Suicidal behavior in late life: Population and patient perspectives

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In loving memory of my grandfather,

for his strength and love of life

ABSTRACT

Older adults have high rates of suicide, and the strong role of depression is often emphasized in studies on suicidal behaviour in this age group. The literature regarding other factors is rather sparse. This thesis utilizes data from three population-based studies and one clinical study with the aim of increasing knowledge about factors associated with suicidal behavior in late life.

S*tudy I* is based on data from *EURODEP*, a multicenter study involving 15,890 adults (9,429 women, 6461 men) aged 64-104 years. In *Study II*, all 97-year-olds living in Gothenburg were invited to take part and 269 (197 women, 72 men) without dementia participated. *The Prospective Population Study on Women*, initiated in 1968, provided data for *study III;* 800 middle-aged women were examined in 1968 and followed over a 42-year period. In *Study IV* a hospital cohort of 80 individuals (42 women, 38 men) aged 70-91 were interviewed after a suicide attempt.

Findings from *study I* showed that both intermediate and high functional disability was associated with death wishes in both sexes. Results remained after adding depressive symptoms to the model. Among the 97-year-olds in *study II*, 11.5 % reported suicidal feelings in accordance with the Paykel questions and the majority (77.4 %) of these fulfilled criteria for neither major nor minor depression. Sleep problems and deficient social contacts were associated with suicidal feelings; relationships were independent of depression. One fourth of the women who participated in *study III* had experienced suicidal thoughts at some point during their life and 8 % had made at least one suicide attempt. Onset of suicidal behavior occurred after age 40 in half the women. Women who reported five or more early childhood adversities were significantly younger when they had their first-episode of suicidal thoughts. In *study IV* a strong association between major depression and low Sense of Coherence (SOC) was observed. Low SOC was associated with deficient social contacts and having moved in the past five years, and these relationships remained also after adjustment for depression.

While early detection and treatment of depression is imperative, interventions to reduce suicidal behavior in later life may also need to target functional disability, pain and sleep problems, and limited social networks.

Keywords: Older adults, death wishes, suicidal feelings, suicidal thoughts, suicide attempt, functional disability, social factors, early childhood adversity, Sense of Coherence.

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SAMMANFATTNING PÅ SVENSKA

Äldre har höga suicidtal, den starka kopplingen till depression betonas ofta i studier av suicidalt beteende i denna åldersgrupp. Litteratur som fokuserar på andra faktorer är sparsam. Denna avhandling baseras på data från tre populationsbaserade studier samt en klinisk studie, med syftet att öka kunskapen om faktorer som är associerade med suicidalt beteende sent i livet.

Studie I består av data från en multicenter studie, *EURODEP*, vilken är baserad på 15 890 personer (9429 kvinnor, 6461 män) i åldrarna 64-104 år. *Studie II* är del av *95+ studien*, i vilken alla 97-åringar i Göteborg bjöds in att delta. Totalt deltog 269 (197 kvinnor, 72 män) utan demens. *Studie III* är del av *Kvinnoundersökningen (KVUS)*, vilken initierades 1968 då 800 kvinnor i åldrarna 38-54 år genomgick en psykiatrisk intervju. Uppföljningsintervjuer genomfördes vid fem tillfällen under 42 år. *Studie IV* består 80 individer (42 kvinnor, 38 män) i åldrarna 70-91 som intervjuades efter ett suicidförsök.

Resultaten av *studie I* visade att både medelhög och hög funktionsnedsättning var associerat med dödsönskan bland både män och kvinnor, dessa resultat var oberoende av depressiva symtom. I *studie II* rapporterade 11,5 % av 97-åringarna att de hade livsleda, dödsönskan, eller suicidtankar. Sådana tankar och känslor var associerade med depression men trots detta, uppfyllde majoriteten (77,4 %) inte kriterierna för egentlig eller mild depression. Livsleda, dödsönskan, eller suicidtankar var associerade med sömnproblem och bristfälliga sociala kontakter, associationerna var oberoende av depression. En fjärdedel av kvinnorna i *studie III* hade någon gång under livet haft suicidtankar och 8 % hade gjort ett eller flera suicidförsök. Hälften av kvinnorna hade suicidtankar eller gjorde ett suicidförsök första gången då de var 40 år eller äldre. De kvinnor som rapporterade fem eller fler tidiga livshändelser var yngre än de som inte rapporterade sådana händelser då de för första gången hade suicidtankar. *Studie IV* visade en stark association mellan egentlig depression och låg känsla av sammanhang (KASAM). Lågt KASAM var associerat med bristfälliga sociala kontakter och att ha flyttat de senaste fem åren, oberoende av om de hade depression.

Tidig upptäckt och behandling av depression är av ytterst vikt, men för att minska suicidalt beteende bland äldre kan även interventioner behöva rikta sig mot grupper med funktionsnedsättning, sömn och smärtproblematik och begränsade sociala nätverk.

LIST OF PAPERS

This thesis is based on the following studies, referred to in the text by their Roman numerals.

I. Fässberg, M.M., Östling, S., Braam, A.W., Bäckman, K., Copeland, J.R.M., Fichter, M., Kivelä, S-L., Lawlor, B.A., Lobo, A., Magnússon, H., Prince, M.J., Reischies, F.M., Turrina, C., Wilson, K., Skoog, I., Waern, M. Functional Disability and Death Wishes in older Europeans: Results from the EURODEP Concerted Action. *Social Psychiatry and Psychiatric Epidemiology*. 2014 Feb 20.

II. Fässberg, M.M., Östling, S., Börjesson-Hanson, A., Skoog, I., Waern, M. Suicidal feelings in the twilight of life: A cross-sectional population-based study of 97-year-olds. *BMJ Open*. 2013 Feb 1;3(2).

III. Fässberg, M.M., Joas, E., Hällström, T., Östling, S., Gustafson, D., Wiktorsson, S., Kaplan, M., Hawton, K., Skoog, I., Waern, M. Suicidal thoughts and attempts in a population-based sample of women followed over 42 years: The influence of early life adversity. *In manuscript.*

IV. Mellqvist, M., Wiktorsson, S., Joas, E., Östling, S., Skoog, I., Waern, M. Sense of coherence in elderly suicide attempters: The impact of social and health-related factors. *International Psychogeriatrics.* 2011 Aug; 23(6):986-93.

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ABBREVIATIONS

CIRS-G	Cumulative Illness Rating Scale for Geriatrics
CPRS	Comprehensive Psychopathological Rating Scale
DSM-III	Diagnostic and Statistical Manual of Mental Disorder, third edition
DSM-III-R	Diagnostic and Statistical Manual of Mental Disorder, third edition, revised.
DSM-IV	Diagnostic and Statistical Manual of Mental Disorder, fourth edition
GDS	Geriatric Depression Scale
MADRS	Montgomery-Åsberg Depression Rating Scale
MOR	Median Odds Ratio
OR	Odds Ratio
SOC	Sense of Coherence
UN	United Nations
WHO	World Health Organization

1 INTRODUCTION

Suicide is a global public health problem and remains one of the leading causes of death in western countries. Older adults have higher rates of suicide than younger age groups in most countries [1], with those aged 75 and above constituting the demographic group with the highest rates of suicide [2]. According to the World Health Organization (WHO) there are approximately 1 million suicides and 10 million suicide attempts annually [3]. As the proportion of older adults is estimated to increase dramatically in the years to come [4], the number of suicides is expected to increase accordingly. By the year 2020 suicide is expected to be one of the ten most common causes of death [5].

Suicide rates are at an intermediate level in Sweden, with rates of 19.2/100,000 in 2012 [6]. There are approximately 1,500 suicides [6] and 9,000 suicide attempts [7] annually. Among individuals aged 65 and above the number of suicides per year is estimated to 400 [6]. There is reason to believe that these numbers do not correspond to actual figures as the number of unknown cases may be large. This may partly be due to that deaths among older adults are less likely to be investigated than deaths in younger persons, as they are more likely to die by natural causes [8]. While a steady decrease of suicide rates was observed in the 1980's and 90's, this trend stagnated since the beginning of the millennium. The development has not been as positive for older adults compared to middle aged. As seen in Figure 1 which shows suicide rates over the life cycle in Sweden, a dramatic increase of suicide rates has been observed among men aged 80 and above. Women on the other hand, have stable suicide rates during late life.

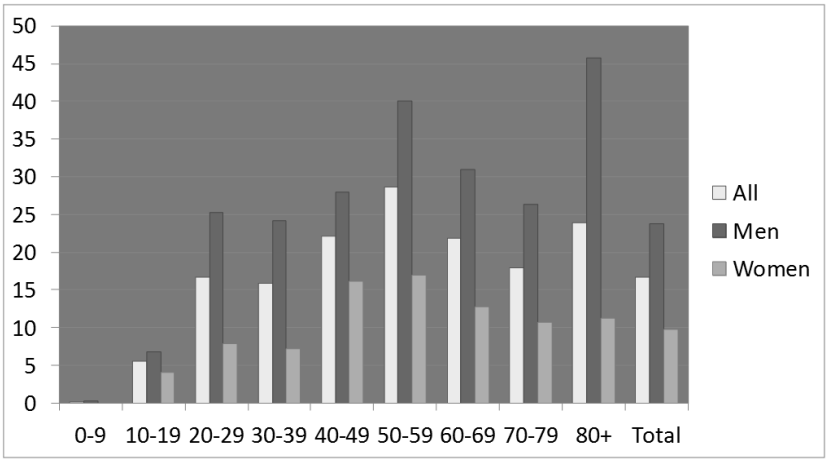

Figure 1. Suicide rates per 100,000 by age groups in Sweden, 2009 (NASP).

Sweden has one of the highest life expectancies in the world. Dating back 150 years, life expectancy has increased almost constantly. This trend is not only observed in Sweden; aging populations around the world are growing at a rapid speed. According to the United Nations (UN), those aged 80 years and above constitute the fastest growing age group, and in a period of fifty years we will see a fourfold increase in proportion of this age group [9]. Growing old is a time associated with loss for the individual, with declining physical and mental health, decreased autonomy and loss of social network. Such factors may in part be part of the reason as to why older adults have the high suicide rates.

1.1 History of suicide

The word "suicide" originates from the Latin words *sui* (oneself) *caedere* (to kill). Discussions of suicide date back to the late 6th century BC, with Greek philosophers condemning such actions. While it was not considered a crime to attempt suicide, the burial of suicide decedents began to be refused. According to the philosopher Plato it was not the individual's choice to end

one's own life, and Aristotle considered suicide to be a crime against the state. In ancient Rome, attempting or assisting suicide was subject of penalization. As it was believed that death would bring them closer to Christ, suicide became more common among early Christians. St. Augustine pronounced that suicide was a cowardly action and a sin [10]. There was a shift during the Renaissance and Age of Enlightenment**,** with philosophers expressing the individual's right to die [11]. With the release of Émile Durkheim's *Le suicide* [12] in 1897, a new outlook on the phenomena was observed. Suicide had previously been viewed as an act which was merely a result of individual despair; Durkheim could show that there was a social dimension to the phenomena. While the view of suicide and suicidal behavior has changed it still remains strongly stigmatized.

1.2 Gender paradox of suicidal behavior

Non-fatal suicidal behavior is more common among women while men generally have higher rates of suicide [13]. This is referred to as the gender paradox of suicidal behavior [13] and is observed in most western countries. Although gender is a theoretical established concept, there is no consensus on how it should be defined. According to the WHO [14], gender refers to "socially constructed roles, behavior, activities and attributes that a particular society considers appropriate for men and women". Thus, gender does not refer to biological and physiological differences between men and women, but social norms and cultural expectations of the sexes.

Studies have shown that women have higher rates than men in regards to non-fatal suicidal behavior, although women tend to survive a suicide attempt more often than men do. There are many theories for reasons of this, with choice of method being one. Men tend to choose highly lethal methods, such

as hanging and fire arms, while women tend choose less lethal methods such as pills [15]. Choosing a less lethal method of suicide indicates a higher likelihood of being found by someone who can intervene, and this may account for the fact that more women than men survive a suicide attempt. In many parts of the world, suicide attempts are seen as a typical feminine attribute [16] and has been looked upon as a cry for help, not a way to end their lives such as men [17, 18]. In the past, lethal methods which more often lead to suicide were seen as an indicator of suicide intent. However, some studies have shown that women and men have equally high suicide intent [19, 20]. It is possible that non-fatal suicidal behavior in men may be underreported as a result of cultural attitudes regarding masculinity [17]. Also, men may be less prone to report suicidality to their surroundings, due to fear of social stigma [21].

Women are generally reported to have higher rates of depression than men, although lower rates of suicide. According to the WHO, women are more likely to be diagnosed with depression than men, even in the presence of identical symptoms or similar scores on standardized instruments [22]. Women might be more prone to seek professional help for mental disorders, and this might explain why women have lower rates of suicide than men [17]. Some studies of completed suicide have shown that a large proportion of older adults who committed suicide had sought medical care a month preceding the suicide [23]. However, the majority had not communicated any thoughts of suicide to the physician [24]. Another study showed that more than three quarters of men sought health care the month before their suicide [21]. This might indicate that both sexes seek professional help, although, they may seek different types of care and for different reasons.

In contrast to suicide attempts, suicide is often looked upon as a typical male attribute [16]. Women may be reluctant to commit suicide because of the taboo against female suicide [13]. There may be a gender bias in regards to the sex differences among lethal suicides [13]. For example a woman's suicide might be more likely to be classified as an accident compared to a suicide committed by a man [13]. Underreporting suicide in women may also be an effect of cultural and social beliefs that suicidal behavior is a reflection of failed relationships [25].

1.3 Terminology of suicidal behavior

The terminology of both non-fatal and fatal suicidal behavior has been discussed for many years. While by some referred to as either "suicidality" or "suicidal behavior", there is still no consensus. Nomenclature is important as it should be applicable across fields [26]. However, this can be difficult with regards to for instance longitudinal studies as definitions used in previous studies cannot be altered. In this thesis, the term suicidal behavior is used and refers to life-weariness, death wishes, suicidal thoughts and suicide attempts, and suicide. Life-weariness refers to thoughts that life is not worth living. Death wishes often referred to as death ideation in the literature, refers to the individual wishing to be dead by for example falling asleep and not waking up again. Suicidal thoughts, also referred to as suicidal ideation, includes both thoughts and/or planning suicide. A suicide attempt is defined according to Beck [27] as "a situation in which a person has performed an actual or seemingly life-threatening behavior with the intent of jeopardizing his life, or to give the appearance of such an intent but which has not resulted in death".

1.4 Epidemiology of suicidal behavior in late life

Population-based studies have shown that the prevalence of past month life weariness in older is approximately 15 % [28, 29]. However, such thoughts are uncommon in individuals without a psychiatric disorder. A study by Skoog and colleagues [30] showed that only 4 % of mentally healthy 85-year-olds had thoughts that life was not worth living during the past month. The corresponding figure for those who fulfilled criteria for any DSM-III-R disorder was 29.2 %. The same study reported that life weariness was more than twice as common in women as in men [30]. The lifetime prevalence of life weariness in older adults varies with reports of 10-41 % [29, 31, 32].

Death wishes may constitute the first step in the suicidal process [33]. Death wishes are not uncommon among older adults, with approximately 3-10 % reporting such wishes during the past year [28, 34-37]. Most studies found that death wishes were more common among women [28, 34-36], however, the study by Rurup and colleagues [37] could not show such an association. Death wishes may be more prevalent in nursing home settings; an Italian study reported that nearly a third of the participants acknowledged such feelings [31]. The prevalence rate of death wishes across the lifetime seems to be around 8-15 % [32, 37, 38].

Regarding suicidal thoughts, previous studies have shown past year prevalence figures ranging between 1-6 % [39-42]. No sex difference could be found in most studies [31, 40, 42], while one study found such thoughts to be more common among men [39]. The lifetime prevalence rate of suicidal thoughts is approximately 5-9 % [29, 31, 32].

Results from the WHO/EURO multicenter study [43], on adults aged 65 years and above, showed that rates of attempted suicide range between 32.3/100,000 in Guipuzcoa, Spain and 116.9/100,000 in Stockholm, Sweden. Two thirds of suicide attempts were committed by women. Lifetime prevalence rates of suicide attempts are rarely reported in population-based studies. However, two Italian studies have shown figures ranging between 1-5 %, with similar rates in men and women [31, 32]

1.5 Risk factors for suicidal behavior in late life

1.5.1 Psychiatric disorders

The proportion of psychiatric disorders is high in studies of non-fatal and fatal suicidal behavior. Studies based on retrospective data including close informant interviews, so called psychological autopsy studies, have shown that 62-97 % of older adults who die by suicide suffer from such disorders [44, 45]. Although studies have shown that suicide decedents seek their doctor shortly before their death, physical ailments are often the focus of the visit [24]. It has been shown that older suicide decedents visit psychiatrists before their death to a lesser extent than younger suicide victims [45].

Depression is the most common psychiatric disorder reported as a risk factor for suicide in late life [46-52]. While it is estimated that as many as 65-75 % suffer from depression at the time of suicide [53], this disorder is also considered to be the most treatable risk factor for suicide in late life [54]. Identification and treatment of depression is seen as the main objective for the prevention of suicide attempts and suicide among older adults. It has been estimated that nearly three quarters of serious suicidal behavior in late life could be prevented if depression was successfully treated [46]. A mixed age

study showed that suicidal ideation could be reduced by 47 % if mood disorders were eliminated [55].

There is a high comorbidity between anxiety disorders and depression [56]; however, a review of mixed aged samples reported that anxiety disorders may be independently associated with suicidal behavior [57]. A population-based study of 70-year olds from Sweden showed that anxiety symptom burden was independently associated with suicidal feelings [58]. Similar results were found in a community-based study from Australia, which showed that individuals (aged 60-101 years) who reported suicidal thoughts were more likely to have anxiety than those who did not acknowledge such thoughts [39]. Rates of anxiety disorder were low both for older suicide decedents and their population-based comparisons aged 70 and above in Hong Kong [47]. In contrast, Waern and colleagues found that 15 % of suicide decedents and only 4 % of the comparison group, aged 65 and above, had anxiety disorder [23]. Similar rates were found in a study from the U.S. [59] focusing on a somewhat younger sample.

Suicide risk in individuals with dementia appears to be similar to or less than that of the general population [60]. However, individuals who recently received a diagnosis might be at risk for suicidal thoughts [61], suicide attempt [62] and suicide [63]. This may in part be a result of the person not wanting to become a burden on their surroundings. Increased risk of suicidal behavior in the early stages of dementia, but not in later, may also be due to the possibility of the individual being unable to attempt or complete suicide as a result of the impairment.

Results regarding the association between Alcohol Use Disorder (AUD) and suicidal behavior are mixed. A review of psychological autopsy studies showed prevalence ranging from 3-45 % [44]. While some studies show high

proportions of this disorder [46, 64, 65] others report lower rates [66, 67]. Reasons for disparate results may be due to methodological differences. For instance, as some studies use collateral data sources, the proportion of individuals diagnosed with this disorder is likely to increase. Another possibility is that results may reflect cultural differences in drinking patterns, with lower suicide risk in countries with continental drinking patterns [68].

1.5.2 Cognition

A recent clinical study showed that older adults with depression who had suicidal ideation or had attempted suicide had impaired executive function and global cognitive function when compared to non-suicidal adults with depression and a non-psychiatric comparison group [69]. Older adults with depression who attempted suicide performed less well on problem solving tasks than non-suicidal older adults with depression [70]. Clark and colleagues [71] reported that older adults with depression who had attempted suicide had a deficit in risk-sensitive decision-making. Similar to younger adults, older adults appear to disregard the outcome and thus make poor choices. Dombrovski and colleagues [72] recently showed that, in a sample of adults aged 50 and above with depression, disruptive paralimbic reward signals and impulsivity and/or carelessness was associated with an increased risk of suicide attempt.

1.5.3 Physical illness and functional disability

Physical illness and functional disability is more common among older adults with suicidal behavior compared to younger age groups [73]. Several case-control studies have found an association between physical illness and suicidal behavior in late life [23, 36, 54, 74]. An Australian study found that physical illness or disability was the primary factor in one third of suicides among older adults [75]. Using specified medications as a proxy marker for

specific conditions, Juurlink and colleagues showed that the risk of suicide increased with number of illnesses [76].

There is some evidence indicating that functional disability may be a stronger risk factor for suicide than physical illness [77]. A large U.S. population-based study on mixed ages showed that physical illness did not remain a risk factor for suicide when adding functional disability to the model [77]. In a qualitative psychological autopsy study, relatives revealed that the deceased persons loss of ability to function lead to fear of losing independence [78, 79].

While some studies have found that the risk for both fatal and non-fatal suicidal behavior is higher in men with either physical illness or disability compared to women [52, 80, 81] others have not found such an association [77].

Relatively little is known regarding the association between pain and suicidal behavior. However, associations have been observed in both clinical and non-clinical settings [82, 83]. There are indications that the association between pain and suicidal behavior may be stronger among men. For instance, a Canadian study showed that although pain was associated with suicide among both older men and women, this association was stronger among men [76]. Others have shown that pain was only associated with suicidal thoughts [84] and self-injury ideation [85] among older men. This is an area requiring elucidation; in particular, sex-specific studies are needed.

The literature regarding the association between perceived health and suicidal behavior is sparse. The results of two population-based studies have shown that persons with a negative perception of their health more often report death wishes [36] and suicidal ideation [35] compared to their counterparts.

1.5.4 Sleep

Sleep problems are common among older adults [86, 87]. A large prospective study recently showed that the association between sleep problems and suicide was stronger among younger compared to older adults [88]. However, population-based studies have shown that when examining older adults with suicidal behavior and their counterparts, individuals with sleep problems were more likely to have death wishes [36] and die by suicide [89]. Results from a study based on primary care patients showed that insomnia symptoms were associated with suicidal ideation, however, this relationship was mediated by depressive symptoms [90].

1.5.5 Personality

A clinical study of inpatients with depression aged 50 years and above showed that individuals with high neuroticism were more likely to acknowledge past month suicidal ideation, while persons with low scores on extroversion were more likely to have a lifetime history of suicide attempts [91]. This association was later demonstrated in studies on non-fatal [92, 93], and fatal suicidal behavior [45] in older adults. Further, a psychological autopsy study showed that when compared to both younger suicide decedents and a comparison group matched for age, suicide decedents aged 50 and above scored lowest when measuring "openness to experience" [94]. A British study showed that obsessional and anxious personality traits was associated with suicide [50]. In a qualitative psychological study older suicide decedents were described by next of kin as controlling and obstinate [95].

1.5.6 Sociodemographic factors

Results regarding the effect that level of education has on suicidal behavior are varied. Low education was found to be a risk factor for suicide attempt in the Swedish study by Wiktorsson [96]. Others have found no such association [46, 66]. In contrast, Almeida and colleagues [39] found that individuals with suicidal thoughts had higher education than those who did not report such thoughts. Disparate results may be due to methodological differences. Also, there is a possibility of a cohort effect of accessibility to education.

Some studies show that individuals with both non-fatal [36, 96, 97] and fatal suicidal behavior in younger older adults [49] less frequently have a partner than their counterparts, while others do not [34, 66, 89, 92, 98, 99]. It has also been reported that older adults who *have* a partner are at increased risk of suicidal behavior [46, 67, 100]. Reasons for mixed results may be many. For instance, the risk of suicide may be strongest a short period after the death of a partner. A register-study comprising of the entire Danish population over the age of 50 showed that men aged 80 years and above who had lost their partner during the past year had a 15-fold increase in suicide risk compared to middle-aged men who were married [101]. Being married says nothing about the quality of the relationship, and it is possible that age-related changes which affect one or both partners can put a strain on the relationship.

Living alone was not associated with death ideation in a study of primary care patients with depression, anxiety or problematic alcohol use [98]. Nor was an association found with suicidal ideation in a study of community dwelling older adults living in Taiwan [97]. Persons aged 70 and above who were hospitalized in connection with a suicide attempt were more likely to be living alone compared to the population-based comparison group [96]. Living

alone, however, did not infer increased risk for suicide in a study on completed suicide from the same region [102]. That study found no differences between the sexes with regards to living arrangements [102], nor in separate analyses between age groups (65-74 vs. 75+) [103]. Few studies have examined the effect that living in an institution has on suicidal behavior. A German population-based study showed that individuals living in nursing homes and senior citizens' homes were more likely to acknowledge suicidal behavior than those who did not [34]. The study by Wiktorsson, mentioned above, did not find that living in an institution was associated with suicide attempt [96].

1.5.7 Social factors

The literature on social factors and suicidal behavior in late life is sparse, as demonstrated by a recent systematic review [104]. Only 16 articles from 14 studies fulfilled criteria for inclusion. A recent meta-analytic review of social relationships and mortality risk among mixed ages showed that the likelihood of survival increased by 50 percent for persons with satisfactory social relationships [105]. Results of the association between social factors and suicidal behavior in late life are mixed [104]. It has been estimated that rates of serious suicidal behavior could decrease with 27 % if older adults had satisfactory social support [46], while 38 % of persons with suicidal ideation would no longer report suicidal thoughts if poor social support was eliminated [39]. While some have shown that the size of the social network was not associated with suicidal ideation [106], others mean that perceiving social support as low may be a predictor of such thoughts and feelings [42]. When considering contacts specifically with children and relatives, no association was found with death ideation in a study of older primary care patients set in the U.S. [98]. On the other hand, institutionalized older adults with suicidal ideation were less satisfied with family relationships and

relations with children compared to those with no suicidal ideation [107]. Another study found that the presence of a relative or friend who was thought of as a confidant was associated with decreased likelihood of suicide [89]. Relationship discord is likely to affect these associations. Family discord was more common among individuals who attempted [92] and died by suicide [92, 102, 103] when compared to community based comparisons. The role of community participation seems to be an important factor, as it has been shown to be associated with a smaller likelihood of both suicide ideation [97] and a decreased risk of suicide [102].

Death wishes were more common among persons who reported loneliness than those who did not [37, 108]. Associations have also been found in studies of both suicide attempt and suicide [96, 102, 103]. The study by Rubenowitz [102] showed a nearly 7-fold increase in odds of suicide for men, while the effect was 8-fold for women. Stratifying for age (65-74 vs. 75+) showed that while feelings of loneliness were associated with suicide in both age groups, higher odds of were found for the younger age group [103].

Religious activities may be a source of social interaction, providing the individual with sense of being connected to a specific community. No association could be found between frequency of religious activity and death ideation nor suicide ideation in study of older primary care patients [98]. On the other hand, a study from Taiwan [97] showed that not having a religious affiliation was more common among older individuals who acknowledged suicidal ideation. Turvey and colleagues [89] showed that persons who died by suicide were less likely to attend religious services at least monthly compared to their population-based comparisons. Similar results were found two other U.S. based studies consisting of somewhat younger samples [49, 109].

2 SUICIDE PREVENTION IN LATE LIFE

Suicide in all ages is a tragedy for the decedent, close ones and for society. As the suicidal process fluctuates over time, identifying suicidal individuals is difficult [33]. Older adults at risk for suicide are particularly difficult to identify as suicide attempts are far more uncommon in older adults compared to younger. It has been estimated that the ratio is approximately four attempts per suicide in older adults [110]. Thus, preventing suicidal behavior in late life is crucial.

According to the Institute of Medicine [111] prevention can be implemented at three different levels. *Universal* prevention focuses on the macro level; aiming at targeting entire populations regardless of the risk of any individual or group in it. *Selective* prevention focuses on the meso level, aiming at reducing risk in groups who are at risk for suicide, for instance persons who have recently lost a loved one. *Indicated* prevention focuses on the micro level, aiming at reducing risk in individuals with for instance severe suicidal thoughts or those who have attempted suicide. Utilizing one or more of these levels will be most effective in the prevention of suicide in late life [112].

Early detection and treatment of depression is central to the prevention of suicidal behavior in late life, due to its strong association with suicide in late life. An example of a successful universal prevention was presented in a meta-analysis by Oyama and colleagues [113]. Interventions were multifaceted and included depression screening and referrals, and engaged older adults in educational health workshops, or provided group activities with social and recreational activities. The intervention areas had significantly lower suicide rates compared to the control areas. However, while the risk was reduced in both men and women when followed-up by

psychiatrists, this effect was only found in women when follow-up was conducted by general practitioners.

Community-based intervention such as the quasi experimental Tele-help/Telecheck service [114] is an example of such a selective intervention which has shown positive results. The service provided a telephone-based outreach, evaluation and support service to frail individuals who had been referred by general practitioners or social workers. Over 18,000 participants were followed during an 11-year period. Fewer suicides occurred among women in the region that offered the services compared to a neighboring region that lacked services; no difference could be shown for men.

Men may be more reluctant than women to use social resources [115], and it seems that such interventions benefit women more than men [116]. As stigma may prevent older men to seek psychiatric care [117], indicated interventions designed to appeal to both women and men are needed. Whilst results of the randomized trial have not yet been presented, The Senior Connection (TSC) [118] is promising. The intervention appeals to primary care patients with feelings of loneliness or feeling as a burden to others. Seniors are assigned a peer companion or care as usual in order to determine if this relationship can reduce burdensomeness.

3 AIM

The overall aim of this thesis was to increase knowledge about factors related to suicidal behavior in late life. The specific aims were:

Study I

To explore the association between functional disability and death wishes, and to determine whether such a proposed relationship is independent of depressive symptoms.

Study II

To estimate the frequency of thoughts of own death and suicidal feelings in a total population cohort of 97-year-olds without dementia and to identify factors associated with such feelings.

Study III

To examine the lifetime prevalence of suicidal thoughts and attempts in women followed into late life. Further, to examine how early life adversity influences age at first episode of suicidal behavior in women.

Study IV

To examine the associations between social and health-related factors and low Sense of Coherence (SOC) in suicide attempters aged 70 and above.

4 METHODS

Study samples were derived from three population-based studies, *EURODEP*, the *95+ study*, the *Prospective Population Study of Women (PPSW)* and one clinical study *When life gets difficult to live.* Samples are described in Table 1.

Table 1. Description of the samples

Study	Design	Sample	Participants n	Ages	Examination year	Follow-up examination
I	Cross-sectional	EURODEP	15,890	64-104	1983-1997	
II	Cross-sectional	95+	269	97	1998-2007	
III	Longitudinal	PPSW	800	38-54	1968	1974-1975, 1992-1993, 2000-2002, 2005-2007, 2009-2011
IV	Cross-sectional	When life gets difficult to live	80	70-91	2003-2006	

4.1 Study I

The sample for study I was derived from the EURODEP Concerted Action, a collaboration between 14 research groups in eleven European countries, involved with population-based studies on older adults. The consortium was created in order to study the variation in the prevalence of depression among adults aged 64 and above [119]. Sampling was based on municipality registers or on general practitioner registers, and inclusion criteria varied somewhat among the centers. All participants took part in psychiatric examinations. The overall sample size of the pooled EURODEP dataset amounts to 22,570 participants, and consists of a representative sample of older persons aged 64-104 years. In the present study eleven centers

(n=15,890) which had information on death wishes were included, consisting of individuals living in Amsterdam (n=3,987), Berlin, (n=488), Dublin (n=1,012), Reykjavik (n=772), Liverpool (n=3,366), London (n=637), Ähtäri (n=1,035), Gothenburg (n=447), Munich (n=346), Verona (n=202), and Zaragoza (n=3,598).

4.1.1 Neuropsychiatric examination

Several instruments were used to test cognitive function. Nine centers used the Mini Mental State Examination (MMSE) [120]. MMSE score was analyzed as a continuous variable. The diagnosis of dementia was based on the AGECAT algorithm [121] in nine centers. This algorithm has previously been validated against dementia diagnosis according to clinicians and against DSM-III-R criteria with satisfactory results [122, 123]. The diagnosis of dementia was based on DSM-III-R criteria in the Gothenburg sample, using tests of short- and long term memory, abstract thinking, aphasia, apraxia, and agnosia [124]. In Äthäri, the Wilson Mental Capacity Scale was used to diagnose dementia [125].

4.1.2 Psychiatric examination

Depressive symptoms were measured with the EURO-D scale. This harmonized scale was developed by expert opinion in order to facilitate analyses in this pooled dataset, as several different depression assessments were used. The Geriatric Mental State scale (GMS) [126] was used in eight of the centers, one center used the Comprehensive Assessment and Referral Evaluation (SHORT-CARE) [127], one center used the Comprehensive Psychopathological Rating Scale (CPRS) [128], and one the Zung Self-Rating Depression Scale (ZSDS) [129]. The EURO-D scale consists of 12 items (depressive affect, pessimism, death wishes (as defined below), guilt, sleep problems, lack of interest, irritability, appetite problems, fatigue,

reduced concentration, lack of enjoyment and tearfulness). Each item receives a rating of 0 (not present) or 1 (present), with a sum thus ranging from 0-12. Higher scores reflect greater depression symptom burden. For the purpose of this study, the death wishes item was removed from the EURO-D scale, yielding a maximum score of 11.

4.1.3 Dependent variable

Death wishes were assessed with several instruments as described above. The GMS [126] and SHORT-CARE [127] used the same questions: Have you felt that life was not worth living? Have you ever felt that you'd rather be dead? Have you ever felt you wanted to end it all? Have you ever thought of doing anything about it yourself? One center used the Paykel question [130] (Have you ever wished that you were dead – for example that you would fall asleep and never wake up again?). Lastly, the ZSDS [129] question: I feel that others would be better off if I were dead was used at one center. A person was considered to have death wishes if the death wish/suicidal ideation item of the EURO-D scale was endorsed. As decision trees differentiating between suicidal ideation and attempts varied at different sites, a more detailed analysis of specific types of suicidal behavior was not possible.

4.1.4 Explanatory variables

Functional disability

Most centers used the Katz scale [131] in order to rate *functional disability*. Activities of Daily Living (ADL) measure the individual's ability to carry out everyday activities such as bathing, dressing, toileting, transfer, continence and feeding. Total score was trichotomised into "no", "intermediate" or "high" levels of functional disability at each site [132]. "High" levels of functional disability were defined as those in the highest tertile.

Chronic condition

Number of *chronic conditions* was available in ten of the centers; these were categorized as “none, “one” and “two or more” [132].

Sociodemographics

Education was assessed in different ways among the centers, and therefore a range of index scores (0-1) was computed [133].

Marital status consists of two categories; “married” and “non-married”. The “non-married” category included individuals who had never been married, divorced/separated or widowed.

Social factors

Ten of the eleven centers included in this study had data on *perceived loneliness* (yes/no). The specific questions for each center can be found in Appendix A.

4.1.5 Statistics

In order to analyze the association between death wishes and the independent variables a generalized linear mixed model with a logistic link function was used to analyze the association between independent variables and the dependent variable. Age was added as a continuous variable, and results are reported as how a 10-year increase in age increases the prevalence of death wishes. Plausible interactions (sex and functional disability; sex and chronic condition; sex and marital status; functional disability and depressive symptoms) were added to the model and tested. As the interactions proved sensitive to the inclusion or exclusion of other independent variables, a model containing only main effects was chosen. Results are presented as odds ratios

(OR) and 95 % confidence intervals (CI). Odds ratios are what is termed "subject specific" and should be interpreted as the effect that a predictor variable has on the odds of developing death wishes for any given center. The median odds ratio (MOR) was calculated from the intercept variance, this measure can be understood as the effect that belonging to a certain center will have on the odds of having death wishes. If two random persons from two different centers who share the same covariate values were to be picked, one would have higher odds of death wishes and the other lower odds. Using the person with the higher odds in the numerator and the person with lower odds in the denominator repeating this procedure for every possible combination of subjects-centers would result in a distribution of odds ratios. The MOR is the median of this distribution and can be compared to the fixed effect estimates, yielding a measure of the relative size of the unexplained variation in comparison to the effects that explanatory variables have. Statistical analyses were performed with IBM SPSS Statistics, V.20 for Windows and Glimmix in SAS 9.3.

4.2 Study II

The sample for Study II was derived from the Gothenburg 95+ study [134]. The study was initiated in 1996 and focuses on mental health in very late life. Participants were examined at ages 95, 97, 99 and thereafter annually. For the purpose of this study we used the sample consisting of 97-year-olds. All individuals born between July 1, 1901, and December 31, 1909 (N=973, 817 women, 156 men), who were living in Gothenburg, were invited to participate. The Swedish Population Register provided names and addresses. Persons living at home and in institutions were included in the study. Forty-eight persons died before they could be contacted, eight persons were excluded due to insufficient knowledge of the Swedish language, four had

emigrated, and a further two persons could not be traced, leaving 911 persons eligible for inclusion (764 women, 147 men). A total of 591 (484 women, 107 men) participated in the study. In cases with severe cognitive impairment, proxy consent was obtained via next-of-kin. The overall response rate was 65 %. No difference between participants and non-participants in regards to 2-year mortality rates could be found (52.8 vs. 50.9 %) [135]. Three-hundred-twenty-two individuals received a research diagnosis of dementia and were excluded from the current study, leaving 269 individuals (197 women, 72 men). Figure 2 shows the participation flow.

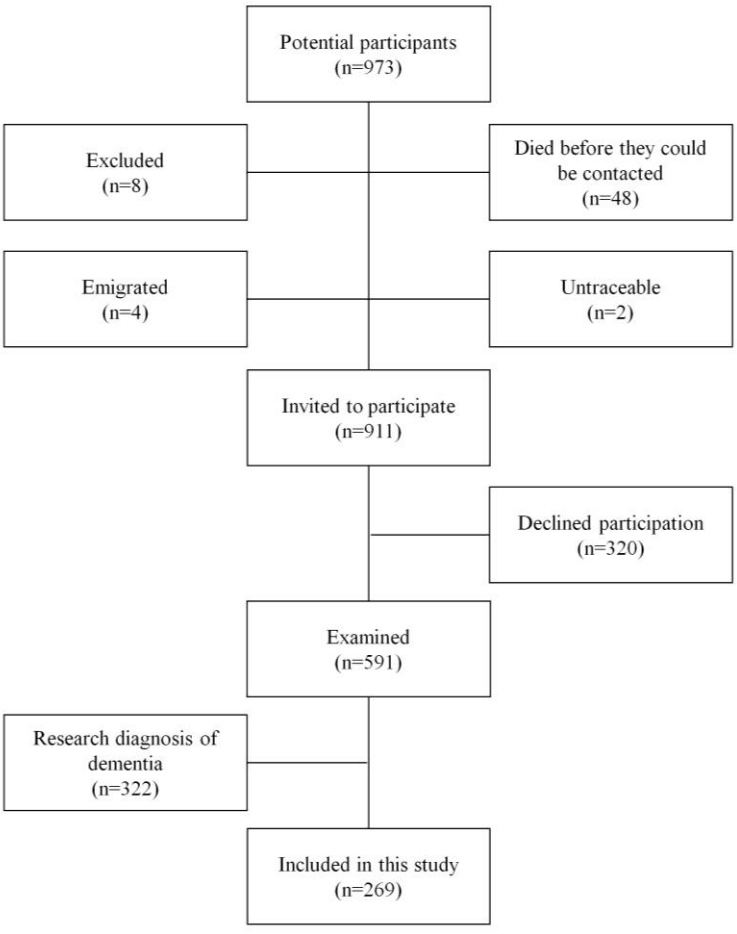

Figure 2. Participation flow, study II.

4.2.1 Procedure

Examinations were carried out by a psychiatrist/psychiatric nurse/research psychologist during two home visits. These procedures have been described in more detail previously [135]. The structured examination included physical and neuropsychiatric examinations, a history of previous and current disorders, prescription drug use and assessments of activities of daily living, sociodemographics and social factors. Participants were also asked to identify a next-of-kin who could give collateral information via a telephone interview.

4.2.2 Neuropsychiatric examination

The cognitive examination included the Swedish version of the Mini Mental State Examination (MMSE) [120] and tests of short and long-term memory, abstract thinking, aphasia, apraxia, agnosia. This has previously been described in detail [136]. A research diagnosis of dementia was made in accordance with DSM-III-R criteria, using the results from the examination and the interview with the close informant, and was used as an exclusion criterion only [136].

4.2.3 Psychiatric examination

The semi-structured examinations included ratings of psychiatric signs and symptoms during the preceding month in accordance with the Comprehensive Psychopathological Rating Scale (CPRS) [128].

4.2.4 Dependent variable

The Paykel questions [130] were used in order to assess life weariness, death wishes and suicidal thoughts using the following questions: (1) Have you ever felt that life was not worth living? (2) Have you ever wished you were dead, for instance, that you could go to sleep and not wake up? (3) Have you

ever thought of taking your life, even if you would not really do it? (4) Have you ever reached the point where you seriously considered taking your life, or perhaps made plans how you would go about doing it? (5) Have you ever attempted to take your life? The most recent time any of these thoughts had occurred was noted. In this study, responses regarding the past month were used, in order to coincide with measures employed for psychiatric symptoms and signs. If a person responded "yes" to any of the five Paykel questions regarding the past month, they were considered to have *suicidal feelings*.

4.2.5 Explanatory variables

Frequent thoughts of own death

Participants were asked how often they thought of their own death (never, occasionally, more frequently than once a week, several times per week and daily). In this study, a person who acknowledged thoughts of own death more often than once a month was considered to have *frequent thoughts of own death.*

Sleep

A single question was used in order to assess if the participants were *satisfied with their sleep* (no/yes). A person scoring ≥4 on the CPRS reduced sleep item was considered to have *reduced sleep*. Correspondingly, a score of ≥4 on the increased sleep item was defined as *increased sleep*. Participants were asked if they had *difficulties initiating sleep*, defined as >½ hour latency, and if they experienced problems with *early morning awakening*. Lastly, participants were asked about total hours of sleep, which was based on times of sleep initiation and awakening for night-time sleep and naps. This information was used to estimate number of hours of sleep per 24-hour period.

Health

Stroke/TIA was diagnosed using multiple sources of information. Questions regarding sudden onset of focal symptoms or acute aphasia, symptom duration and admission to hospital due to stroke/TIA were asked both during the self-report examination and close-informant interview. The Swedish Hospital Discharge register also provided diagnoses of stroke and TIA. Only cases with evidence of focal symptoms (i.e. paresis or aphasia) as documented by any of the above sources were considered to have *stroke/TIA* [135].

Hearing impairment was defined as deafness or a hearing defect which disturbed conversation during the interview despite hearing aid use. *Vision impairment* was defined as blindness or a defect which made some of the examination tasks impossible to perform despite own glasses or use of magnifying glass.

Aches and pains was defined as a score of ≥4 on the CPRS pain item, which corresponds to long-standing and disturbing aches or pains, need for pain relief, or intensive disabling pains.

A subgroup of participants, those born in 1905-1909 (n=166), were asked how they *perceived their current health*. Responses were dichotomized as follows: good (fairly good/good/very good) and poor (fairly poor/poor/very poor).

Motor function

The Gottfries-Bråne-Steen scale (GBS) [137] was used to measure six different motor functions (dressing, eating, physical activity, spontaneous activity, personal hygiene, and control of bladder and bowel). This instrument

has shown high reliability and validity [138]. Items are rated 0 (normal function) to 6 (maximal disturbance), yielding a maximum score of 36.

Sociodemographics

Data regarding sociodemographics were dichotomized and categorized as follows: *education beyond mandatory* (yes/no), *living in an institution* (yes/no), *currently has partner* (yes/no), *divorced* (yes/no), *widowed* (yes/no), *always been single* (yes/no).

Social factors

Among the subgroup born 1905-1909 (n=166) additional questions on social factors were asked. All items were dichotomized (no/yes) as follows: *Do you have a confidant? Do you have more than one confidant? Do you feel that you spend too little time with your children? Your grandchildren? With friends and acquaintances? With neighbours? Do you spend less time with friends and family than before retirement? Do you feel lonely?*

A single question (no/yes) was used to assess if the participants considered that they were *religious*. Individuals who attended services or followed services by radio or TV were considered *"actively religious"*.

4.2.6 Collateral data sources

The Swedish Hospital Discharge Registry provided diagnostic information for all individuals discharged from hospitals on a nationwide basis since 1978. Dates of death were obtained from the Swedish Population Register, a national register comprising all Swedish citizens. Three-year mortality was calculated from date of examination.

4.2.7 Diagnostic procedures

Psychiatric disorders were diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised (DSM-III-R) [122]. Minor depression was diagnosed in accordance with DSM-IV research criteria [139]. As some information is lacking, the six month duration criteria of psychotic symptoms for diagnosis of schizophrenia was disregarded. A diagnostic hierarchy was used. Depression (major depression, minor depression) or Generalized Anxiety Disorder (GAD) was not diagnosed if a psychotic disorder was present. GAD was not diagnosed if major depression was present. Diagnostic entities were merged for analyses regarding psychiatric illnesses. Schizophrenia and schizophreniform disorders were treated as one entity, *psychotic disorder*. This disorder also included Delusional disorder and Psychotic disorder not otherwise specified (NOS). Major and minor depression were merged into *any depression. Anxiety disorder* included GAD and phobic disorder (agoraphobia/social phobia/simple phobia).

4.2.8 Statistics

Differences in means were tested using t-tests and differences in proportion were tested with the $\chi 2$ and Fisher's exact test. In order to analyze associations between suicidal feelings and variables of interest, exact logistic regression was used. This method was chosen due to the small number of participants in some subgroups. When an independent variable showed a significant association with suicidal feelings in the bivariate exact logistic regression analyses, a separate multivariate exact logistic regression model was performed, adjusted for sex and any depression. Statistical analyses were performed with IBM SPSS Statistics, V.20 for Windows and SAS V.9.2. Results were considered significant when $p<0.05$.

4.3 Study III

Data was derived from the Prospective Population Study of Women in Gothenburg, which was initiated in 1968 and is still ongoing [140, 141]. The baseline sample consists of 1,462 women (participation rate 90 %), who were born in 1908, 1914, 1918, 1922 and 1930 and systematically drawn from the Swedish Population Registry [142].

A sub-sample of women (N=899) born in 1914, 1918, 1922 and 1930 were systematically selected for a psychiatric examination at baseline [143]. Between selection and examination, 7 women died and 8 women moved from Gothenburg. Of the remaining 884, a total of 800 women were examined by a psychiatrist (participation rate 89 %) [144]. The current study is based on the latter group. The participants were aged 38-54 years. All surviving women were invited to participate in the follow-up examinations in 1974-75, 1992-93 (all cohorts except women born in 1930), 2000-02, 2005-07 and 2009-11. Numbers of participating women and participation rates are shown in Table 2.

Table 2. Participants in the psychiatric examinations, The Prospective Population Study of Women in Gothenburg (PPSW)

	Examination					
	1968-69	1974-75	1992-93	2000-02	2005-07	2009-11
Born 1914, n	90	79	32	21	16	5
Born 1918, n	290	248	154	120	87	49
Born 1922, n	309	264	185	145	121	75
Born 1930, n	111	86	-	77	75	53
Total, n	800	677	371	363	299	182
Participation rate[a]	89 %	84.6 %	67.2 %	72.7 %	74.8 %	67.7 %

[a]Among eligible women, i.e. surviving and living in Sweden at the time of examination.

4.3.1 Procedure

In 1968, 1974 and 1992 examinations were performed by psychiatrists and in 2000, 2005 and 2009 by experienced psychiatric nurses. The semi-structured examination included an extensive battery of neuropsychiatric tests, a comprehensive psychiatric interview and observations of mental symptoms and signs [124]. From 1992 participants were asked to identify a close relative who could give collateral information and these were contacted for a telephone interview. In order to increase participation, home visits were offered from 2000 and onwards, which reduced participation bias [145].

4.3.2 Psychiatric examination

At the baseline examination in 1968, fourteen standard questions were used in order to assess any current psychiatric disturbance, its duration, psychiatric contact or in-patient treatment and current treatment with psychotropic drugs. In 1974 a working version of the Comprehensive Psychopathological Rating Scale (CPRS) [146] was added to the study and was used to rate psychiatric symptoms and signs during the preceding month. In 1992, the finalized version of CPRS [128] was added and was used in subsequent examinations in 2000-02, 2005-07 and 2009-11. The suicide item (rated 0-6, with 6 indicating the most severe level) is identical to that included in the Montgomery-Åsberg Depression Rating Scale (MADRS) [147].

4.3.3 Dependent variables

In 1968, participants were asked the following questions regarding suicidal behavior: Have you ever felt in your life that life was not worth living? Had suicidal thoughts? Made any attempt at suicide? The maximum degree of reported suicidal behavior was set according to a 5-degreee scale: 0) No suicidal tendency; 1) Life-weariness; 2) Suicidal thoughts; 3) Self-destructive

act without definite suicidal wish; 4) Seriously intended suicide attempt. A woman who responded yes to question 2 was considered to have suicidal thoughts. The same questions were also asked in the examinations conducted in 1992, 2000 and 2005.

In 1974, the participants were asked one question assessing suicidal behavior during the past year. Responses include: 0-1) Enjoys life or takes it as it comes. 2-3) Weary of life. Only fleeting suicidal thoughts. 4-5) Much better off dead. Suicidal thoughts are common, and suicide is considered as a possible solution, but without specific plans or intention. 6) Explicit plans for suicide when there is an opportunity. Active preparations for suicide. 7) Suicidal act, unclear lethal intent. 8) Suicidal act with lethal intent. For the purpose of this study, yes responses to any of questions 4-6 were considered suicidal thoughts. One question assessing suicidal thoughts during the past six years was also asked. Responses include: 0-1) Enjoys life or takes it as it comes. 2-3) Weary of life. Only fleeting death wishes. 4-5) Much better off dead. Suicidal thoughts are common, and suicide is considered as a possible solution, but without specific plans or intention. 6) Explicit plans for suicide when there is an opportunity. Active preparations for suicide. Women who responded yes to any of questions 4-6 were considered to have suicidal thoughts.

Since 1992, the Paykel questions on suicidal feelings have been included in the examinations. The items (all dichotomous yes/no) characterize whether individuals had ever (1) Felt that life was not worth living. (2) Wished you were dead-for instance, that you could go to sleep and not wake up. (3) Thought of taking your life, even if you would not really do it. (4) Reached the point where you seriously considered taking your life, or perhaps made plans how you would go about doing it. (5) Attempted to take your life.

Suicidal thoughts were considered present in women who responded yes to questions 3 or 4.

In 1992, the CPRS question regarding suicidal thoughts during the past week, month and year was added. Responses include: 0-1) Enjoys life or takes it as it comes. 2-3) Weary of life. Only fleeting death wishes. 4-5) Much better off dead. Suicidal thoughts are common, and suicide is considered as a possible solution, but without specific plans or intention. 6) Explicit plans for suicide when there is an opportunity. Active preparations for suicide. For the purpose of this study, a yes to any of questions 4-6 were considered suicidal thoughts.

Case records from inpatient and outpatient departments and general practitioners were reviewed for evidence of suicidal behavior. All available data from the 6 examination waves and case record review were utilized to determine a best estimate of age at onset of suicidal thoughts and attempts.

4.3.4 Explanatory variables

Early life adversities

At the baseline examination in 1968 nine early life adversities were documented (poverty, parental quarrel, unhappy childhood, physical abuse, strict upbringing, poor emotional contact with parents, feeling misunderstood as a child, alcoholism in father, and broken home (prior to age 16).

4.3.5 Statistics

Fisher's exact test was used to test differences in proportions. In order to analyze associations between early life adversity and history of suicidal thoughts and attempts at baseline logistic regression was used. Women (n=6) with missing data on four or more early life adversities were excluded from the analyses. Cox regression models were used to examine the association

between number of early life adversities and suicidal thoughts and attempts. The results are presented as hazard ratios (HR) and 95 % confidence intervals (CI). Linear regression models were used to examine the association between early life adversity and age of first suicidal thoughts/attempt. Results are presented as estimates and standard errors (SE). Women with undetermined age at onset were excluded from these analyses (suicide thoughts model: n=37); suicide attempt model n=15). All statistical models where adjusted for birth cohort. Statistical analyses were performed with IBM SPSS Statistics, V.20 for Windows and R 3.0.1. Results were considered significant when $p<0.05$.

4.4 Study IV

The sample was derived from *When life gets difficult to live*, a clinical study focusing on factors associated with attempted suicide in late life [96]. Individuals aged 70 and above, who were admitted to emergency wards in connection with a suicide attempt were recruited from five hospitals in the western part of Sweden during 2003-06. For the purpose of Study IV, a suicide attempt is defined as "a situation in which a person has performed an actual or seemingly life-threatening behavior with the intent of jeopardizing his life, or to give the appearance of such an intent but which has not resulted in death" [27]. A total of 145 individuals who had attempted suicide were registered residents in the study area. Exclusion criteria included terminal illness, Mini Mental State Examination (MMSE) [120] score <15, and insufficient knowledge of the Swedish language. After exclusions, 140 potential participants were identified. Of these, seven were discharged from hospital before they could be informed about the study, and 28 declined

participation. Two individuals accepted participation but died of natural causes on the hospital ward before the scheduled interview. A total of 103 individuals participated in the study, which corresponds to 77.4 % of the eligible sample. No difference was found between participants and non-participants in regards to sex and age [96]. Eight persons who received a research diagnosis of dementia [96] were excluded from the present analyses, as were those fifteen persons who were lacking complete SOC data, leaving a total of 80 participants (38 men, 42 women, mean age 79.4 years, age range 70-91). Figure 3 shows the participation flow.

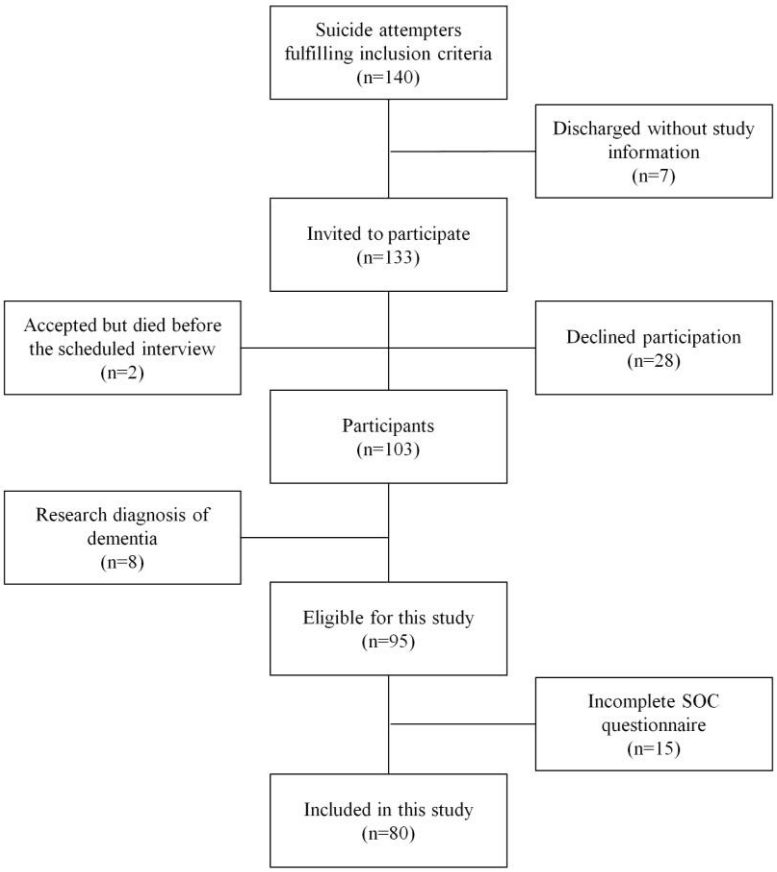

Figure 3. Flowchart of participants in study IV.

4.4.1 Procedure

Face-to-face interviews with the individuals who had made a suicide attempt were performed by one psychologist (Stefan Wiktorsson). The median time between the suicide attempt and the interview was eleven days. The majority of the interviews took place at the hospital ward, but fourteen were carried out after discharge. Twelve of these interviews took place at the individual's home, one at a psychiatric outpatient clinic and one at a nursing home.

4.4.2 Neuropsychiatric examination

The cognitive examination included the Swedish version of the Mini Mental State Examination (MMSE) [120] and tests of short and long-term memory, abstract thinking, aphasia, apraxia, agnosia. This has previously been described in detail [124]. A research diagnosis of dementia was used as an exclusion criterion only.

4.4.3 Psychiatric examination

The Comprehensive Psychopathological Rating Scale (CPRS) [128] was used to rate psychiatric symptoms during the month prior to the suicide attempt. Items are scored 0-6, with increasing symptom severity.

4.4.4 Dependent variable

The Sense of Coherence (SOC) [148] questionnaire is an instrument which measures the individuals' capacity to manage stressful events. The interviewer read the 29-item questionnaire and recorded their responses. The Swedish version of the SOC scale was used in this study. This version has been tested and showed high reliability and validity [149]. Items are rated 1-7, yielding a total score of 203. A high score indicates a strong SOC. The SOC questionnaire measures three components; *comprehensibility* which is

the cognitive component, measures the extent that the individual perceives inner and outer stimuli as tangible [150], *manageability* - the behavior component, measures the extent the individual perceives themselves as having resources to their disposal [150], and *meaningfulness* which is the motivational component marking the importance of taking part of processes surrounding the individual creates the individuals destiny as well as daily experiences [150]. As these components are interrelated, we used total SOC scores rather than the separate subscales in accordance with Antonovsky [148].

4.4.5 Explanatory variables

Mental health

Hopelessness (yes/no) was assessed with a single item (Do you think your situation is hopeless?) from the Geriatric Depression Scale (GDS) [151].

Data regarding the participant's mental health was dichotomized as follows: *Current psychiatric treatment* (yes/no), *psychiatric treatment more than five years ago* (yes/no), *previous suicide attempt* (yes/no).

Physical illness

The Cumulative Illness Rating Scale for Geriatrics (CIRS-G) [152] was used to rate physical illness/disability. A score ranging from 0 (no pathology) to 4 (extremely severe illness/disability) was rated for each organ system. For the purpose of this study, ratings of 3 (severe/constant disability or "uncontrollable" chronic problems) or 4 (extremely severe illness or severe disability) in any of the thirteen somatic categories were considered to have *serious physical illness/disability*.

Sociodemographics

For the purpose of this study, data on sociodemographic characteristics were dichotomized as follows: *education beyond mandatory* (yes/no), *economic situation during adolescence* (poor/very poor, average/good/very good), *currently has partner* (yes/no), *divorced/separated* (yes/no), *widow/widower* (yes/no), *living alone* (yes/no).

Social factors

Data regarding the individual's social situation were dichotomized and categorized as follows: *has or has had children* (yes/no), *past year relationship problems in family* (yes/no), *too little time spent with children* (yes/no), *too little time spent with grandchildren* (yes/no), *too little time spent with neighbours* (yes/no), *perceived loneliness* (yes/no), *moved in the past five years* (yes/no).

4.4.6 Collateral data sources

Interview data and case records from primary care, psychiatric clinics, hospital emergency departments and geriatric departments were reviewed.

4.4.7 Diagnostic procedure

An algorithm based on CPRS items [128] and in accordance with the DSM-IV was used for diagnosis of major depression [124] (see Appendix B). A diagnosis of dementia, which was used as an exclusion criterion only, was based on MMSE and results from tests of short-and long-term memory, abstract thinking, aphasia, apraxia and agnosia as previously described [124].

4.4.8 Statistics

Total SOC score was dichotomized (lowest quartile (<114) versus all others). Exact logistic regression was used to analyze associations between independent variables and the dependent variable (low SOC). Each independent variable that showed a significant association with low SOC in the univariate exact logistic regression analyses was analyzed in a separate multivariate exact logistic regression model adjusting for sex, age, and major depression. Statistical analyses were performed with Statistical Package for the Social Sciences (SPSS), V.16 for Windows and SAS V.9.2.

5 ETHICAL CONSIDERATIONS

For *study I* all participating studies adhered to standards according to local or university ethical committees. The Ethics Committee for Medical Research at the University of Gothenburg approved of *studies II, III and IV*. All participants were informed of their right to withdraw from the study at any time. In accordance with the provisions of the Helsinki Declaration, informed consent was obtained from participants and/or their next of kin.

6 RESULTS

6.1 Study I

Characteristics of the participants of EURODEP are presented in Table 3.

Table 3. Demographic characteristics of the eleven EURODEP centers with data on death wishes (n=15,890)

Center	Instrument Psychiatric symptoms	Functional Disability	Reference for disability scale applied	n (%)	Mean Age (range)	Female n (%)	Married n (%)	High Education n (%)
Amsterdam	GMS	Interview	Katz [131]	3,987 (25)	74 (65-84)	2,488 (62)	1,939 (49)	1,042 (26)
Berlin	GMS	Interview	Katz [131]	488 (3)	84 (70-103)	240 (49)	148 (30)	147 (31)
Dublin	GMS	Interview	-	1,012 (6)	74 (64-98)	648 (64)	495 (49)	301 (30)
Reykjavik	GMS	Interview	Katz [131]	772 (5)	86 (83-89)	463 (60)	216 (28)	166 (21)
Liverpool	GMS	Interview	Katz [131], Prince [153]	3,366 (21)	79 (69-104)	1,751 (52)	1,256 (37)	729 (22)
London	SHORT-CARE	Interview	Katz [131], Prince [153]	637 (4)	75 (65-99)	383 (60)	235 (37)	121 (19)
Ähtäri	ZSDS	Self-report	Zung [129]	1,035 (7)	73 (65-95)	635 (61)	503 (49)	75 (7)
Gothenburg	CPRS	Proxy interview	Östling & Skoog [154]	447 (3)	85	313 (70)	100 (23)	110 (26)
Munich	GMS	Observed	Oswald & Fleischmann [155]	346 (2)	88 (85-99)	268 (78)	63 (18)	103 (30)
Verona	GMS	Observed	Belloc [156]	202 (1)	74 (65-100)	125 (62)	106 (53)	47 (23)
Zaragoza	GMS	Interview	Katz [131]	3,598 (23)	77 (65-102)	2,115 (59)	1,897 (53)	498 (14)
All centers				15,890 (100)	77 (64-104)	9,429 (59)	6,958 (44)	3,339 (21)

GMS, Geriatric Mental State; ZSDS, Zung Self-Rating Depression Scale; CPRS, Comprehensive Psychopathological Rating Scale.
Numbers of persons in denominators vary due to missing observations.

Death wishes were reported by 6 % (n=976), with similar rates observed for both sexes (Table 4). The prevalence of death wishes varied widely between the centers ranging from 3 % to 27 % with the lowest prevalence found in Amsterdam and Zaragoza and the highest in Munich.

Table 4. Prevalence of death wishes by center and sex

	Death wishes		
	Men n (%)	Women n (%)	Total n (%)
Amsterdam	40 (3)	87 (3)	127 (3)
Berlin	51 (21)	67 (28)	118 (24)
Dublin	29 (8)	67 (10)	96 (9)
Reykjavik	7 (3)	29 (6)	36 (5)
Liverpool	66 (4)	88 (5)	154 (5)
London	23 (9)	40 (10)	63 (10)
Ähtäri	15 (4)	71 (11)	86 (8)
Gothenburg	12 (9)	47 (15)	59 (13)
Munich	24 (31)	69 (26)	93 (27)
Verona	3 (4)	22 (18)	25 (12)
Zaragoza	31 (2)	88 (4)	119 (3)
All centers	301 (5)	675 (7)	976 (6)

The numbers and proportions of men and women with death wishes by disability level is shown in Figure 4. For each increase in disability level, the proportion of death wishes increased, indicating a dose-response relationship in both sexes.

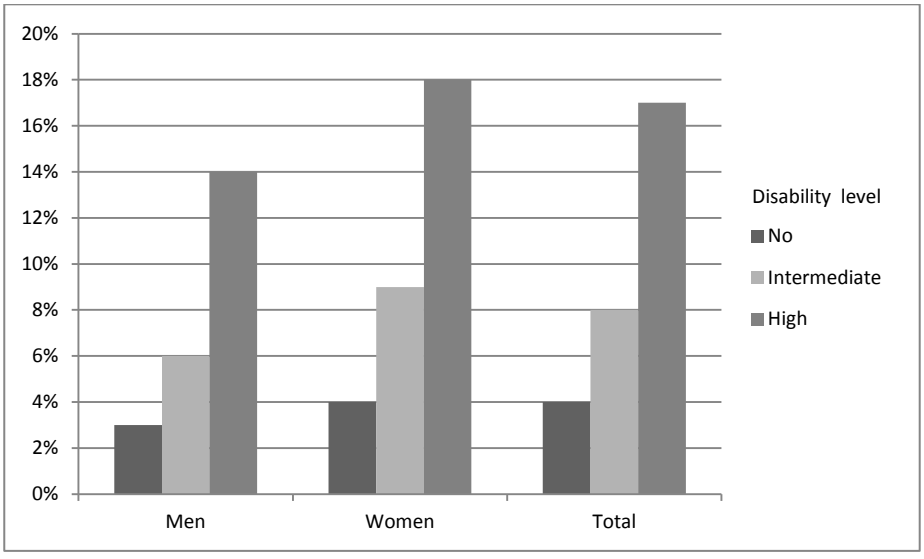

Figure 4. Prevalence of death wishes by disability level and sex within eleven EURODEP centers (n=15,686).

The results of the multivariate model are shown in Table 5. The odds of having death wishes was nearly two-fold among the group with an intermediate disability level, while the effect was more than three-fold among those with a high disability level. There was no difference between men and women. No association was found between a 10-year increase in age and death wishes, nor could an association between education or being unmarried and having such wishes be shown. A nearly four-fold increase in odds of having death wishes was found for those with perceived loneliness.

Having one chronic condition somewhat increased the odds of having death wishes, while the effect was nearly two-fold for two or more chronic conditions. The odds of having death wishes increased by 5 % for each one point decrease in MMSE score (OR 1.050 (1.030; 1.071), p=<.0001). The

between-center variation (calculated by the MOR) was strong; however, the effect was not as large as high functional disability.

Table 5. Multivariate model showing odds ratios of having death wishes (n=11,030*)

Fixed (within center) effects		OR (95 % CI)	P**
Functional disability (no)		REF	<.0001
Intermediate vs. (no)		1.894 (1.420; 2.526)	
High vs. (no)		3.220 (2.344; 4.422)	
Sex (female)		1.180 (0.967; 1.440)	0.1038
Age Δ=10		0.875 (0.759; 1.009)	0.0664
Education index Δ=0,1		1.017 (0.960; 1.077)	0.5627
Marital status (not married)		1.214 (0.928; 1.589)	0.1315
Perceived loneliness		3.975 (3.285; 4.809)	<.0001
Chronic condition (0)		REF	0.0013
1 vs. (0)		1.324 (1.051; 1.669)	
2 or more vs. (0)		1.795 (1.374; 2.343)	
MMSE		1.050 (1.030; 1.071)	<.0001
Random effects	Variance σ^2	MOR	p-value
Center	0.8673	2.4311	<.0001

* Based on data from 8 centers. Reykjavik was excluded due to missing data on MMSE, Dublin due to missing data on Chronic condition and Verona due to missing data on Perceived loneliness.
** Type 3 tests used.

When adding Euro-D score to the multivariate model a decrease of the effect which the predictor variables had on death wishes was observed (Table 6). However, all associations remained statistically significant. The group reporting perceived loneliness had the highest odds of having death wishes. We reran the multivariate analyses after excluding individuals who fulfilled criteria for dementia; however, this did not affect our results (results not shown).

Table 6. Multivariate model showing odds ratios of having death wishes with inclusion of depression (n=11,030*)

Fixed (within center) effects		OR (95 % CI)	P**
Functional disability (no)		REF	0.0002
Intermediate vs. (no)		1.602 (1.196; 2.146)	
High vs. (no)		2.439 (1.767; 3.366)	
Sex (female)		1.064 (0.869; 1.302)	0.5491
Age Δ=10		0.865 (0.748; 0.999)	0.0489
Education index Δ=0,1		1.027 (0.969; 1.088)	0.3685
Marital status (not married)		1.365 (1.041; 1.789)	0.0299
Perceived loneliness		2.720 (2.231; 3.317)	<.0001
Chronic disease (0)		REF	0.0325
1 vs. (0)		1.210 (0.957; 1.530)	
2 or more vs. (0)		1.459 (1.110; 1.917)	
MMSE		1.033 (1.013; 1.055)	0.0013
Euro-D		1.783 (1.635; 1.945)	<.0001
Random effects	Variance σ^2	MOR	p-value
Center	0.731	2.26044	<.0001

* Based on data from 8 centers. Reykjavik was excluded due to missing data on MMSE, Dublin due to missing data on Chronic condition and Verona due to missing data on Perceived loneliness.
** Type 3 tests used.

6.2 Study II

More than one quarter (26.7 %) of the participants reported that they thought of their own death more than once a month. Approximately one tenth had experienced some level of suicidal feelings during the last month, and this was more common in women than in men (Table 7). Thoughts that life is not worth living were endorsed by 7.9 %. One tenth acknowledged death wishes; these were more common among women. Thoughts of taking one's own life were reported by 3.8 %. Serious consideration of taking one's own life was uncommon among both men and women (0.8 %). None of the participants reported that they had attempted suicide during the past month.

Table 7. One-month frequency of suicidal feelings[a] in a population sample of 97-year-olds without dementia, by sex (n=269).

	Women (n=197)	%	Men (n=72)	%	Total (n=269)	%	P[b]
Any suicidal feelings	27/197	13.7	4/72	5.6	31/269	11.5	0.045
Thoughts that life is not worth living	17/196	8.7	4/70	5.7	21/266	7.9	0.308
Death wishes	25/196	12.8	3/70	4.3	28/266	10.5	0.033
Thought of taking own life	9/194	4.6	1/70	1.4	10/264	3.8	0.206
Seriously considered taking own life	1/194	0.5	1/70	1.4	2/264	0.8	0.461
Attempted suicide	0/194	(-)	0/70	(-)	0/264	(-)	

[a] According to Paykel [130]. [b] sex differences, in accordance with Fisher's exact test.

Individuals reporting suicidal feelings more often reported that they had frequent thoughts of own death compared to those without such feelings (70.0 % vs. 21.2 %, p=0.000). Associations between demographic and diagnostic characteristics with past month suicidal feelings are presented in Table 8.

Suicidal feelings were more common among individuals who reported that they had never had a partner and those who did not have children. Less than one quarter fulfilled criteria for major or minor depression, although, a strong association with suicidal feelings was observed. No association could be found with other psychiatric disorders or history of psychiatric inpatient or outpatient care. Mean MMSE scores did not differ among individuals with and without suicidal feelings (25.23 vs.25.72, 95 % CI -0.99-1.96, p=0.519).

Nearly 90 % of those reporting suicidal feelings were dissatisfied with sleep, compared to two-thirds of those without such feelings. Having difficulties initiating sleep was more common among those with suicidal feelings, although, mean number of hours of sleep reported per day was similar among

participants with and without suicidal feelings (7.7 vs. 7.8 (95 % CI -0.71-0.87, p=0.836)).

The group with suicidal feelings reported aches and pains significantly more frequently. A total of 13 % of the total group rated their current health as rather poor/poor. No difference could be found between those with and without suicidal feelings. No other health related factors were associated with suicidal feelings. Over half of the participants died within three years, however, no significant difference in proportions between those with and without suicidal feelings was found (64.5 % vs. 50.8 %, p=0.106).

Table 8. Associations with past month suicidal feelings[a] (n=269).

	Suicidal feelings (n=31)	%	No suicidal feelings (n=238)	%	P[b]
Demographics					
Education beyond mandatory	9/20	45.0	100/169	59.2	0.447
Living in an institution	11/30	36.7	66/236	28.0	0.216
Partner status (current)					
Partner	0/31	(-)	10/235	4.3	
Divorced	2/31	6.5	10/235	4.5	0.418
Widow/widower	21/29	67.7	187/235	79.6	0.105
Always been single	8/31	25.8	28/235	11.9	0.039
Children	10/31	32.3	126/234	53.8	0.019
Life events					
Death of a parent before age 16	5/22	22.7	26/167	15.6	0.280
Death among children/grandchildren	8/18	44.4	40/166	24.1	0.061
Religion					
Religious	18/30	60.0	133/236	56.4	0.430
Actively religious	12/30	40.0	91/236	38.6	0.514
Psychiatric disorders					
Any depression	7/31	22.6	15/238	6.3	0.007
Anxiety disorder	4/31	12.9	12/238	5.0	0.097
Psychotic disorder	1/31	3.2	11/238	4.6	0.587
Sleep					
Dissatisfied with sleep	26/30	86.7	153/233	65.7	0.013
Reduced sleep	6/28	21.4	34/233	14.6	0.242
Difficulties initiating sleep	22/30	73.3	103/235	43.8	0.002
Early morning awakening	5/30	16.7	22/235	9.4	0.174
Increased sleep	1/28	3.6	3/233	1.3	0.367
Health					
Stroke/TIA	7/31	22.6	37/238	15.5	0.224
Aches and pains	12/29	41.4	58/237	24.5	0.046
Poor perceived health	3/13	23.1	12/93	12.9	0.270
Impairments					
Hearing impairment	10/30	33.3	88/238	37.0	0.431
Vision impairment	8/31	25.8	69/238	29.0	0.447

[a] According to Paykel [130]. [b] In accordance with Fisher's exact test.

Table 9 shows the results of the separate exact logistic regression models. Never having children was associated with suicidal feelings. However, this association did not remain in the adjusted analysis. Depression was associated with a four-fold increase in odds of having suicidal feelings, and the association remained after adjusting for sex. As suicidal ideation is a symptom of depression, we reanalyzed data after removing this symptom from the diagnostic algorithm. This did not affect our results. Both dissatisfaction with sleep and difficulties initiating sleep were associated with a more than three-fold increase in odds of having suicidal feelings. However, after adjusting for sex and depression, only difficulties initiating sleep remained an independent determinant.

Table 9. Results of separate exact logistic regression models showing odds of having past month suicidal feelings[a] (n=269).

	Crude OR[b]	95 % CI	p	Adjusted OR[c]	95 % CI	p
Sex	2.69	0.89-11.0	0.089			
Always been single[d]	2.56	0.90-6.67	0.078			
Children[e]	0.41	0.16-0.96	0.037	0.47	0.18-1.11	0.091
Any depression	4.30	1.35-12.6	0.013	3.79[f]	1.18-11.2	0.025
Dissatisfied with sleep[g]	3.39	1.12-13.8	0.026	3.02	0.99-12.4	0.053
Difficulties initiating sleep[h]	3.51	1.43-9.50	0.004	3.52	1.41-9.73	0.004
Aches and pains[i]	2.17	0.89-5.16	0.091			

[a] According to Paykel [130]. [b] Bivariate exact logistic regression. [c] Separate exact logistic regression, adjusted for sex and any depression. [d] Missing value for 3 subjects. [e] Missing value for 4 subjects. [f] Adjusted for sex. [g] Missing value for 6 subjects. [h] Missing value for 4 subjects. [i] Missing value for 3 subjects.

Detailed data regarding social interactions were available for participants born in 1905-1909 (n=166) (Table 10). Too little time spent with friends, acquaintances and neighbours was more common among individuals reporting suicidal feelings. The same was the case for reports of less time spent with friends and family than before retirement and perceived loneliness.

Table 10. Social characteristics in participants with and without past month suicidal feelings[a] (n=166[b]).

	Suicidal Feelings n=19	%	No Suicidal Feelings n=147	%	p[c]
Has a confidant	13/18	72.2	105/141	74.5	0.517
More than one confidant	6/17	35.3	59/135	43.7	0.348
Too little time spent with children	5/10	50.0	18/104	17.3	0.027
Too little time spent with grandchildren	2/9	22.2	21/101	20.8	0.600
Too little time spent with friends and acquaintances	8/16	50.0	18/127	14.2	0.002
Too little time spent with neighbours	6/18	33.3	11/138	8.0	0.006
Less time spent with friends and family than before retirement	8/16	50.0	72/167	25.2	0.041
Perceived loneliness	12/18	66.7	45/139	32.4	0.006

[a] According to Paykel [130]. [b] Data available for participants born 1905-1909 only. [c] In accordance with Fisher's exact test.

The results of the separate exact logistic regression models are shown in Table 11. When adjusting for sex and any depression, too little time spent with friends and acquaintances and too little time spent with neighbours remained significant. The strongest association was found between spending too little time with friends and acquaintances, which yielded a more than six-fold increase in odds in the adjusted model.

Table 11. Results of separate exact logistic regression models showing the association between social characteristics and past month suicidal feelings[a] (n=166[b]).

	Crude OR[c]	95 % CI	p	Adjusted OR[d]	95 % CI	p
Too little time spent with children[e]	4.69	0.97-22.8	0.054			
Too little time spent with neighbours[f]	5.67	1.46-20.7	0.011	5.00	1.10-20.9	0.036
Too little time spent with friends and acquaintances[g]	5.94	1.71-20.9	0.004	6.61	1.59-29.9	0.007
Less time spent with friends and family than before retirement[h]	2.94	0.88-9.83	0.082			
Perceived loneliness[i]	4.14	1.33-14.3	0.011	3.33	0.98-12.3	0.053

[a] According to Paykel [130]. [b] Data available for participants born 1905-1909 only. [c] Bivariate exact logistic regression. [d] Separate exact multivariate logistic regression, adjusted for sex and any depression. [e] Missing value for 52 subjects. [f] Missing value for 10 subjects. [g] Missing value for 23 subjects. [h] Missing value for 23 subjects. [i] Missing value for 9 subjects.

6.3 Study III

At the baseline interview in 1968, 28.8 % reported that they had more than mandatory education, and four fifths (80.7 %) were married. Sixty women were diagnosed with major depression at the time of or a few weeks prior to the examination [144]. A total of 18.3 % of the women (n=146) had past or present suicidal thoughts and 4.4 % had a history of attempted suicide (n=35). Using data from all study waves and case record review combined showed that the lifetime prevalence of suicidal thoughts was 24.9 % (199 out of 800). Half of the women with data on age of onset (82 out of 162) reported their first episode of suicidal thoughts after the age of 40 and 38 (23.5 %) after the age of 60 (Figure 5).

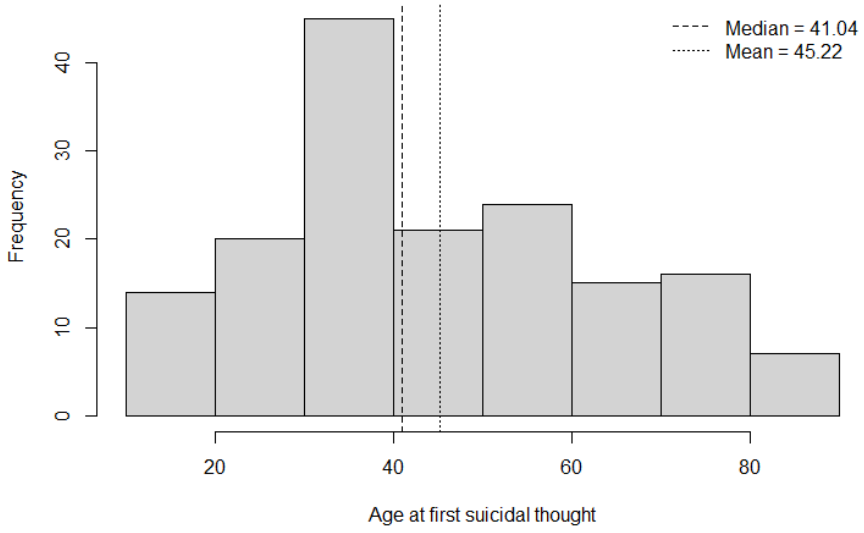

Figure 5. Distribution of first episode of suicidal thoughts by age group. The Prospective Population Study of Women (PPSW) (n=162).

A total of 62 women (7.8 %) made at least one suicide attempt at some point during their lifetime. More than half (26 out of 47) were over the age of 40 at the first attempt (Figure 6), while twelve women (25.5 %) made their first attempt at or above the age of 60.

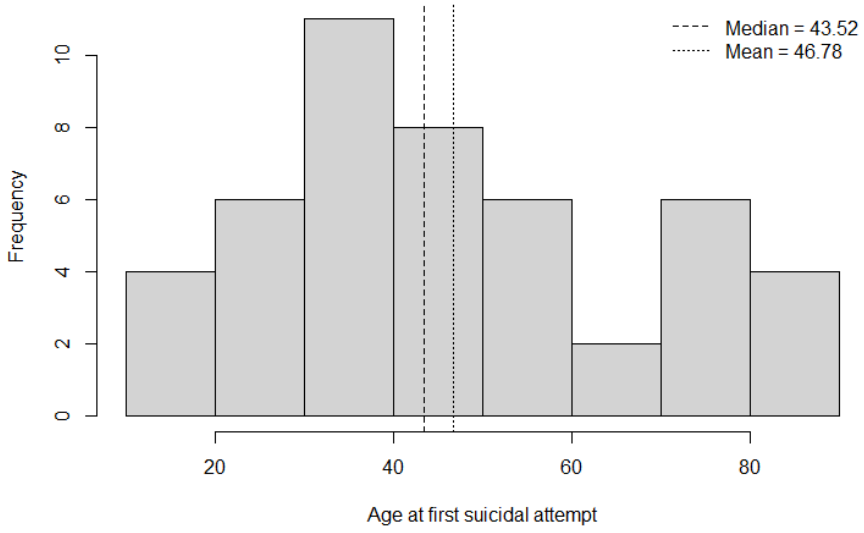

Figure 6. Distribution of first episode of suicide attempt by age group. The Prospective Population Study of Women (PPSW) (n=47).

Early life adversity was frequently reported in the total group (Table 12). Most of the adversities were associated with a history of suicidal thoughts at baseline but only one (feeling misunderstood as a child) showed a significant association with history of suicide attempt.

Table 12. Early life adversity in women with and without a history of suicidal thoughts and attempts at baseline in 1968. The Prospective Population Study of Women (PPSW) (n=800[a]).

		History of suicidal thoughts in 1968			History of suicide attempt in 1968		
	Total n (%)	Yes n=146 n (%)	No n=653 n (%)	P[b]	Yes n=35 n (%)	No n=763 n (%)	P[b]
Early life adversity							
Poverty[c]	171 (24.1)	37 (29.4)	134 (22.9)	0.080	9 (30.0)	162 (23.8)	0.281
Parental quarrel[d]	394 (62.3)	87 (73.7)	307 (59.7)	0.003	17(73.9)	377 (61.9)	0.172
Unhappy childhood[e]	131 (18.2)	53 (41.4)	78 (13.2)	0.000	9 (31.0)	122 (17.7)	0.063
Physical abuse[f]	464 (58.4)	94 (64.4)	370 (57.0)	0.061	18 (51.4)	446 (58.7)	0.248
Strict upbringing[g]	386 (52.8)	91 (64.5)	295 (50.0)	0.001	21 (65.6)	365 (52.2)	0.095
Poor emotional contact with parents[h]	448 (58.3)	106 (75.2)	342 (54.5)	0.000	429 (58.3)	19 (57.6)	0.536
Feeling misunderstood as a child[i]	297 (38.1)	85 (60.3)	212 (33.2)	0.000	19 (55.9)	278 (37.3)	0.024
Alcoholism in father[j]	100 (13.2)	28 (20.0)	72 (11.7)	0.008	8 (23.5)	92 (12.7)	0.066
Broken home (before the age of 16)	111 (13.9)	18 (12.3)	93 (14.2)	0.324	8 (22.9)	103 (13.5)	0.099

[a] Two women were excluded due to missing data on suicide items. [b] Differences between group with and without history of suicidal thoughts and group with and without history of suicide attempt in accordance with Fisher's exact test. [c] Missing value for 90 subjects. [d] Missing value for 168 subjects. [e] Missing value for 81 subjects. [f] Missing value for 5 subjects. [g] Missing value for 69 subjects. [h] Missing value for 31 subjects. [i] Missing value for 21 subjects. [j] Missing value for 42 subjects.

As seen in Table 13, all associations remained significant when tested in a logistic regression, with OR's ranging from 1.82 (95 % CI 1.24-2.66) to 4.65 (95 % CI 3.04-7.11).

Table 13. Associations between early life adversity and history of suicidal thoughts and attempts at baseline in 1968. The Prospective Population Study of Women (PPSW) (n=800[a]).

	History of suicidal thoughts in 1968			History of suicide attempt in 1968		
	OR[b]	95 % CI	p	OR[b]	95 % CI	p
Early life adversity						
Parental quarrel[c]	1.89	1.21-2.96	0.005			
Unhappy childhood[d]	4.65	3.04-7.11	0.000			
Strict upbringing[e]	1.82	1.24-2.66	0.002			
Poor emotional contact with parents[f]	2.53	1.68-3.83	0.000			
Feeling misunderstood as a child[g]	3.05	2.10-4.44	0.000	2.13	1.06-4.26	0.033
Alcoholism in father[h]	1.90	1.17-3.07	0.009			

[a] Two women were excluded due to missing data on suicide items. [b] Logistic regression. [c] Missing value for 168 subjects. [d] Missing value for 81 subjects. [e] Missing value for 69 subjects. [f] Missing value for 31 subjects. [g] Missing value for 21 subjects. [h] Missing value for 42 subjects.

A strong association between number of early life adversities and both suicidal thoughts (HR 1.30, 1.21-1.40 95 % CI) and suicide attempt (HR 1.22, 1.07-1.40 95 % CI) was observed (Tables 14 and 15). Women who reported five or more early life adversities were significantly younger when they had their first episode of suicidal thoughts compared to their counterparts (Estimate -2.63 years per trauma (SE 0.68)). A similar trend was noted for those who had attempted suicide (Estimate -0.48 years per trauma (SE 1.37)); however, the difference did not reach statistical significance.

Table 14. Associations between early life adversities and lifetime suicidal thoughts. The Prospective Population Study of Women (PPSW) (n=757[a]).

	Hazard Ratio[b] – (95 % CI)	Linear model[c] – Estimate (SE)
Early life adversities (0-9)	1.30*** (1.21-1.40)	-2.63*** (0.68)
Birth cohort	1.03 (0.99-1.06)	
(Intercept)		59.09*** (5.44)
Year of birth (counting from 1914)		-0.18 (0.31)

*** p < 0.001, ** p < 0.01, * p < 0.05. [a] n=37 excluded due to missing data for age at onset of suicidal thoughts and n=6 due to missing data on early life adversity. [b] Cox regression model. [c] Linear regression model.

Table 15. Associations between early life adversities and lifetime suicide attempt. The Prospective Population Study of Women (PPSW) (n= 779[a]).

	Hazard Ratio[b] – (95 % CI)	Linear model[c] – Estimate (SE)
Early life adversities (0-9)	1.22** (1.07-1.40)	-0.48 (1.37)
Birth cohort	1.02 (0.96-1.09)	
(Intercept)		61.68*** (11.36)
Year of birth (counting from 1914)		-0.94 (0.71)

*** p < 0.001, ** p < 0.01, * p < 0.05. [a] n=15 excluded due to missing data for age at first suicide attempt and n=6 due to missing data on early life adversity. [b] Cox regression model. [c] Linear regression model.

6.4 Study IV

Characteristics of all participants (n=80) and the subgroup with low SOC (n=20) are presented in Table 16.

Table 16. Health and social characteristics of all participants and the subgroup with low Sense of Coherence (SOC)[a] (n=80).

	All n=80	%	Low SOC n=20	%
Sex				
Men	38	47.5	10	50
Women	42	52.5	10	50
Mental health				
Major depression[b]	52	65	19	95
Hopelessness[c]	44	55	15	75
Current psychiatric treatment	32	40	11	55
Psychiatric treatment more than 5 years ago	38	47	12	60
Previous suicide attempt	25	31	8	40
Serious physical illness/disability[d]	45	56	14	70
Education beyond mandatory	40	50	8	40
Very poor/poor economic situation during adolescence	29	36	9	45
Partner	29	36	5	25
Divorced/separated[e]	15	20	4	21
Widow/widower[f]	35	46	9	47
Has or has had children	72	90	16	80
Living alone[g]	26	34	3	16
Past year relationship problems in family	27	34	10	50
Too little time spent				
with children[h]	25	36	10	62
with grandchildren[i]	26	38	11	69
with neighbours[j]	23	29	9	45
Perceived loneliness[k]	47	59	17	85
Moved in the past 5 years	20	25	9	45

[a] Low SOC is defined as the lowest quartile of Total SOC score (<114). [b] Including bipolar. [c] Measured by the Geriatric Depression Scale question Do you think your situation is hopeless? [151] . [d] A rating ≥3 according to the Cumulative Illness Rating Scale – Geriatrics (CIRS-G) [152]. [e] Missing value for 5 subjects. [f] Missing value for 4 subjects. [g] Missing value for 4 subjects. [h] Missing value for 11 subjects. [i] Missing value for 12 subjects. [j] Missing value for 1 subject. [k] Missing value for 1 subject.

The mean SOC score for the total group was 129.56 (range 56-184). The results of the exact univariate logistic regression model are shown in Table 17. Sex and age was not associated with low SOC. Major depression was associated with a fifteen-fold increase in odds of having low SOC. Hopelessness was common among individuals with low SOC, however, a significant association between the two could not be found. Nor could a relationship between serious physical illness/disability and low SOC be shown. An association between past year relationship problems within the family and low SOC was found, with a more than threefold increase in odds. Too little time spent with children was associated with a fourfold increase in odds of low SOC; while a fivefold increase was observed for the group reporting spending too little time spent with grandchildren. A more than fivefold increase in odds of low SOC was observed for the group with perceived loneliness. Lastly, having moved during the past five years was also associated with low SOC.

Table 17. Separate exact logistic regression models showing associations between low Sense of Coherence (SOC)[a] and health and social variables (n=80).

	OR	95 % CI	p
Sex	0.88	0.28-2.73	0.998
Age	1.01	0.92-1.12	0.797
Mental health			
Major depression[b]	15.2	2.13-669	0.013
Hopelessness[c]	3.16	0.94-12.6	0.066
Current psychiatric treatment	2.25	0.72-7.24	0.189
Psychiatric treatment more than 5 years ago	1.94	0.62-6.36	0.301
Previous suicide attempt	1.67	0.50-5.43	0.481
Serious physical illness/ disability[d]	2.16	0.67-7.83	0.240
Education beyond mandatory	0.59	0.18-1.63	0.439
Economic situation during adolescence	1.63	0.51-5.16	0.498
Partner	0.81	0.24-2.58	0.902
Divorced/separated[e]	1.09	0.22-4.44	1.00
Widow/widower[f]	1.07	0.33-3.45	1.00
Has or has had children	0.29	0.05-1.75	0.205
Living alone[g]	0.28	0.05-1.15	0.086
Living in an institution	1.00	0.02-13.3	1.00
Past year relationship problems in family	3.55	1.08-12.0	0.036
Too little time spent			
with children[h]	4.12	1.13-16.5	0.030
with grandchildren[i]	5.28	1.40-22.9	0.011
with neighbours[j]	2.59	0.78-8.62	0.132
Perceived loneliness[k]	5.37	1.35-31.6	0.012
Moved in the past 5 years	3.58	1.04-12.4	0.042

[a] Low SOC is defined as the lowest quartile of Total SOC score (<114). [b] Including bipolar. [c] Measured by the Geriatric Depression Scale question Do you think your situation is hopeless? [151]. [d] A rating ≥3 according to the Cumulative Illness Rating Scale – Geriatrics (CIRS-G) [152]. [e] Missing value for 5 subjects. [f] Missing value for 4 subjects. [g] Missing value for 4 subjects. [h] Missing value for 11 subjects. [i] Missing value for 12 subjects. [j] Missing value for 1 subject. [k] Missing value for 1 subject.

Results of the separate multivariate exact logistic regression analyses are presented in Table 18. When adjusting for sex, age and major depression, too little time spent with children, grandchildren and having moved in the past five years all remained independent factors. Major depression remained strong in all analyses, with OR's ranging from 10.6 (CI 1.33-471) to 17 (CI 2.24-792).

Table 18. Separate multivariate exact logistic regression showing associations between mental health and social variables and low Sense of Coherence (SOC)[a] (n=80).

	OR	95 % CI	p
Past year relationship problems in family	3.65	0.98-15.0	0.055
Too little time spent			
with children[b]	4.38	1.11-19.2	0.032
with grandchildren[c]	6.41	1.43-37.3	0.011
Perceived loneliness[d]	3.89	0.90-24.0	0.074
Moved in the past 5 years	5.32	1.22-27.2	0.023

[a] Low SOC is defined as the lowest quartile of Total SOC score (<114). [b] Missing value for 11 subjects. [c] Missing value for 12 subjects. [d] Missing value for 1 subject.

7 DISCUSSION

7.1 Strengths

Among the strengths of this thesis is that it covers perspectives of both the general population and of patients. The studies included in this thesis encompass a large age range spanning from 64-104 years of age. Studies II-IV include both individuals living at home or in institutions, which is a strength since community-based studies may miss persons with more severe health issues and limited social networks. A particular strength pertaining to study I is the large sample size. In all three of the studies that were set in Sweden (II-IV) the comprehensive examinations were conducted by experienced mental health professionals (psychiatrists, psychiatric nurses and a psychologist). Diagnostics in these studies were based on face-to-face interviews with clinicians trained in the use of a structured instrument for the rating of psychiatric symptoms. The CPRS which was used in the Gothenburg center in study I and in studies II-IV has been shown to have good reliability and validity in older clinical samples [157]. In study III data from the PPSW was used, the multi-disciplinary longitudinal study includes six examinations during more than 40 years. For this study, collateral data sources were used in order to identify suicidal behavior.

7.2 Limitations

Studies I, II and IV are of a cross-sectional design, outcome and explanatory factors are measured at the same point in time, and thus nothing can be said regarding causality. For study I, response rates varied widely across centers [158]. The response rates for studies II-IV ranged from 65-89 %. We cannot

exclude the possibility that those who declined participation might have a higher prevalence of suicidal behavior than those who participated, which might have led to an underestimation of suicidal behavior in our samples. For studies II and IV, some subgroups are small which is reflected by the large confidence intervals. Participants in studies II-IV all live in Gothenburg, a large city in Sweden which makes ethnical and cultural generalizability difficult.

For study I, measurements of death wishes/suicidal thoughts varied across countries therefore it was not possible to compare direct prevalence rates of death wishes. Further, several rating scales were used to measure functional disability, and disability level was trichotomised at each site. Therefore, there is a possibility that two individuals with the same disability level may have ended up in different categories. Number of depressive symptoms was measured with the EURO-D; we cannot say anything about the severity of each item.

The Paykel questions utilized in study II include a broad range of the phenomena, and life weariness and death wishes were far more common than serious suicidal thoughts. Although this is the largest population-based study performed in extreme old age, the number of persons who seriously considered taking their lives during the past month was not large enough to allow for separate analyses.

In study III all "pre-baseline" data is retrospective thus perceptions of early life may be affected by later experiences. Early life adversity was recorded as having been present or absent, we do not have any information on the severity or the duration of each individual stressor. Self-harm behaviors were registered but the presence of suicidal intent was not clarified, thus nothing

can be said regarding for instance non-suicidal self injury. As symptoms of depression were not rated between examination waves, analyses regarding age at onset could not be adjusted for this disorder. As study III is a longitudinal study, there are a number of structured instruments which did not exist at the study initiation which were introduced at later waves. Only women are included in this study, thus results of the study cannot be generalized for men.

Cases in study IV were recruited from a hospital setting, and some older adults who attempt suicide might not seek hospital care. As the participants were interviewed a short period after their suicide attempt and were in a frail state, the interviewer read the SOC questions out loud and recorded the responses which may have affected the responses. There is a possibility that the participants have a stronger SOC than those who declined. Lastly, while study IV is part of a larger case-control study, the SOC questionnaire was not administered to the comparison group.

7.3 Discussion of results

7.3.1 Study I

Using data from a large multicenter study, we found that functional disability was associated with death wishes in older adults aged 65-104 years. This association remained also after adding depressive symptom score to the model. A dose-response relationship was observed for both sexes regarding death wishes and disability level.

A total of 6 % reported death wishes and no difference was found between men and women. The results of our study, that functional disability was independently associated with death wishes, is similar to the results of studies

consisting of "younger" older [41, 74] and older adults [35, 61]. An association between death wishes with both one and two or more chronic conditions was observed in both sexes. These results are in line with previous studies examining death wishes [36], suicide attempt [159] and completed suicide [76]. However, a study from Australia with a sample aged 60 and above, showed that although number of chronic conditions was associated with suicidal thoughts, the association did not remain in a multivariate model that included a large number of clinical and sociodemographic characteristics [39].

We could not show a sex difference regarding the strength of the association between functional disability and death wishes, and this was the case for chronic conditions as well. These findings were somewhat unexpected, as the literature suggests that physical illness and disability may be more strongly related to both fatal and non-fatal suicidal behavior in men than in women [92, 159, 160]. However, one British study that focused on a somewhat younger age group (55-74 years) did not find this to be the case [161].

A strong association between perceived loneliness and death wishes was observed. Few studies have examined the association between perceived loneliness and suicidal behavior [104]. However, our results are in line with the findings from two studies consisting of persons aged 58-98 years [37] and in 65-75 year-olds [108] with wishes to die. Further, Swedish studies have shown that feelings of loneliness are associated with both attempted suicide [96] and suicide [102]. Individuals with limited social networks may be more vulnerable in the face of functional disability. In a Danish study the presence of strong social relationships postponed functional decline in men living alone [162].

7.3.2 Study II

To the best of our knowledge, this is the first population-based study to examine thoughts of own death and suicidal feelings among individuals who have reached extreme old age. There was a strong association between depression and suicidal feelings, however, three-quarters of those who acknowledged such feelings did not fulfill criteria major or minor depression. Social factors were strongly associated with suicidal feelings.

Our results showed that having difficulties initiating sleep was associated with suicidal feelings even after adjusting for depression. Another population-based study with a somewhat younger sample showed similar results [36]. It is important to stress that associations may be bidirectional. The wish to die may keep the individual awake, and problematic sleep may lead to a wish to die.

We found no association between health-related factors and suicidal feelings. This was somewhat unexpected as previous studies have shown an association between physical disability with both death wishes [36] and death by suicide [77] in "younger" older populations. However, individuals who reach their upper nineties represent a survival population. Interestingly, nearly 90 % of the participants reported that they had a good or very good health. It could be argued that persons who have poor health would decline participation; however, our attrition analysis regarding mortality suggests that this is not the case. Perceptions of health and quality of life may shift among the "oldest old" [163] which could be a possible explanation to why health factors are of less importance in explaining suicidal feelings in extreme high age.

Too little time spent with neighbours and friends and acquaintances was strongly associated with suicidal feelings, even after adjusting for depression. Surprisingly little is known regarding social factors and suicidal behavior in late life [104]. Number and frequency of contacts have been reported in only a couple of studies. In this study, the approach allowed participants to give a subjective view of their social relations. This is important as also persons who are not socially isolated may feel detached from the community [164].

7.3.3 Study III

To our knowledge, this is the first population-based study to examine age of onset of suicidal thoughts and attempts in women followed into late life. One quarter of the women acknowledged suicidal thoughts at some point in life and nearly one tenth had attempted suicide. The first onset of suicidal behavior occurred after the age of 40 in half of these women. Number of early life adversities influenced age at onset of suicidal thoughts.

The lifetime prevalence of suicidal thoughts among women in this study was 25 %, which is higher than previously reported. Cross-sectional studies have reported a lifetime prevalence of 4-15 % [165-167]. While this might in part reflect actual geographic/cultural differences, a number of methodological issues can be identified. Most of the literature is based on retrospectively collected data, and previous suicidal ideation may be forgotten or underreported after only a few years, as demonstrated in a recent Australian study [168]. Further, most previous studies use a single measure for the detection of suicidal thoughts; in the current study we employed several different approaches.

Regarding the relationship between number of early life adversities and suicidal thoughts, it is possible that women with suicidal behavior at or

before the baseline interview in midlife may have been more likely to retrospectively view their childhood as negative. The lack of association between most of the early life adversity and suicide attempt was unexpected considering that several others have found that childhood abuse is associated with suicidal attempts in early adulthood [169] up to the age of 54 [170]. A population-based study from the Netherlands showed a significant association between early life adversity and new onset of suicidal attempts in subjects aged 18-64 [171]. One explanation for the lack of association with suicide attempts might in part be attributed to low study power. Another partial explanation might be that childhood hardships were common in Sweden the first part of the twentieth century.

7.3.4 Study IV

In this clinical study of older adults who had attempted suicide, we found a strong association between low SOC and depression, but this could not explain observed associations with a number of social variables. These included too little time spent with children and grandchildren, and moving in the past five years.

The mean SOC score in this study was 129, which was lower than that reported in a study focusing on older psychophysically active German persons (mean age 67, mean SOC 151) [172]. It is also lower than that observed (mean SOC 144) for female survivors of myocardial infarction (mean age 72) [173]. In a population-based study from Sweden [174], the mean SOC score among 70-79 year olds was 142 and 149 in those aged 80 and above. Previously published studies have found that low SOC is associated with suicidal thoughts [175] and suicide attempts [176, 177], thus it is not unexpected that suicide attempters would have lower SOC in comparison with their peers. Problem solving ability is a related concept, and

older adults with depression who attempted suicide perform less well on problem solving tasks than non-suicidal individuals with depression (Gibbs *et al*., 2009).

Our results showed a very strong association between major depression and low SOC. A Swedish study of individuals aged 85 and above, which used the 13-item version of the SOC-scale, could not show such an association [178]. However, it should be noted these studies are not completely comparable, as that study included individuals who had been successfully treated for depression as well as those who received a depression diagnosis.

We could not show an association between low SOC and serious physical illness/disability. These results were somewhat unexpected as lower SOC scores have been observed among older individuals with chronic health conditions including heart failure, obstructive lung disease, and osteoarthritis [178]. The age range in our study spanned over more than two decades, and as risk factors for completed suicide may differ between younger older and oldest old [103], we chose to stratify by age group. The sample was divided into young old (70-79) and old (80-91), however, we could not show a difference between the two groups with regard to physical illness and SOC (results not shown). It should be noted that rates of serious physical illness/disability were high among individuals with and without low SOC, and therefore a larger sample would be necessary to demonstrate statistical significance. This applies to the test of associations among specific diagnostic entities, as well.

A number of social factors were related to low SOC and these associations remained after adjusting for major depression. Previous cross-sectional [179] and prospective studies [180] have shown a correlation between social

support and SOC. In this study, we could show a strong association between both too little time spent with children and with grandchildren. The amount of time that is spent with children and grandchildren impacts both social support and social inclusion. As social network changes in late, with the loss of close ones such as partners, relatives and friends, the role of offspring may be a prominent part of the older adults' network. For instance, they may be relied upon in different situations, making life easier to live. It is also possible that older adults experience spending time with the younger generations as uplifting. Several factors will interact to determine how an older individual will experience both the frequency and the quality of social contacts. For example, hostility in relationships may affect suicidal individuals' perception of their social support [181]. One qualitative study suggests that older men who commit suicide may be lacking in the ability to show emotions, and this impacts their capacity to have meaningful relationships [95].

Lastly, having moved in the past 5 years was also associated with low SOC. Moving might affect the individuals' level of social inclusion. Moving implies change in the external world that might disrupt individuals' sense of comprehensibility. Moving may be necessitated by a change in the internal world, related to loss of autonomy or death of a partner.

8 CONCLUSION

This thesis utilized both population-based and clinical data to provide new knowledge on suicidal behavior in late life. Both intermediate and high functional disability was associated with death wishes and this relationship remained also after depression was accounted for. However, individuals who reported feelings of loneliness had the highest odds of death wishes. Although depression was strongly associated with suicidal feelings among 97-year-olds, only one fourth fulfilled criteria for the diagnosis. Deficient social contacts were found to have the strongest association with suicidal feelings. By following the same women from mid- to late life, we were able to show that previous reports of the lifetime prevalence of suicidal thoughts and attempts are underestimated in population-based studies among older women. Also, early life adversity was associated with onset of suicidal behavior in both mid- and late life. A strong association between major depression and low SOC was found among individuals who had recently attempted suicide. Several social variables were also related to low SOC, and these associations remained after adjusting for depression.

The country of Sweden has adopted a "zero vision" for suicide and the WHO's goal is to reduce suicide rates by a tenth by 2020 [182]. Early detection and treatment of depression is imperative, and attention also needs to be paid to persons with functional disability, pain and sleep problems and those with limited social networks. Suicidal behavior is not part of normal aging and increased awareness among health care personnel and the general public is important. Involving family or other persons in treatment planning may also be positive as these individuals may be able to detect changes in the individual.

9 FUTURE PERSPECTIVES

Results presented in this thesis cannot be generalized to other cultural settings; studies with large sample sizes are needed. We found large cross-national differences in the prevalence of death wishes, and studies with consistent methodology across study sites are called for. Our study was the first to examine suicidal behavior in those who reach extreme old age; further studies focusing on individuals over in this age group is called for.

The lifetime prevalence of suicidal behavior in women seems to be underestimated; population-based studies with a longitudinal design are needed in order to examine suicidal behavior over time. Considering the fact that suicide rates are particularly high in older men, prospective studies on suicidal behavior in males are sorely needed. Studies examining specific risk factors for both sexes are sought after. The effect that gender has on suicidal behavior in late life needs to be further examined. Using qualitative design method could assist in elucidating social conceptions of what it means to be a man or a woman in late life. Qualitative studies can also provide us with knowledge about individuals' experiences with suicidal behavior, which cannot be gained through quantitative measures.

Coping strategies in older adults with suicidal behavior need to be further explored. For instance, prospective studies are needed in order to determine if SOC-strengthening interventions can reduce suicidal behavior in late life. Lastly, research is needed to determine whether interventions that aim at strengthening social connections can reduce suicidal behavior in this growing age group.

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APPENDIX A

Amsterdam, Berlin, Dublin, Reykjavik, Liverpool, Munich, Zaragoza: Do you feel lonely?

0=No
1=Feels lonely
2=Feels very lonely
8=Does not know/No answer
9=Not asked
Coding: 0=0 (no), 1-2=1 (yes) (all else missing)

London: Have you felt lonely in the past month?
0=No
1=Yes

Athäri: How often do you feel lonely?
1. Often
2. Sometimes
3. Never
Coding: 3=0 (no), 1-2=1 (yes)

Gothenburg: Do you feel lonely? If so, how often?
1. Never
2. Rarely
3. Sometimes
4. Often
Coding: 1=0 (no), 2, 3, 4=1 (yes)

APPENDIX B

Numbers in parentheses refer to Comprehensive Psychopathological Rating Scale [128] symptom severity required for the item to be included in the operational criteria.

Major Depressive Episode

Five or more of the following symptoms; at least one of the symptoms is either (1) or (2)

(1) Depressed mood, subjective (2-6) or observed (4-6)

(2) Anhedonia (2-6)

(3) Significant weight loss or weight gain or decrease or increase in appetite (2-6)

(4) Insomnia (3-6) or hypersomnia (4-6) nearly every day

(5) Psychomotor agitation (4-6) or retardation (4-6), observed decreased amount of speech (2-6)

(6) Fatigue or loss of energy (3-6) or loss of initiative (3-6) nearly every day

(7) Feelings of worthlessness or excessive or inappropriate guilt (3-6)

(8) Diminished ability to think or concentrate (4-6) or indecisiveness (3-6) (subjective) or inability to think or concentrate (4-6) or distractibility (4-6) (observed)

(9) Recurrent thoughts of death, recurrent suicidal ideation (2-6)