

# BMJ Open Are suicide deaths under-reported? Nationwide re-evaluations of 1800 deaths in Scandinavia

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## ABSTRACT

**Objective:** Valid mortality statistics are important for healthcare planning and research. Suicides and accidents often present a challenge in the classification of the manner of death. The aim of this study was to analyse the reliability of the national suicide statistics by comparing the classification of suicide in the Scandinavian cause of death registers with a reclassification by 8 persons with different medical expertise (psychiatry, forensic pathology and public health) from each of the 3 Scandinavian countries.

**Methods:** The cause of death registers in Norway, Sweden and Denmark retrieved available information on a sample of 600 deaths in 2008 from each country. 200 were classified in the registers as suicides, 200 as accidents or undetermined and 200 as natural deaths. The reclassification comprised an assessment of the manner and cause of death as well as the level of certainty.

**Results:** In total, 81%, 88% and 90% of deaths registered as suicide in the official mortality statistics were confirmed by experts using the Swedish, Norwegian and Danish data sets, respectively. About 3% of deaths classified as accidents or natural deaths in the cause of death registers were reclassified as suicides. However, after a second reclassification based on additional information, 9% of the natural deaths and accidents were reclassified as suicides in the Norwegian data set, and 21% of the undetermined deaths were reclassified as suicides in the Swedish data set. In total, the levels of certainty of the experts were 87% of suicides in the Norwegian data set, 77% in the Swedish data set and 92% in Danish data set; the uncertainty was highest in poisoning suicides.

**Conclusions:** A high percentage of reported suicides were confirmed as being suicides. Few accidents and natural deaths were reclassified as suicides. Hence, reclassification did not increase the overall official suicide statistics of the 3 Scandinavian countries.

## INTRODUCTION

A valid classification of the causes and manners of death is essential in healthcare planning and for research purposes.

## Strengths and limitations of this study

- The present study is based on relatively large nationwide data sets of 600 adults from each of the three Scandinavian countries.
- Many various relevant manners and causes of death were included.
- The samples were re-evaluated individually by eight people with different but relevant expertise: psychiatry, forensic pathology and expert coders.
- Transnational comparisons of the data sets.
- The major difference between the Scandinavian countries in terms of the information given on death certificates is a methodological limitation.

The WHO publishes the International Statistical Classification of Diseases and Related Health Problems (ICD), which contains detailed definitions and instructions for the use of mortality statistics.<sup>1</sup> The three Scandinavian countries, Denmark, Norway and Sweden, implemented the 10th ICD revision in 1994, 1996 and 1997, respectively. Obtaining reliable mortality statistics requires completion of all steps in the registration process, including obtaining the correct cause and manner of death given by the physician issuing the death certificate and a precise registration of the information given on the certificate in the national cause of death register.

According to the WHO, “for the act of killing oneself to be classed as suicide, it must be deliberately initiated and performed by the person concerned in the full knowledge, or expectation, of its fatal outcome.”<sup>2</sup> There are considerable differences between countries in reported suicide rates, and these differences might reflect challenges in distinguishing between unwitting, sudden and unexpected natural deaths, accidents and suicides. Most suicides occur without other people present, and in



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only 20–38% of suicides is a suicide note left.<sup>3–5</sup> Hence, discerning between suicide and accidents in the classification presents a particular challenge. In some religious groups, suicide is considered a sin, and thus deaths by suicide might be under-reported and instead registered as accidents or natural deaths in the national mortality statistics.<sup>6</sup> An autopsy that includes measures of toxic agents may help in distinguishing between natural and unnatural deaths, but not between suicides and accidents caused by an overdose of drugs or poison.

It is claimed that the suicide rate in most countries is underestimated and that suicides might be ‘hidden’ in categories of ‘deaths of undetermined intent’, ‘accidents’ and ‘ill-defined and unknown cause of mortality’. However, different studies have drawn different conclusions. Some have reported fairly reliable suicide statistics,<sup>7–14</sup> whereas others have involved under-reporting in the range of 10% to an almost fourfold difference between the official suicide rate and the reclassified rate.<sup>15–26</sup> A review based on 31 studies of the reliability of suicide statistics concluded that comparisons of nationwide statistics between countries are lacking.<sup>27</sup> To our knowledge, no studies have reviewed and reclassified a national representative sample from different countries within the categories suicides, accidents and natural deaths.

The aims of the present study were to:

1. Analyse possible misclassification of suicides, accidents and natural deaths, and thus assess the reliability of suicide statistics in the three Scandinavian countries.
2. Assess the level of certainty among specialists within psychiatry, forensic pathology and public health relative to their individual reclassification of the manner of death.

## METHODS

### Description of data

The reclassification was based on 1800 deaths in 2008 among people aged 18 years or older, 600 from each of the three Scandinavian countries. In the national Cause of Death Register in each country, 200 of these deaths were registered as suicides, 200 as accidents and undetermined manner of deaths, and 200 as natural deaths by different causes. The sample of 200 suicides included all suicide methods (ICD-10: X60–X84, Y870). The sample of 200 accidents and undetermined manner of deaths included traffic accidents (ICD-10: V01–V99), accidental poisoning (ICD-10: X40–X49), accidental drowning (ICD-10: W65–W74), accidental fire and flame (ICD-10: X00–X09) and undetermined intent (ICD-10: Y10–Y34, Y872). The Norwegian and Swedish accident samples did not include all types of traffic accidents but comprised the category ‘car occupant injured in transport accident’ (ICD-10: V43–V45.5, V47–V48.5, V49.4), which most likely may include some suicides. The Danish data set included all types of

traffic accidents (pedestrian, pedal cyclist, bus occupant, etc; ICD-10: V01–V99). The Swedish data set also included deaths registered as undetermined intent. The Norwegian data set included no cases of undetermined intent because no cases had been coded as undetermined intent in the Norwegian Cause of Death Register in 2008. We intended to include cases of undetermined intent in the Danish data set, but unfortunately this category was not extracted. In all three countries, natural deaths included deaths registered with a psychiatric disorder as the underlying cause of death because of the reported high risk of suicide for people with these mental disorders.<sup>28</sup> These included ‘mental and behavioural disorders due to psychoactive substance use’ (ICD-10: F10–F19), ‘schizophrenia, schizotypal and delusional disorders’ (ICD-10: F20–F29), ‘mood (affective) disorders’ (ICD-10: F30–F39) and ‘disorders of adult personality and behaviour’ (ICD-10: F60–F69). The Danish data set also included ‘ill-defined and unknown causes of mortality’ (ICD-10: R96–R99; [table 1](#)). The Norwegian and Swedish data sets were stratified. The Danish data set was not stratified. In order to get the Danish data set quite similar to the Norwegian and Swedish data sets, the official figures within the extracted categories were used to calculate how many people that should be included in each category. All cases were randomly selected within similar main and subcategories (eg, suicides, traffic accidents).

The reclassification was based on information given in the death certificates and autopsy reports. In the Norwegian sample of 600 deaths, autopsies had been performed on 325 (54%), and 86 of these had a complete autopsy report available. In a further 239 cases, the reclassification was based on information on the manner and cause of death from a revised death certificate and the results from the autopsy were notified using the specific coding Systematized Nomenclature of Medicine (SNOMED). SNOMED is a systematic, computer-processable collection of clinical terminology used by pathologists. Local regulations and traditions explain why some pathology departments submit a complete autopsy report, while others only send a revised death certificate and SNOMED codes to the Norwegian Cause of Death Register. The information given to the experts was identical to the information used by the Cause of Death Register. The Swedish data set did not include any autopsy reports, even though an autopsy had been performed in 483 (81%) of the 600 cases. In cases of an unnatural manner of death in the Danish data set, the death certificates contained in text form an excerpt of the clinical data, information from a death scene investigation, findings of an external post-mortem examination and eventually an autopsy report when available. In 191 (32%) of the 600 Danish cases, an autopsy had been performed and information from the autopsy report was included in the death certificates.

**Table 1** Data extracted according to manner and cause of death

Manner and cause of death (ICD-10 codes)	Norway (n)	Sweden (n)	Denmark (n)
Suicide (X60–84, Y87.0)	200	200	200
Accident	200	200	199
Traffic accident (V01–V99)*	29	34	45
Accidental poisoning (X40–X49)	129	70	104
Accidental drowning (W65–W74)	16	21	21
Accidental fire and flame (X00–X09)	26	15	29†
Undetermined intent (Y10–Y34, Y87.2)	0	60	0
Natural death	200	200	200
Mental and behavioural disorders due to psychoactive substance use (F10–F19)	155	149	59
Schizophrenia, schizotypal and delusional disorders (F20–F29)	19	14	31
Mood (affective) disorders (F30–F39)	24	37	51
Disorders of adult personality and behaviour (F60–F69)	2	0	0
Ill-defined and unknown causes of mortality (R96–R99)	0	0	59
Total number of cases	600	600	599

\*The Norwegian and Swedish data sets included a selection of traffic accidents (ICD-10: V43–V45.5, V47–V48.5, V49.4), whereas the Danish data set included all traffic accidents (ICD-10: V01–V99). In the Danish data set, 14 cases were within the same selection of traffic accidents as in the Norwegian and Swedish data sets (ie, V43–V45.5, V47–V48.5, V49.4).

†One male was excluded because of age <18 years.

ICD, International Statistical Classification of Diseases and Related Health Problems.

### Re-evaluation of the data sets

All cases were de-identified and given a random identification number before they were individually re-evaluated by the experts, although the age and sex were indicated on the death certificates. The eight experts from the three Scandinavian countries who performed the reclassifications were psychiatrists (ØE, MCK, UN), forensic pathologists (SR, KH-L, IT) and expert coders (GØ). The expert coders have in-depth knowledge about implementing the WHO's ICD principles and were thus able to evaluate the reliability of the coding systems. The forensic pathologists have special competence in the evaluation of the manner and cause of death. The psychiatrists' skills include assessing motives behind human behaviour.

Per protocol, we divided 600 cases from each country into 12 groups of 50 cases in each group to ensure the reclassification of cases from all three countries by all three expert groups (figure 1). In each group, a random sample of causes of death was included. Thus, all 1800 cases would be re-evaluated by at least three experts, and some cases re-evaluated by all experts. In the present study, the Norwegian psychiatrist re-evaluated 1000 cases (600 from the Norwegian data set and 200 from each of the Swedish and Danish sets). The Swedish and Norwegian forensic pathologists and the Norwegian expert coder re-evaluated 800 deaths (400 deaths from his/her own country and 200 from each of the other two). The Swedish psychiatrist and the three Danish experts re-evaluated 600 cases each, 200 from each country.

For each case, a coding form was used to assess the manner of death (ie, natural death, suicide, accident, homicide, undetermined) and then the cause of death (hanging, cardiovascular disease, etc). The expert then stated the level of certainty regarding the manner and

cause of death as follows: 1, certain; 2, possible; 3, uncertain; 4, insufficient information to determine the manner and cause of death; and 5, insufficient information to determine the cause of death. Certainty group levels 1 and 2 were merged into one group (certain) and group levels 4 and 5 into another group (insufficient information). Group level 3 (uncertain) was unchanged in the further processing of data.

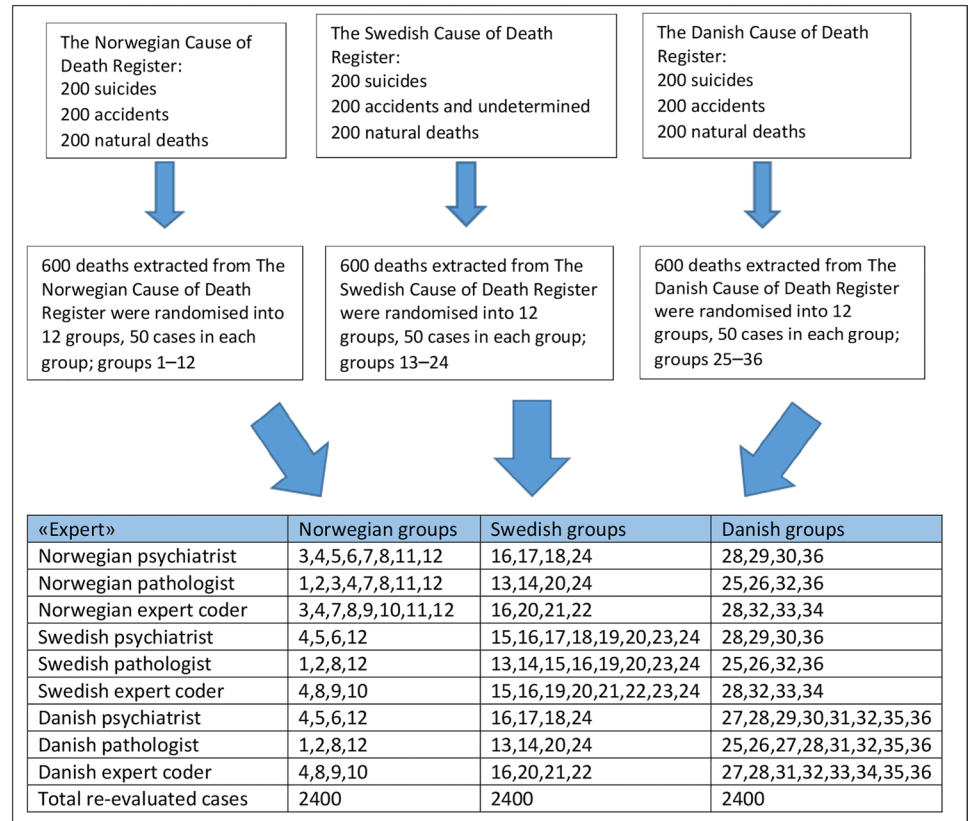
### Second re-evaluation of the Norwegian and Swedish data sets

Because much of the information was sparse in the Norwegian and Swedish cases, two of the experts (SR, ØE) did a second reclassification of Norwegian cases for which a forensic autopsy report had been made available and, in Swedish cases, for which a forensic autopsy and police report had been made available. This included 180 Norwegian and 483 Swedish cases. In the Norwegian data set, in addition to these 180 cases, 59 cases contained a death certificate issued by a forensic pathologist plus SNOMED codes. These cases included autopsies performed in institutions other than the Norwegian Institute of Public Health and were not included in the second re-evaluation. ØE re-evaluated 180 Norwegian cases and SR 124 in the second re-evaluation. Among the Swedish cases, ØE and SR re-evaluated the same 200 cases as in the first re-evaluation and all cases classified as undetermined intent in the Swedish Cause of Death Register. In total, ØE re-evaluated 235 and SR re-evaluated 247 Swedish cases in the second re-evaluation.

### Statistics

SPSS statistics V.21.0 (Armonk, New York) were used for data analysis. Differences in demographic characteristics and level of certainty were analysed using  $\chi^2$  tests with a

**Figure 1** Distribution of the 1800 extracted cases. This distribution of cases ensured that the experts with a similar profession re-evaluated a minimum of 200 similar cases extracted from each of the cause of death registers in 2008. We planned to have a third 'expert coder' from Sweden, but this person had to withdraw during the process.



significance level of 0.05. Crosstabs were used to compare official statistics with the re-evaluations. The percentage suicide agreement was calculated by summarising the total number of confirmed suicide deaths divided by the total number of re-evaluated suicide deaths. All cases were plotted manually in SPSS, and in a control analysis of 800 numbers, there were 0.6% incorrectly plotted numbers. These numbers were corrected before the analyses were performed.

## RESULTS

### Description of sample

There were significantly more men than women (68% men,  $p < 0.001$ ; table 2). The autopsy frequencies were

81% (Swedish data set), 54% (Norwegian data set) and 32% (Danish data set). The most frequent suicide method was hanging, strangulation or suffocation: Norway and Sweden (35%), and Denmark (38%;  $p = 0.77$ ; table 3). Poisoning was the second most frequent suicide method: Norway (24%), Sweden (29%) and Denmark (31%;  $p = 0.26$ ). Use of firearms was significantly more frequent in the Norwegian data set (18%) than in the Swedish (10%) and Danish (9%) data sets ( $p = 0.01$ ).

### Re-evaluation of the Norwegian data set

In total, there was 88% (range 54–100%) agreement in the classification of suicide deaths between the official mortality statistics and the experts' reclassifications. The

**Table 2** Demographic characteristics

	Total	Norway	Sweden	Denmark
Total number of cases	1799	600	600	599*
Male gender, n (%)	1223 (68%)	432 (72%)	403 (67%)	388 (65%)
Age (years), mean (SD)	55.7 (20.0)	52.9 (19.3)	56.2 (19.2)	58.1 (21.2)
Cases with medical death certificates, n (%)	1790 (99.5%)	590† (98%)	600	599*
Cases with an available autopsy report	998 (55.5%)	325 (54.2%)	483 (80.5%)	190 (31.7%)
Natural deaths, n (%)		32 (16%)	108 (54%)	15 (7.5%)
Suicides, n (%)		136 (68%)	192 (96%)	36 (18%)
Accidents, n (%)		157 (78.5%)	124 (87.9%)	139 (69.8%)
Undetermined, n (%)			59 (98.3%)	

\*One male was excluded because of age <18 years.

†In six cases, death was only certified by police authorities, in three cases, we received only an autopsy report, and in one case, the death certificate was issued abroad.



**Table 3** Suicide by method extracted from the cause of death registers

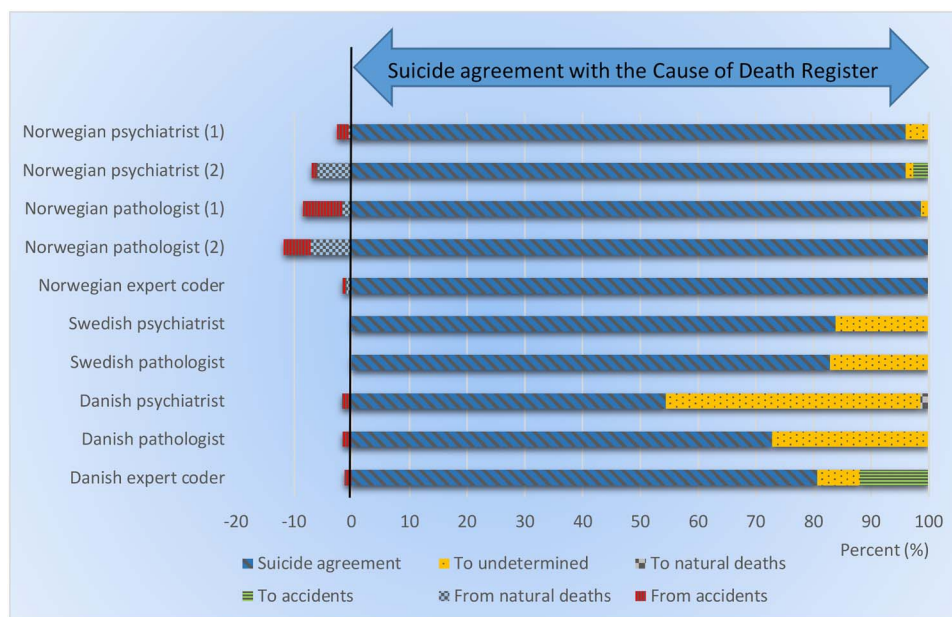
ICD-10 Code	Text to ICD-10 code	Norway n (%)	Sweden n (%)	Denmark n (%)
X60–X69	Intentional self-poisoning	47 (24%)	58 (29%)	61 (31%)
X70	Intentional self-harm by hanging, strangulation and suffocation	70 (35%)	70 (35%)	76 (38%)
X71	Intentional self-harm by drowning and submersion	12 (6%)	12 (12%)	17 (9%)
X72–X75	Intentional self-harm by firearm or explosives	36 (18%)	20 (10%)	18 (9%)
X76	Intentional self-harm by smoke, fire and flames	2 (1%)	3 (2%)	0
X78	Intentional self-harm by sharp object	8 (4%)	4 (2%)	6 (3%)
X80	Intentional self-harm by jumping from a high place	9 (5%)	15 (8%)	8 (4%)
X81	Intentional self-harm by jumping or lying before moving object	4 (2%)	15 (8%)	11 (6%)
X82	Intentional self-harm by crashing of motor vehicle	2 (1%)	2 (1%)	2 (1%)
X83	Intentional self-harm by other specified means	9 (5%)	1	1
X84	Intentional self-harm by unspecified means	1	0	0
Y870	Sequelae of intentional self-harm	1	0	0
	Total	200	200	200

ICD, International Statistical Classification of Diseases and Related Health Problems.

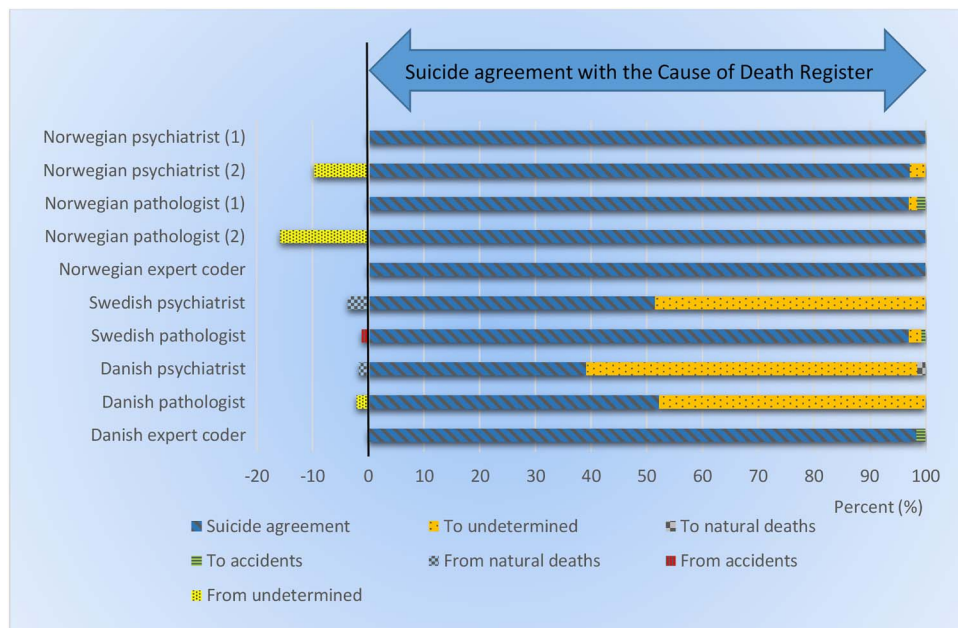
Norwegian expert coder was 100% in agreement with the Norwegian Cause of Death Register. Disagreement between the official mortality statistics and the experts' reclassification was found in the reclassification of suicides as undetermined manner of death in 11% (range 0–44%) of the cases (figure 2). Among all cases registered as suicides in the mortality statistics, 1% (range 0–12%) were reclassified as accidents and 0.1% as natural deaths. The Danish psychiatrist and forensic pathologist reclassified 30 (44%) and 19 (27%) of the cases registered as suicides in the Cause of Death Register as undetermined deaths, respectively. The other experts reclassified 0–17% of suicides as undetermined deaths.

In total, 2% (range 0–7%) of accidental deaths and 0.5% (range 0–1.5%) of natural deaths were reclassified as suicides.

The second re-evaluation, for which more information was available, was performed by the Norwegian psychiatrist (ØE) and forensic pathologist (SR). ØE and SR reclassified 1 (6% and 7%, respectively) case originally registered as a natural death as suicide and 1 (1%) and 3 (5%), respectively, deaths originally registered as accidents. ØE reclassified 2 (3%) cases registered as suicides as accidents and 1 (1%) suicide as undetermined death, whereas SR agreed 100% with the classification of all deaths reported as suicides.



**Figure 2** Reclassification of suicides in the Norwegian data set. First re-evaluation (1), and second re-evaluation (2). Agreement (blue slanted lines) in classification of manner of death between the Norwegian Cause of Death Register and the experts' classification. Bars to the left of the vertical black line show the experts' reclassifications (%) from suicides to undetermined, natural deaths and accidents. Bars to the right of the vertical black line show the experts' reclassifications (%) of accidents and natural deaths to suicides.



**Figure 3** Reclassification of suicides in the Swedish data set. First re-evaluation (1), and second re-evaluation (2). Agreement (blue slanted lines) in classification of manner of death between the Swedish Cause of Death Register and the experts' classification. Bars to the left of the vertical black line show the experts' reclassifications (%) from suicides to undetermined, natural deaths and accidents. Bars to the right of the vertical black line show the experts' reclassifications (%) of accidents, undetermined manner of deaths and natural deaths to suicides.

### Re-evaluation of the Swedish data set

In total, there was 81% (range 39–100%) agreement in the classification of suicides between the official mortality statistics and the experts' reclassifications. In total, there was 18% (range 0–59%) disagreement between the official mortality statistics and the experts' reclassification of suicides as undetermined manner of death. The Swedish psychiatrist, the Danish psychiatrist and the Danish forensic pathologist had 51%, 39% and 52% agreement, respectively, with the official mortality statistics. The disagreement concerned mainly the reclassification of suicides as undetermined manner of death. The other experts had more than 97% agreement (figure 3). Among the suicides, 0.5% (range 0–1.5%) were reclassified as accidents and 0.1% (range 0–0.5%) as natural deaths. Among the accidents, 0.3% (range 0–1%) were reclassified as suicides, 0.5% (range 0–4%) as natural deaths and 0.6% (range 0–2%) as undetermined deaths.

In the second re-evaluation, ØE reclassified 2 (3%) cases registered as suicides in the Cause of Death Register as undetermined deaths. ØE and SR reclassified 10 (17%) and 15 (25%) cases, respectively, that had been registered as undetermined manner of death in the Cause of Death Register as suicides.

### Re-evaluation of the Danish data set

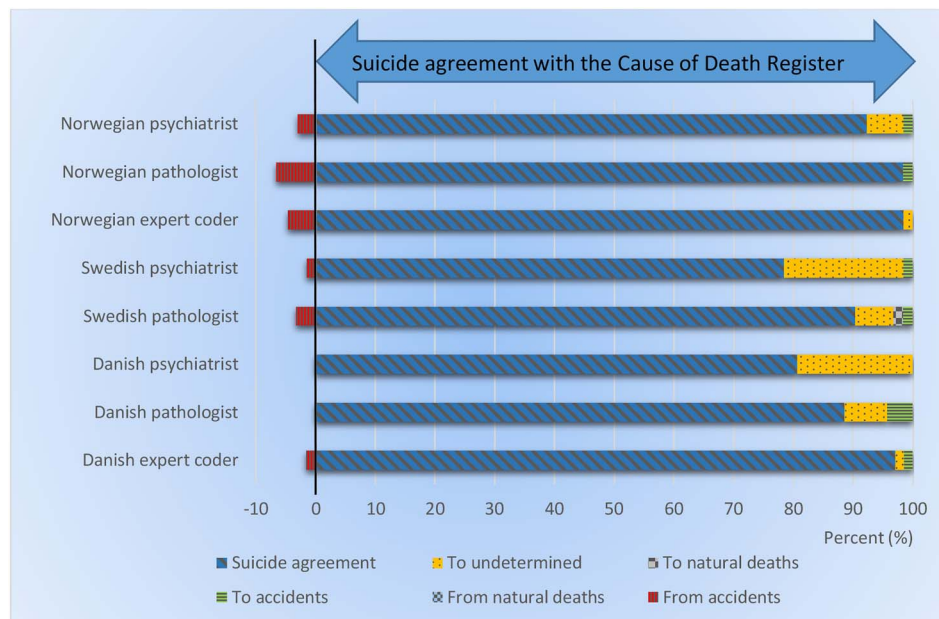
In total, there was 90% (range 78–98%) agreement in the classification of suicides between the official mortality statistics and the experts' reclassification (figure 4). In total, there was 8% (range 0–20%) disagreement between the official mortality statistics and the experts'

reclassification of suicides as undetermined manner of death. The Swedish and Danish psychiatrists each reclassified 13 (20% and 19%, respectively) cases registered as suicides in the Cause of Death Register as undetermined deaths. The other experts reclassified 0–5 (0–7%) suicides as undetermined deaths. None of the reported natural deaths in the Danish Cause of Death Register was reclassified as suicide, and 2.5% (range 0–7%) of the accidental deaths were reclassified as suicide. None of the experts reclassified any traffic accident deaths as suicides. Among the natural deaths, the Swedish forensic pathologist reclassified significantly more ( $p=0.046$ ) of the 'ill-defined and unknown causes of mortality' (ICD-10: R96–R99) as undetermined deaths compared with the other cases of natural death. The other experts did not reclassify significantly more deaths in the 'R96–R99-group' as undetermined deaths compared with the other natural deaths.

### Level of certainty in the reclassifications

The experts' assessments of the level of certainty varied according to the expert's professional background (psychiatrist, forensic pathologist, expert coder) and the stated manner and cause of death. Among all deaths in the Norwegian data set, the experts expressed certainty in 69%, uncertainty in 8% and insufficient information in 23% of all the re-evaluations. Most cases for which the experts noted insufficient information involved natural deaths (43%) and accidental drownings (45%). Among all deaths, the Norwegian expert coder expressed most certainty in her re-evaluations (98%),

**Figure 4** Reclassifications of suicides in the Danish data set. Agreement (blue slanted lines) in classification of manner of death between the Danish Cause of Death Register and the experts' classification. Bars to the left of the vertical black line show the experts' reclassifications (%) from suicides to undetermined, natural deaths and accidents. Bars to the right of the vertical black line show the experts' reclassifications (%) of accidents and natural deaths to suicides.



whereas the Swedish and Danish psychiatrists and the Swedish forensic pathologist expressed the lowest level of certainty, 34%, 37% and 53%, respectively. The other experts recorded 63–80% certainty. Among the reported suicides, intentional self-poisoning differed from the other suicide methods in terms of the assessment of certainty; this difference was significant ( $p$  from  $<0.001$  to  $0.01$ ) in the re-evaluations by the Danish pathologist and all three psychiatrists (table 4).

In the second re-evaluation of the Norwegian data set, when more information was available (ie, from autopsy reports), the Norwegian psychiatrist's (ØE) certainty increased from 70% in the first re-evaluation to 87% in the second re-evaluation, and the percentage of cases with insufficient information decreased from 25% to 10%. The percentage for the Norwegian forensic pathologist (SR) increased from 76% to 95%, and the percentage with insufficient information decreased from 17% to 0%. In the second re-evaluation, ØE and SR each expressed uncertainty in 6 (3% and 5%, respectively) cases, and all of these cases were classified as either natural deaths or accidental poisonings in the Cause of Death Register.

Among all deaths in the Swedish data set, the experts expressed certainty in 68% of the re-evaluations, uncertainty in 9% and insufficient information in 23%. Most cases for which the experts reported insufficient information involved undetermined deaths (53%). The Norwegian expert coder recorded the highest level of certainty for the re-evaluations (100%), and the Swedish and Danish psychiatrists had the lowest, 25% and 36%, respectively. The other experts had 60–89% certainty. Among the suicides, the assessment of certainty recorded by the Swedish psychiatrist and forensic pathologist and the Danish forensic pathologist and expert

coder differed significantly regarding intentional self-poisoning ( $p$  from  $<0.001$  to  $0.01$ ) compared with other suicide methods.

In the second reclassification of the Swedish data set, which included autopsy and police reports, the Norwegian psychiatrist's (ØE) certainty increased from 71% in the first re-evaluation to 73%. ØE had 97% certainty for the suicides and 32% certainty for undetermined deaths. The Norwegian forensic pathologists (SR) percentage increased from 89% to 93% in the second re-evaluation and was 100% for suicides.

Among all deaths in the Danish data set, the experts expressed certainty in 69%, uncertainty in 9% and insufficient information in 22% of all reclassifications. Most cases for which the experts reported insufficient information involved natural deaths (46%) and accidental drownings (22%). None of the experts reported significant differences in certainty for the 14 traffic accident deaths for the ICD codes V43–V45.5, V47–V48.5 and V49.4 compared with the other 31 traffic accidents. For the natural deaths, the Danish forensic pathologist assessed that significantly more information was insufficient among the 'ill-defined and unknown causes of mortality' (ICD-10: R96–R99) compared with the other natural deaths, 57% and 26%, respectively ( $p=0.045$ ). The other experts did not report significantly more cases with insufficient information among the 'R96–R99 group' compared with the other natural deaths. Among all deaths, the Norwegian and Danish expert coders expressed the most certainty in the reclassifications, 96% and 90%, respectively, whereas the Swedish pathologist and the Swedish and Danish psychiatrists had the lowest levels of certainty, 52%, 50% and 54%, respectively. The certainty of the other experts was between 60% and 73%. In the re-evaluations by the Swedish forensic pathologist and the Norwegian and



**Table 4** Level of certainty

'Expert'	Level of certainty	Norwegian data set		Swedish data set		Danish data set	
		Intentional self-poisoning	Other suicides	Intentional self-poisoning	Other suicides	Intentional self-poisoning	Other suicides
Norwegian psychiatrist	Certain	40 (85%)	149 (97%)	23 (96%)	46 (100%)	13 (72%)	47 (100%)
	Uncertain	2 (4%)	1 (1%)	1 (4%)	0	1 (6%)	0
	Insufficient information	5 (11%)	3 (2%)	0	0	4 (22%)	0
Norwegian pathologist	Certain	29 (94%)	108 (98%)	18 (95%)	48 (100%)	21 (100%)	41 (100%)
	Uncertain	1 (3%)	0	1 (5%)	0	0	0
	Insufficient information	1 (3%)	2 (2%)	0	0	0	0
Norwegian expert coder	Certain	34 (100%)	104 (100%)	19 (100%)	42 (100%)	18 (95%)	42 (100%)
	Uncertain	0	0	0	0	0	0
	Insufficient information	0	0	0	0	1 (5%)	0
Swedish psychiatrist	Certain	7 (44%)	36 (70%)	1 (5%)	33 (72%)	12 (67%)	42 (89%)
	Uncertain	2 (12%)	9 (18%)	0	0	1 (5%)	1 (2%)
	Insufficient information	7 (44%)	6 (12%)	21 (95%)	13 (28%)	5 (28%)	4 (9%)
Swedish pathologist	Certain	12 (67%)	45 (86%)	20 (59%)	92 (93%)	15 (72%)	39 (96%)
	Uncertain	2 (11%)	1 (2%)	14 (41%)	5 (5%)	3 (14%)	1 (2%)
	Insufficient information	4 (22%)	6 (12%)	0	2 (2%)	3 (14%)	1 (2%)
Danish psychiatrist	Certain	2 (12%)	38 (74%)	1 (4%)	28 (62%)	10 (59%)	45 (90%)
	Uncertain	4 (23%)	4 (8%)	0	0	1 (6%)	1 (2%)
	Insufficient information	11 (65%)	9 (18%)	22 (96%)	17 (38%)	6 (35%)	4 (8%)
Danish pathologist	Certain	7 (39%)	46 (88%)	6 (31%)	29 (62%)	20 (84%)	45 (98%)
	Uncertain	6 (33%)	2 (4%)	11 (58%)	15 (32%)	3 (12%)	1 (2%)
	Insufficient information	5 (28%)	4 (8%)	2 (11%)	3 (6%)	1 (4%)	0
Danish expert coder	Certain	14 (82%)	45 (90%)	17 (89%)	34 (81%)	22 (96%)	45 (100%)
	Uncertain	0	2 (4%)	2 (11%)	0	0	0
	Insufficient information	3 (18%)	3 (6%)	0	8 (19%)	1 (4%)	0
All 'experts'	Certain	145 (73%)	571 (92%)	105 (59%)	352 (85%)	131 (81%)	346 (96%)
	Uncertain	17 (9%)	19 (3%)	29 (16%)	20 (5%)	9 (6%)	4 (1%)
	Insufficient information	36 (18%)	33 (5%)	45 (25%)	43 (10%)	21 (13%)	9 (3%)

The experts' reported level of certainty about intentional self-poisoning and all other suicide methods, n (%).

Danish psychiatrists, the assessment of the level of certainty for the reported suicides differed significantly between intentional self-poisoning and the other suicide methods ( $p=0.001-0.03$ ).

## DISCUSSION

### Statement of principal findings

This study was based on a reclassification of 1800 deaths among adults in the three Scandinavian countries. The reclassification was performed by eight experts in psychiatry, forensic pathology and public health. In total, the agreement between the official suicide statistics and the experts was 88%, 81% and 90% in the Norwegian, Swedish and Danish data sets, respectively. The major disagreement concerned reclassification of suicides as undetermined manner of death. Few natural deaths and

accidents were reclassified as suicides. Thus, when adding the reclassified accidents (0.3–2%) and natural deaths (0–0.5%) into the suicide groups, in total, the experts reclassified fewer suicides compared with the official mortality statistics in Norway, Sweden and Denmark: 90%, 82% and 92%, respectively. However, with additional information on autopsy reports and police reports, the experts reclassified 3% of the accidents and 6% of the natural deaths as suicides in the Norwegian data set, and 21% of the registered undetermined manner of deaths as suicides in the Swedish data set.

### General discussion

There was a real difference between the experts' reclassifications; that is, suicides were more often reclassified as undetermined deaths by psychiatrists and forensic pathologists than by expert coders. The Norwegian



expert coder used the WHO's ICD coding manual systematically, whereas the other experts used more 'clinical judgement'. The reclassification of suicides by the Norwegian expert coder was close to the official mortality statistics in Norway and Denmark, and was similar to the official mortality statistics in Sweden, implying that the coding in the cause of death registers in Scandinavia is reliable. From this study, we conclude that the uncertainty regarding misclassification relates mainly to the certifying physician's assessment of the manner and cause of death.

There are major differences between the three Scandinavian countries in terms of the comprehensiveness of the information given on death certificates. In Norway and Sweden, the death certificates contain sparse information, whereas the Danish death certificates in cases of unnatural death present an excerpt of medical and clinical information about the deceased, results of the death scene investigation, information about the postmortem examination and eventually selected information from an autopsy report. These differences influenced the reclassification of the samples from the different Scandinavian countries. In view of the reclassifications compared with the statements about the manner and cause of death in the death certificates, the certifying physician might have had more information about the deceased, especially in cases of medicolegal postmortem examinations whereby the police inform the physician about the circumstances of the death, or in cases where clinical information is available. In the Norwegian data set, the forensic autopsy report provided more information, but such reports had been obtained for only a small proportion of the data set in the first re-evaluation. In the second re-evaluation of the Norwegian data set, for which more information was available, a larger percentage (9%) of accidents and natural deaths were reclassified as suicides. This indicated that more information about each death could have led to a higher frequency of deaths being reclassified as suicide, but the small percentage of autopsied natural deaths must also be considered. This is supported by the findings of Reseland *et al.*<sup>29</sup> They compared suicide rates in four Nordic countries with autopsy and ill-defined death rates, and found a close correlation between suicides and both autopsy (positive correlation) and ill-defined death rates (negative correlation). The Swedish death certificates included information regarding the manner of death and the underlying cause of death in cases where a forensic autopsy had been performed (in 81% of the dataset). In the second re-evaluation of the Swedish data set, the two experts reclassified as suicides 21% of the reported undetermined manner of deaths. Sweden has traditionally reported more undetermined deaths than Norway. In the second re-evaluation when more information was made available, the reclassification from an undetermined manner of death to suicide might, at least in part, reflect the Norwegian practice of

classifying uncertain cases as possible accidents or possible suicides. Each year, 300–400 deaths in Sweden are reported as undetermined intent. If 20% of these cases were 'missed' suicides, the suicide rate in Sweden would have increased from 12.7 to 13.4 suicides per 100 000 in 2008, which is considered a small change in the suicide rate.

### Comparisons with other studies

In previous studies, two basic methods have been used to evaluate the quality of suicide statistics, which includes misclassification and uncertainty regarding the intention of injury-related deaths. These two methods include review and reclassification of selected manners and causes of death and statistical analyses, which estimate upper and lower suicide rates by including cases of undetermined deaths and other relevant death categories (ie, poisoning deaths, 'ill-defined and unknown causes of mortality', etc) to the suicide rate.<sup>30–32</sup> Kolmos and Bach<sup>31</sup> studied 'sources of error in registering suicide' in four Nordic countries (Finland, Sweden, Denmark and Norway) in 1977–1983 and concluded that the reported differences in suicide rates reflected true differences between these countries. In contrast to the present study, the study by Kolmos and Bach was a statistical analysis of 'controversial cases', poisoning, hanging and strangulation, drowning, firearms and explosives, unknown causes of death and manner of death not stated. The authors concluded that there were two types of potential sources of error in suicide registration: deaths from drowning and deaths registered as unknown cause of death. However, they wrote that 'even if a number of suicide should be hidden by these two types of potential sources of error, the possible numbers would be too small to equalise the differences in the suicide rates between the countries'. In the present study, most cases for which the experts reported insufficient information involved natural deaths and accidental drowning in the Norwegian and Danish data sets, and undetermined manners of death in the Swedish data set. In addition, intentional self-poisoning differed compared with the other suicide methods in terms of the assessment of the level of certainty, but few accidents and natural deaths were reclassified as suicides. Both Kolmos and Bach's study and our present study indicate that the official suicide rates in Scandinavia are reliable.

In contrast to the present study, most other studies of the reliability of suicide statistics have included only a single or a few categories of deaths in which suicides could be hidden (eg, drowning accidents, poisoning accidents and undetermined intent).<sup>7 18</sup> Ekeberg *et al.*<sup>18</sup> studied 210 drowning and poisoning accidents, and found a possible minor (10%) under-reporting of suicides in Norway. A study from Sweden<sup>7</sup> that analysed 580 officially registered traffic deaths in Sweden in 1999 revealed that only 490 (84%) were true accidents and that 18 (3%) were suicides, 12 (2%) undetermined and 59 (10%) natural deaths. In the present study, among all

accidents, relatively few (0.3–2.5%) were reclassified as suicides. However, among drowning accidents recorded in the Norwegian and Danish data sets, the experts assessed that the available information was insufficient to state the manner of death either as accident or suicide, and reclassified the manner of death as undetermined.

The present study is more comprehensive than previous studies<sup>27</sup> with regard to being nationally representative and having the reclassification performed by experts from psychiatry, forensic pathology and public health, and from different countries compared with evaluations only performed by coroners/medical examiners within a given country. Allebeck *et al* evaluated 322 cases of deaths of young men in Sweden with unclear circumstances and reclassified 9 of the 47 cases officially registered as undetermined death as suicide. The study concluded that injury-related deaths were reported with high accuracy but that the ‘true’ number of suicides was difficult to assess even after close scrutiny of the information available.<sup>8</sup> Few other studies have compared the classification of suicides between countries. One example is a study from 1975 based on a small sample of 40 cases from Denmark and England, in which the causes of death were evaluated by coroners and regional medical officers with expertise in postmortem examination. The Danish experts consistently classified more cases as suicide than did the English coroners.<sup>33</sup>

### Strengths and weaknesses of the study

The present study is based on a relatively large sample that included both genders in nationwide samples of adults, making the extracted sample comparable to the official mortality statistics. The relative proportions of suicide methods in the sample were consistent with the official suicide statistics in the three countries, except the subgroup ‘intentional self-harm by drowning and submersion’ in the Swedish data set, in which the official percentage in 2008 was 4.7% and in this data set was 12%.<sup>34–36</sup> There were significantly more men than women (68% men,  $p < 0.001$ ) in the extracted sample, and this is consistent with official data in which the suicide and accident rates are 2–3 times higher for men than for women in Scandinavia. In this study, the Swedish data set had the highest, and the Danish the lowest frequency of forensic autopsies, which is consistent with the official data.<sup>37–39</sup> Another strength is that the various relevant manners and causes of death were included. Transnational comparisons are important because the decreases in suicide rates during the past 30 years in Denmark, Sweden and Norway are very different in relative and absolute rates, and because of the different procedures in making mortality statistics. Another strength of this study is that the samples were re-evaluated individually by eight people with different but relevant fields of expertise from all three countries. There was no need for translation because of the similar languages in Scandinavia. A methodological limitation is

the major differences between the three countries in terms of the information given on the death certificates. The extracted categories in the Danish data set differed somewhat from the Norwegian and Swedish data sets, and this might have influenced the results somewhat. The Danish data set included ‘ill-defined and unknown causes of mortality’, but no natural deaths were reclassified as suicides. The Danish data set did not include undetermined intent, and it is likely that some undetermined intent would have been reclassified as suicides if they had been included in the Danish data set.

### Further research

Further studies are needed to reduce the uncertainty in the classification of the manner of death of all unnatural deaths. These studies should include more information from physicians who have treated the deceased and from family or friends, and the results of external post-mortem examination and forensic autopsy (including toxicological analyses).

### CONCLUSIONS

A high percentage of reported suicides were confirmed as being suicides. In most cases where there was a disagreement between the official mortality statistics and the experts’ reclassification, the officially reported suicides were reclassified as undetermined deaths. There was a real difference between the experts’ reclassifications, and suicides were more often reclassified as undetermined deaths by psychiatrists and forensic pathologists than by expert coders. Few accidents and natural deaths were reclassified as suicides. Hence, the reclassification did not increase the ‘overall’ official suicide statistics of the three Scandinavian countries. Because of sparse information about some of the deceased, some degree of under-reporting cannot be excluded.

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