Predictors of suicidality and self-harm related admissions to psychiatric and general hospitals

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Thesis for the degree of philosophiae doctor (PhD)

at the University of Bergen

2017

Date of defence: 22.11.2017

Scientific environment

The work presented in this thesis was conducted at the Department of Clinical Medicine, Faculty of Medicine and Dentistry, University of Bergen and at the Research Department, Division of Psychiatry, Haukeland University Hospital. The research has been conducted in collaboration with the National Centre for Suicide Research and Prevention, University of Oslo. During parts of the study period, there has been collaboration with the Centre for Clinical Research, Haukeland University Hospital.

Acknowledgements

This thesis is based on data from the SIPEA study – "Suicidality in Psychiatric Emergency Admissions", which has been conducted at the Psychiatric Acute Unit (PAU) at the Division of Psychiatry, Haukeland University Hospital, in Bergen. I would like to thank the Director of the Division, Hans Olav Instefjord, and Kristin Jordheim Bovim, Director of the Clinic of Psychiatry, for initiating and facilitating the data collection for this study. The Department of Research at the Division of Psychiatry has been the main funder of the project, and an arena for scientific – as well as more informal – discussions, data management, and all that is needed to run a research project. Many thanks to all my colleagues here (see below) for invaluable support. I also would like to thank the University of Bergen, which has given me the possibility, support and necessary time to finish this thesis.

Above all, thanks to my supervisors Professor Emeritus Hugo A. Jørgensen and Professor Lars Mehlum. I am not sure any of them would have agreed to take on this task if they knew what kind of "polar expedition" it would become. Along with building up the Department of Research at the Division of Psychiatry, Hugo was also the Principal Investigator (PI) of the SIPEA study during its first years. His generous sharing of knowledge, his questions, suggestions and support, has been invaluable to me. Lars, who is the Director of the National Centre for Suicide Research and Prevention at the University of Oslo, has shared his knowledge of and insight into the field of suicidology with me, and invited me to participate in the research meetings and conferences at the Centre. His scientific guidance and encouragement throughout the project have been essential for the SIPEA study in general, and for me in particular.

Professor Ketil Ødegaard has been PI of the SIPEA study and Head of the Department of Research after Hugo retired. He has given me and the project

Abstract

Background and aims:

Although suicide risk is a frequent reason for acute psychiatric admissions, there is a lack of knowledge on the prevalence and characteristics of such admissions and very little is known about the short- and long-term outcome in relation to severe self-harm after psychiatric discharge. The overall aim of this thesis was to describe the prevalence of suicide risk, suicidal ideation, non-suicidal self-harm, and suicide attempt as the main or contributing reasons for acute psychiatric admissions: as well as to study these variables together with other clinical, sociodemographic, diagnostic, and treatment related variables as predictors of acute psychiatric readmissions and self-harm induced somatic admissions.

Methods:

This thesis is based on the results from two prospective, observational and longitudinal cohort studies, and one interview study. The studies are based on data from patients admitted to a psychiatric acute unit at a hospital, which has a catchment area of about 400 000 inhabitants. Papers I (n=1245) and II (n=2827) used data obtained by the standardised assessments of all consecutive admissions during one and three years respectively. Study I examined the data assessed at the index admission (each patient's first admission to the psychiatric acute unit during the inclusion period) as predictors of readmission due to any cause, and readmissions due to suicide risk, within a mean follow-up time of 1.5 years. Study II analysed data assessed at index admission and possible readmissions, as well as follow-up data on psychiatric outpatient treatment as predictors of self-harm induced somatic admissions within a mean follow-up time of 2.3 years. Paper III included 308 patients who were randomly selected from non-psychotic patients consecutively admitted to the psychiatric acute unit, due to suicide risk. A multiple regression model was used to examine if post-traumatic stress disorder (PTSD) predicted the number of self-harm induced somatic admissions

within 6 months, when adjusted for borderline personality disorder (BPD). Secondly, a structural model comprising two latent BPD factors, 'dysregulation' and 'relationship problems', as well as PTSD and several other diagnostic variables was applied to examine the associations between these variables and the number of post-discharge self-harm induced somatic admissions.

Results:

Suicide risk was the main or contributing reason for 54% of the total index admissions and 62% of the total readmissions. In the most frequently admitted patients, 80% of the admissions were related to suicide risk. Of the total cohort, about one in ten patients had at least one self-harm induced somatic admission during follow-up. The proportion of patients having their first such admission within the first six months after psychiatric discharge was 48%, while 42% of the patients had their first self-harm induced somatic admission within the subsequent six months. Important predictors of self-harm induced somatic admission, were having had the most recent psychiatric admission related to non-suicidal self-harm or to a suicide attempt. Other significant predictors were having a history of psychiatric hospitalisation before the index admission, psychiatric readmissions during follow-up, an increasing number of psychiatric outpatient consultations during follow-up, and having a diagnosis of recurrent depression, BPD, substance use disorders, or PTSD. Only about half of the somatic hospital admissions identified by the researchers as caused by self-harm, received an ICD-10 diagnosis of intentional self-harm.

In the subgroup of patients with suicide risk related acute psychiatric admissions one in five patients had at least one self-harm induced somatic admission within 6 months after discharge. Among these patients, PTSD and BPD predicted the number of self-harm induced somatic admissions with nearly the same estimates. An emotional dysregulation factor based on the BPD criteria was significantly associated both directly and indirectly, via PTSD, with the

number of somatic self-harm admissions; even when controlled for other relevant psychiatric disorders and symptoms.

Conclusions: Suicide risk is a frequent reason for acute psychiatric admissions, and about one in ten patients have at least one self-harm induced somatic admission during the year following psychiatric discharge. The risk of such severe self-harm is high over an extended period after discharge. Treatment of the underlying disorder(s) may not be sufficient to prevent self-harm, and the repetition of self-harm in particular. In addition, there is a need for evidence-based psychosocial and behavioural interventions that may directly and transdiagnostically address suicidal thoughts and behaviours. Treatments that help patients to better deal with problems related to emotional dysregulation may contribute to preventing or reducing self-harm behaviour in several subgroups of patients admitted to psychiatric acute units.

Abbreviations

BPD	=	Borderline personality disorder
CBT	=	Cognitive behavioural therapy
DBT	=	Dialectical behaviour therapy
DSM-IV	=	Diagnostic and statistical manual for mental disorders, fourth revision
GAD	=	Generalised anxiety disorders
GAF-S	=	Global Assessment Function Scale – Split version
ICD-10	=	International Classification of Diseases, tenth revision
Index admission	=	Each patient's first admission during the inclusion period
MADRS	=	Montgomery Aasberg Depression Rating Scale
MAR	=	Missing at random
MBT	=	Mentalisation-based treatment
MDD	=	Major depressive disorder
MINI	=	The Mini International Neuropsychiatric Interview for DSM-IV Axis I disorders
MCAR	=	Missing completely at random
MNAR	=	Missing not at random
NSSI	=	Non-suicidal self-injury
NSSH	=	Non-suicidal self-harm
PAU	=	The Psychiatric acute unit at Haukeland University Hospital
PD	=	Panic disorder
PTSD	=	Post-traumatic stress disorder
SA	=	Suicide attempt
SB	=	Suicidal behaviour
SCID II	=	The Structured Clinical Interview for DSM-IV Axis II disorders
SI	=	Suicidal ideation
SH	=	Self-harm

| SEM | = Structural equation model |
| SUD | = Substance use disorders |

ERRATUM:

Paper III, Abstract, third last paragraph: The original text was as follows: "A structural model comprising two latent BPD factors, dysregulation and relationship problems, as well as PTSD and several other variables demonstrated that PTSD was an important *predictor* of the number of self-harm admissions". The journal's proofreader had replaced the term "predictor" with the term "correlate" in the e-published version of the paper. The correct term "predictor" appears in the paper version of the Journal of Traumatic Stress.

List of publications

Paper I. Mellesdal, L., Mehlum L., Wentzel-Larsen, T., Kroken, R., Jørgensen, H.A. (2010): «Suicide Risk and Acute Psychiatric Readmissions: A Prospective Cohort Study", Psychiatric Services, Vol. 61: 25-31.

Paper II. Mellesdal L., Kroken R.A., Lutro, O., Wentzel-Larsen, T., Kjelby, E., Oedegaard, K.J., Jørgensen, H.A., & Mehlum, L. (2016): «Self-harm induced somatic admission after discharge from psychiatric hospital- a prospective cohort study", European Psychiatry, Vol. 29: 246-252.

Paper III. Mellesdal, L., Gjestad, R., Johnsen, E., Jørgensen H.A., Oedegard, K.J., Kroken R.A., & Mehlum, L. (2016): "Borderline Personality Disorder and Posttraumatic Stress Disorder at Psychiatric Discharge Predict General Hospital Admission for Self-Harm", Journal of Traumatic Stress, Vol. 29: 1-7.

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1. Introduction

Patients admitted to acute psychiatric units present with a broad spectrum of diagnoses and sociodemographic characteristics. Some are admitted due to illness onset, others due to a relapse, and yet others due to serious life crises. Irrespective of such reasons, suicide risk is likely to be involved in a large proportion of the acute psychiatric admissions. To determine whether a patient has a heightened risk for suicide depends on the referring health-care professional's assessment of the patient's current mental state, knowledge about the patient's psychiatric history and previous suicidal behaviour, as well as the professional's ability to use these details from the patient's history in combination with all relevant information.

A large number of studies have demonstrated a strong association between mental disorders and both suicide (1-3) and various forms of self-harm (4-6). Factors associated with both suicide (7, 8) and non-fatal self-harm (9) in psychiatric inpatients, as well as the high risk for suicide after discharge of psychiatric patients (10, 11) and after somatic admission for self-harm (12), are also well documented. Various studies, including a register-based study (13), interview studies (14, 15), and retrospective chart reviews (16), have investigated self-harm after discharge from psychiatric hospitals in selected high-risk patient subgroups. The only study (17), which has presented data on somatic hospital admissions due to self-harm after psychiatric discharge in an unselected patient cohort found that 6.5% of all patients discharged over a year were readmitted to somatic or psychiatric hospitals due to self-harm within 12 months after discharge. Self-harm, whether suicidal or non-suicidal, has a profound impact on patients and their families (18), health-care providers, and society at large (19). In addition to the risk for causing serious bodily harm, self-harm is also a strong risk factor for suicide (12), with repeat self-harm further augmenting this risk (20). The paucity of knowledge on severe self-harm after psychiatric discharge, and hence the need to fill this knowledge gap, has been a strong impetus for the studies presented in this thesis.

The studies investigated the prevalence of suicide risk and the related variables suicidal ideation, non-suicidal self-harm, and suicide attempt as the main reasons for, or contributing factors to, acute psychiatric admissions. The studies also examined follow-up data for all admitted patients on their readmission to a specific psychiatric acute unit (PAU), as well as on self-harm-induced somatic admissions after psychiatric discharge. It was hypothesised that suicide risk, as a reason for acute psychiatric admission, would predict readmission and that patients with suicide risk-related acute psychiatric admissions have an increased risk for post-discharge self-harm-induced somatic admissions. Due to the scarcity of empirical evidence, the above hypotheses were based mainly on clinical experience. Lastly, a subgroup of patients admitted to the PAU due to suicide risk were also examined. This study particularly focussed on borderline personality disorder (BPD) and post-traumatic stress disorder (PTSD) as predictors of post-discharge self-harm-induced somatic admissions.

There has been much debate on patients with borderline personality disorder (BPD) and their frequent suicidality-related psychiatric admissions (21, 22). Intense emotional responses to stress, coupled with difficulties in regulating these emotions, are core characteristics of people with BPD (23). Many BPD patients report that cutting, or other forms of self-harm, provide immediate relief of the mental pain, and that the physical harm is more effective than words at demonstrating how upset they are or how bad they feel (23). Consequently, these patients often present in various outpatient clinical settings with great despair and suicidal threats. Despite clinical guidelines (24), as well as BPD experts (25, 26), have suggested that inpatient treatment has the potential to reinforce, rather than prevent, repetitive suicidal behaviour in BPD patients they are often admitted to psychiatric acute units due to suicide risk. Although a large proportion of self-harm in BPD patients is not suicidal and does not require somatic inpatient treatment, there is also a high prevalence of serious self-harm (27) and suicide (28) among individuals with BPD. Therefore, it can be reasonably assumed that BPD patients admitted to a psychiatric acute unit due to suicide risk would have

an increased risk for self-harm-induced somatic admission after discharge from the psychiatric hospital. Previous studies (6, 29) showed that several borderline criteria, including impulsivity, unstable relationships, affective instability, anger problems, fear of being abandoned, identity disturbances, feelings of emptiness, and dissociation, are associated with an increased risk for repetitive self-harm and suicidal behaviour in patients with BPD. However, many people may experience problems related to some of these symptoms (criteria), even if they only meet subthreshold levels for a diagnosis of BPD. Therefore, it can be hypothesised that the underlying dimensions of the borderline symptoms play a role in the self-harm process in patient groups other than those diagnosed with BPD too, for instance in patients with post-traumatic stress disorder (PTSD) since, like BPD, PTSD is also associated with emotion regulation difficulties and various forms of self-harm behaviour (28, 30). However, BPD and PTSD often co-occur, and some previous studies of outpatient- and population-based samples (31, 32) found that PTSD was not an independent predictor for self-harm when co-occurring with BPD (31). Therefore, the third study presented in this thesis aimed to examine the relationship between BPD, PTSD, and post-discharge self-harm in patients admitted to the PAU due to suicide risk.

1.1 Nomenclature and definitions

Numerous terms have been used to describe non-lethal self-harm. For example, parasuicide, unsuccessful suicide, deliberate self-harm, self-harm, non-fatal self-harm, suicide attempt, suicidal acts, suicidal behaviour, instrumental suicidal behaviour, non-suicidal self-injury, non-suicidal self-harm, and self-mutilation (33-35). Such diversity of terms and definitions complicate both clinical practice and research. The challenge faced by both clinicians and researchers is highly related to the issue of suicide intent: did the individual intend to end his or her life by the act? The efforts to reach agreement about nomenclature and definitions mirror the complexity, and the wide range of motivations and behaviours which the terms intend to describe. For instance, self-harm may be

caused by the wish to die, or by the need for emotional relief that is not associated with a death wish. In individuals with repetitive self-harming behaviour, different methods and motivations may occur in the same individual over time (36). In many cases, ambivalence towards the wish to die is present in individuals who harm themselves (34, 37). Despite the fact that consensus of terms and definitions has not been achieved, there seem to be an agreement on subdividing self-harm behaviour based on the presence or absence of suicide intent whenever possible. The different terms used in this thesis are defined in chapter 1.1.1.

1.1.1 Definitions of terms in this thesis

S*uicide attempt* (SA) is defined as "self-harm in which there is some intent to die". *Suicidal ideation* (SI) is defined as "thoughts of killing oneself". The definition of S*elf-harm* (SH) is in accordance with the guidelines of The National Institute for Health and Clinical Excellence (NICE) (38): "intentional self-poisoning or injury, irrespective of the apparent purpose of the act. Self-harm includes asphyxiation, cutting, burning and other self-inflicted injuries". Thus, the broad and overarching concept of self-harm does not assume knowledge of suicidal motives and covers all types of self-inflicted harm, which is not accidental. For instance, non-intended substance overdose is not included in the concept. The term self-harm will be used in this thesis when citing older studies using terms which are no longer in use, such as parasuicide, deliberate self-harm and unsuccessful suicide, or when the cited studies lack a definition of suicide attempt. *Non-suicidal self-harm* (NSSH) is defined as "self-harm without suicide intent". *Non-suicidal self-injury* (NSSI) is normally defined as "direct, deliberate destruction of one's own body tissue with no intent to die" (39). S*uicidal behaviours* (SB) covers a wide range of behaviours, such as suicidal ideation or thoughts, planning to end one's life, suicide threats, suicide gestures, suicide attempt, and suicide. *Suicide risk* is an important and frequently used term in this thesis. However, no specific definition of suicide risk exists. This thesis adopts

the following pragmatic definition of suicide risk: "The risk that an individual will end his/her life through suicide within a given time and in a given situation".

Study I used the term non-suicidal self-injury (NSSI) more broadly than the definition presented above: as baseline variable it covers all methods of self-harm, including self-poisoning. Thus, its usage in paper I has the same meaning and content as non-suicidal self-harm (NSSH), which is also used in Study II and in the remaining part of the thesis. When these studies were planned, the term NSSI seemed to have a slightly less precise meaning than at present, where the term refers strictly to self-inflicted skin tissue destruction. The study uses the above definition of suicide attempt (SA).

Study II and Study III used the terms non-suicidal self-harm (NSSH) and suicide attempt (SA) according to the definitions above, when such behaviours were reported as baseline variables. The outcome data in Study II and Study III was self-harm which required inpatient treatment at somatic/general hospital. Information about suicide intent was not always available in relation to such admissions. Therefore, the broader self-harm (SH) variable was used, according to the definition above. The term used in Study II is *self-harm induced somatic admission,* while the corresponding term used in Study III is *self-harm admission to general hospital*. This difference in terms is due to suggestions made by the journal editors. Further, in this text, the term introduced in study II will be used.

1.2 Models of suicidal behaviour and non-suicidal self-harm

Suicidal behaviour and non-suicidal self-harm are complex behaviours and several attempts of constructing theoretical models have been made. Some are based on empirical studies of risk factors, while others are theoretical models with limited empirical support. Thus far, there is no single model that takes into account that individuals with the same psychiatric disorder who are exposed to similar life events differ in reactions, from no suicidal behaviour to non-suicidal

self-harm, suicide attempt or suicide. This thesis is not designed to test theoretical models, but has chosen to describe three models, which bring various perspectives, that may contribute to the discussion of findings: (1) The Stress-diathesis model for suicidal behaviour, (2) The Interpersonal theory of suicide, and (3) The Integrated theoretical model of the development and maintenance of non-suicidal self-harm.

1.2.1 The Stress-diathesis model for suicidal behaviour

The stress-diathesis model for suicidal behaviour (Figure 1) was proposed by Mann et al. (40, 41). This model integrates distal and proximal risk factors in a broad framework for understanding self-harm and suicidal behaviour, including suicide. Proximal risk factors such as acute life crises may act as stressors, but a stressor can also be the acute worsening of a psychiatric disorder such as a psychotic episode. The reaction to such events depends on the diathesis, as a more distal risk factor. The term diathesis was originally used to describe a predisposition or vulnerability related to biological traits produced by genetic disposition or childhood adversities. Pessimism, hopelessness, impulsivity, or low cholesterol levels are examples of factors that influence the diathesis for suicidal behaviour, as suggested by Mann (41). Recently, it has been broadened to include cognitive and social factors as well, and the model is said to be compatible with gene-environment interaction models (42) . Van Heeringen (42) discusses the concept of a continuous diathesis. According to him, repeated exposure to stressors may gradually diminish the resilience toward stress. As a result, stressors of decreasing severity may lead to suicidal behaviour with increasing severity. Van Heeringen proposes that repetition of suicide attempt, which often precedes suicide, may be understood in this context: the diathesis increases by increasing suicidal attempts, and each time a "suicidal mode" is activated, it becomes increasingly accessible in mind and requires less triggering stimuli to be activated again. He describes suicidal mode as suicide-related cognitions, negative affect, and the motivation to engage in suicidal behaviour in

the context of a depressive episode and following exposure to triggering life-events.
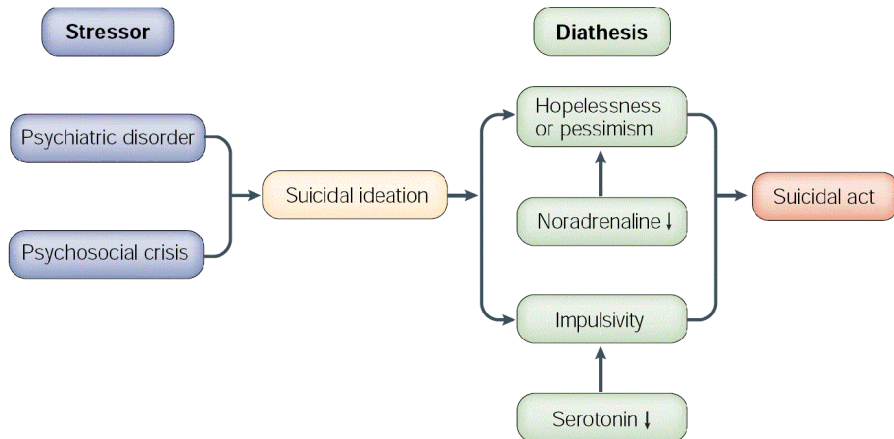
Figure 1 **A stress–diathesis model of suicidal behaviour.** Components of the diathesis include pessimism and impulsivity, and biological correlates are hypothesized. Mann (2003)

1.2.2 The Interpersonal theory of suicide

Joiner et al. (43) adds to the understanding of the process of suicidal behaviour. According to him, the core elements of the theory, "perceived burdensomeness" and "low belonging/social alienation", may answer the question of "who would want to die by suicide?" Sustained co-occurrence of these two states of mind explains the suicidal desire to a large extent. Perceived burdensomeness implies a self-view where the suicidal person is convinced that "my death will be worth more than my life to family, friends, and society". Low belongingness implies being alienated, not being an integrated part of a valued group such as family and friends. The theory suggests that interaction between (high) burdensomeness and (low) belonging may lead to suicidal ideation. However, the theory also introduces a third element that has to be present if those who have the desire to die shall respond to this by severely self-harming: "acquired ability to enact lethal self-harm". This aspect of the theory suggests that the desire to die has to fight against the strong human instinct of self-preservation. Furthermore, the theory hypothesises that the ability for suicide is acquired largely through

repeated exposure to painful or fearsome experiences, resulting in elevated tolerance of physical pain and a sense of fearlessness of death. The fact that a large proportion of those who die by suicide have a history of non-suicidal self-harm (NSSH) may be understood in this context; through habituation, these individuals have acquired the ability to perform lethal self-harm. Hamza et al. (44) suggest that this contributes to explaining the link between NSSH and suicidal behaviour.

1.2.3 Nock's Integrated model of the development and maintenance of non-suicidal self-harm

Nock (45, 46) suggests an integrated theoretical model of the development and maintenance of non-suicidal self-harm (Nock uses the term self-injury). According to this model, several distal risk-factors (such as genetic risk factors, childhood abuse) increase the likelihood of vulnerability factors (such as, high emotion reactivity, poor social skills). This in turn, increases the risk for mental disorders and maladaptive behaviour such as self-harm. Various specific risk factors for choosing self-harm as method to regulate emotions and social relationships are proposed, for example, social modelling or self-hatred. According to this theory, self-injury is perceived as an effective means of signalling distress and to elicit for help from others. Nock points to several ways of understanding the paradoxical finding in his and others' studies, that people who repeatedly harm themselves seem to feel little pain during the episodes of self-harm. For example, it may result from habituation to physical pain, the release of endorphins in the blood stream, which reduces pain, or the belief that one deserves to be injured. People who harm themselves also report several negative consequences of the behaviour, such as anger, guilt and shame. Still, the behaviour is maintained when the reinforcing mechanisms outweigh the negative consequences. In short, self-harm functions as a means of regulating emotions (intrapersonal function) and it communicates with or influences others, for instance as an help-seeking behaviour (interpersonal function). The immediate

regulation effect of self-harm is an important aspect in the repetition and maintenance of the behaviour.

1.3 Suicide risk as a reason for acute psychiatric admissions and self-harm-induced somatic admissions after psychiatric discharge

Few electronic medical systems are designed to record suicidality-related variables in a way that enables data extraction for statistical analyses. Clinicians' findings from patient evaluations are written usually only in the patient's medical records. Consequently, unless the International Classification of Diseases, tenth revision (ICD-10) (47) diagnostic code for intentional self-harm (X6n) is considered relevant by the clinician *and* recorded in the electronic medical system, any research studies relying on data from hospital and national registers would lack crucial information on self-harm and suicidality as reasons for psychiatric admissions. Moreover, the diagnostic code of X6n, when used, is usually recorded as one of several secondary diagnoses and hence will only show in registers that report both the primary and additional diagnoses. Therefore, the lack of relevant and accurate recording of the diagnosis of intentional self-harm and other suicidality-related variables could explain the scarcity of studies reporting on such variables in relation to acute psychiatric admissions. The high rate of underreporting of the X6n diagnoses has also been associated with self-harm-induced somatic admissions (48, 49). As part of the work presented in this thesis, a literature search was performed in June 2016 to identify papers reporting on the prevalence and predictors of: (a) suicide risk, non-suicidal self-harm, and/or suicide attempt as reasons for psychiatric admissions, and (b) self-harm-induced somatic admissions after psychiatric discharge.

1.3.1 Literature search method

Relevant literature searches were performed of studies reporting on prevalence and predictors of suicide risk, non-suicidal self-harm, and/or suicide attempt as

reasons for psychiatric admissions, including readmissions, using the databases PubMed, PsychINFO, and Embase. The following combinations of search terms were used to identify studies related to suicide risk, non-suicidal self-harm, and/or suicide attempt as reasons for psychiatric admissions, included readmissions: ('psychiatric hospital', 'psychiatric institution', 'psychiatric ward', 'psychiatric unit', 'mental hospital', OR 'mental institution') AND ('patient admission', 'inpatients', 'readmission', 'rehospitalisation', 'heavy users', 'frequent users', OR 'revolving door') AND ('suicid* behaviour', 'suicid* ideation', 'suicide* risk', 'self-harm*', 'self-injur*', 'non-suicidal self-harm', 'self-inflicted injur*', 'self-mutila*', 'self-injur* behaviour', 'self-destructive behaviour', 'self-poison*', 'deliberate self-harm', 'suicidal', OR 'suicide attempt').

Moreover, the following search term combinations were used to identify studies related to self-harm-induced somatic admissions after psychiatric discharge: ('psychiatric hospital', 'psychiatric institution', 'psychiatric ward', 'psychiatric unit', 'mental hospital', OR 'mental institution') AND ('discharge', 'follow-up', OR 'prospective') AND ('somatic hospital', 'general hospital', 'somatic admission', OR 'inpatient medical treatment') AND ('suicid* behaviour', 'self-harm*', 'self-injur*', 'non-suicid* self-harm', 'self-inflicted injur*', 'self-mutila*', 'self-injur* behaviour', 'self-destructive behaviour', 'self-poison*', 'deliberate self-harm', OR 'suicide attempt').

The above literature searches on suicide risk-related psychiatric admissions and self-harm-induced somatic admissions identified a total of 1730 and 4727 papers, respectively, all of which were reviewed by the author of this thesis. The majority of the 1730 studies identified on suicide risk-related psychiatric admissions were not relevant, as they focussed on lifetime self-harm, inpatient self-harm, inpatient suicide, or suicide after psychiatric discharge. Likewise, the majority of the 4727 studies identified on self-harm-induced somatic admissions were not relevant, since they did not include self-harm occurring *after* discharge from a psychiatric hospital, however, some focussed on

psychiatric inpatient self-harm or suicide and others on suicide after self-harm-induced admissions to psychiatric or somatic hospitals. Some studies focussed on referrals from a somatic hospital to a psychiatric hospital following treatment for self-harm. Since only one study (17) provided data on self-harm-induced *somatic admissions* after psychiatric discharge in an unselected patient cohort, interview studies reporting data on *self-reported self-harm* after psychiatric discharge were included in the literature review. Table 1 presents an overview of the included studies from the literature review on self-harm after psychiatric discharge, and Table 2 gives an overview of the variables which were examined as potential predictors of self-harm after psychiatric discharge. Since there was considerable variability in study samples or populations among the different studies, the studies were categorised as follows: (a) those including an *unselected patient cohort* (all patients consecutively admitted to PAUs), (b) those including subsamples of patients whose *psychiatric index admission was due to self-harm/suicide attempt*, (c) those including subsamples of patients diagnosed with *mood disorders at index admission*, and (d) those including subsamples of patients whose index admission was related to *alcohol/substance use problems or diagnoses*. It should be mentioned that patient samples classified as 'unselected' in the interview studies were selected by patients' willingness and ability to provide informed consent and participate in interviews. However, these samples consisted of consecutively admitted patients who were not selected by diagnoses or other characteristics and, therefore, they are labelled 'unselected'. Results of the literature searches are presented below.

1.3.2 Prevalence of suicide risk, non-suicidal self-harm, or suicide attempt as reasons for psychiatric admissions

The majority of studies describing suicide risk or self-harm as a reason for acute psychiatric admissions focussed on 'frequent' or 'heavy' users of PAU services (50, 51) or on diagnostic subgroups of patients with major depressive disorder (MDD) (52), bipolar disorders, or schizophrenia (53). The most frequently used source of research findings on suicide risk- or self-harm-related psychiatric

admissions has been retrospective chart reviews (50, 54-58). However, the definitions of self-harm and suicide attempt, when presenting as reasons for admission, are often missing. Therefore, the term 'self-harm' in the following text refers to either non-suicidal self-harm or suicide attempt, or both.

Various retrospective chart reviews have examined suicidality-related variables as reasons for acute psychiatric admissions. A study on 'heavy users' of PAU services (50) reported that self-harm and suicidal ideation were the reasons for 18% and 45% of the total admissions, respectively, throughout 1 year. Another study on first-time admitted patients found that about 50% of the patients presented with suicidal ideation (56). Moreover, suicide risk was the reason for 29% of index admissions in a random sample of acute psychiatric admissions (54), and in a study of patients admitted to an open PAU, it accounted for 66% of the total consecutive admissions, which included readmissions, over a 1-year study period (57).

A 6-month (59) and 3-month study (60), using standardised prospective assessment of the reasons for admissions in all acutely admitted patients, found that 'prevention of suicide or self-harm' was the main reason for, or a contributing factor to, 22% and 36% of admissions, respectively. A study of nearly 8000 patients with serious mental illness found a recent suicide crisis ('the patient feels hopeless and wants to kill him-/herself or has had a recent attempt or behaviour') as the reason for acute admissions in 9% of patients with bipolar manic episodes, 21% of those with schizophrenia–schizoaffective disorders, 43% of those with bipolar depression, and 50% of those with unipolar depression (53). Another prospective study, using a scale measure for suicide risk in about 10,000 consecutively admitted patients, found severe, moderate, and mild risk and no risk in 33%, 26%, 12%, and 28% of admissions, respectively (61). Neither of these studies provided data on readmission.

1.3.3 Suicide risk or self-harm as predictors of psychiatric readmission

Suicide risk as a reason for index admissions (54) and a lifetime history of self-harm (58) were not significantly different in readmitted versus non-readmitted groups, as described in two studies based on retrospective chart reviews. A cross-sectional interview study, which presented historical data on previous admissions, found that suicide risk was the most common reason for admissions (66%) and readmitted patients reported more distress about having suicidal ideation than non-readmitted patients (62). An interview study of consecutive admissions to a psychiatric hospital found that 'suicide potential' (part of the 'Severity of Illness Scale') was negatively associated with readmission within 6 months after discharge (63). Only a few studies have combined suicidality measures assessed at psychiatric admission with hospital register data on readmission. One such study focussed on 'heavy users' of inpatient services, in which 'dangerousness to self and others' measured on a subscale of the Crisis Triage Rating Scale was found not to be significantly associated with readmission (51). Another study, using standardised assessment of all patients at psychiatric admission, found that self-harm prior to admission predicted readmission within 30 days (64). In addition, a Canadian research group developed a readmission risk index used prior to discharge to determine the probability of psychiatric readmission within 30 days (65). Using this readmission risk index in a large study cohort, the scale item 'emergent admission due to harm to self/others' was associated with a high risk of 30-day readmission.

The above diverging findings on suicide risk or self-harm as predictors of readmission could be explained, in part, by differences in patient samples and study designs and/or different definitions of the variables assessed.

1.3.4 Studies of self-harm after psychiatric discharge

Table 1 presents the 15 included studies from the literature review, the length of the follow-up period in each study, the number of patients included in each study, and the number and proportion of patients in each study who either self-reported self-harm or were recorded as presenting with self-harm after discharge from a psychiatric hospital.

Of these 15 studies, only one study of an unselected patient cohort (17) provided data on self-harm-induced somatic admissions after psychiatric discharge (17) (see Section 1.3.1, Literature search method). This was a register-based study of all patients discharged during 1 year from all psychiatric hospitals in England, and outcome data included somatic and psychiatric hospital admissions due to self-harm within 12 months after psychiatric discharge (17). In addition, the literature search identified four interview studies of unselected cohorts, which provided data on self-reported self-harm after discharge from psychiatric hospitals (33, 66-68). Five interview studies included data on self-reported self-harm after discharge of patients whose psychiatric index admission was related to self-harm (irrespective of suicide intent) (14, 15, 69-71). Two interview studies presented data on self-reported self-harm after discharge of patients diagnosed with mood disorders (depressed or bipolar) at index admission (72, 73), and one study of patients with mood disorders presented data on self-harm-induced somatic admissions obtained from chart reviews of medical records (16). One interview study included data on self-reported self-harm and hospital records in patients whose index admission was related to alcohol/substance use problems or diagnoses (74), and another study of patients with alcohol use disorders presented data from Veteran Health Administration registers (13) which were obtained from both outpatient emergency clinics and somatic hospitals.

The number of patients included in the interview-based studies ranged from 59 to 954 patients (most studies in the lower range), whereas the two register-based studies included 22,319 and 75,401 patients, respectively.

1.3.5 Predictors of self-harm-induced somatic admissions after psychiatric discharge

Table 2 provides an overview of the variables studied as possible predictors of future self-harm after discharge from an index admission.

The most commonly studied variables as possible predictors of future self-harm was gender and age, which were studied in 15 and 14 of the total 15 studies respectively. Female gender was found to be associated with an increased risk for future self-harm in four out of five studies of unselected cohorts, whereas findings related to gender were inconsistent in the selected subsamples. Younger age was also associated with an increased risk for future self-harm in three studies of unselected cohorts and in three studies of subsamples of patients with index admissions due to suicide risk. Findings related to age were inconsistent in patients with mood disorders and in patients with substance use disorders.

The presence of a lifetime history of self-harm, or self-harm as a reason for index admission, was examined in 13 of the 15 studies. Associations with an increased risk for future self-harm were identified in all but one of the studies examining this variable. Suicidal ideation as a reason for index admission was studied as a predictor of future self-harm in only six studies, with inconsistent findings. Since there are only a few studies examining the other possible predictor variables, their findings are summarised in Table 2 and not discussed here. Moreover, there are inconsistent results from various subsamples on how several variables assessed at index admission predicted future self-harm. The most striking finding of the literature review is, however, the scarcity of studies investigating self-harm after discharge from psychiatric hospitals.

Table 1. Studies included in the review of studies of future self-harm after psychiatric discharge

Terms used: Suicide ideation (SI), self-harm irrespective of intention (SH), suicide attempt (SA), non-suicidal self-harm (NSSH). The studies are sorted according to whether they included unselected cohorts (all patients consecutively admitted to psychiatric acute units) (N=5), subsamples of patients whose index admission was due to self-harm or suicide attempt (N=5), subsamples of patients diagnosed with mood disorders at index admission (N=3), or subsamples of patients whose index admission was related to alcohol/substance use problems or diagnoses (N=2).

Author (Year), Country	Study design/sample	Follow-up time	N of patients included (N of patients with future SH/SA)%	Comments
Unselected cohorts				
Goldston (2015), USA[68]	Prospective Interview-based Adolescents discharged from a psychiatric hospital	Mean =13.5 years (max = 17.5 years)	180 (109) 61%	Self-reported SH The patients were followed from adolescence through adulthood
Gunnell et al. (2008), England[17]	Prospective cohort study Register-based national data All patients discharged from psychiatric hospitals	1 year	75, 401 (4,935) 6.5%	Register-based national data on somatic and psychiatric hospital admissions due to SH
Qurashi (2006), UK[66]	Prospective Interview-based Patients discharged from a psychiatric hospital	3 months	69 (15) 22%	Self-reported SH
Sadeh & McNiel (2013), USA[67]	Prospective Interview-based Patients consecutively admitted to a psychiatric acute ward	1 year	748 (124) 17%	Self-reported SA
Skeem et al. (2006), USA[33]	Prospective Interview-based Patients discharged from a psychiatric hospital	1 year	954 (217) 23%	Self-reported SA and NSSH

Index admission due to self-harm				
Hayashi et al. (2012), Japan[15]	Prospective Interview-based Patients admitted to a psychiatric acute ward after SH	2 years	106 (71) 67%	Self-reported SH
Johnsson et al. (1996), Sweden[69]	Prospective Interview-based Patients admitted to a psychiatric suicide research center after SA	5 years	75 (17) 23%	Self-reported SA
Lebret et al., (2006), France[71]	Retrospective chart reviews/telephone interviews Elderly patients admitted after SA	Follow-up time varied, not reported	59 (8) 14%	Follow-up data on SA collected by telephone interviews with the patient's attendant physician (GP)
Links et al. (2012), UK, England[14]	Prospective Interview-based Patients admitted due to suicide risk/suicide attempt (80% after suicide attempt)	6 months	120 (41) 34%	Self-reported SH
Tejedor et al. (1999), Spain[70]	Prospective Interview-based Patients admitted voluntarily after SA	Mean = 10 years	150 (37) 25%	Self-reported SA
Mood disorders				
Chan et al. (2014), Malaysia[72]	Prospective Interview-based Depressed patients consecutively admitted to a psychiatric hospital	1 year	75 (12) 16%	Self-reported SA
Oquendo et al. (2002), USA[73]	Prospective Interview-based Depressed patients admitted to a psychiatric unit	2 years	136 (21) 15%	Self-reported SA
Ruengorn et al. (2011), Thailand[16]	Retrospective Chart reviews Mood disorder patients admitted to a psychiatric ward after SA	1 year	235 (36) 15%	Follow-up data on SH after psychiatric discharge: chart reviews of medical records

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Alcohol/ substance use problems/disorders			
Britton et al. (2015), USA[13]	Prospective Register-based national data Patients with alcohol use disorder and/or non-bipolar depression discharged from a Veteran Health Administration hospital	1 year	22,319 (903) 4%	Register-based data on SH one year before (predictors) and one year after VHA discharge. Not reported whether the patient was treated for the SH in somatic hospital or at outpatient emergency units
Johnsson & Fridell (1997), Sweden[74]	Prospective Interview-based/ hospital records Drug abusers, admitted for detoxification and short-term rehabilitation	5 years	125 (41/25) 33%/20%	Self-reported and hospital records of SH. Hopsital records identified that 25 of the patients had been hospital treated for SH.

Table 2. Variables examined at acute admission as potential predictors of future self-harm after psychiatric discharge

[1] The results are presented according to the study categories: unselected cohorts (N=5); subsamples consisting of patients whose index admission was due to self-harm or suicide attempt (SH/SA) (N=5); subsamples of patients diagnosed with mood disorders (depressed or bipolar) at index admission (N=3); subsamples of patients whose index admission was related to alcohol/substance use problems or –diagnoses (N=2).

[2] In the table, "SH" is used as an abbreviation for future (post discharge) self-harm of any kind.

Characteristics	Number of studies within each study category examining this variable[1]	Predictors of future self-harm (SH)[2]
Gender	5;5;3;2	Four studies of unselected cohorts found a positive association between female gender and SH. One study of unselected cohorts found no association between gender and SH.
		In the subsample of patients whose index admission was due to SH/SA: Four out of five studies found no association between gender and SH. One study of elderly people found a positive association with SH in females who felt socially isolated.
		All three studies of the subsample of patients with mood disorders examining gender found no significant association with SH.
		In the subsample of patients with alcohol-or drug related index admission, one study found a positive association with SH, while one study found no significant association.

Age	4;5;3;2	Three studies of unselected cohorts identified a positive association between younger age and SH. One study of an unselected youth cohort followed through adulthood found no significant association between age and the cumulative number of attempts, but increasing age was associated with increased medical lethality of SH. One study of unselected cohorts found no significant association with age.
		In the subsample of patients with index admission due to SH/SA, three studies found a positive association between younger age and SH, while two such studies found no significant association.
		In the subsample of patients with mood disorders, younger age was associated with increased risk of SH in one study, while two studies found no significant association.
		In a subsample of patients with alcohol- or drug related index admission, one study found an increased risk of SH in younger individuals, one study found no significant association.
Self-harm (irrespective of intent) during a lifetime or before index admission	5;4;3;1	In unselected cohorts, SH before index admission (various time frames) was associated with increased risk of future SH in all five studies.
		In the subsample of patients with index admission due to SH/SA, three out of four studies found a positive association between the numbers of lifetime SH episodes before index admission and future SH.
		In the subsample of mood disorders, all three studies found a positive association between the numbers of lifetime SH episodes before index admission and future SH.
		In the subsample of patients with alcohol- or drug related index admissions, the only study examining SH before index admission found a positive association with SH.
Suicide ideation in relation to index admission	1;2;2;1	In unselected cohorts, the only study which examined suicide ideation as a possible predictor of SH identified a positive association.
		In the subsample admitted to index admission due to SH/SA, suicide ideation was associated with increased risk of SH in one study, while one such study found no significant association.
		In the subsample of patients with mood disorders, one study found a positive association between suicide ideation and SH, while one such study found no significant association.
		The only study of the subsample of patients with alcohol-or drug related index admissions which assessed suicide ideation found a positive association with SH.

Ethnicity	3; 0;1;0	One study of unselected cohorts found a positive association between being Caucasian and SH. One study found no association; however, there was a large amount of missing data in this study.
		In the subsample of patients with mood disorders, the only study which included data on ethnicity found no significant association with SH.
Married/ in relationship	2;4;3;0	No associations were found in the two studies of unselected cohorts which included data on being married or cohabiting with someone.
		Not being married was associated with increased risk of SH in one study of the subsample with index admission due to SH/SA. Three such studies found no significant association.
		Three out of tree studies of patients with mood disorders found no significant association between being married/living in relationship and SH.
Having own children	0 ;0 ; 1;0	No significant association with SH was found in the only study of patients with mood disorders which included data on having own children.
Being homeless	2;0;0;0	No significant association found between being homeless and SH in the two studies of unselected cohorts which included homelessness as possible predictor.
Employment	3 ;1;0;0	No significant association found between employment status and SH in two studies of unselected cohorts. One such study found an increased risk of SH in patients who were unemployed.
		In the subsample of patients with index admission due to SH/SA, being employed was associated with reduced risk of SH in the only study including employment.
Education	0 ;1;3;0	In the subsample of patients with index admission due to SH/SA, the only study including education found no significant association.
		None of the three studies of patients diagnosed with mood disorders which examined education found significant associations with SH.

| Schizophrenia/ other psychotic disorders as main or secondary diagnosis | 2 ; 5;0;1 | In unselected cohorts, schizophrenia was associated with a reduced risk of SH in one study. One such study found no significant association.

In the subsample of patients with index admission due to SH/SA, being diagnosed with schizophrenia was associated with a reduced risk of SH in one out of five studies, while four such studies found no significant associations.

The only study of the subsample of patients with alcohol-or drug related index admissions examining schizophrenia found no significant association with SH. |
|---|---|---|
| Mood disorders | 3; 4;2;2 | In unselected cohorts, depression was associated with an increased risk of SH in all studies examining the variable.

In studies of patients whose index admission was due to SH/SA, four studies examined major depressive disorder or scale measures of depression as possible predictors of SH. Associations were not identified in any of these.

Studies with various mood disorders as inclusion criterion mainly examined other variables than the selection disorders as predictors of SH. However, one study with several follow-up interviews found a positive association between major depression during follow-up and SH. This again was related to non-adequate antidepressant treatment. One study found no significant difference between major depressive disorder (MDD) and bipolar disorder in relation to SH.

In the subsample of patients with alcohol- or drug related index admission, a primary diagnosis of depression increased the risk of SH in one study, as did "depressive moods" in another study of this subgroup. |
| Anxiety-, stress-related- and adjustment disorders | 2;4;0;1 | Anxiety-, stress-related- and adjustment disorders were associated with increased risk of SH in one study of unselected cohorts. No significant association was found in the other such study examining this variable.

In the subsample of patients with index admission due to SH/SA, one study found an increased risk of SH, while three studies found no significant associations.

In the subsample of patients with alcohol- or drug related index admission, the only study examining comorbid anxiety-, stress-related- or adjustment disorders found no significant association with SH in patients. |

Substance use disorders (SUD)/ alcohol- or drug related index admissions	2;5;1;0	In unselected cohorts, SUD was associated with increased risk of SH in the two studies examining SUD as a possible predictor of SH.
		In the subsample of patients with index admission due to SH/SA, one study found a positive association between excessive drinking and SH. Four out of five such studies found no significant associations.
		In the subsample of patients with mood disorders, one study found a positive association between comorbid SUD and SH.
		The two studies using SUD as inclusion criterion examined other variables than the selection disorder or alcohol-/drug problems as predictors of SH.
Personality disorders	2;5:1;1	The two studies of unselected cohorts examining personality disorders found a positive association with SH.
		In the subsample of patients with index admission due to SH/SA, two out of five studies found a positive association between personality disorders and SH. The remaining three studies found no significant association.
		In the subsample of patients with mood disorders, the only study including comorbid personality disorders in the analyses found no significant association with SH.
		In the subsample of patients with alcohol- or drug related index admissions, the only study including comorbid personality disorders found no significant association with SH.
Psychotic symptoms (scale measured)	1; 1;2;1	The only study of unselected cohorts examining thought disturbance (subscale of Brief Psychiatric Rating Scale (BPRS)) found no significant association with SH.
		The only study of the subsample of patients with index admission due to SH/SA examining thought disturbance (BPRS subscale) found no significant association with SH.
		In the subsample of patients with mood disorders, one study found reduced probability of SH in patients who displayed psychotic symptoms at index admission. One such study found no significant associations.
		In the subsample of patients with alcohol- or drug related index admissions, the only study examining psychotic symptoms found no significant association with SH.

Depressive symptoms (scale measured)	2;4;1;1	In unselected cohorts, increasing scores on BPRS anxiety-depression subscale was associated with increased risk of SH in one study, while another study using the same scale found no significant association between the level of depression and SH. The same subscale found no significant association in another study.
		In the subsample of patients with index admission due to SH/SA, the Beck Depression Inventory (BDI) found a positive association with increased level of depression and SH in three studies. One study measuring the level of depression by The Hamilton Depression Scale (HDS) found no significant association with SH.
		In the subsample of patients with mood disorders, the only study examining scale measured depression found no significant association with SH.
		In the subsample of patients with alcohol- or drug related index admissions, depressive mood was associated with increased risk of SH in the only study examining depressive symptoms.
Anxiety symptoms (scale measured)	2;2;0;1	In unselected cohorts, one study found a positive association between increasing anxiety measured on the subscale of the BPRS and SH, while another study found no significant association with anxiety measured by the same scale.
		In the subsample of patients with index admission due to SH/SA, increasing scores on the anxiety subscale of the SCL-90 was associated with SH. Another study using the Hamilton Anxiety Rating Scale found no such association.
		In the subsample of patients with alcohol- or drug related index admissions, anxiety symptoms were positively associated with SH in the only study examining such symptoms. The scale used was not reported.
Hopelessness	1;3;0;1	Only one study of unselected cohorts measured hopelessness. No significant association was found in this study.
		All three studies of the subsample with index admission due to SH/SA which examined hopelessness found a positive association between increased hopelessness and SH.
		The only study of the subsample of patients with alcohol- or drug related index admissions examining hopelessness found a positive association with SH.
Impulsivity	0;1;0;0	In total, impulsivity was only examined in one study of patients with index admission due to SH/SA. A positive association with SH was found in this study.
Violence or aggression	1;0;0;0	In total, violence was only examined in one study of the unselected cohorts. This study found that a tendency to engage in angry behavior was associated with increased risk of SH in men. The same study found a negative association between violence and SH in females.

Physical illness/disability	0;3;0;0	In total, physical illness was examined in three studies of the subsample with index admission due to SH/SA. Two out of these studies found a positive association with SH. No significant association was found in the third study.
Social network/social support	0;3;1;1	In the subsample of patients with index admission due to SH/SA, two studies found a positive association between poor social network and SH. One such study found no significant association.
		In the subsample of patients with mood disorders, one study examined social support. No significant association with SH was identified.
		In the subsample of patients with alcohol- or drug related index admissions, one study found no significant difference in social welfare services provided to self-harm repeaters vs non-repeaters.
Childhood trauma/adversities	1;0;0;0	Only one study of an unselected cohort measured childhood sexual victimization as predictor of SH. A positive association with SH was found in this study.
Medical lethality/physical consequence of index self-harm / SA	0;1;0;1	Only one study of the subsample of patients with index admission due to SH/SA assessed the physical consequences of the index self-harm as a possible predictor of SH. Increased severity of the index SH was associated with increased risk of future SH.
		In the subsample of patients with alcohol- or drug related index admissions, receiving medical care during index admission was associated with increased risk of SH in one study.
Length of stay	1;1;0;0	The only study of unselected cohorts examining the association between the length of stay and future self-harm found no significant association.
		In the subsample admitted to index admission due to SH/SA, the only study examining the length of index stay in relation to SH found that longer length of stay increased the risk of future SH.
In- and outpatient psychiatric treatment history/psychiatric follow-up treatment	3;2;0;1	Two studies of unselected cohorts examined psychiatric hospitalization prior to index admission. Both found a positive association between a history of psychiatric admission and SH. One study examined outpatient treatment after index stay and found that an increasing number of outpatient treatment sessions was associated with an increased risk of SH.
		In the subsample of patients admitted to index admission due to SH/SA, one study found that those who repeated SH more often had ongoing psychiatric treatment when compared to non-repeaters. The other study examining psychiatric treatment (type of treatment not specified) found no significant association with SH.
		The only study of the subsample of patients with alcohol- or drug related index admissions examining treatment variables found a positive association between having been previously hospitalised and SH.

| Treatment compliance | 1; 0;1;0 | The only study of unselected cohorts examining treatment compliance found that non-compliance with medication was associated with increased risk of SH. |
| | | The only study of patients with mood disorders examining treatment compliance found that compliance with medication was protective for SH. |

2. Aims

The overall aim of this thesis is twofold: firstly, to determine the prevalence of suicide risk and the related variables suicidal ideation, non-suicidal self-harm, and suicide attempt as the main reasons for, or contributing factors to, acute psychiatric admissions; and secondly, to study these variables, in combination with other clinical, sociodemographic, diagnostic, and treatment-related parameters, as potential predictors of acute psychiatric readmissions and self-harm-induced somatic admissions.

The first study (Study I) of this thesis aimed to determine which variables are associated with acute psychiatric admissions and readmissions, particularly focussing on suicide risk as a reason for these admissions. Specifically, the study aimed to assess if an index admission due to suicidal ideation, non-suicidal self-harm, or suicide attempt could predict readmissions in general and readmissions due to suicide risk, when adjusted for other clinical, sociodemographic, diagnostic, and treatment-related variables.

The second study (Study II) aimed to examine factors related to self-harm-induced somatic admissions within approximately 2 years after discharge from the psychiatric index admission to the PAU, specifically determining the rate, diagnostic coding, timing, predictors, and characteristics of self-harm.

The third study (Study III) had two objectives. The first objective was to examine whether PTSD in patients with a previous psychiatric hospital admission due to suicide risk would predict the number of subsequent self-harm-induced somatic admissions, including after adjusting for the presence of BPD. Based on the theoretical understanding and prior empirical findings regarding a possible relationship between BPD, PTSD, and self-harm, the second objective was to test the empirical support for a model of the relationship between BPD, PTSD, and self-harm when adjusted for other conditions commonly associated with self-harm. The model

specifically includes borderline factors (based on BPD diagnostic criteria) as predictor variables, and PTSD, substance use disorders, anxiety disorders, and depressive symptoms as intermediate variables, with the number of self-harm-induced somatic admissions as the outcome measure. Study III is referred to as the Interview study and the study sample as the Interview sample.

3. Methods

3.1 Setting and design

All three studies presented in this thesis are prospective, observational, and longitudinal, and are based on data from patients admitted to the 19-bed PAU at the Department of Psychiatry at Haukeland University Hospital in Bergen. The hospital has a catchment area of about 400,000 inhabitants, and during the entire study period (i.e. inclusion and follow-up), approximately 95% of all acute psychiatric admissions from this catchment area were allocated to this unit. Patient inclusion and follow-up periods for the three studies are presented in Table 3. In Norway, the entire population is covered by a universal health insurance system and a publicly funded health service which provides psychiatric treatment to the majority of patients. For all three studies, the inclusion period commenced on 1 May, 2005. Study I and Study II included all patients consecutively admitted to the PAU over 1 and 3 years, respectively. Patients included in Study I were also included in Study II, with the latter study also including patients admitted over 2 additional years. Study III included a representative sample of non-psychotic patients whose admissions were related to suicide risk. In order to achieve the required sample size, the inclusion period for Study III was extended by 1.5 months, compared to that for Study II. Table 3 gives an overview of patient samples, inclusion periods, outcome variables, and follow-up periods for each of the three studies.

Table 3. Patient samples and numbers, inclusion periods, outcome variables, and mean follow-up periods

	Patient sample	*N* (% male)	Inclusion period	Main outcome variables	Mean follow-up period
Study I	All patients consecutively	1245 (54)	1 year: 1 May, 2005 to 30	(a) Time to, and number of, psychiatric	1.5 years

	admitted to the PAU		April, 2006	readmissions due to all reasons (b) Time to readmission due to suicide risk	
Study II	All patients consecutively admitted to the PAU	2827 (52)	3 years: 1 May, 2005 to 30 April, 2008	(a) Time to somatic hospital admissions due to self-harm (b) Number and characteristics of self-harm admissions to somatic hospitals (c) Number of ICD-10 X6n (intentional self-harm) diagnoses at somatic hospital admissions due to self-harm	2.3 years
Study III	Randomly selected non-psychotic patients with suicide risk-related admissions to the PAU	308 (44)	37.5 months: 1 May, 2005 to 15 June, 2008	Number of somatic hospital admissions due to self-harm	6 months

3.2 Patients, procedures, and outcome measures in Study I and Study II

Methods of inclusion of patients and collection of baseline data were similar for Study I and Study II and hence will be described together. Since the outcome

variables differed for each of these two studies, these will be presented separately for each study.

Each patient's first admission to the PAU during the inclusion period was labelled as the index admission, and any subsequent admissions to the PAU during the follow-up period (from index discharge to end of follow-up) were labelled as readmissions. Baseline data were derived from information generated by the hospital's standard assessment procedures on patient admission and discharge. Study I included 1245 patients (54% males), with a mean age of 41.6 years (standard deviation [SD] ± 16.4) at index admission. Study II included 2827 patients (52% males), with a mean age of 42 years (SD ± 17.4) at index admission.

At index admission and each readmission to the PAU, psychiatry residents trained in the applied scoring instruments assessed the patients. Using all available information—including verbal communication with, and referral letters from, referring clinicians, as well as information given by the patients themselves— psychiatry residents scored whether suicide risk (yes/no) was involved as the main reason for, or a contributing factor to, the admission or whether such risk was detected by the residents. An operationalised variable was then scored as: (a) no known suicide risk, (b) suicidal ideation without a plan, (c) suicidal ideation with a plan, (d) non-suicidal self-harm (labelled as non-suicidal self-injury in Study I), or (e) suicide attempt. Primary and secondary ICD-10 diagnoses (47), and the symptom measure Global Assessment of Functioning-Split version (GAF-S) (75, 76) scores were determined at discharge by the psychiatrist or psychologist in charge of the patient's treatment. The GAF-S score was used in Study I only.

Research assistants trained for the purpose of the study prospectively collected data on sociodemographic variables such as gender, age, source of income, education, housing, and living situation (i.e. whether the patient lived alone or with someone). They also recorded the use of mental health care services before patient admission and the follow-up agency to which the patient was referred after discharge.

Coding of the treatment history before the index admission differed in certain aspects between Study I and Study II, and details are given in Paper I and Paper II.

Follow-up treatment after discharge used different data types in the two studies. Study I recorded which follow-up treatment the patient was referred to according to discharge (and not the treatment received). Study II used data from each attended and non-attended assigned psychiatric outpatient consultation. These data were retrieved by register linkage with the outpatient clinics' administrative databases and the national health care compensations register [in Norwegian, *Kontroll og utbetaling av helserefusjoner* (KUHR)]. Some predictors used in Study II could vary for the individual patient during the follow-up period, and how this variability was addressed is described in relation to the statistical approaches and methods used in Study II (see Section 3.5.2. Statistical approaches and methods in Study II).

3.2.1 Outcome variables in Study I

Outcome variables in Study I included: (a) readmissions to the PAU during the follow-up period for any reason (general readmissions), and (b) readmissions to the PAU during the follow-up period due to suicide risk.

3.2.2 Outcome variables in Study II

Self-harm-induced somatic admissions, as defined in Section 1.1.1 (Definitions of terms in this thesis), was the main outcome variable in Study II. Data were obtained as follows. First, all admissions to somatic hospitals within the catchment area during the follow-up period were identified by register linkage between the study cohort and hospital registers. All ICD-10 main and secondary diagnoses assigned at each somatic admission were retrieved from the hospital registers to determine if the ICD-10 diagnostic code for intentional self-harm (X6n) was given (49). Since previous studies have shown that the diagnosis of self-harm was often missing in cases where it should have been assigned (48), all available sources of relevant information from these somatic admissions were searched to determine if the admissions were due to self-harm, and if so, the methods and characteristics of self-harm were recorded. Sources of information included ambulance notes, somatic hospital records, notes from evaluations by the liaison psychiatrist, and records from the psychiatry department in cases where the self-harm episode took place during psychiatric

readmission. The author of this thesis performed the above data searches, and a random sample of 70 patient records was additionally assessed for reliability testing by an experienced psychiatrist. Lethality of the self-harm method was scored on a scale ranging from 'no risk' or 'minor risk' to 'moderate risk', 'high risk', and 'survival unlikely' by a specialist in internal medicine, and a random sample of these data was then assessed for inter-rater reliability testing by an experienced clinician. Kappa tests demonstrated very good inter-rater reliability for both self-harm scoring (0.88) and lethality scoring (0.87).

3.3 Patients, procedures, and outcome measures in Study III

Study III (also called the Interview study) included a subsample of the patient cohort in Study II, with 308 patients who were admitted to the PAU due to suicide risk. Of these, 44% were male, and the mean age was 38 years (SD ± 14). The main inclusion criterion was suicide risk as a reason for admission. In addition, eligible patients had to be able to provide their written informed consent to participate in semi-structured research interviews, as well as read, comprehend, and complete self-report forms. The exclusion criterion included a diagnosis of current psychosis (bipolar disorder type I, schizophrenia, schizoaffective disorders, and psychotic disorders not otherwise specified). Transient, stress-related paranoid ideation and severe dissociative symptoms (as a diagnostic criterion for BPD or a diagnostic feature of PTSD) were not exclusion criteria. The clinician in charge of the patients' treatment assessed their eligibility for inclusion in Study III. Of the 1744 patients who had at least one admission due to suicide risk during the inclusion period, 1253 fulfilled the inclusion criteria for study participation. Since it was not possible to invite all eligible patients for interviews, a random sample of 383 patients was selected, of whom 308 provided written informed consent. The randomisation process to ensure representativeness is as described in Paper III. The admission when the patient was included to participate in the Interview study was labelled as baseline admission. As patients could have had previous admissions during the study period not related to suicide risk, or where they

were not selected to be invited to participate, the index admission and the baseline admission could be different.

Psychiatric diagnoses were made from structured diagnostic interviews within the first days of a participant's hospital stay. Diagnostic interviews were conducted by the clinician in charge of the patient's treatment or by mental health nurses who were trained for the task. A psychiatrist with expertise in relevant psychometric methods trained the interviewers, listened to audiotapes of the interviews, and scored the interviews for reliability, and also provided feedback to the interviewers both after their first interview and intermittently throughout the study. The Mini International Neuropsychiatric Interview (MINI) for Diagnostic and Statistical Manual for Mental Disorders, fourth revision (DSM-IV) axis I disorders (77) was used to diagnose current post-traumatic stress disorder (PTSD), major depressive disorder (MDD), substance use disorders (SUD), generalized anxiety disorder (GAD), and panic disorder (PD). The Structured Clinical Interview for DSM-IV axis II disorders (SCID-II) (78) was used to diagnose borderline personality disorder (BPD). Additionally, each of the nine BPD criteria was scored according to the Zanarini Rating Scale for Borderline Personality Disorder (Zan-BPD). The Zan-BPD 5-point (0–4) scale rating of BPD criteria has been shown to yield higher inter-rater reliability than dichotomous scoring of the criteria (79). The level of depression was measured using the Montgomery and Åsberg Depression Rating Scale (MADRS) (range 0–60) (80). The inter-rater reliability kappa values for BPD and PTSD were 0.83 and 0.91, respectively, and the inter-rater reliability tests for the borderline criteria gave intra-class correlation (ICC) values ranging from 0.72 for the ninth criterion (paranoid ideation/dissociative symptoms) to 0.92 for the fifth criterion (recurrent suicidal behaviour/self-mutilation).

3.3.1 Outcome variable in Study III

The outcome variable in Study III was the number of self-harm-induced somatic admissions within 6 months after the baseline interview. This is the same outcome

variable as assessed in Study II, and the method of data retrieval is as described in Section 3.2.2 (Outcome variables in Study II).

3.4 Handling of missing data

Missing data are common in most clinical research studies, and a variety of methods have been used to address this challenging problem (81). Missing data are usually classified as: (a) missing completely at random (MCAR), (b) missing at random (MAR), and (c) missing not at random (MNAR) (81). In cases of MCAR, the missingness is not associated with values in other variables or characteristics of the variable itself; the missing data result from a random process, which hence may cause power problems, although the generalisation is not affected. In cases of MAR, the missingness may be related to values in observed variables other than the study variable itself, e.g. gender and age. Thus, the observed scores in cases of MAR constitute a random subset of possible scores of the variable itself, but conditional on observed variables. MNAR arises when the missingness is related to the variable itself, e.g. when information on the history of suicidal behaviour is missed due to the patient's reluctance to answer questions about prior suicide attempts. In addition to potential power problems, the remaining data may be biased and hence no longer representative of the original population.

It could be very difficult to determine the precise reasons behind missing data. Based on the assumption that the data are MCAR or MAR, and even with some deviation for assuming a case of MAR, one general method recommended for handling missing data is multiple imputation (81). This method creates several complete data sets whereby the missing values are randomly drawn, based on information on all variables in the data set and the distributional aspect of the variables. According to Sterne and colleagues (81), the construction of several data sets is important because the presence of several estimated values for each case reflect the level of uncertainty of the imputation. Nevertheless, it is not possible to make precise reconstructions of the true values of the missing data. According to Rubin's rules (82), multiple imputation combines estimates from each completed data

set, taking into account both the level of uncertainty within and the variation between imputed data sets. Multiple imputation was used in Study I and Study III. In Study II, statistical analyses included time-dependent predictors (variables that changed during a follow-up period), as described in Section 3.5.2 (Statistical approaches and methods in Study II), with possible multiple data lines for each participant. Methods for multiple imputations of time-dependent variables were not available when Study II was conducted, which meant complete observation analyses had to be applied for the study. Moreover, in Study II, prior to deciding on the statistical approach to use, the descriptive analyses showed that 83% of patients had complete data (i.e. no lines involving missing values) and 4.5% had missing values for some variables in some lines. Therefore, since at least 83% of the patients contributed to the main analyses, it was assumed that the statistical power was sufficient without the need for imputing values.

3.5 Statistical analyses

Descriptive analyses were used in all three studies to provide an overview of the baseline predictors. Inter-rater reliability was calculated using Cohen's kappa for dichotomous variables, and ICCs for continuously measured variables. Spearman's rank correlation coefficients (rho) were used to test ordinally measured variables. The main statistical analyses used are described in relation to the statistical approaches applied for each study. Statistical analyses were conducted using different versions of R and R packages, including Design and rms, as well as survival (83), different versions of SPSS (84-86), and Mplus version 7.3 (87).

3.5.1 Statistical approaches and methods in Study I

Survival analyses with univariate and multivariate Cox regression models were conducted to assess predictors of the time elapsed between discharge from the index admission and the first readmission in general (for any reason). The literature review revealed that, to date, predictors of suicide risk-related readmissions have not been examined. Therefore, survival analyses were also performed for readmissions due to

suicide risk as outcome. The literature review also showed that very few previous studies examined predefined and prospectively assessed self-harm- and suicidality-related variables as possible predictors of future readmissions. Therefore, the operationalised self-harm/suicidality variable described in Section 3.2 (Patients, procedures, and outcome measures in Study I and Study II) was used as a predictor and scored as follows: (a) no known suicide risk (reference category), (b) suicidal ideation without a plan, (c) suicidal ideation with a plan, (d) non-suicidal self-harm (labelled as non-suicidal self-injury in Paper I), and (e) suicide attempt. To reduce the number of categories, the subcategories 'suicidal ideation with a plan' and 'suicidal ideation without a plan' were merged. Then this four-category suicidality variable was entered into the multivariate model, together with other clinical, sociodemographic, and treatment-related variables. The final estimation using the Cox model was based on ten multiple imputed data sets. Based on check of non-linearity, the continuous variables GAF-S and length of index stay were entered non-linearly in the final estimation. This strategy is based on the assumption that in a non-linear relationship, the hazard ratio for, say, an increase in length of stay from 10 to 20 days may not be the same as the hazard ratio for an increase from, say, 20 to 30 days or 80 to 90 days.

For additional analyses of the readmission rate, Poisson regression with the same covariates as the survival analyses was used.

3.5.2 Statistical approaches and methods in Study II

The main dependent variable in Study II was self-harm-induced somatic admissions, with Cox regression as the main analysis performed. The operationalised suicidality variable scored as (a) no known suicide risk (b) suicidal ideation/plan, (c) non-suicidal self-harm, and (d) suicide attempt was entered, together with other clinical, diagnostic, sociodemographic, and treatment-related variables. The Cox regression analyses were hierarchically organised as follows. Model 1 included variables assessed at index admission. In Model 2, follow-up treatment variables were added. Some covariates, which could vary during follow-up, were entered in a time-

dependent manner, e.g. the length of stay and suicidality-related scores were retrieved from the last PAU admission. The readmission variable was given a value of '1' in time intervals when the patient was in psychiatric readmission and '0' at other times during the follow-up period. The number of attended and unattended psychiatric outpatient consultations was calculated at each time point during the follow-up period (details are described in Paper II). A Kaplan–Meier analysis was performed to show graphically the time elapsed from index discharge to the first self-harm admission that occurred after discharge for the following four patient groups: (a) those whose index admission was not related to suicide risk, and those whose index admission was related to (b) suicidal ideation, (c) non-suicidal self-harm, or (d) suicide attempt. The Kaplan–Meier analysis also calculated the proportion of patients who had self-harm-induced somatic admissions within specified time periods after their index discharge.

3.5.3 Statistical approaches and methods in Study III

Two statistical approaches were used in Study III: (a) a multiple regression model and (b) a structural equation model (SEM). The multiple regression model was used to analyse BPD and PTSD as predictors of the number of future self-harm-induced somatic admissions. The distribution of the number of self-harm-induced somatic admissions was highly skewed (skewness = 5.39), and censored regression with a floor effect was specified. Thereafter, a one-dimensional measurement model and a two-dimensional measurement model ('relationship problems' and 'dysregulation') of the BPD criteria were tested using confirmatory factor analysis (CFA). After establishing the validity of the measurement model, the SEM included the borderline factors relationship problems and dysregulation, PTSD, and the intermediate covariate variables GAD, panic disorder, SUD, and the level of depression (MADRS). Direct and indirect relationships between the borderline factors and the number of self-harm-induced admissions to somatic hospitals were estimated, as well as indirect relationships through symptom diagnoses and the level of depression. Chi-square with significance test, comparative fit index (CFI), Tucker–Lewis index (TLI), and root mean square error of approximation (RMSEA) with confidence intervals were used to evaluate the model fit using the SEM (88).

3.6 Ethical considerations

The Regional Committee for Medical and Health Research Ethics (reference numbers 202.04/2009-1057) and the Norwegian Data Protection Agency (2005712-2) approved the studies. Permission to retrieve and use data from assessments at psychiatric admissions and outpatient follow-ups, as well as data from somatic hospital admissions, was granted by the Norwegian Directorate of Health (07/2558).

Data collection for Study I and Study II, without asking for patients' informed consent, was approved by the above-mentioned authorities for two reasons. First, the potential gain of new knowledge from these studies by identifying factors associated with the risk for suicidal behaviour or suicide in all patients admitted to PAUs was considered of high importance. Second, patients would not experience any excess risk, harm, or burden while participating in the studies, since data gathering was based on standard assessments at admission, information from medical records, and register data.

Study III was based on informed consent, and eligible patients were asked to participate in research interviews because these were outside the scope of the standard assessment procedure at the PAU. The clinician in charge of the patient's treatment assessed their patients for study eligibility according to the inclusion and exclusion criteria. The main inclusion criterion was suicide risk as the main reason for, or a contributing factor to, admission, and the main exclusion criterion was psychosis. The clinician in charge of the patient's treatment assessed for the presence of psychosis and whether their patient was able to understand the information given, provide informed consent, and take part in an approximately 1-hour diagnostic interview as well as an approximately 2-hour research interview (data not used in this thesis). Patients were informed that data gathered from their interviews would be added to their standard clinical assessment and, as such, could be useful to their treatment plan. If patients did not approve of the information gathered from their interviews to be made available to their treatment team, the inclusion procedure was terminated. This is because if the interviews revealed information indicating an

increased suicide risk or suicidal plans not known to the clinicians, this information had to be communicated to the treatment team. Only two patients did not agree to their interview data being shared with their treatment team. Overall, the vast majority of participants appreciated the opportunity of being given a thorough clinical assessment, and the general impression was that the participants acknowledged their interviews were highly useful.

4. Results- summary of papers

4.1.1 Study I. Suicide Risk and Acute Psychiatric Readmissions: A prospective cohort study

Suicide risk was the main or contributing reason for 617 (54%) of the 1245 index admissions to the PAU, of which 42% were related to suicidal ideation; while non-suicidal self-harm and suicide attempt each preceded 6% of the index admissions. The subcategories of suicidal ideation with (17%) and without (25%) a plan were not reported in the paper, since they were merged together in the analyses. Within the mean follow-up time of 1.5 years, 1234 readmissions to the PAU were registered, of which 62% were related to suicide risk. The proportion of patients who were readmitted among patients with and without suicide risk related index admissions were 42% and 43% respectively. When adjusted for other variables, none of the suicidality categories predicted readmission for any reason. However, patients whose index admission was related to suicidal ideation had a nearly doubled risk of readmission because of suicide risk, when compared to those whose index admission was scored as no known suicide risk. Factors that were significantly associated with both readmissions in general and readmissions due to suicide risk were psychiatric hospitalisation within the last year before index admission, personality disorders (mainly borderline personality disorder), substance use disorders, in addition to receiving sick-leave, disability, unemployment, or social benefits. Younger age was also associated with suicide risk related readmissions, as was increasing length of stay up to about ten days. A small sub-group of patients contributed disproportionately to the number of readmissions and a higher number of readmissions per individual patient was associated with a greater tendency of being readmitted due to suicide risk. In the ten patients with the highest number of readmissions 80% of the admissions were related to suicide risk (53% related to suicidal ideation/plan, 16% preceded by suicide attempt, 12% preceded by non-suicidal self-harm).

4.1.2 Study II. Self-harm induced somatic admission after discharge from psychiatric hospital – a prospective cohort study

During the follow-up time of 2.3 years, 296 (10.5%) of the 2827 patients included in this study had 792 self-harm induced somatic admissions. The corresponding rate within one year of follow-up was 9.5%. A subgroup of 14 (5%) patients had 10 or more such admissions and counted for 256 (32%) of self-harm induced somatic admissions. Diagnoses in this subgroup were recurrent depression, borderline personality disorder (BPD), substance use disorders (SUD), post-traumatic stress disorder (PTSD), and bipolar disorders. The self-harm method was self-poisoning in 80% of the episodes. The severity of the self-harm method was assessed as unlikely survival, and low/minor risk in 2% of the admissions respectively. High lethal risk was assessed in 39%, and moderate risk in 56% of the episodes. Five episodes resulted in death, but the majority of admissions did not result in organ damage sustained at discharge. About 90% of those who were somatically admitted due to self-harm, had their first such admission within the first year after the index discharge. Forty-eight percent of the patients had their first self-harm induced somatic admission within the first six months vs 42% between seven and 12 months after discharge. Having had a PAU admission related to non-suicidal self-harm was associated with more than a four-fold risk of post-discharge self-harm induced somatic admission, when compared to patients with no known suicide risk at admission. The corresponding risk for patients admitted to PAU after a suicide attempt were about three-fold; and the risk for patients admitted in relation to suicidal ideation/plan was more than doubled. Other predictors were having a history of psychiatric hospitalisation before the index admission, readmissions during follow-up (the risk for somatic admission was increased during psychiatric readmission), an increasing number of outpatient appointments during follow-up, as well as diagnoses of recurrent depression, personality disorders, substance use disorders, and anxiety- and stress-related disorders. The diagnoses in the personality disorder group were mainly borderline personality disorders (BPD), and the anxiety-and stress-related diagnoses mainly involved of post-traumatic stress disorder (PTSD) (not specified in the Paper II). Remarkably, only 49% of the somatic hospital admissions identified

through manual inspection as caused by self-harm, had received an ICD-10 diagnosis of intentional self-harm.

4.1.3 Study III. Borderline Personality Disorder and Posttraumatic Stress Disorder at Psychiatric Discharge Predict Prospective Hospital Admission for Self-Harm

All 308 patients in this interview study were admitted due to suicide risk, which was the main inclusion criterion. Of the included patients, 36.7% were diagnosed with borderline personality disorder (BPD), 24.4% with a current post-traumatic stress disorder (PTSD), whereas 13.6% were diagnosed with both disorders. Self-harm preceded 32% of the interview admissions (not reported in the paper). Within the follow-up time of 6 months, 18.5% of the patients had at least one self-harm induced somatic admission. The mean number of such admissions for the subjects who were hospitalised for self-harm was 1.49 (SD±1.42). When adjusted for each other, both PTSD and BPD were independent predictors of the number of self-harm induced somatic admissions. A structural model comprising two latent BPD factors, 'dysregulation' and 'relationship problems', as well as PTSD and generalized anxiety disorder, panic disorder, substance use disorder, and the level of depression, demonstrated that PTSD was a strong and direct predictor of the number of self-harm induced somatic admissions. The BPD factor 'dysregulation' also predicted self-harm directly, as well as through PTSD. Only the statistically significant associations are presented in Figure 1, in Paper III.

5. Discussion

5.1 Main findings

The three studies constituting this thesis described the prevalence of suicide risk and the related variables suicidal ideation, non-suicidal self-harm, and suicide attempt as the main reasons for, or contributing factors to, acute psychiatric admissions. In addition, these variables were examined as possible predictors of psychiatric readmissions and self-harm-induced somatic admissions after psychiatric discharge. The main findings showed that the majority of both index admissions (54%) and readmissions (62%) were associated with suicide risk, and the rates of suicide attempt, non-suicidal self-harm, and suicidal ideation as reasons for acute psychiatric admissions increased with an increasing number of readmissions in individual patients. In addition, about one in ten patients from the entire patient cohort had at least one self-harm-induced somatic admission during the follow-up period following discharge from the psychiatric index admission. The strongest predictors of self-harm-induced somatic admissions were the variables non-suicidal self-harm, suicide attempt, and suicidal ideation as reasons for previous psychiatric admissions. The risk for self-harm-induced somatic admissions was increased in the first year of follow-up, during readmission, with an increasing number of outpatient appointments, and in patients diagnosed with recurrent depression, BPD, substance use disorders, and PTSD. On hospital discharge, only about 50% of self-harm-induced somatic admissions were assigned a ICD-10 diagnosis of intentional self-harm (X6n) (47).

In the subgroup of patients with suicide risk-related acute psychiatric admissions, results showed that PTSD and BPD were comparable predictors of the number of self-harm-induced somatic admissions. When analysed using a structural model including BPD factors, PTSD, and self-harm, PTSD was found to be a strong and direct predictor of the number of self-harm-induced somatic admissions. The BPD dysregulation factor also predicted self-harm directly, as well as via PTSD.

5.2 Findings in relation to previous research

5.2.1 Study I. Suicide risk and acute psychiatric readmissions

The findings that 54% of psychiatric index admissions were related to suicide risk was in line with findings from a previous Canadian study of about 65,000 acute psychiatric admissions (65) and a US study of about 10,000 acute psychiatric admissions (61). The standardised assessments of these two studies demonstrated that 50% and 58% of the consecutive admissions were related to suicide risk respectively. In addition, a study of first-time psychiatric admissions in northern Norway found that suicide risk was the reason for 52% of admissions (56). No data were found from other unselected cohorts for comparison with the important finding that the rate of suicide attempt and non-suicidal self-harm as reasons for acute psychiatric admissions increased with an increasing number of readmissions in individual patients. Results from Study I are in agreement with previous findings that a history of psychiatric hospitalisation (54, 58, 65, 89-91), a history of psychiatric outpatient treatment (65, 90), and a diagnosis of personality disorder (65, 90) or substance use disorder (90, 92) can predict psychiatric readmission.

5.2.2 Studies II and III. Self-harm-induced somatic admissions after psychiatric discharge

Within 1 year after discharge from the psychiatric index admission, 9.5% of patients in the entire cohort had at least one self-harm-induced somatic admission. A register-based study of a similar patient cohort in England (17) is the only other study with published data on hospital-treated self-harm after psychiatric discharge. In this study 6.5% of patients had at least one self-harm-induced somatic or psychiatric admission within an equivalent follow-up period. Subsequent personal communication with the study authors revealed that, of these 6.5% of patients, 4.7% were somatic admissions. The most likely explanation for the discrepancy in the rate of self-harm-induced somatic admissions is underreporting of the ICD-10 diagnosis of intentional self-harm (X6n). Such underreporting is a well-known problem within the field of suicidology (48, 49). In Study II, combining register linkage and manual inspection

of records related to each somatic admission revealed that only 50% of admissions identified by study researchers to be caused by self-harm were assigned the X6n diagnosis. Given the national study discussed above (17) involved similar underreporting, there is reason to believe that the true rate in the study would approach that found in Study II.

Study III (The Interview study) consisted of patients admitted to the PAU due to suicide risk. Current self-harm preceded baseline admission in 32% of these cases. Within 6 months in the follow-up period, 18.5% of these patients had at least one self-harm-induced somatic admission. Comparison with other studies has proven difficult because of differing study samples, follow-up periods, and outcome measures of self-harm. In a previous interview study (14) involving an identical follow-up period, 40% of the patients reported post-discharge self-harm. However, 59% of these patients had presented at baseline admission with current self-harm. The higher baseline rate, as compared to that in Study III, may partly explain this result discrepancy, as previous self-harm is a strong risk factor for future self-harm (20). Moreover, the difference could also be explained by the fact that the outcome variable in the comparison study was self-reported episodes, which also included self-harm that did not require inpatient medical treatment.

5.3 General discussion

As discussed in Chapter 1 (Introduction), many factors are involved when patients are admitted to psychiatric acute units due to suicide risk. Admissions to the PAU at Haukeland University Hospital were scored as suicide risk-related when the referring clinician assigned suicide risk as the main reason for, or a contributing factor to, the admission or when such risk was identified by the psychiatric resident who assessed the patient on arrival. In addition, the psychiatric resident scored the admission as related to suicidal ideation or as directly preceded by a non-suicidal self-harm episode or a suicide attempt. The following case example illustrates how PAU admissions were classified. Peter was referred to the PAU for observation of his psychotic symptoms and the potential onset of a schizophrenic disorder. The referring clinician

did not mention a possible suicide risk, but the psychiatric resident's assessment of the patient on arrival revealed that Peter had been thinking about suicide for some time and had planned to drown himself. His admission was therefore scored as related to suicide risk and suicidal ideation with a plan.

By using findings from standardised assessments, a naturalistic account of the prevalence of suicide risk as a reason for acute psychiatric admissions was obtained. The finding that over 50% of admissions were related to suicidal ideation, non-suicidal self-harm, or suicide attempt demonstrates the important role of psychiatric acute units in managing and treating suicide risk and various forms of self-harm behaviours. Preventative measures, in accordance with national guidelines for suicide prevention (93), are likely implemented in all Norwegian psychiatric acute units. Although these guideline recommendations have not been systematically evaluated since their introduction nearly a decade ago, two studies (94, 95) have found some support that they contribute to a more focussed and safe practice around patients with an increased risk for suicide and self-harm. Nevertheless, results from the studies presented in this thesis showed high rates of suicide risk related psychiatric readmissions and post-discharge self-harm-induced somatic admission.

There may be several pathways to these worrisome readmission patterns. As suggested by Nock (46), self-harm may, for some people, be a way of communicating their difficulties to others, and by admitting patients into hospital in an attempt to address their self-harm behaviour, the treatment community may be reinforcing, rather than restraining, the patients' behaviour (21). Moreover, sometimes, acute unit staff may contribute to reinforcing self-harm behaviour by responding with caring and supportive treatment and attention or simply by offering time in an inpatient setting. Therefore, all these points highlight the need to develop treatment strategies and an appropriate milieu aiming at helping these patients to find more constructive ways of communicating their needs.

Another pathway leading to a readmission pattern characterised by increasing suicidal behaviours is possibly related to a longer duration of illness. Inadequate

treatment of the underlying illness and its related problems may result in hopelessness and resignation. This hopelessness may increase with an increasing number of admissions, thus not contributing to the subjective experience of improvement of symptoms and quality of life. Moreover, many patients with a longer duration of illness may experience alienation and feel that they are a burden to others. The interpersonal theory of suicide (43) suggests that co-occurrence of alienation and burdensomeness could play an important role in the suicidal process and that repeated self-harm could be related to a habituation process, which implies a higher tolerance of physical pain and less fear of dying. Thus, it may not be only the illness itself, but also other factors involved when patients are repeatedly readmitted following increasingly severe self-harm episodes. Therefore, acute unit staff should use any readmission as an opportunity to (re-)establish adequate treatment and follow-up measures. Not least, the potential of developing a destructive readmission pattern highlights the importance of giving first-time admitted patients thorough diagnostic and psychosocial assessments, as well as tailored follow-up treatments planned ahead of hospital discharge and aiming to avoid readmission if possible.

The fact that about one in ten patients of the entire PAU cohort had at least one self-harm-induced somatic admission during the year after the index discharge indicates a continued and long-standing risk of self-harm. The self-harm variable assessed in relation to somatic admissions did not differentiate between non-suicidal self-harm and suicide attempt. In many cases, the patients were ambivalent about their intentions, or the physicians only described the type of self-harm, e.g. 'self-poisoning', rather than the motivation for self-harm. Consequently, hospital records did not always provide the information needed to assess possible suicide intent. However, the somatic self-harm variable is equivalent to high-lethality self-harm described in studies using the 'Lethality Rating Scale' (27, 96), which defines self-harm requiring inpatient medical treatment as high-lethality self-harm. In the following text, the term 'severe self-harm' is used interchangeably with 'self-harm-induced somatic admission'.

In patients whose PAU admission was related to non-suicidal self-harm, the risk of post-discharge self-harm-induced somatic admissions was more than fourfold, when compared to patients whose PAU admission was not related to suicide risk. The corresponding risk was nearly threefold in patients whose PAU admissions were related to suicide attempt or suicidal ideation. Since non-suicidal self-harm has been suggested to function as a means to regulate emotions, relieve distress, and communicate with, or elicit help from, others (46), it has often been dismissed as manipulative and hence is considered less serious than suicide attempt (27, 33). Therefore, findings from Study II related to the non-suicidal self-harm variable may support those from a previous study (97), which found no significant difference between the objective lethality of non-suicidal self-harm and that of suicide attempt. Moreover, patients who carried out non-suicidal self-harm perceived their self-harm to be less lethal, and hence with greater likelihood of being rescued. Altogether, these findings demonstrate that any kind of suicide risk-related acute psychiatric admission is associated with a highly increased risk for future severe self-harm. Of note, the Interview study (Study III) included a randomly selected sample from this high-risk group of patients.

The Interview study identified PTSD as a strong and independent predictor of severe self-harm in patients with suicide risk-related PAU admissions. This finding contradicts those from two previous studies, which found that PTSD was not a statistically significant predictor when adjusted for BPD (31, 32). One of these studies (31) examined lifetime PTSD and lifetime self-reported suicidal attempt, whereas the Interview study assessed current PTSD and prospective self-harm. In addition, both previous studies (31, 32) recruited patients mainly from outpatient clinical settings or through fliers, whereas patients were included in the Interview study shortly after their acute psychiatric admission and outcome data were collected after an observation period of 6 months. Thus, the acuity of illness and ongoing PTSD symptoms may have contributed to a higher risk of self-harm in patients in the Interview study. A limitation of the Interview study is that self-harm assessed at somatic admission did not distinguish between non-suicidal self-harm and suicide attempt. In contrast, both previous studies (31, 32) used suicide attempt as outcome

measure, and it is possible that the association between PTSD and self-harm in the Interview study was predominantly between the diagnosis and non-suicidal self-harm. However, given the severity of the somatic self-harm variable, this is not likely to be the full answer and further studies are needed for a better understanding of these associations.

To determine whether possible underlying dimensions of the borderline criteria also may contribute to the self-harm process in other patients than those diagnosed with BPD, all patients included in the Interview study were assessed by structured diagnostic interviews. The factor analysis based on the ordinal scale measuring of the borderline criteria supported two underlying dimensions: 'relationship problems' and 'dysregulation'. Using the structural model in the Interview study, PTSD was analysed as an intermediate variable between these borderline factors and the outcome variable of self-harm. Generalized anxiety disorder, panic disorder, substance use disorders, and depression level were included as adjustment variables, as previous studies showed an association between these disorders and symptoms and self-harm and suicidal behaviour (see Paper III). In the model used here, PTSD was found to be a significant and strong direct predictor of self-harm-induced somatic admissions. The borderline dysregulation factor predicted self-harm both directly and indirectly via PTSD. Previous studies have shown that the high rates of self-harm in patients with BPD are, to a large extent, related to problems with emotion regulation (23). PTSD is also characterised by emotion dysregulation and various forms of self-harm and suicidal behaviour (28) and, although less prominent in the suicide research literature, some studies have addressed these associations. For instance, a study of inpatients with substance use disorders examined the moderating role of emotion dysregulation and lifetime PTSD on various forms of self-harm behaviour (30). In these patients, high levels of overall emotion dysregulation, lack of emotional awareness, and limited access to effective regulation strategies were associated with increasing frequency of non-suicidal self-harm. High levels of non-acceptance of emotions were associated with self-harm versatility. Concerning the latter finding, the authors suggested that individuals with

PTSD who are less accepting of their emotions may be more likely to resort to a greater variety of methods of self-harm in an effort to eliminate their experiences. Although these dimensions of emotion dysregulation may share some characteristics with the borderline dysregulation factor, there are also some differences. In the Interview study, the estimated underlying borderline dysregulation factor was found to be associated with impulsivity, self-harm/suicidality, affective instability, inappropriate anger problems, and transient stress-related paranoid ideation/severe dissociative symptoms. The finding that the borderline dysregulation factor contributed to future severe self-harm via its association with PTSD may lend support to previous studies (98, 99), suggesting that emotional dysregulation may contribute to the development, maintenance, and/or exacerbation of PTSD, which, in turn, increase the risk for various forms of maladaptive behaviour such as self-harm. Possible mechanisms underlying such development are described in the Introduction section of Paper III. Due to a lack of information about the temporal relationship between the occurrence of borderline and PTSD symptoms, it is not possible to conclude whether PTSD is a true mediator between the borderline dysregulation factor and self-harm-induced somatic admissions. However, the above-mentioned evidence lends support to such inference. Also, it is not known whether self-harm functioned as an attempt to regulate emotions or whether these patients intended to end their lives. In any case, self-harm has the potential to cause severe bodily harm or death, if patients do not receive medical treatment. Moreover, both suicidal and non-suicidal self-harm are strong predictors of future suicide (12). To prevent self-harm and suicidal behaviour in patients admitted to psychiatric acute units due to suicide risk, there seems to be a need for treatments that directly address emotion dysregulating problems. This has been recognised and addressed in patients with BPD, particularly through the manualised treatment programme of dialectical behaviour therapy (DBT) (23). Based on findings from Study III targeting dysregulating problems could also contribute to self-harm prevention in patients with PTSD. Moreover, the direct influence of dysregulation on self-harm, as demonstrated in Study III, also implies that addressing dysregulating problems could contribute to preventing severe self-harm, irrespective of the patient's diagnosis. In addition to

DBT, a couple of other therapeutic treatment interventions, which have also shown promising results in reducing suicidal behaviour are described in Section 5.6 .2 (Implications for practice).

5.3.1 Multiple self-harm-induced somatic admissions

The repetition rate of self-harm requiring inpatient somatic treatment was high. This is an alarming finding, given repetition of self-harm is associated with a high risk for future suicide (20). Although the somatic self-harm variable did not differentiate between non-suicidal self-harm and suicide attempt, the general severity of the self-harm indicated that a large proportion of these patients may have had some suicide intent with the self-harm. A high repetition rate in patients with BPD was expected, as recurrent non-suicidal self-harm and suicidal behaviour are among the defining criteria for this disorder (28). However, in addition to patients with BPD, a subgroup of patients with more than ten self-harm-induced somatic admissions consisted of those with recurrent depression, substance use disorders, PTSD, and bipolar disorder. Several approaches are needed to understand why some patients repeatedly harm themselves severely. In some cases, the repetition may be related to depression or other mental conditions that are insufficiently treated. An underlying diathesis (42), including, for instance, psychobiological factors, hopelessness, impulsivity, and cognitive factors (not studied in this thesis), may play an important role in some patients who repeatedly self-harm. According to the stress–diathesis model (42), the diathesis augments each time a person harms themselves, and consequently stressors of decreasing severity may lead to suicidal behaviour with increasing severity. Nock's theoretical model (46) suggest that the immediate emotion-regulating effect of self-harm, as well as habituation to self-harm, is an important aspect in the repetition and maintenance of the behaviour in patients who struggle with dysregulating problems. However, this mechanism probably mainly applies to cutting and other self-inflicted skin and tissue damages, whereas the majority of the self-harm-induced somatic admissions in Study II and III were related to severe self-poisoning. Further studies are needed to provide understanding of the mechanisms behind repeated self-poisoning behaviour. A factor which paradoxically may

contribute to the repetition of self-harm is the successful medical treatment of severe self-harm. For instance, the findings in Study II showed that even high-lethality self-harm rarely caused sustained severe organ damage. This can induce a feeling that repeating self-harm is not as dangerous as it may be, thus contributing to the unwarranted consequence that some patients repeat this dangerous behaviour. The interpersonal theory of suicide (43) suggests that repetition of self-harm results in a higher tolerance of physical pain and a sense of fearlessness of death, thus contributing to an acquired capability for suicide. The heterogeneity of patients who repeatedly self-harm, hence putting themselves at risk for severe bodily harm and/or suicide, highlights the need to develop tailored treatment programmes aiming at preventing such behaviour after psychiatric discharge.

5.3.2 Self-harm-induced somatic admissions and follow-up treatments

An increasing number of outpatient psychiatric consultations during follow-up was associated with an increased risk for self-harm-induced somatic admissions. An increased risk was also found in patients who had a history of psychiatric hospitalisation before their index admission and during readmissions after their index discharge. These findings are supported by two previous studies (33, 100). The most plausible explanation for these findings is that those patients considered to be at high risk for suicidal behaviour were given more frequent outpatient consultations and/or were returned to psychiatric inpatient care. The long-lasting risk for severe self-harm despite intensive treatment raises questions about the effectiveness of the treatment provided. Some previous studies found that treatment of the underlying disorder was not adequate for self-harm prevention in discharged psychiatric patients (101, 102); thus, factors such as feeling worthless, high number of admissions, motor impulsivity, and poor control of suicidal thoughts substantially and significantly predicted suicide attempt, whereas depressive symptoms did not. Studies based on data from suicide prevention clinics in Denmark (103, 104) showed that psychosocial therapy focussing directly on suicide prevention seems to lower the risk for repeated self-harm, as well as the risk for general mortality and suicide. This is supported by a

recent meta-analysis which found that such direct interventions were effective in the prevention of suicide and suicide attempts both immediately after treatment and in the long term (105). Indirect treatments, i.e. treatments of the underlying disorders, were only effective in the long term. Therefore, providing direct and specific treatment for suicidal behaviours is likely to be a more effective strategy than targeting the underlying disorders only.

5.3.3 Underreporting of the ICD-10 diagnosis of intentional self-harm

In Study II, only approximately 50% of relevant somatic admissions were given the ICD-10 diagnosis of self-harm (X6n) (47), in agreement with previous studies (48, 49). This diagnosis underreporting has many implications and, probably, several reasons. In contrast to most somatic diagnoses, making a diagnosis of self-harm does not bring any income to hospitals. Another plausible explanation is that physicians responsible for the medical treatment do not consider the diagnosis of self-harm useful in day-to-day clinical practice and instead feel that dealing with the psychological aspects that motivated the self-harm behaviour is time-consuming and emotionally challenging. Importantly, the scenario of not having self-harm communicated to health-care professionals in charge of patients' medical and psychiatric follow-up could have serious implications. Moreover, underreporting the diagnosis of self-harm at discharge also affects the accuracy of hospital, as well as national, registers, negatively impacting on research relying on such data. Concerns about underreporting of self-harm in hospital registers has led to the development of the National Registry of Deliberate Self Harm in the Republic of Ireland (106) and a multicentre study of self-harm in England (107). In addition, Denmark has established nationwide multicentre studies based on data from Danish suicide prevention clinics (104). These nationwide centres and clinics provide comprehensive data on all their respective treatment contacts due to self-harm. However, the national register data on hospital-treated self-harm in these countries may still be affected by underreporting of self-harm. Therefore, it is essential that researchers and health-care authorities target this problem of underreporting.

5.4 Strengths and limitations

This prospective and longitudinal cohort study assessed a nearly complete psychiatric hospital-treated patient population from a combined urban and rural catchment area. Although health-care systems vary in different countries, this study population should allow valid national and international generalisability of patients acutely admitted to psychiatric hospitals. However, such naturalistic data cannot be used to infer causation of any kind. Moreover, there are variables which were not assessed in this study, which could have significant impact on increasing or decreasing the risk for readmission and self-harm, e.g. genetic and neurobiological factors (41), neuropsychological factors (108), medications provided (109), childhood adversities and other trauma exposure (110), and somatic disorders and pain syndromes (111, 112).

5.4.1 Strengths and limitations of Study I

In Study I, readmission is defined as any repeated admission to the PAU during the follow-up period. A time interval of 30 days is commonly used when unplanned readmissions are studied as a treatment outcome (113). However, Study I focussed on the covariates' estimated impact on time to the first readmission, even if not directly linked to the former admission. The study of suicide risk-related readmissions, in addition to readmissions due to any reason, added clinically important knowledge, not reported in previous studies.

5.4.2 Strengths and limitations of Study II

Study II presented prospective and longitudinal data of a large and unselected patient cohort. Using a combination of register linkage and manual examination of patient records enabled the identification of all self-harm-induced somatic admissions for each individual patient. Time-dependent survival analyses allowed the inclusion of treatment and clinical changes during the entire follow-up period. However, the fact that the self-harm variable did not differentiate between non-suicidal self-harm and suicide attempt limited the interpretations of the study findings. Another limitation

was the lack of information on the types of treatment given, prescribed medications, and compliance with treatment. It is possible these factors could have influenced the outcome if they were included in the analyses. Both Study I and Study II used ICD-10 hospital discharge diagnoses. The longitudinal aspect of the studies implies that a large number of clinicians participated in the diagnostic procedures and reliability tests were not performed.

5.4.3 Strengths and limitations of Study III

The self-harm outcome variable is the same as that used in Study II, with the same strengths and limitations. The main focus of Study III was on underlying BPD dimensions and PTSD as possible predictors of self-harm-induced somatic admissions. It would be relevant to include data on childhood adversities and other trauma exposure in the model used in this study, as these factors may be directly associated with self-harm and suicidal behaviour, as well as with both BPD and PTSD (21, 99). Such variables should be included in future studies. Psychosis was an exclusion criterion in this study; thus, the results are representative for non-psychotic patients only. In addition, patients admitted to hospital due to suicide risk likely have a particularly high risk for self-harm and suicidal behaviour. Therefore, the findings may not be relevant to outpatient samples. Except for these key issues, this study included mixed-gender patients with an age range of 18–77 years. Therefore, generalisability of the results to non-psychotic patients who are hospitalised due to suicide risk can be considered valid.

5.5 Conclusions

Study findings presented in this thesis described the prevalence and characteristics of suicide risk-related variables as the reasons for acute psychiatric admissions, as well as the prevalence, characteristics, and predictors of self-harm-induced somatic admissions after psychiatric discharge. Suicide risk was reason for more than half of the total acute psychiatric admissions, and in eight out of ten admissions in the group of the most frequently admitted patients. Moreover, suicide attempt or non-suicidal

self-harm preceded the admission substantially more often in these frequently admitted patients, when compared to the total cohort. The suicide attempt or non-suicidal self-harm variables were also found to be strong predictors of future self-harm-induced somatic admissions. The risk for self-harm requiring inpatient somatic treatment was high throughout the first year after psychiatric discharge. Patients with PTSD had a similarly high risk for severe self-harm after discharge, compared to patients with BPD. A borderline dysregulation factor was associated directly, as well as via PTSD, with self-harm-induced somatic admissions. This dysregulation may also be important in other patient groups, particularly those with repetitions of severe self-harm. A large proportion of patients repeated severe self-harm at least once, whereas a small and diagnostically heterogeneous subgroup of patients contributed disproportionally to the number of self-harm-induced somatic admissions. Although a large proportion of self-harm cases requiring inpatient somatic treatment had the potential to cause organ damage or death, such outcome was rare. Only half of somatic admissions due to self-harm were assigned the ICD-10 diagnostic code for self-harm at discharge.

5.6 Implications

5.6.1 Implications for further research

An important question, which should be addressed in future research, is whether the interplay between the patient and their treatment providers contributes to repetition of self-harm behaviour and subsequent readmissions to psychiatric or somatic hospitals.

Moreover, there is a great need for designing treatment programmes which are tailored to various patient subgroups, with a view to preventing unfavourable psychiatric readmissions and severe self-harm. Importantly, these treatment programmes should be designed in such a way that would allow evaluation of their effectiveness.

In addition, treatment programmes that have shown promising results mainly in female patients with BPD and PTSD should also be assessed for their effectiveness in male patients with BPD and PTSD.

Patients with substance use disorders were not studied in this thesis. These patients are known to have an increased risk for suicide risk-related readmissions, self-harm-induced somatic admissions, and somatic admissions due to accidental overdoses. Therefore, patients with substance use disorders should be included in future treatment interventions and research.

Future research should also study to what extent post-discharge self-harm occurs in patients who are assessed with "no known suicide risk". Some of these patients may have increased risk of future self-harm although they may be unable, or reluctant, to answer questions about suicidal ideation or plans. It would be important to determine which factors are related to possible post-discharge self-harm in these patients.

5.6.2 Implications for practice

Identifying suicide risk as the reason for acute psychiatric admission helps to identify patients at high risk for severe self-harm after discharge. Therefore, thorough suicide risk assessments on patient admission, along with diagnostic assessments, followed by treatment according to up-to-date clinical guidelines (114, 115), are essential. However, our findings support previous studies (105) suggesting that treatment of the underlying disorder(s) may not be sufficient to prevent repetition of self-harm. In addition, there is a need for evidence-based psychosocial and behavioural interventions that address both directly and transdiagnostically suicidal thoughts and behaviour. The collective term 'psychosocial therapy' includes several therapeutic approaches. A Cochrane review (116) concluded that DBT is the only treatment found to have sufficient replication of its effectiveness to be considered evidence-based for the treatment of BPD patients with self-harm. Although not studied extensively, single studies of mentalisation-based treatment (MBT) have found MBT to reduce self-harm and suicidal behaviour in adult patients with BPD (117) and self-

harm in adolescents (118). Treatment programmes combining the principles of DBT with trauma-focussed interventions (119, 120) have shown promising findings in patients with both BPD and PTSD. These programmes are particularly relevant to patients who use self-harm as a means to regulate emotions. Up to now, these treatment programmes have been offered mainly to female patients and therefore should be offered to both male and female traumatised patients with emotion dysregulation problems. A recent Cochrane review (121) found that cognitive behavioural-based psychotherapy (CBT) showed promising results in reducing repetition of self-harm in patients who had previously been treated for self-harm in general hospital settings or emergency clinics. The reasons for self-harm and suicidal behaviour differ, and various treatments may be effective in different patient groups. Thus, these therapeutic programmes, or at least the treatment principles based on them, should be available and considered either as the main treatment or as supplementary follow-up treatment for patients who may be at risk for various forms of self-harm after discharge from acute psychiatric admission.

For several decades, Norwegian national strategies for the prevention of self-harm and suicide have recommended collaborations between somatic hospitals and community health services in the care of patients who have been admitted to somatic hospitals due to self-harm (122). However, a recent report (123) revealed that 59% of Norwegian municipalities did not have established routine plans in place for the immediate aftercare of such patients. The Norwegian guidelines for suicide prevention in psychiatric health care (93) recommend that patients who have been admitted in a psychiatric hospital due to suicide risk should be offered a follow-up appointment within a week after discharge. Continuity of care, according to these strategies and guidelines, usually refers to follow-up appointments with those responsible for the aftercare of discharged psychiatric patients. However, consistency of treatment principles is also important. Patients participating in, for instance, DBT or MBT programs should not be given different principles of treatment when admitted to psychiatric acute units for crisis interventions, compared to treatments they otherwise receive in outpatient settings. Therefore, to ensure treatment consistency, education of inpatient, as well as outpatient, staff on these therapeutic

interventions is critical. The Norwegian national guidelines on suicide prevention also recommend that regular teaching and training of clinicians on suicide risk assessment and preventative measures and strategies should be mandatory in all psychiatry units. Last but not least, individualised safety plans for patients who have been admitted due to suicide risk are also recommended by the Norwegian national guidelines, as well as in many other countries (38). Taken together with the above-mentioned report (123), study findings presented in this thesis highlight the need to intensify efforts to implement guideline recommendations, as well as the need for a monitoring system and appropriate measures to reduce the long-term risk of self-harm in patients discharged from acute psychiatric care.

Finally, the negative impact of underreporting of the ICD-10 diagnostic code of self-harm (X6n) is clear, as discussed in this thesis. Addressing the issue of underreporting lies primarily in the hands of health-care authorities to make reporting of the X6n diagnosis mandatory, whenever relevant.

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II

Original article

Self-harm induced somatic admission after discharge from psychiatric hospital – a prospective cohort study

CrossMark

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ARTICLE INFO

ABSTRACT

Background: Few studies have examined rate and predictors of self-harm in discharged psychiatric patients.
Aims: To investigate the rate, coding, timing, predictors and characteristics of self-harm induced somatic admission after discharge from psychiatric acute admission.
Method: Cohort study of 2827 unselected patients consecutively admitted to a psychiatric acute ward during three years. Mean observation period was 2.3 years. Combined register linkage and manual data examination. Cox regression was used to investigate covariates for time to somatic admission due to self-harm, with covariates changing during follow-up entered time dependently.
Results: During the observation period, 10.5% of the patients had 792 somatic self-harm admissions. Strongest risk factors were psychiatric admission due to non-suicidal self-harm, suicide attempt and suicide ideation. The risk was increased throughout the first year of follow-up, during readmission, with increasing outpatient consultations and in patients diagnosed with recurrent depression, personality disorders, substance use disorders and anxiety/stress-related disorders. Only 49% of the somatic self-harm admissions were given hospital self-harm diagnosis.
Conclusions: Self-harm induced somatic admissions were highly prevalent during the first year after discharge from acute psychiatric admission. Underdiagnosing of self-harm in relation to somatic self-harm admissions may cause incorrect follow-up treatments and unreliable register data.

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1. Introduction

Self-harm represents a large public health problem, not only in terms of the burden such behaviour impinges on patients, their families [22] and health care providers [17], but self-harm is also an important risk factor for completed suicide [1]. Patients with psychiatric disorders [21,24], in particular patients recently discharged from psychiatric inpatient treatment [5,15], have a substantially increased risk of committing suicide. Patients with suicide risk related psychiatric admissions are also more likely to become rapidly re-hospitalised because of such risk [7].

Management of patients' imminent and/or overt self-harm behaviour is an important and common task in emergency psychiatric inpatient units and effective intervention for self-harm is assumed to represent the best opportunity to prevent future suicidal behaviour [6]. However, up to now, the vast majority of studies on suicidal behaviour after psychiatric hospitalisation have focused on completed suicide.

An interview-based study of patients discharged from psychiatric hospital found that 18% and 5% of the patients were involved in respectively suicide attempt or non-suicidal self-harm within one year post discharge [18]. A national register based study [2] of patients discharged from psychiatric hospitals found that 6.5% had at least one self-harm admission to somatic or psychiatric hospital during the year following discharge. We have not been able to find other studies showing rates of hospital treated self-harm after discharge from psychiatric hospital in unselected

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patient cohorts. However, a study based on English national registers [3] showed some decline in hospital treated self-harm during a given time period after national policy initiatives aimed at reducing suicide risk in the post-discharge period were introduced.

Inconsistencies in the definitions of self-harm [8], a variable use of self-harm codes or failure to use such codes when appropriate [2,13,14] poses limitations to research based on register data. Moreover, register-based studies usually do not provide data on type and severity of self-harm. Hence, there is a need for prospective studies of post discharge self-harm in unselected psychiatric cohorts.

The aim of the present study was to investigate the rate, diagnostic coding, timing, predictors and characteristics of self-harm induced somatic admissions within two years after discharge from psychiatric acute admission in a large, unselected and consecutively admitted cohort. To overcome the above-mentioned problems related to the coding of self-harm, we used predefined definitions and variables on suicidal behaviour (below) and a combination of register linkage and manual data inspection of patient files.

2. Methods

2.1. Setting and patients

The cohort consisted of all patients consecutively admitted to the Psychiatric acute unit (PAU) at Haukeland University Hospital in Bergen, Norway. During the study period, the PAU received 95% of all psychiatric acute admissions in a catchment area with about 400 000 inhabitants covered by the Norwegian universal health care system. The inclusion period lasted from May 1, 2005 to April 30, 2008 and the patients' first admission during the inclusion period was labelled index admission. The observation period started at each patient's discharge from the index admission and lasted to the end of the study, February 28, 2009. The mean length of the observation period was 2.3 years (median 2.4 years, range 0.8–4.2 years). Of the 2842 patients (52% males) admitted to the PAU during the inclusion period, 2827 constituted the study cohort (four patients died during the index admission, and 11 were not discharged from the index admission before the end of the study). Altogether, 234 (8.3%) patients died during the observation period: 43 (1.5%) by suicide and 191 (6.8%) by other causes. Five of those who died by suicide are included in the somatic self-harm admissions as they reached the hospital alive: two died during their first somatic self-harm admission, three died during subsequent somatic self-harm admissions. As self-harm was the subject of this study, the 38 patients who died by suicide outside somatic hospital and the 191 (6.7%) who died by other causes were censored from the analyses at the date of death. Fig. 1 shows an overview of the study design, and socio-demographic data is shown in Table 1.

2.2. Psychiatric treatment during observation period

After the PAU-stay, lasting an average of 4 days (S.D.: 4.6, median: 3.9 days), 61% of the patients were transferred to other hospital wards, whereas 39% were directly discharged and referred for follow-up at psychiatric outpatient clinics, addiction clinics, general practitioners and/or community care. The mean total length of psychiatric hospital stay was 38 days (S.D.: 86, median: 14 days). During the observation period, 1168 (41%) patients had a total of 3284 readmissions (range: 0–34) to the PAU. After discharge from the index stay, 1405 (50%) of the patients received at least one planned psychiatric outpatient consultation. When consultations following index admission and psychiatric readmissions were added, 1792 (63%) patients had had a total of 48 975

planned psychiatric outpatient consultations (mean: 27, median: 16, range: 1–306).

2.3. Definitions

Suicide-related behaviour includes a spectrum of behaviours, from completed suicide to suicide attempt and non-suicidal self-harm [16]. In this paper, self-harm (SH) is defined according to the National Institute for Health and Clinical Excellence's (NICE) guidelines [9] as "intentional self-poisoning or injury, irrespective of the apparent purpose of the act. Self-harm includes poisoning, asphyxiation, cutting, burning and other self-inflicted injuries". Non-suicidal self-harm (NSSH) is defined as self-harm without suicide intent. Suicide attempt (SA) is defined as self-harm in which there is some intent to die, and suicide ideation is defined as thoughts of killing oneself [12]. Suicide risk status is, in this paper, used to describe whether suicide ideation, non-suicidal self-harm or suicide attempt preceded psychiatric admissions.

2.4. Baseline and treatment data

At all admissions to PAU, sociodemographic and treatment-related variables were recorded by research assistants. At intake, trained psychiatric residents assessed whether suicide risk was either the main or a contributing reason for the admission. They coded the suicide risk status according to the following categories: (a) no known suicide risk; (b) suicide ideation without a plan; (c) suicide ideation with a plan; (d) non-suicidal self-harm or (e) suicide attempt. Suicide ideation with and without a plan were collapsed into one category in the present paper. Primary and secondary ICD-10 diagnoses [23] were determined by the psychiatrist or psychologist in charge of the patient's treatment. After discharge from PAU, data on attended and not attended planned psychiatric outpatient consultations were retrieved from the outpatient clinics' administrative databases and the National health care compensations register by using the unique person identifier given to all Norwegian citizens at birth.

2.5. Outcome data

By using the unique person identifier, dates and duration of somatic admissions in the study cohort during the observation period, together with diagnostic data, were retrieved from the patient registries at the somatic hospitals in the catchments area. All available information in patient files was used to determine whether the admission was due to self-harm (yes/possible/no). Available information included ambulance notes, somatic file notes, notes from psychiatric liaison evaluations and psychiatric file notes for patients who were referred from or to psychiatric inpatient admission. The assessments were performed by the first author. A random sample of 70 patient records was then reassessed by an experienced psychiatrist (R.K.), demonstrating a high level of inter-rater reliability with a weighted Kappa of 0.88. Methods of self-harm were classified as poisoning, cutting, hanging/strangulation, jumping from heights, jumping/lying in front of a moving object, crashing of a motor vehicle, smoke/fire/flames, shooting or others.

Lethality of the self-harm methods was scored on a Likert type scale from 0 to 3: 0: "no or minor risk", 1: "moderate risk", 2: "high risk" and 3: "survival unlikely". The physical injury/organ damage caused by the self-harm was scored as 0: "no organ damage at discharge", 1: "organ damage present at discharge" and 2: "dead". Organ damage was defined, for instance, as pathologic results of laboratory tests indicating organ injury (raised s-creatinine for renal damage, raised s-ALT for hepatic damage) or persistent physical injury. Elevation in, for instance, electrolytes or CRP was
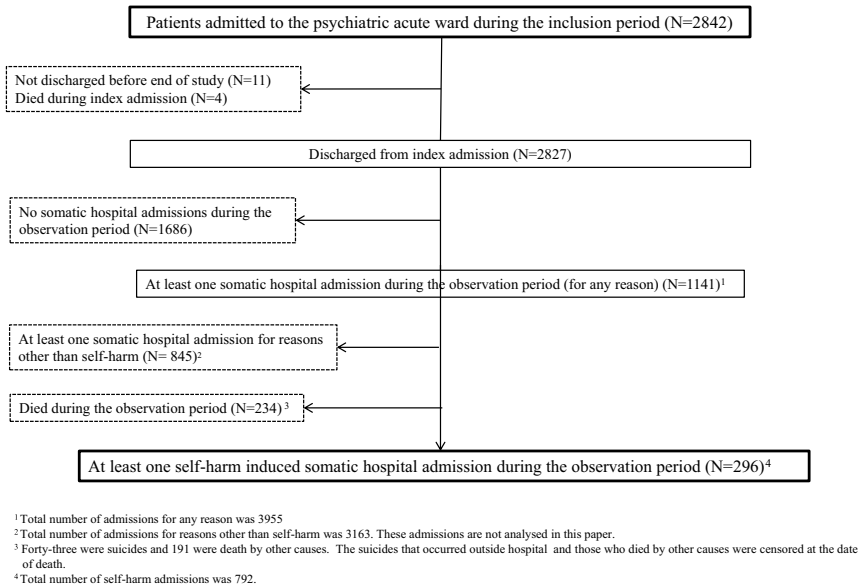
Fig. 1. Flow diagram of patients included, total somatic hospital admissions, self-harm induced somatic admissions and patients censored because of death.

not recorded as organ damage. The assessments of the lethality of the methods and physical injury/organ damage were based on all available information in the patient records. The assessments were made by a specialist (O.L.) in internal medicine, experienced in emergency medicine. A random sample of 54 cases was reassessed by a second rater, a psychiatrist (E.K.), experienced in clinical consultation-liaison psychiatry. The inter-rater reliability demonstrated a weighted Kappa of 0.87 for the lethality-scoring. The raters only disagreed in one physical injury/organ damage scoring.

2.6. Statistical methods

Descriptive analyses were performed to give an overview of patient characteristics, diagnostic codes and treatment variables. Spearman correlation analysis was used to examine the relationship between the lethality of the self-harm method and the severity of the injury. A Kaplan-Meier analysis was performed to view graphs of the time elapsed from the index discharge to the first somatic hospital admission due to self-harm and to calculate the proportion of patients having somatic self-harm admissions within specified time-periods after index discharge. Predictors of time to first somatic self-harm admission were analysed by multivariate Cox regression analyses. The diagnosis variables used were based on a primary and a secondary and tertiary diagnoses. There are reasons to believe that the secondary and tertiary diagnoses might be important for the outcome of self-harm. Therefore, some patients may have been classified as having both e.g. alcohol/substance abuse and personality disorder. Covariates changing during follow-up were entered time-dependently [20]:

- length of stay;
- data on whether suicide-related behaviour was the reason for the admission were retrieved from the last PAU admission;
- psychiatric outpatient follow-up treatment: at each time point (new date for consultation) during the observation period, the number of attended planned outpatient consultations per time unit (days) was calculated by dividing the number of consultations

by the number of days since the last PAU discharge. For patients readmitted to the PAU, a new counting started after discharge from each readmission. The same procedure was used for non-attended consultations;
- the readmission variable was given the value 1 in time intervals when the patient was in psychiatric readmission, and 0 elsewhere during the observation period.

The multivariate analyses were hierarchically ordered; in Model I sociodemographic variables, diagnostic variables, suicide risk status and length of psychiatric inpatient stay were entered. In Model II, we added the follow-up treatment variables; specialist outpatient consultations, non-attended specialist outpatient consultations and being in psychiatric readmission. Age and length of stay were modelled flexibly non-linearly, using restricted splines with four knots [4], to account for the possibility that, for instance, a change in the length of stay from 4 to 5 days could be more important than a change from 104 to 105 days (similarly for age). For all analyses, we used the statistical program R [19] with the R package rms for regression analyses.

2.7. Approvals

The study was approved by the Regional Committee for Medical Research Ethics and the Norwegian Social Science Data Service. The Norwegian Directorate for Health gave permission to use patient information.

3. Results

3.1. Rate of somatic hospital admissions due to self-harm

During the observation period of 2.3 years, 1141 patients (40%) had a total of 3955 somatic hospital admissions for any reason. Through manual assessment of each patient record, 792 of the somatic admissions were found to be due to self-harm, 10 were coded as possible cases of self-harm (five of these were

Table 1

Patient and treatment characteristics at index admission (*n* = 2827 patients). Hierachical multivariate Cox regression model[a] with adjusted Hazard Ratios (HRs) for somatic self-harm admissions.

Covariates[b]	Patient and treatment characteristics at index admission		Somatic hospitalisation for self-harm	*P* value
	n = 2827	%	Adjusted HR (95% CI)	
Gender				
Male	1469	52	1	
Female	1358	48	1.77 (1.36–2.29)	<0.001
Age (mean ± S.D.)	42 ± 17			
Age increasing from 20 to 50 years[c]			0.62 (0.44–0.89)	<0.001[d]
				0.070[e]
Source of income (n = 2689)				
Employed/full-time student/retired	968	36	1	
Disability pension/unemployment/social support	1721	64	1.06 (0.79–1.44)	0.681
Housing/cohabitation (n = 2757)				0.116
Cohabiting with partner, family or other person	1194	43	1	
Living alone	1151	42	1.25 (0.96–1.62)	0.097
Nursing home or part-time staffed residence	228	8	1.10 (0.61–1.97)	0.747
Homeless/sheltered house/asylum centre/prison	184	7	0.65 (0.34–1.21)	0.174
Education (n = 2687)				
Primary school (9 years)	1267	47	1	
Beyond primary school	1420	53	0.73 (0.56–0.94)	0.014
Suicide risk status[f] (n = 2638)				<0.001
No known suicide risk	1154	44	1	
Suicidal ideation/plan	1138	43	2.50 (1.75–3.56)	<0.001
Non-suicidal self-harm	170	6	4.42 (2.79–7.02)	<0.001
Suicide attempt	176	7	2.78 (1.66–4.65)	<0.001
Schizophrenia, schizotypal and delusional disorders (F20-F29)				0.188
No psychotic disorder	2159	76	1	
Schizophrenia/schizoaffective	371	13	1.09 (0.61–1.95)	0.771
Other psychotic disorders	297	11	0.47 (0.20–1.10)	0.083
Mood disorders (F30-F39)				0.010
No mood disorder	1648	58	1	
Bipolar/manic episode/other	415	15	1.28 (0.84–1.95)	0.259
Depressive episode	447	16	1.41 (0.96–2.07)	0.078
Recurrent depression	317	11	1.84 (1.29–2.65)	0.001
Alcohol/substance use disorders (F10-F19)				
No alcohol/substance use disorder	2134	75	1	
Alcohol/substance use disorders	693	25	1.63 (1.24–2.16)	0.001
Anxiety-/adjustment disorder/PTSD (F40-F48)				
No anxiety-/adjustment disorder/PTSD	2193	78	1	
Anxiety-/adjustment disorder/PTSD	634	22	1.54 (1.16–2.05)	0.003
Personality disorders (F60-F69)				
No personality disorders	2587	92	1	
Personality disorders	240	8	1.75 (1.24–2.47)	0.002
Psychiatric hospital history (n = 2823)				
First psychiatric admission	1302	46	1	
Prior admitted	1521	54	1.63 (1.23–2.16)	0.001
Length of stay increasing from 2–10 days[g]			1.06 (0.87–1.29)	0.641[d]
				0.652[e]

[a] Cox Model I is displayed in the table. The Hazard Ratios for the variables added in Model II are described in the Results section.

[b] For covariates with missing values, the total *n* is presented.

[c] Only the HR for the interval for 20–50 years is shown in the table.

[d] Overall *p*-value.

[e] *p*-value for non-linearity. A significant p-value would have indicated a non-linear relationship.

[f] The suicide risk status at the last psychiatric admission was entered in the analyses

[g] The Length of stay (LOS) at the last psychiatric admission was entered in the analyses. Only the HR for the interval from 2–10 days is shown in the table. No intervals for LOS gave significant HR.

substance overdoses) and 59 admissions were scored as unknown (41 of these were substance overdoses). The somatic admissions not related to self-harm are not analysed in this paper. The 792 self- harm admissions involved 296 (10.5%) of the patients (mean: 2.7, range: 1–37). A subgroup of 14 (5%) patients had 10 or more admissions and accounted for 256 (32%) of the total somatic

self-harm admissions. The diagnoses in this group were recurrent depression, personality disorders, alcohol and substance use disorders, anxiety disorders and bipolar disorder (data not shown).

For comparisons with other studies, the rate of patients with one or more somatic self-harm admissions within a one-year observation period was calculated to be 9.5% (*n* = 269).

3.2. Psychiatric liaison service

The patients were seen by a member of the hospital's psychiatric liaison team in 366 (46%) of the self-harm admissions. The members of the liaison team carried out risk assessments, evaluation of the patients' need of short-term psychiatric treatment and safety measures and they were involved in referring the patients to in- or outpatient follow-up.

3.3. Diagnoses of intentional self-harm

Most patients received several ICD-10 diagnoses at somatic admissions (mean = 3.1, range = 1–11). Of the 792 admissions scored by us as self-harm, only 391 (49%) were assigned a hospital discharge diagnosis of intentional self-harm (ICD-10 codes X60-X84) as main or secondary diagnosis.

3.4. Time from psychiatric discharge to first somatic self-harm admission

Among the 296 patients in the self-harm group, time to the first somatic self-harm admission was less than one month for 16% ($n = 47$), between two and six months for 32% ($n = 93$), between seven and twelve months for 42% ($n = 125$), and between twelve and twenty-four months for 11% ($n = 31$) of the patients (Kaplan-Meier table not shown). The Kaplan-Meier graphs in Fig. 2 are based on the suicide risk status at the index admission. They show that patients whose index admission was preceded by non-suicidal self-harm had the shortest time to somatic self-harm admission after index discharge, followed by patients whose index admission was preceded by suicide attempt and suicide ideation.

3.5. Predictors of time to first somatic self-harm admission (results from Cox regressions)

Compared to patients who had no known suicide risk in relation to the psychiatric hospitalisation, patients with the last psychiatric admission caused by non-suicidal self-harm had a more than fourfold increased risk of somatic self-harm admission during the observation period (Table 1). A nearly threefold risk was observed in patients with psychiatric admissions caused by a suicide attempt, while patients with the last psychiatric admission related to suicide ideation displayed a two and a half-fold risk increase.

Diagnoses predicting an increased risk of somatic self-harm admission included the following: recurrent depression, personality disorders, alcohol/substance use disorders, anxiety/adjustment-disorders and posttraumatic stress disorder. A history of prior psychiatric hospitalisation increased the risk of somatic self-harm admission, whereas education above primary school (>9 years) decreased the risk.

The Hazard Ratios for the predictors in the hierarchical Model I were note not substantially changed after entering the variables in Model II. In this second step of the hierarchical analyses being in psychiatric readmission was associated with increased risk of somatic self-harm admission (Hazard Ratio [HR] = 1.78, 95% confidence interval [CI] = 1.29–2.45, $p < 0.001$). This means that the self-harm necessitated transfer from psychiatric to somatic hospital for treatment. Increasing number of attended specialist outpatient consultations was also associated with increased risk of somatic self-harm admission (HR = 1.06, CI = 1.01–1.11, $p < 0.001$). Increasing number of non-attended psychiatric outpatient consultations was not significantly associated with increased risk (HR = 1.01, CI = 1.00–1.03, $p = 0.120$).
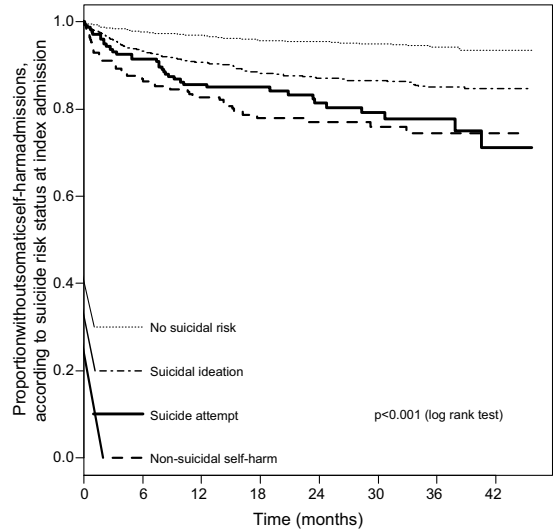

Fig. 2. Kaplan-Meier graphs for time to first somatic self-harm admission.

3.6. Characteristics and severity of self-harm

In 81% ($n = 642$) of the cases, the method of self-harm was poisoning with pharmaceuticals or non-medical substances, in 10% ($n = 80$) alcohol or illegal drugs, in 8% ($n = 61$) cutting and in 6% ($n = 44$) of cases other methods were used. Since several methods were used in some cases, they add up to more than 100%. Survival was assessed to be unlikely in 2% ($n = 14$) of the cases, of which five cases resulted in death and three cases resulted in organ damage that still sustained at discharge from the somatic hospital. None of the 39% ($n = 309$) of cases assessed with high lethal risk resulted in death, while two of these resulted in sustained organ damage at discharge. None of the 56% ($n = 444$) of cases assessed with moderate risk and the 2% ($n = 12$) of cases assessed with low/minor risk resulted in organ damage that sustained at discharge. In 13 cases, the risk was non-assessable. The correlation between the potential lethality of the self-harm method and organ damage was low (Spearman's $\rho = 0.33$, $p < .001$).

4. Discussion

The current study observed a large and complete cohort of patients ($n = 2827$) discharged from a PAU for a mean of 2.3 years in order to identify all self-harm admissions to somatic hospitals in the same catchment area during follow-up.

4.1. Rate and repetition, risk factors and timing

During the total study period, more than one in 10 patients had at least one somatic self-harm admission. The one year rate of 9.5% is higher than the rate found in an English national register based study [2], which included self-harm related readmissions to psychiatric hospital, in addition to somatic admissions. Since both studies were adequately powered, this difference is unlikely to be a random finding. The higher rate found in the current study could be explained by high identification rate due to our use of manual inspection of patient files.

The prospective design revealed that patients in the self-harm group had a mean number of three self-harm admissions during

the observation period, whereas a subgroup of 5% of the patients accounted for 32% of the admissions. An increasing number of self-harm repetitions has been found to be associated with an increased risk of suicide [25], high suffering in the patients and their next of kin [22], as well as high use of health care resources [17]. Thus, to identify and instigate treatment to reduce further repetition in these patients is critical. Psychiatric acute admissions provide an opportunity to perform comprehensive psychosocial assessments [9,10] and to start interventions aimed at preventing self-harm in patients who have not yet self-harmed or to take actions to reduce repetition whenever relevant. We found increased risk of having post discharge self-harm in several diagnostic groups. When controlling for diagnosis and other relevant variables, the strongest predictors for somatic self-harm admission were non-suicidal self-harm, suicide attempt or suicide ideation in relation to the last psychiatric admission. This implicates that adequate treatment for psychiatric disorders, for example according to the NICE guidelines [11], and treatment targeting the risk of self-harm directly should be implemented simultaneously. Although the NICE clinical guidelines for short-term [9] and longer term management of self-harm [10] are designed for people who have self-harmed, the recommendations are also relevant for patients with suicide risk related psychiatric acute admissions without preceding self-harm.

The proportion of patients having had their first post-discharge self-harm admission within the first six months was 48% vs 42% within the subsequent six months. Thus, we did not find the same peak of somatic self-harm admissions immediately after psychiatric discharge as has been found by others [2,3]. One explanation to this could be that our methodological approach combining register linkage and manual examination of all case note materials was possibly able to capture a larger proportion of the true population of repeaters than previously published studies.

Together, the findings from the current and prior studies support the recommendation that patients with severe mental illness or a history of self-harm should be followed-up in the community within 7 days [3] and they emphasise the need for long-term follow-up [10].

4.2. Low rate of lethal outcome

Suicide occurring in patients who were not hospitalized at the time of their death were censored from the analyses at the time of death. Of those who were brought to somatic hospital because of self-harm, only five patients died during the hospital stay. Furthermore, only one percent of the self-harm events caused more than transient organ damage. High-quality somatic hospital treatment probably contributed to less severe outcomes in the majority of self-harm cases. However, it is important to remember that though the rate of severe organic sequelae is relatively low, the patients' and families' personal suffering [22] and the cost of health care [17] may be high.

4.3. Increasing treatments related to increased self-harm admissions

The risk of being admitted to somatic hospital for self-harm was increased in patients with a history of psychiatric admission, during psychiatric readmission and with increasing number of outpatient consultations. The findings are in line with an interview based study [18] showing that the rate of self-harm episodes was significantly higher among patients who received more treatment. The most plausible explanation for this is that patients with an elevated and long-standing risk of suicide-related behaviour will receive more extensive in- and outpatient treatment. However, this study was not designed to answer questions regarding what way the treatment may have affected the course and outcome in the study cohort.

4.4. Underdiagnosing of self-harm

The diagnostic codes of self-harm are frequently missing in register data [13,14]. Despite the fact that only half of the somatic self-harm admissions were assigned an ICD-10 diagnosis of self-harm in our cohort, our manual inspection of the files revealed that the information needed to assess self-harm was available in nearly all (98%) of the admissions. An alternative to manual inspection was used in a study [14] reporting a relatively high case-finding sensitivity (identifying self-harm admissions as such) when combining the presence of diagnostic codes for poisoning, toxic effects, open wounds to elbow, wrist, or forearm, asphyxiation and drowning with the presence of codes for psychiatric disorders. However, in our cohort, such an algorithm would, for instance, have missed intentional substance overdoses which had been only assigned the ICD-10 code for mental disorder due to use of opioids (F11), the intentional insulin overdoses that had been assigned the code for insulin dependent diabetes mellitus (E10), the self-poisoning that had been assigned a T4n-code, and the intentional self-harm with the use of vehicles, jumping from heights, burns and shooting, that had been assigned injury codes without additional mental disorder codes.

Underdiagnosing of self-harm may have several reasons and implications: such codes usually do not bring any additional income to the hospital, the clinicians may not consider these codes useful in daily hospital practice, or the physicians may erroneously believe that self-harm codes should only be used when the self-harm behaviour is motivated by suicide intent and not in cases of non-suicidal self-harm. An important clinical consequence of underdiagnosing of self-harm may be that the patient is not given the correct treatment and it may lead to underestimation of the magnitude of the problem of self-harm and the challenges to clinicians, health care administrators and policy makers.

4.5. Strengths and limitations

Among the strengths of this study is the use of longitudinal data from a large and unselected study cohort consisting of all acute psychiatric admissions from a defined catchment area covered by the Norwegian universal health care system, making the cohort representative of all socioeconomic classes. We believe that we were able to trace close to all the patients' somatic self-harm admissions, and manual assessment of the patient files provided information on the type and severity of self-harm, which is not possible to obtain in register based studies. To our knowledge, this is the first study of somatic self-harm admissions in a large and unselected psychiatric cohort to provide information on psychiatric in- and outpatient treatment during the observation period. The time-dependent Cox regression analysis allowed using information that changed during the observation period, for example, to analyse the risk of being transferred to somatic hospital due to self-harm during psychiatric readmission. The time-dependent analysis also allowed us to start a new counting of attended and non-attended psychiatric outpatient consultations after the index admission and every readmission.

As in register-based studies, however, our psychiatric diagnoses were clinicians' diagnoses, without use of validated structured diagnostic interviews. Data on the outpatient treatment is limited to dates for attended and non-attended consultations; we do not have information about the content of the treatment.

5. Conclusion

Self-harm induced somatic admissions were highly prevalent during the first year after discharge from acute psychiatric

admission. Non-suicidal self-harm, suicide attempt and suicide ideation as main or contributing reasons for psychiatric admission were the strongest predictors for somatic self-harm admission adjusted for diagnoses and other covariates. Psychiatric acute admissions provide opportunities to perform comprehensive psychosocial assessments, including diagnostic assessments, as well as needs and risk assessments. These assessments should be followed by individualised treatment targeted to prevent self-harm, in addition to treatment of associated mental or somatic disorders.

The underdiagnosing of self-harm found in this study may in some cases imply that those in charge of the patients follow-up treatments is not informed about self-harm episodes. Consequently, the patient may not be offered treatment targeted to prevent future non-suicidal or suicidal behaviour. The underdiagnosing of self-harm also leads to unreliable self-harm data in hospital- and national registers. In turn, register data will be less valid for research purposes, such as evaluation of interventions and national strategies aimed at preventing self-harm. Systematic training and supervision of the physicians and other staff members involved in the assignment and recording of diagnoses may be one strategy to improve the self-harm coding practice at local hospitals. On a national level health authorities may wish to create financial incentives as well as quality control measures to enhance the use of appropriate diagnostic codes for self-harm in psychiatric and somatic hospitals.

Disclosure of interest

Acknowledgements

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Borderline Personality Disorder and Posttraumatic Stress Disorder at Psychiatric Discharge Predict General Hospital Admission for Self-Harm

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We investigated whether posttraumatic stress disorder (PTSD) was predictor of suicidal behavior even when adjusting for comorbid borderline personality disorder (BPD) and other salient risk factors. To study this, we randomly selected 308 patients admitted to a psychiatric hospital because of suicide risk. Baseline interviews were performed within the first days of the stay. Information concerning the number of self-harm admissions to general hospitals over the subsequent 6 months was retrieved through linkage with the regional hospital registers. A censored regression analysis of hospital admissions for self-harm indicated significant associations with both PTSD ($\beta = .21$, $p < .001$) and BPD ($\beta = .27$, $p < .001$). A structural model comprising two latent BPD factors, dysregulation and relationship problems, as well as PTSD and several other variables, demonstrated that PTSD was an important correlate of the number of self-harm admissions to general hospitals ($B = 1.52$, $p < .01$). Dysregulation was associated directly with self-harm ($B = 0.28$, $p < .05$), and also through PTSD. These results suggested that PTSD and related dysregulation problems could be important treatment targets for a reduction in the risk of severe self-harm in high-risk psychiatric patients.

Individuals with borderline personality disorder (BPD) have high rates of suicide (5% to 10%) and suicidal behavior (60 to 70%), and there has been a large focus on the clinical challenges related to the management of such behaviors in these patients (Goodman, Roiff, Oakes, & Paris, 2012). Although less prominent in the suicide research literature, posttraumatic stress disorder (PTSD) is also a condition associated with increased risk of suicidal behavior (Panagioti, Gooding, & Tarrier, 2009). This has been demonstrated in a wide range of populations such as war veterans, victims of interpersonal violence or sexual abuse, and in mixed-trauma populations (Panagioti et al., 2009; Panagioti, Gooding, & Tarrier, 2012; Pompili et al., 2013). These findings, however, have mainly been derived from

cross-sectional studies of nonclinical samples or from samples consisting of selected exposure subgroups, and a large proportion of studies failed to take account of other co-occurring disorders. A recent literature review (Sareen, 2014) reported that more than 90% of individuals with PTSD exhibited at least one lifetime co-occurring mental disorder, with major depressive disorder (MDD), substance use disorders, and anxiety disorders as the most prevalent. There have been indications that all of these disorders in different manners influence the risk of suicidal behavior when combined with PTSD (Panagioti et al., 2009). The strongest support is evident for MDD, which was found to either increase or mediate suicidal behavior in individuals with PTSD (Panagioti et al., 2012). There has also been increasing evidence (Sareen, 2014) of the co-occurrence between PTSD and BPD. The rate of BPD in patients with a primary diagnosis of PTSD was reported to be 44.6% (Bohus et al., 2013), whereas the rates of PTSD in clinical BPD samples were found to be between 33% and 79% (Frias & Palma, 2015). Patients suffering from PTSD in addition to BPD displayed a higher frequency (29.7 acts compared to 12.9 acts, $p = .07$) of nonsuicidal self-harm than patients with BPD alone (Harned, Rizvi, & Linehan, 2010). It is not yet clear, however, whether PTSD is an independent predictor of suicidal behavior when co-occurring with BPD. A few studies have concluded that this is not the case (Oquendo et al., 2005; Yen et al., 2003), and have

even suggested that earlier studies might have wrongly identified PTSD as a strong predictor of suicidal behavior because BPD was not adjusted for. In contrast, a large national study (Qin, 2011) found that individuals who had been hospitalized for a diagnosis of reaction to severe stress and adjustment disorders according to the *International Classification of Diseases* (*ICD-10*; World Health Organization, 1992), which includes PTSD, had increased risk of suicide even when the BPD and other mental disorders were taken into account. Therefore, it is surprising that there has been little, if any, research focusing on PTSD with regard to psychiatric hospitalization for suicide risk. This may partly be due to the high comorbidity of PTSD with other disorders, which clinicians and researchers might perceive as more salient in such contexts. Other reasons for the sparse research on PTSD and suicidal behavior in hospitalized psychiatric cohorts could include the fact that PTSD has been underdiagnosed or grouped together with other disorders in relevant studies (Panagioti et al., 2009).

The first months following psychiatric discharge represent a high-risk period for self-harm that can lead to general hospital admission (Mellesdal et al., 2014) or suicide (Qin & Nordentoft, 2005). Thus, it is of great importance to identify risk factors that can be targeted for prevention in patients who are admitted to psychiatric hospitals due to suicide risk. In the present study, we examined the nine borderline criteria and the diagnoses of BPD and PTSD as direct or indirect predictors of self-harm admissions to general hospitals during the first months after psychiatric discharge. There were several reasons for choosing this perspective. During suicide risk-related psychiatric admissions of BPD patients, we thought there might be a tendency to focus largely on the behavioral aspects of self-harm and less on the underlying symptoms. Furthermore, the impact of co-occurring BPD and PTSD on serious self-harm has not yet been examined in a mixed-gender population of hospitalized psychiatric patients. The findings from prior studies have additionally been inconsistent with regard to PTSD as an independent predictor of suicidal behavior when co-occurring with BPD. BPD develops from childhood, and according to the biosocial theory of borderline personality (Crowell, Beauchaine, & Linehan, 2009), the high rates of nonsuicidal self-harm and suicidal behavior in individuals with BPD are to a large extent related to impulsivity and difficulties concerning emotion regulation. Other borderline criteria, such as affective instability, aggression, interpersonal problems (Goodman et al., 2012), and severe dissociation (Wedig et al., 2012), have also displayed associations with suicidal behavior. Borderline criteria are usually scored as *present* or *not present*. A dimensional approach, however, would probably better reflect the severity of psychopathology in individual patients.

In hospitalized clinical samples, there is reason to believe that increasing levels of certain borderline criteria could contribute to increased risk for future self-harm even in patients with subthreshold levels of BPD. Such information could be useful

to identify patients who have a higher risk for future serious self-harm.

A recent review by Frias and Palma (2015) reported several possible explanations for the high comorbidity between BPD and PTSD. For instance, they found strong evidence that childhood trauma predisposes for both. Another possible explanation supported by longitudinal studies was that impulsivity and chaotic lifestyle places individuals with BPD at high risk for being exposed to sexual abuse and other risk situations that can cause trauma and the subsequent development of PTSD. Furthermore, the emotional dysregulation experienced by subjects with BPD has been hypothesized to increase the likelihood of anxious reactions and the development of PTSD symptoms (Frias & Palma, 2015).

The present study aimed to analyze whether PTSD is an independent predictor for the number of subsequent general hospital admissions for self-harm when co-occurring with BPD in patients who have been admitted to psychiatric hospitals due to suicide risk. In addition, based on the above-presented theoretical understanding and empirical findings regarding the possible relationship between BPD, PTSD, and self-harm, we tested a structural model adjusting for other variables commonly associated with self-harm. The model specified borderline factors (based on BPD diagnostic criteria) as predictor variables, and PTSD, substance use disorders, anxiety disorders, and depressive symptoms as intermediate variables with the number of self-harm admissions to general hospitals as the outcome variable.

Method

Participants and Procedure

Participants in the study were patients in the acute psychiatric ward of Haukeland University Hospital in Bergen, Norway. The inclusion period was between May 1, 2005 and June 15, 2008. During this period, the ward received 95% of all acute psychiatric admissions from a catchment area with approximately 400,000 inhabitants. The study had a naturalistic follow-up design. The main inclusion criterion and the reason for the acute psychiatric admission was suicide risk. In addition, eligible individuals had to be able to (a) provide their written, informed consent; (b) participate in semistructured research interviews; and (c) read, comprehend, and complete self-report forms. A diagnosis of current psychosis (bipolar disorder type I, schizophrenia, schizoaffective disorder, and psychotic disorder not otherwise specified) served as an exclusion criterion, whereas transient, stress-related paranoid ideation, severe dissociative symptoms as a diagnostic criterion for BPD, and severe dissociative symptoms as a diagnostic feature of PTSD were not grounds for exclusion. Suicide risk as the reason for the admission was recorded by the psychiatric residents who assessed the patients at admission. Eligibility was assessed the following day by the clinicians in charge of the patients' treatment. To avoid including a biased sample, for example, those

patients assumed to be most willing to participate or those assumed to be most severely or least severely ill, we used a randomization procedure to select the subjects to be invited. Every weekday the total eligible patients admitted during the last day or night were given a number according to when they had arrived at the hospital. Eligible patients admitted during weekends were included in the randomization procedure on Mondays. The statistical program R, version 2.0.1 (The R Foundation for Statistical Computing, Vienna, Austria) sorted these numbers into a randomly reorganized list that was used to decide in which order the patients were going to be invited. If it was only possible to interview two patients on one particular day, the next patients on the list would not be invited. Inclusion did not take place during holidays or when the study staff was not available.

During the inclusion period, 2,937 individuals were admitted at least once, and 1,744 individuals (60%) had at least one admission due to suicide risk (range = 1 to 27). Of these individuals, 1,253 were eligible and 383 were invited to participate. The study sample consisted of the 308 (80.4%) subjects who provided informed consent. The participants mean age was 37.7 years (Mdn = 36.5, range = 18 to 77, SD = 13.07), and 55.8% were female. There were no significant differences between the 308 subjects who consented to participate and the 75 who refused in terms of diagnoses, age, or sex. Eight patients died (seven by suicide) between the baseline interview and the end of the study period.

Of the 308 subjects, 36.7% qualified for a *DSM-IV* diagnosis of BPD and 24.4% for current PTSD; 13.6% were diagnosed with both disorders. The tetrachoric correlation between BPD and PTSD was .38. The majority of the patients (89.9%) were diagnosed with MDD, and the mean Montgomery and Asberg Depression Rating Scale (MADRS) score was 25.1 (SD = 8.77). Substance use disorders (SUDs) were diagnosed in 49.0% of the patients, general anxiety disorder (GAD) in 28.9% of the patients, and panic disorder (PD) in 25.6% of the patients. Childhood neglect was experienced by 167 (54.2%) patients, 106 (34.4%) had experienced childhood sexual abuse, 102 (33.1%) had been exposed to childhood physical abuse. Physical violence in adulthood was experienced by 95 (30.8%) patients, 27 (8.8%) had been raped in adulthood, natural disasters were experienced by 20 (6.5%) patients, 11 (3.6%) patients had witnessed someone being seriously injured or killed, 4 (1.3%) patients had been threatened with being killed, and 2 (0.6%) patients suffered from combat trauma.

The diagnostic interviews were performed by the clinician in charge of the patient's treatment or by one of three psychiatric nurses. A psychiatrist who was an expert in the relevant psychometric methods trained the interviewers. The same person reviewed 85 audiotapes of the interviews and scored them for reliability. He also provided feedback to the interviewers after their first interviews and intermittently throughout the study. The study was approved by the Regional Committee for Medical Research Ethics, the Norwegian Social Science Data Service, and the Norwegian Directorate for Health Care.

Measures

The Mini International Neuropsychiatric Interview (MINI) for *DSM-IV* Axis I disorders (Sheehan et al., 1998) was used to diagnose current (symptoms with regard to the past month) PTSD, MDD, GAD, PD, and SUD. The Structured Clinical Interview for DSM-IV Axis II Disorders (SCID-II; First, Spitzer, Gibbon, Williams, & Benjamin, 1994) was used to diagnose BPD. Additionally, each of the nine BPD criteria was scored according to the Zanarini Rating Scale for Borderline Personality Disorder (Zan-BPD; Zanarini et al., 2003), a 5-level anchored rating scale that is intended to reflect both frequency and severity of psychopathology. For example, the section pertaining to self-destructive efforts have initial questions to assess whether the person has deliberately hurt or threatened to kill him/herself, or made suicide gestures or attempts. If yes to any of the questions, the frequency and intensity are scored as follows: 0 = No Symptoms (*No self-mutilation or suicidal efforts reported or observed during interview.*), 1 = Mild Symptoms (*One vague suicide threat; One instance of scratching or punching self*), 2 = Moderate Symptoms (*One clear-cut suicide threat; Two to three instances of scratching or punching self*), 3 = Serious Symptoms (*Multiple suicide threats; One instance of cutting or burning self; One suicide gesture*), 4 = Severe Symptoms (*Two to three instances of cutting or burning self; One suicide attempt*). This 5-point scale was shown to yield higher interrater reliability than dichotomous scoring of the criteria (Zanarini et al., 2003). In the current study sample, the Zan-BPD scale showed a Cronbach's α = .82. The level of depression was measured using the MADRS (range = 0 to 60; Montgomery & Asberg, 1979), for which a score of 20 or greater generally indicates the need for treatment. In the study sample, the MADRS showed a Cronbach's α = .85. The κ values for the diagnoses were BPD = .83, PTSD = .91, GAD = .87, PD = .75, and SUD = .89. Interrater reliability tests of the continuously measured borderline criteria revealed intraclass correlation (ICC) values ranging from .72 for the ninth criterion (paranoid ideation/dissociative symptoms) to .92 for the fifth criterion (recurrent suicidal behavior/self-mutilation) on the 85 cases rated.

The outcome variable was the number of self-harm admissions to general hospitals. Self-harm was defined according to the guidelines of the National Institute for Health and Care Excellence (2013): "any act of self-poisoning or self-injury carried out by an individual irrespective of motivation. This commonly involves self-poisoning with medication or self-injury by cutting. Self-harm is not used to refer to harm arising from overeating, body piercing, body tattooing, excessive consumption of alcohol or recreational drugs, starvation arising from anorexia nervosa or accidental harm to oneself." Data about the total number of self-harm admissions to general hospitals were retrieved by register linkage: The unique person identifier given to all Norwegian citizens by birth was linked to general hospital admissions that had occurred during the 6 months between the baseline interview and the end of the study. Because prior

studies (Nordentoft & Sogaard, 2005; Patrick et al., 2010) had found that the diagnostic self-harm codes were frequently underreported in register studies, the first author performed inspection of the case records (ambulance records, somatic records, and psychiatric consultant records) related to each admission. If one of the records showed that self-harm had caused the condition requiring general hospital treatment, the admission was recorded as a self-harm admission. A random sample of 70 admissions was reassessed by an experienced psychiatrist (R. K.), demonstrating a weighted $\kappa = .88$.

Data Analysis

Missing data were observed in the nine continuously scored BPD criteria (% missing data in the criteria 1–9 = 14, 14, 14, 13, 13, 13, 13, 13, 21), resulting in a net intact sample of $n = 207$ using the ordinary listwise deletion method.

Based on examination of the relationships among a broad set of clinical, sociodemographic, and treatment-related baseline data and missing borderline criteria, this missing information was assumed to be missing at random (Schafer & Graham, 2002). Multiple imputation is recommended even if missingness to some degree deviates from missing at random, and multiple imputation was used to generate 10 imputed data sets of values at the ordinal level for missing data in the borderline criteria (SPSS, 2007).

The patients who died during the study period were censored on the date of their deaths, and the actual number of self-harm admissions to general hospitals was divided by the individual follow-up time to provide comparable data.

Descriptive statistics (*M*, *SD*, frequency, skewness) were analyzed with SPSS software, version 22 (IBM Corp., 2013). Mplus software, version 7.3 (Muthén & Muthén, 2014) was used to estimate confirmatory factor analyses (CFAs) of dimensionality of the borderline criteria, one multiple regression model, and one structural equation model (SEM). The multiple regression model was examined with the BPD and PTSD diagnoses as predictors. Then, a general one-dimensional model and a two-dimensional model (relationship problems and dysregulation) were tested with CFA. After establishing the measurement model, the SEM included the borderline factors of relationship problems and dysregulation, PTSD, and the intermediate variables of GAD, PD, SUD, and MADRS (level of depression). These Axis I diagnoses have high comorbidity with BPD and PTSD and were explored as potential intermediate variables because they have been shown to play a role in the risk of suicidal behavior in both disorders. Because a large proportion of the sample was diagnosed with MDD, the level of depression (MADRS) was examined instead of the diagnosis to ensure that the depression variable included in the analyses showed adequate variance and predictive power. Thus, this model analyzed direct relationships between borderline factors (exogenous variables) and the number of self-harm admissions to general hospitals (endogenous variable), as well as indirect relationships through the Axis I diagnoses and the level of depression. The full model allowed for the estimation of all relationships to capture possible suppression effects (Cohen, Cohen, West, & Aiken, 2003). To improve the tentative model to a more parsimonious one that accounted for the data equally well, the model was reestimated by restricting parameters (Kaplan, 2008; Wang & Wang, 2012; Jöreskog, 1993) or removing variables from the model (Cohen et al., 2003). This prevents overfitting the data. No earlier study of which we are aware has analyzed these variables including this outcome variable measured over an equal time period within such a statistical model framework. Therefore, there is no reason to analyze the data within the approaches "strictly confirmatory" or "comparison of alternative models" (Jöreskog, 1993, p 295). Jöreskog presents the analytic strategy "model generation" as a refinement of a tentative model, which also includes the possibility of testing several models. "The goal may be to find a model that not only fits the data well from a statistical point of view but also has the property that every parameter of the model can be given a substantively meaningful interpretation" (Jöreskog, 1993, p 313). The distribution of the number of self-harm admissions to general hospitals was highly skewed (skewness = 5.39), and censored regression with a floor effect was specified (Muthén & Muthén, 2012).

The default CFA estimator was weighted least square with diagonal weight matrix (WLSMV) and the maximum likelihood robust (MLR) for the structural model (Muthén & Muthén, 2012). All of the Mplus analyses were estimated based on 10 imputed data sets, providing information about the aggregated parameter levels, but also about parameter uncertainty due to imputations. Mplus MLR estimation, with categorical intermediate variables, does not yield standardized estimates when using several imputed data sets. Therefore, unstandardized regression weights were reported.

CFA models were evaluated by the χ^2 test, comparative fit (CFI), the Tucker Lewis Index (TLI), and the root mean square error of approximation (RMSEA). CFI and TLI should be > .90 and RMSEA <.08 or preferably .05 (close fit; Bollen & Curran, 2006). Model fit in the censored regression model used log likelihood (LL), the Akaike Information Criterion (AIC), and the Bayesian Information Criteria (BIC), with lower values indicating improved model fit. Using imputed data sets in Mplus did not yield statistical tests or confidence intervals of goodness-of-fit indices, nor did it make testing of indirect effects possible (the model indirect command).

Results

Altogether, 18.5% of the study sample had at least one general hospital admission for self-harm during the 6 months elapsed between the baseline interview and the end of the study period. The mean number of such admissions was 0.28 ($SD = 0.84$). Of the subjects who had been hospitalized for self-harm, the mean number of admissions was 1.49 ($SD = 1.42$). All of the BPD criteria showed a distributional form within an acceptable level regarding normal distribution. The highest response levels

were found for the criteria of feelings of emptiness, affective instability, and recurrent suicidal behavior, whereas the lowest was found for the criterion of transient stress-related paranoid ideation/severe dissociative symptoms.

Censored regression of the number of self-harm admissions to general hospitals with the predictor variables of BPD and PTSD diagnoses showed somewhat higher standardized regression weights for the BPD variable ($\beta = .27$, $p < .001$) than for the PTSD variable ($\beta = .21$, $p < .001$).

Confirmatory factor analysis of the nine borderline criteria demonstrated some problems with a one-dimensional solution ($\chi^2 = 80.72$, $df = 27$, CFI $= .96$, TLI $= .95$, RMSEA $= .080$), whereas a 2-factor model with the dimensions of relationship problems (Criteria 1, 2, 3, 7) and dysregulation (Criteria 4, 5, 6, 8, 9) showed a stronger fit to the data ($\chi^2 = 50.37$, $df = 26$, CFI $= .98$, TLI $= .98$, RMSEA $= .055$). Cronbach's α for these two subscales were found to be .76 (dysregulation) and .70 (relationship problems). The correlation between these two dimensions was $r = .84$. This correlation explained 69% of the variance, which shows that at least some information in one variable still is not accounted for by the other. The results showed high factor loadings for all of the criteria.

The structural model with the two latent BPD factors, Axis I diagnoses (PTSD, GAD, PD, SUD), and level of depression (MADRS) and number of self-harm admissions to general hospitals was estimated (Figure 1). Model fit with all parameters included in the tentative model was $LL = -5850.01$, AIC $= 11842.01$, BIC $= 12106.85$, and sample-size adjusted BIC $= 11881.67$. After reestimation, the model fit was: $LL = -5511.09$, AIC $= 11136.19$, BIC $= 11348.80$, and sample-size adjusted BIC $= 11168.02$. The more parsimonious model was preferred. The number of self-harm admissions to general hospitals was predicted by PTSD and by the borderline dysregulation factor, but not by the relationship problems factor or by any of the other Axis I diagnoses or the level of depression. Figure 1 illustrates how dysregulation might play a direct and indirect role through the risk associated with PTSD in patients who harm themselves seriously and therefore are admitted to general hospitals.

Discussion

In the present study, we followed a randomly selected sample of nonpsychotic patients who had been psychiatrically hospitalized due to suicide risk. The purpose was to examine the nine borderline criteria and the diagnoses of BPD and PTSD for their potential roles as predictors of the number of self-harm admissions to general hospitals. Nearly 20% of the patients had at least one such admission within the follow-up period of 6 months. Multiple regression analysis showed that both PTSD and BPD had an additive impact on the risk of self-harm severe enough to warrant hospitalization. Self-harm behavior is one of the nine diagnostic criteria for BPD; it is therefore not surprising that BPD was a significant predictor of such behavior. There has been far less focus on the risk of self-harm in relation

to psychiatric hospitalization of patients with PTSD. The few studies conducted have been inconclusive as to whether PTSD is an independent predictor of self-harm behavior (Oquendo et al., 2005; Panagioti et al., 2012; Yen et al., 2003), possibly because of large sample- and study design differences. An important difference is that although we have considered a current diagnosis of PTSD, some previous studies included only lifetime history of the diagnosis.

The structural model provided an opportunity for performing a more comprehensive and potentially more clinically informative examination of the BPD-PTSD-self-harm associations. Our structural model did not support a unidimensional BPD model satisfactorily. The model was significantly improved by representing the nine BPD criteria using two factors: one labeled as relationship problems and the other dysregulation, though the indicators reflecting relationship problems are heterogeneous and could be said to include causes of such problems as well. The high correlation between the two factors could be an argument for one general dimension; however, the explained variance showed that some information in one variable was not accounted for by the other. Furthermore, the two variables were consistent with theoretical models and previous empirical findings emphasizing interpersonal problems and emotional dysregulation as core BPD features (Brodsky, Groves, Oquendo, Mann, & Stanley, 2006; Crowell et al., 2009). In our model, the borderline dysregulation factor predicted self-harm both directly and indirectly via PTSD. This seemed to correspond well with the mechanisms in the extended version of Linehan's biosocial theory of borderline personality disorder (Crowell et al., 2009), which emphasizes impulsivity and emotional dysregulation as important driving forces for self-harm behavior in individuals with BPD. Because we have used dimensional scores of each BPD criterion and studied these criteria irrespective of whether participants had a full diagnosis of BPD, our results may be generalized to the wider population of patients with some borderline features without having the BPD diagnosis. Our model further gave support to prior studies (Frias & Palma, 2015) suggesting that BPD-linked emotion dysregulation could facilitate the development of PTSD. Knowledge of dysregulation and PTSD as important predictors of the number of self-harm admissions to general hospitals may help clinicians to identify a subgroup of patients with particularly high risk of severe self-harm. These patients may have a tendency to feel overwhelmed by ordinary life experiences, and this, together with substantial problems with downregulation of intense emotional responses, could trigger self-harm.

The finding that level of depression did not predict the outcome may be understood within the context that the majority of the sample was diagnosed with major depression and although there was variation, the depression level was high in the total sample. Another way of understanding this finding is that the level of depression could not compete when adjusted for PTSD and emotional dysregulation in this model. This furthermore emphasized the importance of these variables as risk factors for severe self-harm in the current sample. Alternative models
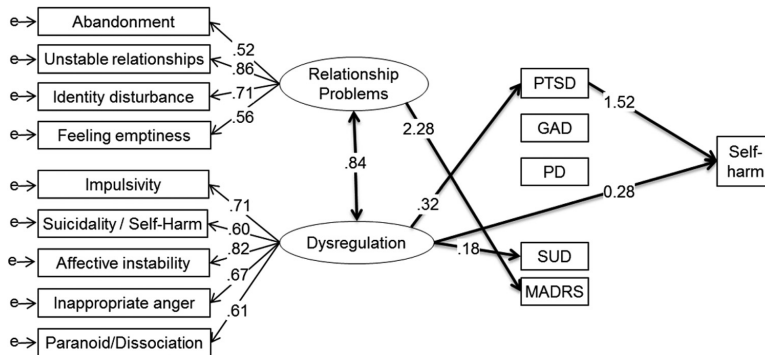
Figure 1. $N = 308$. Relationships (*B* weights) between the borderline factors (relationship problems and dysregulation) and self-harm with the Axis I disorders—posttraumatic stress disorder (PTSD), generalized anxiety disorder (GAD), panic disorder (PD), substance use disorders (SUD), and depressive symptoms (MADRS)—as intermediate variables in patients consecutively admitted to psychiatric hospital because of suicide risk. The level of statistical significance was set to $p < .05$. Only statistically significant associations are presented. The model was based on 10 imputed datasets using censored regression in the prediction of the number of self-harm admissions to general hospital.

not tested due to the focus of this study could have revealed different findings with respect to the associations between the level of depression and self-harm, as well as between other covariate disorders and outcome.

Limitations of the study include the lack of information concerning suicide intent. The data on general hospital admission due to self-harm, however, implied that the outcome variable represents certain severity of self-harm. The study did not address the various exposures to trauma and other stressors, nor the type and severity of PTSD symptoms. Such data could provide useful clinical information and should be examined in future studies. The current sample was very representative of nonpsychotic patients who are admitted to psychiatric acute wards due to suicide risk. Our selection of nonpsychotic patients who had been psychiatrically hospitalized because of suicide risk probably increased the likelihood of discovering some of the associations between clinical features and later self-harm in this study. As we have shown in a previous study (Mellesdal, Mehlum, Wentzel-Larsen, Kroken, & Jorgensen, 2010), suicide risk is the reason for more than half of the psychiatric acute admissions. Our findings are therefore hypothesized to generalize well to similar patient populations. The strengths of the study include that the participants represented a high-risk, mixed gender sample of patients within a large age span. Furthermore, the methods of data collection ensured precise data on the number of general hospital self-harm admissions as well as avoiding recall bias.

The prevention of self-harm has a great implicit potential to prevent future suicide (Bergen et al., 2012). To date, few studies have examined PTSD as a risk factor for severe self-harm after psychiatric discharge. On the contrary, it has been suggested that PTSD may be overlooked as indicating high risk by clinicians, possibly because of avoidance symptoms, an overlap of symptoms with other disorders, and an inadequate assessment of trauma or victimization (Panagioti et al.,

2009). Our findings suggested that psychiatrically admitted patients with PTSD have nearly as high risk for severe self-harm during follow-up as those with BPD. The risk increases even more in patients with co-occurrence of the two disorders and with high levels of emotional dysregulation. The short extent of acute ward stays necessitates efficient assessment of these clinical factors. Therefore, structured diagnostic tools to diagnose PTSD and BPD, including continuous measurement of BPD criteria, should be included as routine assessments in psychiatric acute settings. Interventions based on dialectical behavioral therapy targeting both dysregulation problems and PTSD symptoms have shown promising results in some female patients with co-occurring PTSD and BPD (Bohus et al., 2013; Harned, Korslund, Foa, & Linehan, 2012). To our knowledge, such interventions have not been tested in samples similar to that of the current study. The results of the present study were clinically significant in demonstrating the possibility that targeting dysregulation problems in addition to treating PTSD and BPD may reduce the risk of repetitive severe self-harm during follow-up after psychiatric discharge.

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