICD-10 system are actually episodes of intentional self-harm regardless of whether or not the E-code for intentional self-harm is present [41].

Our study found significantly higher readmission rates among those who were discharged to further treatment compared to those who were discharged to their homes. It is uncertain whether or not referral for specialist follow-up might reduce repetition in adolescents who deliberately poison themselves [38,42]. More research is required to assess hospital readmission rates in self-poisoning adolescents who receive further treatment or follow-up in different kinds of health care institutions.

5.1. Strengths and limitations

The main strength of the study is the use of national routine hospital registers which enabled us to construct profiles of hospital admissions and readmissions in a population covering the entire national residents. In Norway, all citizens are covered by a publicly funded universal health care system, which makes it most likely that all discovered self-poisonings present to hospital for acute treatment. The well-defined inclusion criteria based on ICD-10 diagnoses and the fact that the diagnoses were made by highly qualified clinical doctors further strengthened the ecological validation of the findings. However, some important limitations of the study need to be considered. First, no information about the

sensitivity and specificity of the diagnostic coding system was available. We included patients with a principal diagnosis of acute self-poisoning, potentially leading to an underestimation of the contribution of self-poisoning listed as secondary diagnoses. On the other hand, our main aim was to study self-poisoning and the repetition of this condition. Inclusion of patients with other main conditions resulting from self-poisoning, such as respiratory or cardiac distress, might have introduced bias because most of these patients would have their clinical course affected by their primary medical condition. In our study, we used a generic diagnostic code for self-poisoning by medication which covered a range of different substances. Regional studies from the United Kingdom and Canada comprising self-poisoned patients of all ages found sex differences in the proportions of males and females using specific medications for self-poisoning [43,3]. Rafnsson et al. (2007) found that, in patients admitted for overdose by medications in Edinburgh, the type of medication taken at the first admission influenced readmission risk [44]. Information about which medications the adolescents took could provide insight into the sex differentials we found in our study, but such information was unfortunately not available for the present study. For reasons of patient anonymity, the study lacked information on detailed codes of comorbid psychiatric disorders and the exact dates of hospital admissions. Although admissions that occurred within the same day or the day after the previous hospital admission were excluded, we cannot rule out the possibility that a small number of patients who were transferred between hospital departments were counted as repeaters. An unknown number of patients could have visited hospital for self-poisoning before 2008 or repeated self-poisoning after our observation period. Individuals who died or moved out of the country were lost to follow-up. Our figures covered a variable follow-up period of 1 day to 4 calendar years and undoubtedly underestimate the number of readmissions that would have occurred during a full 4-year follow-up. This study does not generalize to those adolescents who do not present to hospital after self-poisoning [30].

5.2. Clinical and research implications

Clinicians need to be aware that adolescents who are hospitalized for acute self-poisoning with medications are at high risk of repeated self-poisoning. This study found the highest risk of hospital readmission to be in those with psychiatric disorders, which calls for close follow-up treatment in this group of young people. At the same time, we observed that a large portion of self-poisoning repeaters did not receive a diagnosis of psychiatric disorder at their first hospital admission. This indicates the need for careful assessment of psychiatric symptoms and signs as part of a full psychosocial assessment of adolescents admitted to hospital for self-poisoning [45] as soon as possible given their medical status. Psychiatric/psychosocial assessment per se might be beneficial in reducing the risk of repetition [46] and might improve referrals to further treatment. Based on a review of intervention studies targeting adolescent self-harm, Brent et al. (2013) recommend treatment to be initiated before hospital discharge and that motivational interviewing and treatment that target suicidal risk be given priority in this early stage [47]. To limit the availability of means to self-poisoning has been a key strategy in preventing suicidal behavior [48]. Research suggests that adolescents' access to medications is associated with the type of drugs they choose and how many pills they take [49,27]. Adolescent self-poisoning with medications often involves tablets readily available in households or sold over the counter [3,5,6]. Controlling the availability of medications by educating patients and their parents on the importance of having medications locked up or under control might reduce the danger of subsequent overdoses from household supplies. In those adolescents who are on prescribed medications, the prescriptions must be carefully monitored. Clinical trials that aimed to prevent the repetition of adolescent self-harm have been hampered by small sample sizes and less optimized test conditions. So far, it seems that dialectical behavioral therapy [50,51] and mentalization-based treatment [52] have the

strongest research support for their efficacy. Studies based on ICD-10 diagnoses should be conducted periodically every few years in different geographic locations to monitor possible regional differences and time changes in the pattern of hospital-treated self-poisonings. Hospital registrations could be linked to national databases including socioeconomic factors. Clinical studies measuring psychosocial factors, medical severity, specific medications ingested and follow-up treatment could provide insight into the mechanisms behind the sex differentials found in the current study.

6. Conclusion

This nationwide study found that the majority of adolescents treated in hospital for self-poisoning were females aged 15–19 years. Significant sex differences were found in the proportions of cases coded as intentional self-harm, diagnoses of psychiatric disorders, hospital management and readmission for self-poisoning. Psychiatric disorders were associated with an elevated risk of hospital readmission which indicates that those adolescents who are admitted to hospital for acute self-poisoning need psychiatric/psychosocial assessment. National comparative studies are required to monitor the scope and pattern of adolescent self-poisoning. Improved coding of external causes is required for monitoring and research purposes and to ensure targeted treatment to those adolescents who intentionally self-harm by overdosing.

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