



# Incidence Rates of Deliberate Self-Harm in Denmark 1994–2011

## A Nationwide Register Study

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**Abstract:** *Background:* The validity and reliability of suicide statistics have been questioned and few nationwide studies of deliberate self-harm have been presented. *Aim:* To calculate rates of deliberate self-harm in Denmark in order to investigate trends and assess the reliability of hospital records. *Method:* A register study based on all individuals recorded with an episode of deliberate self-harm or probable deliberate self-harm in nationwide registers during 1994–2011. *Results:* A substantial difference in the rates of deliberate self-harm and probable deliberate self-harm was noted for both genders. The average incidence rate of deliberate self-harm for women and men was 130.7 (95% CI = 129.6–131.8) per 100,000 and 86.9 (95% CI = 86.0–87.8) per 100,000, respectively. The rates of deliberate self-harm for women increased from 137.6 (95% CI = 132.9–142.3) per 100,000 in 1994 to 152.7 (95% CI = 147.8–157.5) in 2011. For a subgroup of younger women aged 15–24 years, an almost threefold increase was observed, IRR = 2.5 (95% CI = 2.4–2.7). The most frequently used method was self-poisoning. *Conclusion:* The rates of deliberate self-harm and probable deliberate self-harm differed significantly. An increased incidence of deliberate self-harm among young Danish women was observed, despite detection bias. An improved registration procedure of suicidal behavior is needed.

**Keywords:** deliberate self-harm, suicidal behavior, incidence rates, hospital records, nationwide

Member countries of the World Health Organization (WHO) have agreed that surveillance on numbers of suicide and suicide attempt should be a top priority among suicide preventive initiatives (Saxena & Setoya, 2014; WHO, 2014).

Although more studies have been conducted within suicidology over recent decades, the validity and reliability of statistics have been questioned and detection bias is commonly suggested (Bertolote & Fleischmann, 2005; Gray et al., 2014; Kapusta, Tran, & Rockett, 2011; Tollefsen, Hem, & Ekeberg, 2012). In order to avoid underreporting, registration of both fatal and nonfatal suicidal outcomes should be standardized within individual countries and between countries (Data and Surveillance Task Force of the National Action Alliance for Suicide & Prevention, 2014; De Leo et al., 2013; Kapusta et al., 2011).

Despite general uncertainty in international estimates, the prevalence of suicide attempts has been reported to increase in some countries (Christiansen, Larsen, Agerbo, Bilenberg, & Stenager, 2013; Nock et al., 2008; Perry et al., 2012; Ting, Sullivan, Boudreaux, Miller, & Camargo, 2012). Large national and cross-national studies have reported variation in rates according to gender, age, and

method (Christiansen et al., 2013; Nock et al., 2008; Perry et al., 2012). Few studies have attempted to calculate the rates of hospital-treated deliberate self-harm on a national level (Christiansen et al., 2013; Perry et al., 2012). A Finnish study based on national hospitals discharge records found an incidence rate (IR) of first episode of suicide attempt of 44 per 100,000 for both genders during 1996–2003 (Haukka, Suominen, Partonen, & Lonnqvist, 2008). Reports from the US noted an increase over time in rates of contacts by poisoning, hence a proxy of attempted suicide (Spiller, Appana, & Brock, 2010).

Previous studies of attempted suicide have been based on selected localities, such as one or more hospitals, a specific city, or province (Christiansen et al., 2013; Haukka et al., 2008). Other studies have estimated rates of suicide attempt based on local or regional data obtained from emergency rooms and local hospital discharge records (Bergen, Hawton, Waters, Cooper, & Kapur, 2010) or databases, with varying validity (Bossuyt & Van Casteren, 2007; Saberi-Zafaghani, Hajebi, Eskandarieh, & Ahmadzad-Asl, 2012). Still, measurement of national IRs is important; both in order to observe the development of suicidal behavior as an indicator of public health, but also in order to

survey recording procedures as part of an on-going registration (De Leo et al., 2013).

Suicide attempt is a significant risk factor for subsequent suicidal behavior but also linked to poor psychosocial outcome in general (Carroll, Metcalfe, & Gunnell, 2014; Goldman-Mellor, Caspi, & Harrington, 2014) and it represents a costly imbalance for both the individual and society. Thus, accurate rates are needed to target suicide prevention strategies on various levels.

The aim of this study was to examine rates and trends in deliberate self-harm based on nationwide registers in Denmark in the period 1994 to 2011.

## Method

Individual-level register data on the entire population living in Denmark from January 1, 1994, through December 31, 2011, were obtained. Each individual in Denmark has a unique, personal identification (ID) number, which is assigned upon birth or migration into the country. Data from various administrative registries can be linked for each individual using this ID number. Somatic and psychiatric hospital contacts in Denmark are reported to the National Registry of Patients and the Psychiatric Central Research Registry including information on date of admission and discharge, diagnosis, reason for contact (e.g., suicide attempt or accident; Lynge, Sandegaard, & Rebolj, 2011; Mors, Perto, & Mortensen, 2011). Diagnoses were recorded according to the 10th revision of WHO International Classification of Diseases (ICD). From 1995 onward the hospital registers also cover contacts to emergency department and outpatient facilities.

## Nomenclature

The nomenclature of suicidal behavior is a controversy among experts and relates significantly to an aspect of definition (Silverman, Berman, Sanddal, O'Carroll, & Joiner, 2007). The terminology applied in this paper is *deliberate self-harm* and it matches the definition of suicide attempt according to WHO defined as (Platt et al. 1992):

An act with a non-fatal outcome, in which an individual deliberately initiates a non-habitual behavior that without intervention from others will cause self-harm, or deliberately ingests a substance in excess of the prescribed or generally recognized therapeutic dosage, and which is aimed at realizing changes which the subject desired via the actual or expected physical consequences (p. 99)

Although this definition is widely accepted, it does not address degree of intention adequately (Platt et al., 1992; Silverman et al., 2007).

## Measures of Deliberate Self-Harm

Persons were considered as having had an episode of deliberate self-harm when this had been recorded as the main or subdiagnosis, ICD-10: X60–X84, or where the reason for contact was listed as being deliberate self-harm. Data on contacts were included from both the Psychiatric Research Register and the National Patient Register.

It is well established that deliberate self-harm episodes are under-recorded in Danish hospital registries (Helweg-Larsen, 2006; Nordentoft, 2007). Thus, an operational definition of probable deliberate self-harm was included. This category covered self-harm regardless of intent, for example, poisoning by drugs, biological and nonmedical substances as well as lesions on the hand and forearm. In addition, the following combinations of ICD diagnoses were included: a main diagnosis of a mental disorder, ICD-10: F00–F99, representing organic, psychotic, affective, anxiety, eating, and personality disorders, mental retardation, autism, and behavioral disorders together with one of the following subdiagnoses: S51, S55, S59, S61, S65, S69 (cutting by sharp objects), T36–T50 (poisoning by pharmaceuticals), T52–T60 (poisoning by non-pharmaceuticals) as well as all admissions with a main diagnosis of T39, T40 (poisoning by mild analgesics; except T40.1), T42, T43, and T58 (poisoning by opioids, psychotropics, and by carbon monoxide). While this definition captures more deliberate self-harm it also includes accidents; as many as 30% of cases might not be intentional episodes of deliberate self-harm (Helweg-Larsen, 2006). However, the same definition has been applied previously (Madsen, Agerbo, Mortensen, & Nordentoft, 2013). The guideline for registration in emergency settings is the T39 code in addition to contact code four (deliberate self-harm) given by the Danish health-care authorities (Statens Serum Institut, 2014).

We assessed for double recordings, for example, when the same persons had been registered with an episode of deliberate self-harm twice during the same hospital admission, for instance, in relation to transfers between different units. However, this implies that if a person who was admitted for an episode of deliberate self-harm had another self-harm episode while in admission, this was not considered. Persons who died by suicide during a hospitalization following an episode of deliberate self-harm were considered as suicides and not as episodes of deliberate self-harm.

We distinguished between the following methods of deliberate self-harm: poisonings (T36–T65, X60–69), hanging (X70), drowning (X71), firearms (X72–X74), explosives, fire and burning (X75–X77), sharp objects (S50–S69, X78–79), jumping from high places (X80), moving object (X81–X82), and other methods (X83–X84). S and T diag-

noses refer to cases where episodes of deliberate self-harm were identified through the reason to contact variable, stating suicide attempt. If multiple methods were used, the method was determined based on the main diagnosis.

## Population Investigated

For the analysis, the entire population aged 10 years and older living in Denmark was observed from January 1, 1994, through December 31, 2011. We applied a cohort design where people migrating in or out of the country were included or excluded on the date of the respective event. Likewise, persons dying were censored on the date of death. During preliminary analysis a minor peak in episodes of deliberate self-harm among infants, toddlers, and young children was noted. We considered this finding as indicative of accidents rather than deliberate self-harm (Alander, Dowd, Bratton, & Kearns, 2000). In order, to ensure a certain level of maturity we thus decided to examine deliberate self-harm in persons aged 10 years or older.

## Calculations

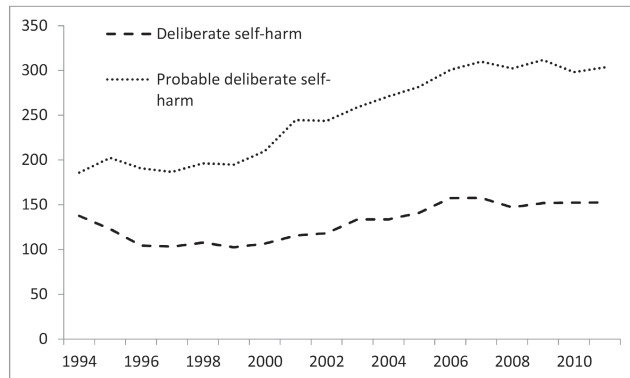
Rates of deliberate self-harm were calculated by single calendar year and age increments for men and women. For each age group and gender, the number of events was divided by the population at risk. The exact numbers of person-days spent by each person in the general population in the same age group and gender strata were presented as person-years. Rates were calculated per 100,000 person-years and with 95% confidence intervals. The IR was defined as any episode of deliberate self-harm recorded, that is, several episodes could be recorded for the same individual. Trends in rates were calculated as incidence rates ratios (IRR).

## Ethical Considerations

Although personal ID numbers were linked to register data, no information was personally identifiable for researchers. Approval from the Danish Protection Agency was obtained. Further ethical approval was not needed.

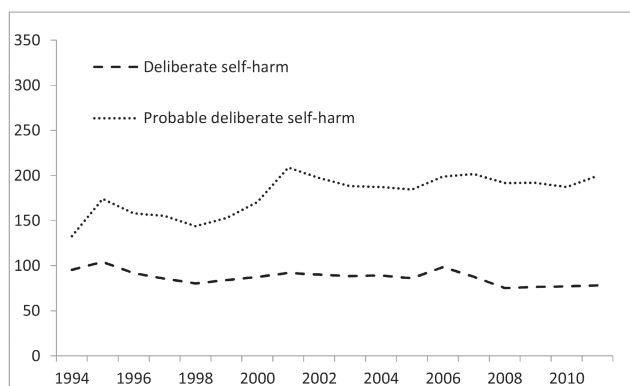
### Women

Incidence rate per 100,000



### Men

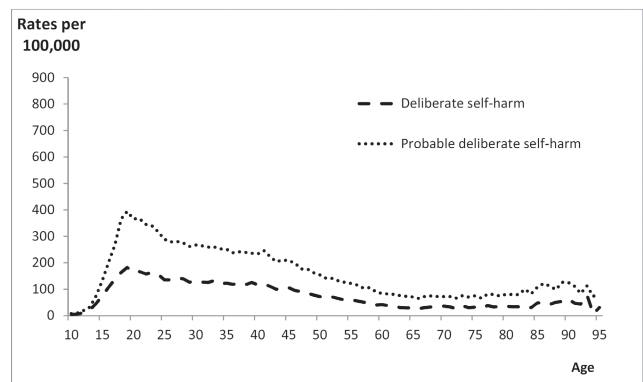
Incidence rate per 100,000



**Figure 1.** Incidence rates by calendar year of registered episodes of deliberate self-harm and probable deliberate self-harm for women and men aged 10+ living in Denmark during 1994–2011.

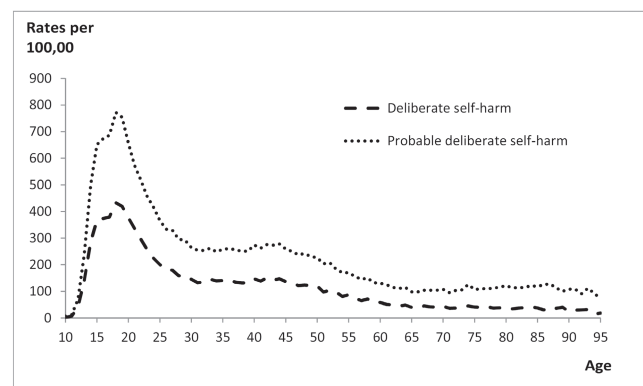
### Women

Incidence rate per 100,000

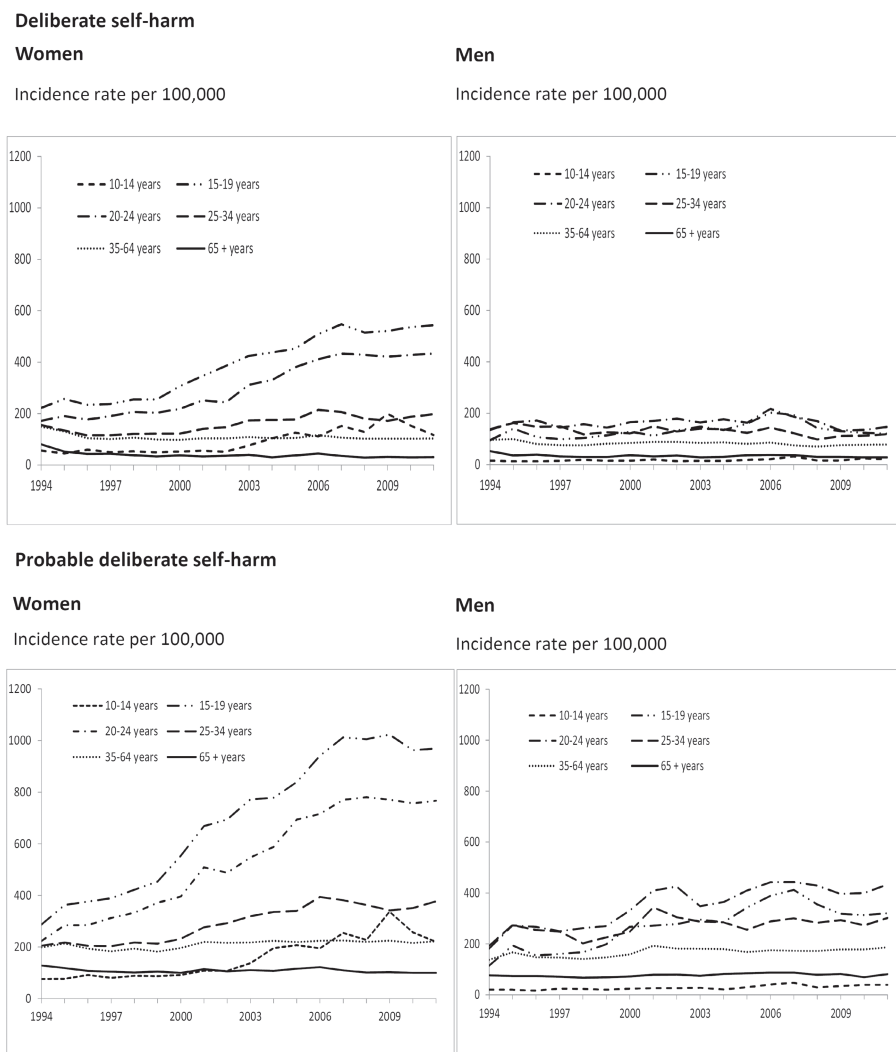


### Men

Incidence rate per 100,000



**Figure 2.** Incidence rates by age of registered episodes of deliberate self-harm and probable deliberate self-harm for women and men aged 10+ living in Denmark during 1994–2011.



**Figure 3.** Incidence rates by age group and calendar year of deliberate self-harm and probable deliberate self-harm for women living in Denmark during 1994–2011.

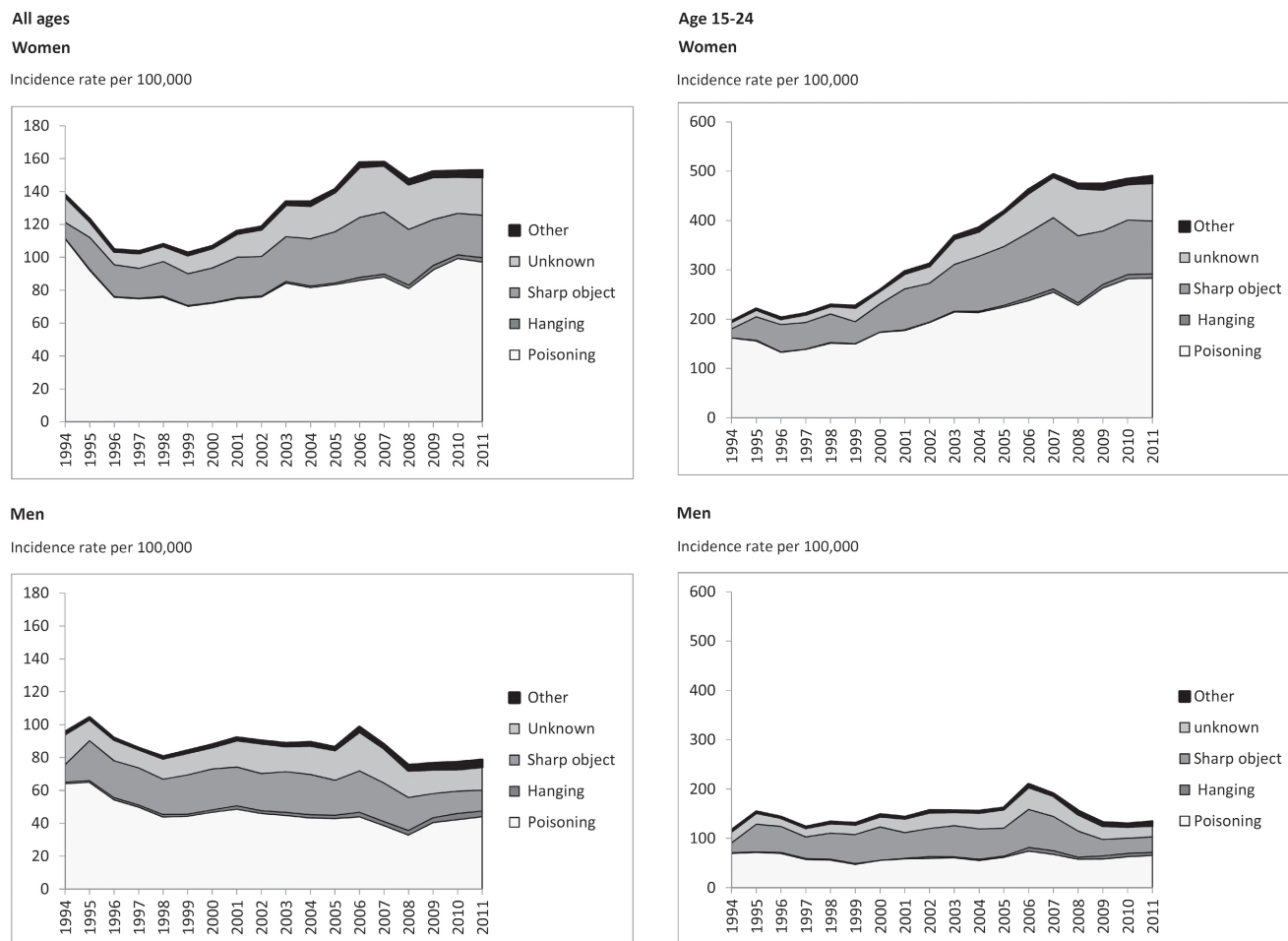
## Results

In total, 56,995 episodes of deliberate self-harm among women were identified over the observed 43,603,346 person-years in the period from 1994 to 2011. The mean age was 33.9 years (*SD* = 16.7, range = 10–101, *median* = 30). For men, 36,847 episodes of deliberate self-harm with a mean age of 36.8 years (*SD* = 15.5, range 10–101, *median* = 35) were recorded during 42,385,189 person-years. Mean number of episodes of deliberate self-harm by the same individual per calendar year was 1.3 for women (range = 1–45) and 1.2 (range = 1–24) for men.

During 1994–2011, the average IR of deliberate self-harm was 130.7 (95% CI = 129.6–131.8) per 100,000 for women, whereas the rate for probable deliberate self-harm was 250.5 (95% CI = 249.0–252.0). The average IR for men was 86.9 per 100,000 (95% CI = 86.0–87.8) and 179.5 (95% CI = 178.2–180.8) for deliberate self-harm and probable deliberate self-harm, respectively (Figure 1).

## Trend Over Time

A substantial difference in the IRs for deliberate self-harm and probable deliberate self-harm was noted for both men and women (Figure 1). Furthermore, a steady increase in the IR of women was noted over time; rates of deliberate self-harm increased from 137.6 (95% CI = 132.9–142.3) per 100,000 in 1994 to 152.7 (95% CI = 147.8–157.5) in 2011 (Figure 1). The rate of probable deliberate self-harm increased from 186.0 (95% CI = 180.5–191.5) in 1994 to 303.4 per 100,000 (95% CI = 296.6–310.2) in 2011. An opposite trend was noted for men with regard to rates of deliberate self-harm. Their IR actually decreased from 95.3 (95% CI = 91.3–99.4) per 100,000 to 78.3 (95% CI = 74.8–81.8) from 1994 to 2011, while the IR of probable deliberate self-harm opposed this trend by increasing significantly from 132.8 (95% CI = 128.1–137.5) per 100,000 to 199.5 (95% CI = 193.9–205.1).



**Figure 4.** Incidence rates pr. 100.000 by means of deliberately self-harming methods for women and men in all age groups as well as for those aged 15–24 years living in Denmark during 1994–2011\*

Note. Other include drowning, jumping, moving objects, weapon, and unspecified means

## Deliberate Self-Harm by Age

The distribution of deliberate self-harm by single age increments in Figure 2 shows that high rates are found among younger age groups for both genders.

By examining the trend in the IR over time by age groups, an increase in both registered deliberate self-harm and probable deliberate self-harm for women was observed (Figure 3). For young women aged 15–19 years, the IR for deliberate self-harm increased from 221.6 (95% CI = 198.5–244.6) in 1994 to 543.8 (95% CI = 509.2–578.5) per 100,000 in 2011. The IR of probable deliberate self-harm for the same age group increased from 287.1 (95% CI = 260.9–313.3) to 968.9 (95% CI = 922.7–1015.1) per 100,000. Similarly, the IR for women aged 20–24 years increased over the studied period, that is, from 171.9 (95% CI = 152.9–191) to 432.9 (95% CI = 401.5–464.3) per 100,000 while rates of probable deliberate self-harm increased from 223.6 (95% CI = 201.8–245.3) to 766.8 (95% CI = 725–808.6) per 100,000.

The trend for men was also characterized by increasing rates; young men aged 20–24 years had an IR of 134.5 (95% CI = 118–151) in 1994 and 146.6 (95% CI = 128.6–164.5) per 100,000 in 2011. An increasing trend was also noted for rates of probable deliberate self-harming episodes, which rose from 181.4 (95% CI = 162.3–200.6) per 100,000 to 433.4 (402.6–464.2).

## Deliberate Self-Harm Among Adolescents and Young Adults

Data for the age groups of 15–19 and 20–24 years were combined to study the observed increase into more detail; an almost threefold higher rate of deliberate self-harm was observed for young women in 2011, IRR = 2.5 (95% CI = 2.4–2.7),  $p < .001$ , for 2011 measured relative to 1994. For young men, the IRR was 1.1 (95% CI = 1.1–1.2),  $p < .001$ .



## Methods of Deliberate Self-Harm

For the entire sample, the most frequently used method was self-poisoning followed by sharp objects (Figure 4). A similar distribution of methods was observed for adolescents and young adults aged 15–24 years. Seemingly, much of the observed increase in the deliberate self-harm rate was related to poisoning.

## Discussion

Using Danish register data we were able to calculate national rates of deliberate self-harm based on all registered hospital contacts of episodes of deliberate self-harm and probable deliberate self-harm over the period between 1994 and 2011. This is, to our knowledge, one of the few attempts of estimating the national IR for deliberate self-harm.

## Main Findings

An increase in the IR of deliberate self-harm was observed over recent years, especially among young women. This trend was confirmed by being observed both for deliberate self-harm as well as probable deliberate self-harm. Deliberate self-harming episodes are predominantly carried out using self-poisoning; this method is being increasingly used by young women in the age group of 15–24 years. We demonstrated differences in rates between deliberate self-harm and probable deliberate self-harm, hence identifying the risk of detection bias.

Increasing IRs of deliberate self-harm have been noted in other countries using data from both national databases as well as emergency records over the same decades (Spiller et al., 2010; Ting et al., 2012). Nevertheless, conflicting trends have also been reported; an Irish study using nationwide register data detected an initial decrease in rates from 2003 to 2006 and a later increase from 2006 to 2009 (Perry et al., 2012). Also, a Belgian study with two separate follow-up periods and a limited sample identified through general practitioner records did not detect significant changes in age-specific IRs over time (Bossuyt & Van Casteren, 2007). Yet other countries have reported decreasing trends over comparable periods albeit using data from selected hospital records or selected emergency departments (Bergen et al., 2010; Kjartansdottir, Bergmann, Arnadottir, & Bjornsson, 2012).

The increase in the IR over time was particularly marked among adolescents and young women. A similar trend has been reported for other countries albeit with shorter or over

different periods (Corcoran, Keeley, O'Sullivan, & Perry, 2004; Levinson, Haklai, Stein, & Gordon, 2006; Perry et al., 2012). The fact that adolescents and young women account for a majority of deliberate self-harm is well known internationally (Hawton & van Heeringen, 2009). Cross-national and national reports have identified female gender and younger age to be associated with increased risk and rates of deliberate self-harm (Borges et al., 2010; Nock et al., 2008). A recent WHO multicenter study found the highest rates of deliberate self-harm among women aged 20–24 years, an overall female-to-male ratio of 2:1, and that analgesics were the most frequent used method of self-poisoning (Flavio et al., 2013). An increase in deliberate self-harm by drug poisoning of younger age groups has been reported in recent international studies (Haukka et al., 2008; Hawton, Rodham, Evans, & Harriss, 2009; Kjartansdottir et al., 2012; Spiller et al., 2010). This increase has, for instance, motivated a pack size restriction for mild analgesics sold as over-the-counter drugs in pharmacies in several European countries (Gunnell et al., 1997; Hawton et al., 2013). This was implemented in Denmark in 2013 (Danish Ministry of Health, 2013).

We found a difference in rates with respect to deliberate self-harm and probable deliberate self-harm. The under-recording of deliberate self-harm in the Danish registers has been pointed out (Morthorst, Krogh, Erlangsen, Alberdi, & Nordentoft, 2012). In general, data quality is a major concern in suicidal research; the coverage and quality of data vary strongly from country to country (Kapusta et al., 2011). People who get in contact with emergency departments owing to deliberate self-harm actions often require clinical procedures with a life-saving focus rather than uniform administrative surveillance. This may lead to differences in registration and surveillance procedures (De Leo et al., 2013), which often make the registration of deliberate self-harm without additional coding of intent less reliable than, for instance, completed suicide (Tollefsen et al., 2012).

## Limitations and Strengths

The Danish register data are collected for administrative purposes, not research. Although the Danish National Board of Health encourages a standardized and consistent registration of deliberate self-harm (Statens Serum Institut, 2014), a substantial under-recording is taking place. By including the category of probable deliberate self-harm, we identify more episodes of deliberate self-harm at the expense of measure validity; likely cases of unintentional self-harm are also present in this group, which as stated may add up to as much as 30% of misclassified cases of deliberate self-harm (Helweg-Larsen, 2006), hence implying a risk of

overestimation. Both options include the risk of detection bias; however, underestimation is thought to be most prominent (Nordentoft & Sogaard, 2005) and this definition of probable deliberate self-harm has been implied in previous studies (Erlangsen et al., 2014; Madsen et al., 2013).

People seeking hospital care after an episode of deliberate self-harm are a subgroup of all people with deliberate self-harm. Some people might seek medical advice from their general practitioner after an episode of deliberate self-harm while yet others might for various reasons not seek any health care at all (Bertolote & Fleischmann, 2009; Hawton et al., 2009). Hence the persons examined in this study may not be representative of all persons who deliberately self-harm at the risk of affecting the external validity.

The current study examined deliberate self-harms in persons aged 10 years or older. Suicidal behavior does occur, albeit seldom, in young children (Goldman-Mellor et al., 2014; Pelkonen & Marttunen, 2003). Age 10 was used as cutoff in order to ensure a certain level of maturity while allowing us to examine the prevalence of self-harm among very young individuals. However, the data did not allow us to distinguish between records of accidental self-injuries and suicidal behavior with sufficient certainty in younger children, unless of course there was a registration of contact code two for accidents, in which case the contact was not included in the calculations.

One of the main strengths of the study is that the Danish nationwide registers provide us with a unique opportunity to survey epidemiological trends on an entire population level (Lynge et al., 2011; Mors et al., 2011). The possibility to merge data on an individual level owing to personal ID numbers makes analyses even more accurate and sophisticated by having access to multiples registers. In general, the reported confidence intervals were narrow, which indicates less uncertainty in the estimates.

The trends observed in this study were reflected in both examined outcomes, which add strength to the validity of the finding. Furthermore, the increasing trend over time observed for women aged 15–24 years seems valid given that no change was observed for other age groups; we have no reason to assume misreporting over time for a specific age group.

## Clinical Implications

The WHO has encouraged accurate registration and surveillance (Saxena & Setoya, 2014; WHO, 2014) and we have shown that there still remains an evitable challenge to registration procedures even in a Western country with straightforward administrative policies. The Comprehensive Mental Health Action Plan 2013–2020 along the WHO stresses the need for targeted suicide preventions

addressing trends suicidal behavior. In Denmark, these findings evoke concern. Subsequent interventions aiming to reduce deliberate self-harm should focus on younger age groups and take action by addressing the female gender. Previous studies have shown that pack size restriction on mild analgesics is effective in reducing self-harm (Hawton et al., 2013), and in 2013 this measure was implemented in Denmark. Moreover, therapeutic interventions and access to health care such as treatment offered in Centers of Excellence in Suicide Prevention in Denmark must still be provided and developed (Erlangsen et al., 2014).

## Conclusion

In sum, the increasing trend in the rate of deliberate self-harm, particularly among adolescents and young women, is demonstrated. This high-risk group needs to be factored in suicide prevention strategies as both pre- and postvention. Although evidence has been provided for intensive psychotherapy in young age groups presenting with self-harm, we may also have to focus on nationwide screening initiatives or surveillance of young people with failure to thrive in order to prevent engagement in suicidal behavior. Regarding the validity of data, the difference in rates with respect to deliberate self-harm and probable deliberate self-harm emphasizes the need for improvement of registration procedures of suicidal behavior in Denmark.

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