

Research paper

Characteristics associated with later self-harm hospitalization and/or suicide: A follow-up study of the HUNT-2 cohort, Norway

Wibeke Stuen Leira^{a,b,*}, Ottar Bjerkeset^{a,c}, Solveig Klæbo Reitan^{a,d}, Eystein Stordal^{a,e}, John Olav Roaldset^{a,b}

^a Department of Mental Health, Faculty of Medicine and Health Science NTNU, Trondheim, Norway

^b Department of Psychiatry, Ålesund Hospital, Møre and Romsdal Health Trust, 6026, Norway

^c Faculty of Nursing and Health Sciences, NORD University, Levanger, Norway

^d Department of Mental Health Norway, St. Olav Hospital, Trondheim, Norway

^e NorthTrøndelag Health Trust, Hospital Namsos, Namsos, Norway



A B S T R A C T

Background: To improve suicide and self-harm prevention in adults, better knowledge on preexisting characteristics and risk factors is of great importance. **Methods:** This is a population-based case-control study; baseline measures were collected in the second wave of the North-Trøndelag Health Study (HUNT-2, 1995–1997) in Norway, and outcomes were observed for up to 19 years. Average follow up time was 4.9 years for self-harm and 6.8 years for suicides. Out of 93,898 eligible adult inhabitants aged 20 and above, a total of 65,229 (70%) participated in the study. The data were linked to the National Mortality Registry and hospital patient records in the three hospitals covering the HUNT-2 catchment area.

Results: Among the participants, 332 patients (68% women) were hospitalized because of self-harm (HSH), and 91 patients (32% women) were died by suicide (SU). A total of 10% of those who died by SU had previously been HSH. People in the HSH and SU groups were younger, reported more depression and anxiety symptoms, sleeping problems, higher use of alcohol and tobacco, poorer social network and more economic problems, compared to the rest of the HUNT-2 population. In addition, the HSH group reported more somatic health problems, higher use of health services, higher sick leave, and lower work participation than the SU group. **Limitations:** Younger adults (20–40 years) were under-represented in HUNT-2. Younger adults (20–40 years) were constituted 31.7% in HUNT-2, 50% in HSH and 33% in SU. Further, we did not identify less severe self-harm, not requiring hospitalization. Life changes, adverse events, and other possible triggers to self-harming behavior were not recorded.

Conclusion: Psychological problems were long-term predictors of both HSH and SU. Somatic health problems and lower functional performance were more present in HSH-group compared to the SU-group.

1. Introduction

Suicide (SU) and self-harm (SH) represent major public health issues; globally, about 800,000 people die by SU each year [dataset] (World Health Organization, 2018; Hawton and Harriss, 2008; Ribeiro et al., 2016; Weber et al., 2013;). SU has major implications for families and networks [dataset] (Public Health England, 2015; McLaughlin et al., 2014). Besides great emotional suffering for those concerned, SU and SH have important implications on the health-care system and economical costs for society. A substantial part of the admissions to psychiatric acute wards is related to SU risk (Flannigan et al., 1994; Mellesdal et al., 2010). Further, costs related to treatment and lost productivity represent more than 90% of the total financial burden associated with SU (Shepard et al., 2016). In order to prevent SU and SH, it is crucial to know both primary and secondary prevention that can identify people at risk and in need of further

intervention (Bachmann, 2018).

Overall, men have a 2–3-fold increased suicide-risk compared to women and tend to use more violent methods (Hawton and van Heeringen, 2009). Though, the difference in SU between genders is smaller in Asian countries, the overall tendency is that it is increasingly higher in males (Bachmann, 2018).

The close relationship between mental disorders and suicidal behavior has been demonstrated in previous population studies (Mortensen et al., 2000; Nock et al., 2010). Findings from psychological autopsy studies do suggest that more than 90% of people who die by SU have a mental disorder before their death (Arsenault-Lapierre et al., 2004; Cavanagh et al., 2003). On balance, however, most people with a mental disorder never become suicidal. Further, a review of SU risk-factors worldwide, showed that more than half of all the people who died by SU met the criteria for current depressive disorder (Hawton and van Heeringen, 2009), and people diagnosed with depression had a risk

* Corresponding author at: Department of Psychiatry, Ålesund Hospital, Møre and Romsdal Health Trust, 6026, Norway.

E-mail address: Wibeke.stuen.leira@helse-mr.no (W.S. Leira).

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for suicide about 30 times higher than that for the general population not suffering from depressive disorder (Bertschy and Vandel, 1991). Among patients, bipolar disorder is related to twice as many cases of SU attempts compared to major depressive disorder (Holma et al., 2014), 5% to –10% of patients with schizophrenia die from SU (Palmer et al., 2005), and up to 20% of postpartum deaths worldwide are caused by SU (Lindahl et al., 2005).

Social factors such as living alone, job insecurity, unemployment, and socioeconomic disadvantages are all associated with increased SU risk (Lorant et al., 2005; Mortensen et al., 2000). A national study in Ireland found that deprivation was a risk factor for SU especially in the rural areas and for young women (O'Farrell et al., 2016). Other factors include acute and long-term stressful life events, personal and interpersonal conflicts, and social and environmental expectations (Ducasse et al., 2018; Foster, 2011). Insomnia (Bjorngaard et al., 2011; Goodwin and Marusic, 2008), nicotine dependence (Schneider et al., 2014), and alcohol consumption (Darvishi et al., 2015) are well known factors associated with increased risk for SU. Comorbid physical illnesses further increase the risk of SU (Copsey Spring et al., 2007). In addition, chronic pain (Calati et al., 2015) and physical illness, independent of mental illness, seem to increase the risk for SU (Harris and Barraclough, 1994; MacLean et al., 2011). Studies of non-psychiatric hospitalizations of young people (Idenfors et al., 2019) and the influence of somatic symptoms on severity of depression on SU among elderly (Jeong et al., 2014), both found somatic symptoms associated with higher risk for SU. Also, interoception, which is ability to perceive and connect psychological and physical sensations in body, has been found to be impaired among suicidal behaviors, and the deficit is greater the more severe the suicidal behavior is (Forrest et al., 2015).

Previous SU attempts are the strongest single predictor for future SU (Borges et al., 2006). It is estimated that there are 7–25 SH cases for every SU case [dataset] (World Health Organization, 2016). SU attempts are not easily discriminated from SH without intention to die. There is considerable overlap in risk factors of non-suicidal and suicidal behavior (Grandclerc et al., 2016). The conceptual proximity between different terms is supported by another study that reported comparable prevalence rates of non-suicidal self-harm (NSSI) and deliberate self-harm (Muehlenkamp et al., 2012). A cohort study revealed prospective relationship between any self-harm episode resulting in a hospitalization and later completed suicide (Cooper et al., 2005), and in a prospective studies in community samples NSSI was one of the more robust predictors of suicide attempts (Scott et al., 2015).

SH shows similarities with SU, but there are also some differences. Whereas SU is more common in males, females are at greater risk of SH. Also, males use more violent methods (Dieserud et al., 2000; Jimenez-Trevino et al., 2012; Weber et al., 2013). However, like for SU, mental disorders are highly associated with SH. Studies indicate psychiatric diagnoses in 76–92% of those hospitalized because of self-harm (HSH) (Haw et al., 2001). Other risk factors related to SH (but are not limited to) include physical illnesses (De Leo et al., 1999), insomnia (Goodwin and Marusic, 2008; Kim et al., 2013), substance use (Madianos et al., 1994; Schneider et al., 2014; Yaworski et al., 2011), pain (Newton-John, 2014; Theodoulou et al., 2005), living alone (Forkmann et al., 2012; Mortensen et al., 2000; Schneider et al., 2014), and low household income (Sareen et al., 2011).

1.1. Aims of the study

SH and SU have been studied in different and heterogeneous groups and diverse settings, making direct comparison of results challenging (Nock et al., 2013; Qi et al., 2014).

In the present study, we wanted to compare characteristics between SH and SU in the same population to reveal differences and similarities.

The two aims of the present study were to follow up 65 000 adults who participated in a population study comprising one out of 20 Norwegian Counties [dataset] (HUNT), in order to

- (i) describe a wide range of baseline characteristics for those who died by SU or were hospitalized because of SH (before January 1, 2014), compared to the rest of the participants, and
- (ii) explore possible differences between the three study groups (HUNT-2, HSH and SU)

2. Methods

2.1. Design, settings, and participants

The study has a case-control design in a naturalistic setting. It is a study linking baseline information from the HUNT-2 database 1999[(Holmen et al., 2003), the Norwegian Cause of Death Registry Norwegian Institute of Public Health, 1999] and patients' hospital records to create a comprehensive data-set for SU and HSH in a general population. The main objectives in HUNT-2 were aimed to the large public issues like cardiovascular disease, diabetes, obstructive lung disease, osteoporosis and mental health (Holmen et al., 2003). Baseline variables were collected in the HUNT-2 study, and SU and HSH cases were registered in the National Mortality Registry and hospital records, respectively, until January 1, 2014.

HUNT-2 is the second wave of a general population study in North-Trøndelag County, Norway (Holmen et al., 2003; Krokstad et al., 2013; Langhammer et al., 2012). The county is situated in the middle of Norway as shown in Figure 1 (reprinted from www.allkunne.no)

The target group comprised 93,898 inhabitants aged 20 and above, living in semi-rural areas including five smaller towns. North-Trøndelag County is fairly representative of Norway, for example regarding geography, economy, industry, sources of income, age distribution, morbidity and mortality (Holmen et al., 2003), but average income, the prevalence of higher education, and current smokers were a little lower than the average of Norway.

The health services are in general public, and the right to health care is equal for everyone. At the time of the study period, this population was described as culturally and ethnically relatively homogenous (Krokstad et al., 2013). Level of education and income were a little beneath the national average, and migration was low (Krokstad et al., 2013; Langhammer et al., 2012). The overall response rate in HUNT-2 was 70% 1999[

The HUNT-2 study was covering a wide range of topics, including:

Large public health issues (subjective health, diabetes, lung diseases, cardiovascular diseases, thyroid diseases, muscle- and skeletal diseases, mental diseases (especially anxiety and depression) quality of life measures, migraine and other headaches, physical and mental dysfunction, prostate complains, quality of life, urine incontinence, female reproductive data on menarche, pregnancies, hormone use and gynecological disease.

Personal environment (Residence, size of household. Education, occupation, in-house environment, neighborhood, friends, and sense of humor).

Personal habits (food intake, use of drugs, use of alcohol and tobacco, physical activities).

Family medical histories and health services consumption.

2.2. Procedure

Invitation to participate in the HUNT-2 survey, information about the survey, consent form, the first questionnaire (Q1), and time and place for attendance to clinical examination on permanent or mobile examination stations, were sent by ordinary mail to all 93,898 adult inhabitants of North-Trøndelag in the period from 15. Aug 1995 to 18. Jul 1997 Questionnaire 1, 1999[Q1, that was self-reported at home, and a written consent confirming participation in study, were delivered at the physical-examination stations. The consent also includes linking data to other registers. Date for attendance was different for the regions in the County, and the time was individual for each participant during

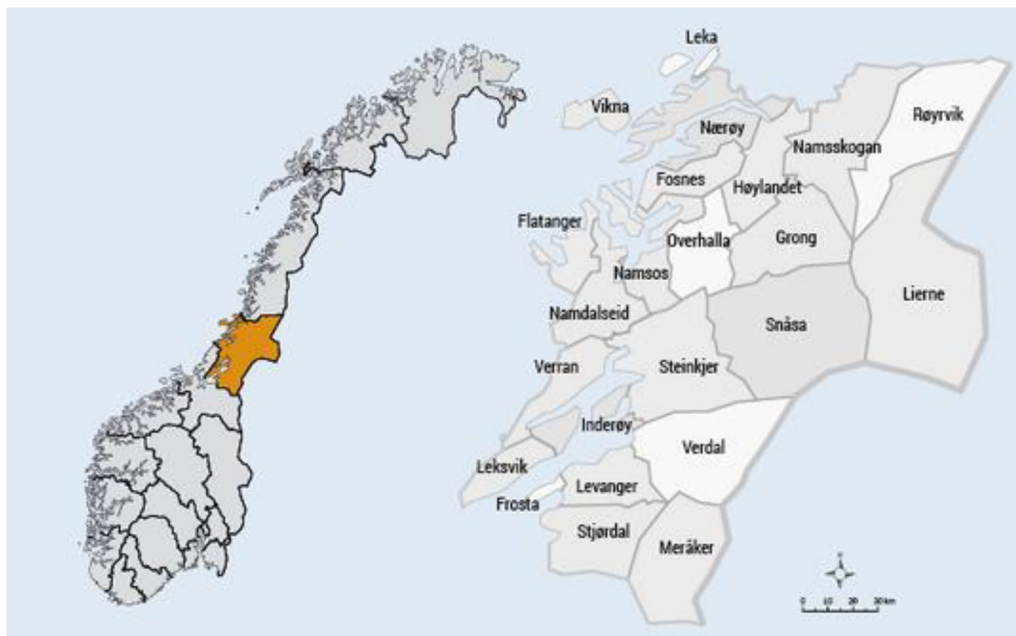


Fig. 1. The Map is showing the geographical location of Nord-Trøndelag County in Norway, in addition to the various municipalities in the County

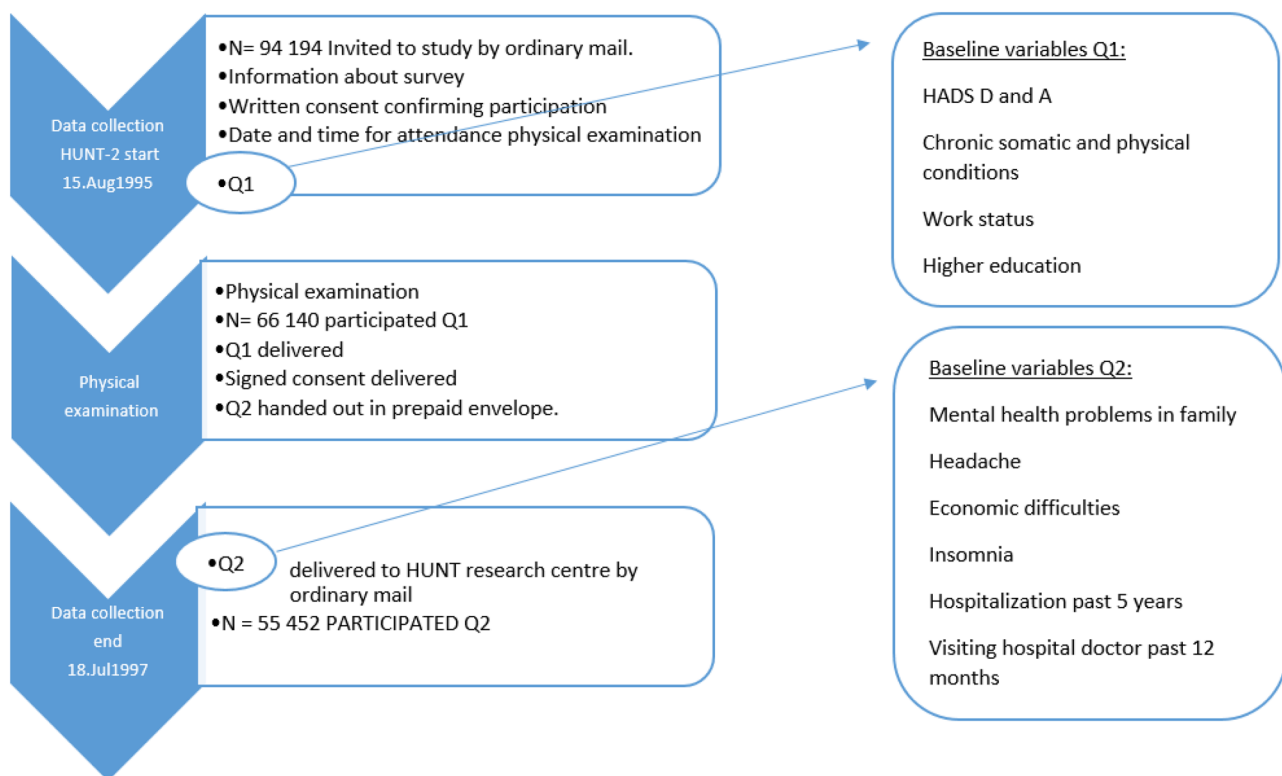


Fig. 2. Flow chart for data collection HUNT-2: questionnaire 1 (Q1) and questionnaire 2 (Q2).

the two years of data-collection. Before leaving station, the second questionnaire (Q2) was handed out to the same people that had fulfilled in Q1 and participated at the physical examination. By these, Q2 was also self-reported at home and sent by mail to HUNT Research Center in a prepaid envelope {dataset} (HUNT2). The procedure is described in a flow chart in Figure 2.

HSH data from the HUNT-2 participants were gathered from hospital records at the only three hospitals in the region (Levanger, Namsos, and St. Olav Hospital, Trondheim) in period from 01.01. 1995

to 01.01.2014. SU data were gathered from the Norwegian Cause of Death Registry {dataset} (NIPH) for same period in time. Before handing information to the research group, all data were merged and anonymized by a technician at the Nord-Trøndelag Hospital Trust.

2.3. Baseline variables from HUNT-2

Baseline variables from questionnaires Q1 and Q2 included a wide range of self-reported questions concerning demography, mental and

physical symptoms, socioeconomic conditions, diseases, health-care utilization, and social security (Krokstad et al., 2013; Langhammer et al., 2012). The variables were either scored dichotomously (0, 1) or within a given range (continuously). The response rate from all the individuals invited to HUNT-2 was 70% for Q1 and 56% for Q2.

2.3.1. The hospital anxiety and depression scale (HADS)

The Hospital Anxiety and Depression Scale (HADS) is a validated, self-completed scale for monitoring depressive and anxiety symptoms (Bech et al., 1984; Zigmond and Snaith, 1983). HADS is widely used, has good psychometric properties, and performs well in assessing cases of depression and anxiety in somatic, psychiatric, and primary-care patients in the general population (Bjelland et al., 2002).

It consists of two sub-scales, HADS-D (depressive symptoms, 7 questions) and HADS-A (anxiety symptoms, 7 questions). For each question, the informant scores from 0 (no complaint) to 3 (maximum complaint). Thus, the range is 0–21 for each subscale (<https://hunt-db.medisin.ntnu.no/hunt-db/#/variable/3050-3062>). Further in text, we refer only to the variable number, and not repeat the following notation: (<https://hunt-db.medisin.ntnu.no/hunt-db/#/>). This is the website giving info on all variables in HUNT-2, with a detailed description of each variable.

2.3.2. Mental health problems in family

In Q2, a variable cluster asked whether relatives had any of the diseases listed in an overview. Among these, participants were asked for mental disorders in (i) mother, (ii) father, (iii) brother, (iv) sister, and (v) children. If at least one of the questions in (i)–(v) was answered with yes, the score was recorded as 1. Otherwise, the score was recorded as 0 (*variable/2566–70*).

2.3.3. Headache

In Q2, participants were asked: “Do you have problems with headache?” There were three answer options: (i) yes, migraine, (ii) yes, headache, and (iii) no. If the participants answered yes in options (i) and (ii), the score was recorded as 1. Otherwise, the score was recorded as 0 (*variable/2716*).

2.3.4. Chronic somatic and physical conditions (scores 0–1)

In Q1, there were multiple variables about lifetime physical conditions and diseases. All these conditions were self-reported, and we have no information if they were previous confirmed by medical doctors. We initially did the analyzes on individual diagnostic groups (data not shown). However, due to low numbers in suicide- group, these analyzes did not reach significance level, but the trend was similar for several of them (data not shown). Therefore we merged the variables (i) cerebrovascular stroke/brain hemorrhage (*variable/2945*), (ii) myocardial infarction (*variable/2941*), (iii) angina pectoris (*variable/2943*), (iv) diabetes (*variable/2947*), (v) cancer (*variable/3008*), (vi) epilepsy (*variable/3004*), (vii) fibromyalgia (*variable/2985*), (viii) rheumatoid arthritis (*variable/2986*), (ix) arthrosis (*variable/2987*), (x) bechterew (*variable/2988*), (xi) other muscle/skeletal diseases (*variable/2989*), (xii) other long-lasting illnesses (*variable/3011*), medication against high blood pressure (*variable/2950*), allergy (*variable/2617*) and/or asthma (*variable/2940*), and pain or stiffness in neck (*variable/2969*), shoulders (*variable/2970*), and/or upper back (*variable/2974*) into a new variable called “Chronic somatic disorders”. If the participants answered yes to one or more of the categories (i)–(xii), the score was recorded as 1. If they answered no to all of them, the score was recorded as 0.

2.3.5. Work status

Q1 included a question regarding current work situation: “What kind of work do you currently do?” There were six response options: (i) paid work, (ii) self-employed, (iii) full-time housework, (iv) student,

military service, (v) unemployed, laid off, and (vi) retired/on social security. If the answer was yes for the questions (i) or (ii), the score was recorded as 1 in the new variable “Work status”. Otherwise, the score was recorded as 0 (*variable/3064–65*).

2.3.6. Higher education

Q1 included a question about level of education: “What is your highest level of education?” There were five possible response options: (i) primary school, continuation school, and folk high school, (ii) high school, intermediate school, vocational school, and 1–2 years of high school, (iii) university qualifying examination, junior college, and A levels, (iv) university or other post-secondary education less than 4 years, and (v) university/college more than 4 years. If the participants answered yes to questions (iv) or (v), the score was recorded as 1. Otherwise, the score was recorded as 0 (*variable/3063*).

2.3.7. Economic difficulties

As an indicator of economic difficulties, the following question was asked in Q2: “Has the household ever had problems paying current expenses?” If the participants answered yes to the options “often” and “sometimes”, the score was recorded as 1. If the participants answered yes to the options “rare” or “no, never”, the score was recorded as 0 (*variable/25,149*).

2.3.8. Living alone

In Q1, there was a question about marital status. The answers options were (i) unmarried, (ii) married, (iii) widow/widower, (iv) divorced, (v) separated, (vi) registered partner, (vii) separated partner, (viii) divorced partner, and (ix) surviving partner. We divided (i), (iii), (iv), (v), (vii), (viii), and (ix) into not married/registered partner, and (ii) and (vi) were put into married/registered partner (*variable/2919*). If the participants answered yes to the options (ii) or (vi), the score was recorded as 1. For the other options, the score was recorded as 0.

2.3.9. Average alcohol intake

In Q1, the following question assessed the average 2-week alcohol intake: “How many glasses of beer (*variable/3037*), wine (*variable/3038*), or spirits (*variable/3039*) do you usually drink in the course of two weeks? Put 0 if you do not drink alcohol.” The three answers for different beverages were summed into one variable: “Units of alcohol during 2 weeks” and given as a single number. As full units but also half units is a possibility, we chose to make it a continuous variable.

2.3.10. Smoking cigarettes

In Q1, participants were asked: “Do you smoke?” The answer options were (i) yes, cigarettes daily, (ii) yes, cigar/cigarillos daily, (iii) yes, pipe daily, and (iv) never smoked daily. This was translated into the variable “smokes daily”. If the participants answered yes to (i), (ii), or (iii), the score was recorded as 1. Otherwise, the score was recorded as 0 (*variable/3024–26*).

2.3.11. Difficulties falling asleep past month 2.3.12 difficulties waking up to early past month

“During the past month, did you ever have problems falling asleep?” (*variable/2638*) and “During the past month, did you ever wake up too early and did not fall asleep again?” (*variable/2639*). There were 4 options for the answers in both variables: 1 “almost every night”, 2 “often”, 3 “sometimes”, and 4 “never”. The answers were changed into categorical options. The answers 1 and 2 were translated into yes, and 3 and 4 into no. If “yes” in 1 or 2, it is scored as 1 in both variables.

2.3.12. Hospitalization

One question in Q2 asked about hospitalization (regardless of condition/hospital department): “Have you been hospitalized during the past 5 years?” If the participants answered yes, the score was recorded as 1. Otherwise, the score was recorded as 0 (*variable/2598*).

2.3.13. Consulting GP, 2.3.15 consulting hospital doctor and 2.3.16 sick leave

In Q2, the following questions examined patterns of consulting different medical doctors: “During the past 12 months, have you:

- (i) visited a general practitioner (community doctor, private doctor, intern) (*variable/2590*),
- (ii) visited a doctor at the hospital (*variable/2592*), and
- (iii) been on sick leave with a medical certificate (*variable/2486*)?”

For each variable, if the participants answered yes, the score was recorded as 1. Otherwise, the score was recorded as 0.

We also merged the data on health-services 2.3.13, 2.3.14, and 2.3.15 in one variable called “Health Services”, presented in the section Results. The scale goes from 0 to 3, where 0 = no services used and 3 = all three services used.

2.3.14. Perceived lack of good friends

In Q2, this question explored social support: “Do you feel that you have enough good friends?” If the participants answered yes, the score was recorded as 0. Otherwise, the score was recorded as 1 (*variable/2516*).

2.4. Outcome variables

2.4.1. HSH

We recorded any SH that lead to hospitalization into medical, surgical, or psychiatric departments among HUNT-2 participants. Acute and emergency attendances in community health care centers that did not lead to hospitalization were not included. An overview of all acute admissions in the HUNT-2 population in the period from 01.01.1995 to 01.01.2014 was generated from the hospital records (patient administrative system, PAS) at Levanger and Namsos (local hospitals covering the entire HUNT-2 catchment area) and St. Olav Hospital (university hospital located outside, but serving the catchment area). Information included codes from the International Classification of Diseases, version 10 (ICD-10), used in Norway since 01.01.97. The ICD-9 diagnoses from the period 1995–1997 were converted from ICD-9 to ICD-10 by a diagnosis-converting program (www.medilexicon.com/icd9codes.php). The following ICD-10 diagnoses were included in the initial search: X6n: Intentional self-harm, Y1n: Event of undetermined intent, X4n: Accidental poisoning by and exposure to noxious substances, Y87.0: Sequelae of intentional self-harm, assault and events of undetermined intent, Z72.8: Other problems related to lifestyle, incl. self-damaging behavior, Z91.5: Personal history of self-harm, incl. parasuicide, self-poisoning and suicide attempt, T4n: Poisoning by drugs, medicaments and biological substances, F32: Depressive episode, F33: Recurrent depressive disorder, F31: Bipolar affective disorder, F34.1: Dysthymia, F43.0: Acute stress reaction, F43.1: Post-traumatic stress disorder, F43.2: Adjustment disorder, F43.8: Other reactions to severe stress, F43.9: Reactions to severe stress, unspecified, F50.0: Anorexia nervosa, F50.1: Atypical anorexia nervosa, F50.2: Bulimia nervosa, F51: Nonorganic sleep disorders, F60: Specific personality disorders, F61: Mixed and other personality disorders, F62.1: Enduring personality change after psychiatric illness, and F62: Enduring personality changes, not attributable to brain damage and disease. Diagnoses were completed by a medical doctor after examination and treatment according to hospital procedures.

In addition, information was collected from a free-text field in the patient files, where nurses described with words the main reason(s) for admission. On the basis of previous research and clinical experience, the Norwegian words for the following terms were used: “alcohol, razor, drunk, conscious, drown, exhaust, etching, attempt, gas, poison, hang, jump, i*x, inhal, innhal, intoks, intoxic, suffocation, drug, overdose, scratch, suicide, self-harm, shot, strangulation, throat, acid, tabl, tbl”. Some of the words had often typo and/or abbreviations, and were

therefore included in the search terms. The procedure has been described in more details previously (Junker et al., 2014).

The search for HSH and the collection of data (Method) were performed by the first author and a research assistant who had relevant education and experience for the task. When positive findings in diagnoses or free-text fields were found according to the protocol, the patient's hospital record was examined to confirm whether it was a HSH case. In cases where there was doubt, the first author was consulted. The first hospitalization due to SH after the beginning of the HUNT-2 survey was defined as the index episode, which is the first event episode registered as HSH.

2.4.2. SU

Data from the Norwegian Cause of Death Registry was used to identify HUNT-2 participants that were confirmed dead by SU. The ICD-10 diagnoses X6n, DSH, identified which methods were chosen for the SU act. A total of 9 (10%) of the persons dead by SU had one or more HSH episodes during the follow-up period. These were excluded from the HSH group and registered as SU only.

2.5. Methods of self-harm (Table 2)

When we registered first HSH episode in hospital records, we also collected information about different methods that were used in the self-harm situation. We divided the methods into “violent” and “non-violent”. Intoxes were categorized into “non-violent” methods. Hanging, shooting, cutting, jumping and drowning, were categorized into “violent” methods. Methods that did not fit into any of these categories were put into “other methods”, categorized under “violent method”.

2.6. Statistics

Data were analyzed by using IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY:IBM Corp.

Categorical data (i.e., gender) were analyzed with the “Pearson's chi-square test of association”, and continuous variables (i.e., age) were analyzed with “the one-way analysis of variance (ANOVA)”. Categorical data are presented as percentage (*n*), and continuous data are presented as mean with a 95% confidence interval (CI).

2.7. Multivariable analyzes

Multinomial logistic regression was used to compare HUNT 2 (reference category) with the two other dependent categories HSH and SU. One multinomial analysis was performed for each of the independent variables adjusted for age and gender.

Similarly, binomial logistic regression was used to compare the two dependent variables HSH (reference category) and SU. One binomial analysis was performed for each of the independent variables adjusted for age and gender.

3. Results

3.1. General characteristics

During the follow-up period of the 66.140 participants lasting up to 19 years from 1995, 332 persons (0.51%) from the HUNT-2 population were recorded with HSH, and 91 persons (0.14%) were registered as dead by SU. The average follow-up time before index episode for HSH and SU was 4.9 years and 6.8 years, respectively, for those with date for study start registered. When date for inclusion in the study was missing, date was replaced by study start. Then the average follow-up time was 5.2 years and 7.8 years for HSH and SU, respectively.

Younger adults (20–40 years) were constituted 31.7% in HUNT-2, 50% in HSH and 33%. The HSH/SU ratio in the HUNT-2 population was

3.65, and the mean incidence was 26.8 and 7.3 per 100,000 inhabitants per year for HSH and SU, respectively. The follow-up study showed that, among the 91 who died by SU, 10% ($n = 9$) had previously been recorded with one or more HSH incidences. These were excluded from HSH- group and recorded as SU only.

3.2. Comparison between the HSH and SU groups (Presented in Table 1)

Compared to the SU group, the HSH group consisted of more women and younger people (20–40 years). Further, they more frequently reported headache and chronic physical conditions and had a higher use of health services (1.85 (1.72–1.97) $p \leq 0.001$) compared to both SU (1.20 (0.90–1.49) $p \leq 0.001$) and HUNT-2 (1.38 (1.37–1.39) $p \leq 0.001$).

Self-harm methods (see Table 2) were mainly non-violent in the HSH group and violent in the SU group. The most frequent violent SU methods were hanging, shooting, drowning, jumping, and “others”. Cutting was the only violent method that occurred more frequently in the HSH population.

3.3. Comparison between the HSH group, the SU group, and the general HUNT-2 population (Presented in Table 1)

Scores on the HADS depression scale were highest in the HSH group, slightly lower in the SU group, and considerably lower in the general HUNT-2 population. We found similar tendencies between the groups in HADS anxiety and in mental disorders in family.

Economy and higher education were lower in both the HSH group and the SU group compared to the HUNT-2 population. The HSH and SU groups also reported a higher lack of good friends compared to HUNT-2 population.

Working capacity was almost the same in the SU group and in the HUNT-2 population but considerably lower in the HSH group, and sick leave during the previous 12 months was almost twice as high in the HSH group compared to both the SU group and the HUNT-2 population.

Substance use (including alcohol and cigarette smoking) was higher in the HSH and SU groups compared to the HUNT-2 population. Units of alcohol during the previous two weeks were higher for both the HSH group and the SU group. There were more regular smokers in the HSH and SU groups.

3.4. Comparison between HSH that later died in SU (HSH-SU) and HSH-group

Of the 332 HSH, 9 (2.7%) later died in SU (her termed HSH-SU). 2 of the 9 HSH-SU (22.2%) were male and mean age was 40.1 (32.7–47.4) years. Significantly fewer were working among HSH-SU; 1 of 6 (16.7%), compared to HSH, 117 of 182 (64.3%), OR 0.11, 95% CI 0.01 – 0.97, $p = 0.028$. Except for significant difference between numbers working in the groups, no other analyzes reached statistical significance. Though not significantly different, some trends were seen. HSH-SU had lower score in HADS depression 3.9 (0.5–7.3) and HADS anxiety 5.7 (1.4–10.0) compared to HSH who scored 5.1 (4.6–5.6) on HADS depression and 7.4 (6.8–7.9) on HADS anxiety. Opposite, HSH-SU reported more mental health problems in family 4 of 9 (44.4%) compared to 96 (28.9%) in HSH. Fewer complained about headache in HSH-SU 2 of 9 (22.2%) compared to 146 (44.9%) in HSH. However, 9 of 9 (100%) of HSH-SU reported more chronic somatic and physical conditions, and slightly lower number, but still high, in HSH 279 (92.7%). Units of alcohol during two weeks was higher in HSH-SU group 5.8 (-3.3–14.9) compared to 4.3 (3.3–5.2) in HSH. 4 out of 9 (44.4%) HSH-SU reported to smoke daily, while number was higher in HSH 185 (58.4%). The differences in use of health care services were minor, and results are not reported.

4. Discussion

4.1. Summary of our main findings

During a 19 year follow up in HUNT-2 0.51% were hospitalized due to HSH and 0.14% lost their lives due to SU. 2.7% of those hospitalized due to HSH later died by SU. 10% of the SU group previously were hospitalized due to HSH.

Comparing HSH to SU showed that the HSH group consisted of younger persons and more women self-harm methods were less violently. The SU group consisted of more males and older people and self-harm methods were more violently. HSH also reported more physical illness, headache and use of health care services compared to SU.

Comparing the HSH and the SU populations to the general HUNT-2 population showed that HSH had highest scores, followed by SU with lowest scores in the general population for HADS depression scale. Trends towards the same pattern were seen for HADS anxiety scale and for the item “mental disorder in family”. HSH and SU compared to the control group both showed lower levels regarding economy and education, lack of good friends, more use of nicotine, alcohol and other substances. Regarding working capacity / activity SU did not differ from controls, while HSH had significantly more sick leave.

Comparing the HSH with HSH-SU showed significantly fewer working in the HSH-SU than HSH. For other factors no significant differences were seen in this small sample (9 persons).

4.2. Comparison of SU and HSH

In line with the literature, we found that more men had died by SU and more women were linked to HSH Freeman et al., 2017; Hawton and Harriss, 2008.

The SU incidence among HUNT-2 participants was lower than findings in North-Trøndelag County and Norway in the same period, which were 11.1 and 11.7 per 100,000 inhabitants per year, respectively [dataset] ((NIPH)). Also, the HSH/SU ratio in our findings was lower than that in most other studies (Hawton and Harriss, 2008; Ribeiro et al., 2016). An explanation for this may be that our study recorded only HSH and not SH in general. Further, our study population (HUNT-2) covered only 70% of the total population in North-Trøndelag County and was only representative for those aged 40–70 years, which may have underestimated HSH outcome variable in age group 20–40 years. As in most population studies, inhabitants with psychiatric and substance-abuse disorders were underrepresented (Krokstad et al., 2013).

In the follow-up study, we found that 2.6% of the HSH patients later died by SU, and that 10% of the SU patients had been hospitalized previously because of SH. SH (and HSH) are not necessarily associated with suicidal ideation (Lenkiewicz et al., 2017; Quinn et al., 2017). In a review, exploring reasons for self-harm expressed by individuals who had harmed themselves, the majority was found to report managing stress/affect regulation as a reason. Furthermore, exerting interpersonal influence was important by many, punishment was a frequent explanation and likewise dissociation (Edmondson et al., 2016). Less frequently described were sensation-seeking behavior, averting suicide, maintaining or exploring boundaries and expressing and coping with sexuality. Still, so far, knowledge on the frequency of the various reasons for self-harm in literature is scarce. Only 9 (2.7%) of the 332 HSH in our study later died by suicide and it is not possible to evaluate from our study whether preventive and treatment strategies implemented after HSH had any effect on fewer incidents of SU in this group. However, the differences between HSH and HSH-SU should be further explored.

The HSH group reported significantly more headache and chronic physical conditions than both the SU group and the HUNT-2 population. Indeed, we must keep in mind that both of these variables were merged into a new category, and this is a limitation in our study. On the

other hand, the same results were reported regarding specialized health services, hospitalizations, sleeping problems, and higher use of sick leave. We did not find any difference between the SU group and the HUNT-2 population in these variables. Our findings indicate that persons with HSH have a more complex and chronic burden, involving somatic factors in addition to psychiatric and socioeconomic factors. How these factors can influence each other and probably sustain a vicious circle is described in a former study (Dantzer et al., 2008), and a recent review found that young people engaging in self-harm reported greater levels of body dissatisfaction, body disownership, and deficits in the experience and evaluation of bodily sensations (Hielscher et al., 2019). Several chronic physical conditions were associated with suicidal behavior in a multi-country review (Scott et al., 2010), yet there were no differences between SU and SH in that study. Other studies have reported no such association (Amer and Hamdan-Mansour, 2014; Webb et al., 2012). These findings are in contrast to our findings. However, there may be substantial differences in social welfare and health-care services between countries, which might influence the association between health problems and HSH. In our study, complaints regarding health were self-reported, and validated diagnoses confirmed in hospital and GP files may have shown different distributions in the HSH group and in the SU group.

4.3. Comparison of SU and HSH with the HUNT-2 population

Overall, many of the unfavorable psychosocial, psychological, and somatic study variables as e.g., not working, depression and chronic somatic and physical conditions, had a strong positive association to both HSH and SU, in line with previous findings (Borges et al., 2006; Ribeiro et al., 2016) (see Table 1).

Both groups reported higher levels of depression and anxiety symptoms, as found in clinical and epidemiological reviews (Haw et al., 2001; Turecki and Brent, 2016) and meta-analyses (Arsenault-Lapierre et al., 2004).

Self-reported mental disorders in close family members were also more frequent in both groups, in accordance with other studies (Qin et al., 2003; Turecki and Brent, 2016).

Compared to the general HUNT-2 population, the HSH group were less educated. This is in line with a Korean health survey, which indicated that people with lower education and who were unemployed were at higher risk for suicidal attempts (Kim et al., 2016). In our study, we did not find that unemployment was a risk factor for SU. This is in contrast to findings in a systematic review and meta-analysis, which suggested that long-term unemployment was associated with a greater incidence of SU (Milner et al., 2013). Again, differences in social welfare may contribute to the discrepancy, but the difference may also be explained by the long-time frame between the time when data were collected and the time when the outcome was registered in our study. Eventual changes in life situation have not been accounted for.

More people in the HSH and SU groups reported sleeping problems compared to the HUNT-2 population. This is in keeping with recent studies reporting an association between sleep disturbance and increased self-harming behaviors (Bernert and Nadorff, 2015; Malik et al., 2014). Insomnia may be explained by mental disorders as well as physical and psychosocial stress factors (Bjorngaard et al., 2011). However, empirical studies investigating mediators of the relationship between insomnia and SU are missing (Woznica et al., 2015).

Financial strain was more commonly reported in both the HSH group and the SU group, in line with a large population-based longitudinal study, where lower income was associated with more mental illnesses and suicide attempts (Sareen et al., 2011). Still, it is difficult to distinguish the economic burden and the mental problems leading to suicidal behavior. The presence of several mechanisms might increase the risk, such as overcrowding, hunger, violence, social networks, and decreased mental and working capacity. A review on this topic concluded that more robust evidence is needed (Bantjes et al., 2016).

The HSH and SU groups reported a lack of good friends more frequently than the controls, which are consistent with findings reporting that social integration can be an important preventive factor in mental illnesses (Tsai et al., 2015).

A greater proportion in the HSH and SU group was drinking alcohol and was smoking daily compared to the general HUNT-2 population. Tobacco dependence and suicidal behaviors have been associated in several studies, but the nature of their relationship is still unclear (Gruca et al., 2014; Lopez-Castroman et al., 2016). Adjustment for psychiatric disorders does not rule out the association between SU and smoking (Bohnert et al., 2014), suggesting nicotine as an independent risk for SU (Schneider et al., 2005). Further, smokers have been found to suffer from more medical comorbidities than non-smokers (Bohnert et al., 2014), and suicidality could be partly explained in this context.

Our findings that the HSH and SU groups were drinking more frequently are in line with preceding findings (Boden and Fergusson, 2011; Darvishi et al., 2015; de Haan et al., 2015; Wojnar et al., 2008)

4.4. Strengths and limitations

This is one of very few studies linking both SU and HSH to a large population-based cohort sample [dataset] (HUNT). The end points are validated, because data were collected from health registry, mortality registry, and hospital records. Especially in SH research, most of the previous studies have relied on self-reported information. Further, it is an advantage that these different endpoints and risk factors are compared within the same large community population in the same period. The large survey and relatively good response rate are factors that strengthen the study. So are the rich dataset and the wide range of sociodemographic and health factors covered by the variables.

Still, some limitations must be kept in mind when interpreting the results. The response rate in HUNT-2 was $n = 92,936$ (70%), but still $n = 26,796$ (30%) of the population in North-Trøndelag are missing. Shortly after study completion of HUNT-2, a random sample of 2.5% of non-attendants was selected for a non-participation study (Holmen et al., 2003). In age group 20–40, where participation was low, main reason not to join was lack of time and staying outside of county (Holmen et al., 2003). Universities and other larger working places are located in the larger cities, and many young people move from their hometowns for study or job. In addition to lower participation in HUNT-2, these demographic factors may have affected young people that actually were participating, as they move to the larger cities (e.g., Trondheim in South-Trøndelag) – and receive health care services there. We tried to capture some of these people by including St Olav Hospital, the Central Hospital closest to North-Trøndelag, but people hospitalized in other parts of Norway because of SH were lost for the follow up. We do not have the numbers of how many who were implicated by this, but this is probably low for the other age groups, since emigration is low in the area (Krokstad et al., 2013). The HUNT-2 non-participation study also found low attendance rate among citizens with severe physical illness, psychiatric disorders, and substance abuse, supported by findings in other population-studies (Haapea et al., 2008; Hansen et al., 2001). Therefore, only parts of important groups have participated in the HUNT-2 study, and this may have led to underestimation of both exposure and outcome variables and their association. Our finding that the SU rate among the HUNT-2 participants was lower compared to the SU rate for the population of North-Trøndelag County found in the Norwegian Cause of Death Registry ((NIPH)) support this assumption.

Most of the questions from HUNT-2 included in this study are not from validated clinical scales, and may not be robust enough for the characteristics that have been analyzed. The answers are self-reported and not diagnostic interviews or evaluation done by clinicians, which makes the answers less reliable. Some variables asked for previous

Table 1
Comparison of HUNT 2, HSH, and SU using multinomial logistic regression analyzes adjusted for age and gender.

Independent variables ^d	HUNT2 population (n = 64,770)	HSH population (n = 332) ^e	SU (n = 91) ^f
Male gender	n = 30,405 (46.9%)	n = 106 (31.9%) a ***	n = 62 (68.1%) a *** b ***
Mean age	50.2 (50.1–50.3)	41.7 (40.2–43.2) a ***	46.7 (43.5–50.0) b **
Range age	82	62.9	64.0
Mental health			
HADS depression (Range 1–21)	3.4 (3.4–3.5)	5.2 (4.7–5.6) a ***	4.8 (4.0–5.6) a ***
HADS anxiety (Range 1–21)	4.2 (4.1–4.2)	7.3 (6.8–7.9) a***	6.1 (5.1–7.0) a ***
Mental health problems in family	n = 96 (37.4%) a***	n = 9913 (18.6%)	n = 21 (31.3%) a*
Somatic health			
Headache	n = 19,877 (30.7%)	n = 102 (44.9%) a**	n = 20 (22%) b**
Chronic somatic and physical conditions	n = 28,034 (43.3%)	n = 185 (55.7%) a***	n = 34 (37.4%) b**
Use of health services			
Previous help seeking (mental problems)	n = 7259 (11.7%)	n = 183 (56.8%) a***	n = 3 (39.3%) a*
Hospitalized past 5 years	n = 18,804 (35.5%)	n = 136 (54.0%) a***	n = 20 (31.3%) b**
Specialized health care past 12 months	n = 14,970 (33.9%)	n = 107 (47.3%) a**	n = 15 (28.8%) b*
Visited GP past 12 months	n = 39,103 (74.9%)	n = 224 (88.2%) a***	n = 50 (73.5%)
Function			
Not married/registered partner	n = 25,761 (39.9%)	n = 185 (56.2%) a ***	n = 45 (49.5%)
Higher education	n = 12,247 (20%)	n = 42 (13.2%) a***	n = 14 (15.9%)
Are working	n = 35,366 (54.6%)	n = 130 (39.2%) a*	n = 49 (53.8%)
Difficult falling asleep past month	n = 4698 (8.8%)	n = 64 (24.6%) a ***	n = 10 (14.7%) a*
Waking up early past month	n = 5177 (9.7%)	n = 56 (21.5%) a***	n = 9 (13.0%)
On sick leave during past 12 months	n = 10,918 (36.7%)	n = 92 (62.6%) a***	n = 15 (33.3%)
Economic difficulties	n = 6669 (15%)	n = 92 (37.1%) a***	n = 17 (28.3%) a**
Interpersonal relationship			
Perceived lack of good friends	n = 8557 (16.2%)	n = 70 (26.9%) a***	n = 18 (27.3%) a*
Substance use:			
Units of alcohol (during 2 weeks)	3.2(3.2–3.3)	4.3(3.3–5.2) a*	6.8 (4.6–9.1) a***
Smokes daily	n = 10,722 (16.5%)	n = 113 (34.0%) a***	n = 25 (27.2%) a**

***p ≤ 0.001 (OR (95% CI)).

**p ≤ 0.01 (OR (95% CI)).

*p ≤ 0.05 (OR (95% CI)).

^aSignificant compared to HUNT2 and sex.

^bSignificant compared to SH/SU.

^cStroke, cardiac MI, angina, diabetes, cancer, epilepsy, fibromyalgia, rheumatoid arthritis, arthrosis, Bechterew, other muscle/skeletal disease, other long-lasting physical illnesses, medication against high blood pressure, allergy and/or asthma, conditions in neck, shoulders, and/or upper back.

^dAll independent variables have data from HUNT-2 survey.

^eHSH variable was collected from hospital records.

^fSU variable was collected from Norwegian Cause of death registry.

SU Suicide.

HSH Hospitalized self-harm.

HUNT 2 Population in North-Trøndelag County that participated in HUNT-2 Survey.

information, creating the possibility for recall bias (Compton and Lopez, 2014). Further, baseline variables were measured only once; yet, these symptoms can have fluctuated considerably during the follow up. In some of the variables, as units of alcohol, not standardized measurements are used. In the HUNT2- study, number of glasses is used instead of numbers standardized units. The term units are not necessarily familiar for the average population, and glasses would be an acceptable estimate. Therefore, our findings may be more inaccurate compared to studies referring to standardized units in their results.

The Health Service variable in the study has three categories concerning the level of health services; (1) admission to hospital during the past 5 years. (2) visit to Hospital Doctor during past 12 months, and (3)

visit to GP during the past 12 months. There are no questions about number of visits to each health service. Our Health Service variable reflects the health service level, but not the frequency in the use of health services, which is a limitation.

Due to the high number of variables and statistical analysis the possibility of type 1 errors is increased. This possibility could be limited by using 99% confidence intervals (CI) or other statistical corrections such as Bonferroni test for multiple comparison. However, since we consider this as an exploratory study, and not a test of hypothesis we wanted type II errors to be low, and kept the 95% CIs. In our results, however, we also have reported which of the analyzes that are within 99% CI.

Table 2
Methods of self-harm and suicide using one-way anova analyzes.

Category	HSH population (n = 332)	SU population (n = 91)	Total (n = 423, 100%)	p-value (of Total)
Intoxes (non-violent methods)	n = 289 (87%)	n = 8 (8.8%)	n = 297 (70.2%)	p < 0.001
Violent methods	n = 43 (13%)	n = 83 (91.2%)	n = 126 (29.8%)	p < 0.001
Hanging	n = 6 (1.8%)	n = 32 (35.2%)	n = 38 (9.0%)	p < 0.001
Shooting	n = 1 (0.3%)	n = 24 (26.4%)	n = 25 (5.9%)	p = 0.99
Cutting	n = 28 (8.4%)	n = 1 (1.1%)	n = 29 (6.9%)	p < 0.001
Jumping	n = 0 (0%)	n = 5 (5.5%)	n = 5 (1.2%)	p = 0.999
Drown	n = 3 (0.9%)	n = 13 (14.3%)	n = 16 (3.8%)	p < 0.001
Others	n = 5 (1.5%)	n = 8 (8.8%)	n = 13 (3.1%)	p < 0.001

In our study, only HSH was recorded. Less severe SH, not admitted to specialized health care settings, were not recorded. It is possible that community samples and hospital samples will have different characteristics as well as different motivations for SH. Evidence from high-income countries suggests that individuals who present to HSH are at higher risk for later SU and important targets for suicide prevention (Knipe et al., 2019). A national cohort study of HSH from Sweden found that individuals with severe mental disorders and SU attempts by violent methods like hanging or other self-injury (vs. the less violent self-poisoning), were at higher risk for later SU (Runeson et al., 2016). A systematic review of Hospital Presenting Self-harm found that 1 out of 25 (4%) died by SU 10 years after index presentation (Carroll et al., 2014). This literature may indicate that HSH are at higher risk for SU compared to other SH, but there are few studies comparing the difference in risk factors and characteristics. Thus our results cannot be generalized to SH, HSH may represent the most severe SH.

5. Conclusion

The present data suggest that there are some differences between the characteristics of the HSH group and the SU group, and the differences may be important regarding the processes leading to either HSH or SU. Compared with SU, people in the HSH group were younger and more often female and had a higher burden of chronic somatic and mental complaints and lower social and working functioning. Compared to the HUNT-2 population (the broader population in North-Trøndelag County), the HSH and SU groups had more mental health problems, lower education, more economic problems, higher use of stimulants, and less social support.

6. Implications for practice

Most of the risk factors in this study are well known and already implemented in clinical practice. Nevertheless, some of the exposures as physical illness and use of health care services seem differentially related to the HSH and SU groups and might call for more specific preventive strategies.

Due to results, HSH group seem to have a more a chronic and complex symptom burden, consisting of both mental and physical illness. SU group reported better outcome in several of the variables measuring mental and physical health, might suggest a better mental and physical function compared to HSH group. Still, the risk factors regarding mental health, sleep, economy and social network are significant also for SU group. This may indicate a higher awareness among health workers (and the environment) of adverse life events, losses in life (as family, friends or reputation) and sudden drop in mental health function as risk factors for future SU.

Findings on alcohol use and smoking for both HSH and SU groups could indicate that health workers should screen patients for their smoking and alcohol use, and provide interventions. However, in 2005, a law prohibiting smoking in public places was introduced in Norway, and smokers have been considerably lower in Norway. As far, we have not seen an effect on SU rate. A lack of good friends could indicate more emphasis among health workers on network building and social activities.

Population-based studies can compare different populations at the group level; yet, their results have limited use in individual clinical assessment and treatment. Risk factors in populations cannot replace the importance of careful monitoring of symptoms, behavior and social and environmental stress factors in the life of individuals. This is supported in a review and meta-analysis of suicide risk assessment among psychiatric inpatients (Large et al., 2018). Qualitative research might help improve our understanding of this complex phenomenon by focusing on the individual and by contextualizing individual differences beyond the common simplistic risk-factors categories (Knizek and Hjelmeland, 2018).

From a population-based point of view, various social welfare and health-care settings seem to be important areas for prevention, especially regarding the HSH group. In clinical setting, extra care should be taken for those patients with a complex symptom burden, including mental, physical, and social health factors.

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Declaration of Competing Interest

None.

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Supplementary materials

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