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Predictive Factors of Non-fatal Self-harm Among Community Dwelling Older Adults Assessed for Support Services

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Keywords:	Suicide, Depression, Physical illness
Abstract:	Background: Older adults receiving support services are a population at risk for self-harm due to physical illness and functional impairment, which are known risk factors. This study aims to investigate the relative importance of predictive factors of non-fatal self-harm among older adults assessed for support services in New Zealand. Methods: interRAI-Home Care (HC) national data of older adults (age≥60) were linked to mortality and hospital discharge data between 1/1/2012 and 31/12/2016. We calculated the crude incidence of self-harm per 100,000 person-years, and gender and age-adjusted standardised incidence ratios (SIRs). The Fine and Gray competing risk regression model was fitted to estimate the hazard ratio (HR; 95% CIs) of self-harm associated with various demographic, psychosocial, clinical factors and summary scales. Results: A total of 93,501 older adults were included. At the end of the follow-up period, 251 (0.27%) people had at least one episode of non-fatal self-harm and 36,333 (38.86%) people died. The overall incidence of non-fatal self-harm was 160.39 (95% CI, 141.36-181.06) per 100,000 person years and SIR was 5.12 (95% CI, 4.51-5.78), with the highest incidence in the first year of follow-up. Depression diagnosis (HR, 3.02, 2.26-4.03), at-risk alcohol use (2.38, 1.30-4.35) and bipolar disorder (2.18, 1.25-3.80) were the most significant risk factors. Protective effects were found with cancer (0.57, 0.36-0.89) and severe level of functional impairment measured by Activities of Daily Living Hierarchy Scale (0.56, 0.35-0.89). Conclusion: Psychiatric factors are the most significant predictors for non-fatal self-harm among older adults receiving support services. Our results can be used to inform healthcare professionals for timely identification of people at high-risk of self-harm and development of more efficient and targeted prevention strategies, with specific attention to individuals with depression or depressive symptoms, particularly in the first year of follow-up.

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Abstract

Background: Older adults receiving support services are a population at risk for self-harm due to physical illness and functional impairment, which are known risk factors. This study aims to investigate the relative importance of predictive factors of non-fatal self-harm among older adults assessed for support services in New Zealand.

Methods: interRAI-Home Care (HC) national data of older adults (age≥60) were linked to mortality and hospital discharge data between 1/1/2012 and 31/12/2016. We calculated the crude incidence of self-harm per 100,000 person-years, and gender and age-adjusted standardised incidence ratios (SIRs). The Fine and Gray competing risk regression model was fitted to estimate the hazard ratio (HR; 95% CIs) of self-harm associated with various demographic, psychosocial, clinical factors and summary scales.

Results: A total of 93,501 older adults were included. At the end of the follow-up period, 251 (0.27%) people had at least one episode of non-fatal self-harm and 36,333 (38.86%) people died. The overall incidence of non-fatal self-harm was 160.39 (95% CI, 141.36-181.06) per 100,000 person years and SIR was 5.12 (95% CI, 4.51-5.78), with the highest incidence in the first year of follow-up. Depression diagnosis (HR, 3.02, 2.26-4.03), at-risk alcohol use (2.38, 1.30-4.35) and bipolar disorder (2.18, 1.25-3.80) were the most significant risk factors. Protective effects were found with cancer (0.57, 0.36-0.89) and severe level of functional impairment measured by Activities of Daily Living Hierarchy Scale (0.56, 0.35-0.89).

Conclusion: Psychiatric factors are the most significant predictors for non-fatal self-harm among older adults receiving support services. Our results can be used to inform healthcare professionals for timely identification of people at high-risk of self-harm and development of more efficient and targeted prevention strategies, with specific attention to individuals with depression or depressive symptoms, particularly in the first year of follow-up.

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Introduction

Suicide is a global public health issue and among the top 20 leading causes of death worldwide (World Health Organization, 2019). Suicide rates are highest in people aged 70 years and above for both genders in almost all regions of the world (World Health Organization, 2014). In New Zealand suicide rates of older men aged 85 years and above between 2011 and 2019 were the second highest among all age groups (Barak et al., 2020). A past history of self-harm is one of the strongest risk factors for suicide in older adults (Hawton and Harriss, 2006; Murphy et al., 2012; Troya et al., 2019a). A previous New Zealand study found 2.1% of older adults who self-harm died by suicide within 12 months, a suicide rate that was over 200 times higher than the general older population (Cheung et al., 2017a). Self-harm in older adults is also associated with high suicide intent and closely related to suicide (Fässberg et al., 2019; Hawton and Harriss, 2008; Salib et al., 2001; Schmutte et al., 2019).

Older adults who self-harm have distinct characteristics to younger populations (Troya et al., 2019a). Local research suggested that when compared to middle-aged people, older adults who self-harm were more likely to report physical illness as a stressor, have a history of depression and be diagnosed with depression at the time of their attempt (Tan and Cheung, 2019). Other risk factors associated with self-harm in the older age group include alcohol use, social isolation, loneliness, interpersonal problems, low education, housing issues and financial problems (Barak et al., 2020; Cheung et al., 2017a; Troya et al., 2019). There are a number of reasons for older adults to self-harm including powerlessness in reaction to losses related to death of loved ones; physical ill-health; pain; immobility; disappointments; sense of alienation and disconnection from family and society and sense of meaningless (Troya et al., 2019b; Wand et al., 2018). However, the relative importance of various risk and protective factors has not been systematically established in the literature. In addition, a recent review criticised that population or community-based data of self-harm in older adults are lacking because previous

For Review Only

studies mostly recruited study participants from self-presentations to hospital settings (Troya et al., 2019a).

interRAI-Home Care (HC) is a comprehensive geriatric assessment developed by a network of health researchers in over 30 countries. It provides clinical information that can support care planning, resource allocation, quality measurement and outcome evaluation (Mathias et al., 2010). Since 2012, New Zealand has implemented a mandated interRAI-HC assessment for all older adults assessed for publicly funded home support services or long-term aged residential care. Older adults assessed by interRAI-HC typically have comorbid physical illnesses and functional impairment (Cheung et al., 2017b); and therefore have a higher background risk of suicidal behaviour than the general older population (Fässberg et al., 2016). The main objectives of this study were to (i) estimate the incidences of non-fatal self-harm in a cohort of older adults who had an interRAI assessment; and (ii) quantify a range of demographic, psychosocial, and clinical factors in predicting non-fatal self-harm in this cohort. Knowledge of self-harm in this at-risk group of older adults could potentially be used to inform selective (as opposed to universal and indicated) suicide prevention strategies. In this study, we used a national older adults community cohort to predict non-fatal self-harm and would provide some unique information to fill a gap in the literature.

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Method

Data Source and Study Population

This is a retrospective cohort study. We used data from 97,426 older adults (age ≥ 60) who had an interRAI-HC (version 9.1) assessment between Jan 1, 2012 and Dec 31, 2016. These participants were from all 20 District Health Boards in New Zealand. interRAI-HC data were routinely collected by trained interRAI assessors. Only the first interRAI assessment record of each person during the study period was used for analysis. The date of the first assessment was coded as the index assessment date.

The Ministry of Health National Minimum Dataset (NMDS) and Mortality Dataset contains public and private hospital discharge information and underlying causes of all registered deaths in New Zealand respectively. interRAI-HC assessment records were linked to these two administrative datasets between Jan 1, 2012 and Dec 31, 2016, using the National Hospital Index, a unique individual-level identifier, to ascertain self-harm discharge diagnosis and death information. Since we set out to identify predictive factors of self-harm, participants who did not have an interRAI assessment record available before a self-harm episode were excluded. We also focused our study scope on non-fatal self-harm and excluded individuals who had 'suicide' recorded as their cause of death (see Figure 1 for the selection procedure of the study cohort). Of the 24 individuals who died by suicide, and therefore excluded from this study, one person had a self-harm episode one day before their suicide and another person nineteen days before their suicide. The other 22 individuals had not self-harmed in the study period.

Measures

The outcome of this study is the first record of non-fatal self-harm during the study period. The self-harm presentation in NMDS was identified according to the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) diagnostic

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codes X60-X84 (self-harm) and Y10-Y34 (self-harm, undetermined intention). Since intention is often difficult to be captured clinically and self-harm are often misclassified as undetermined intention (Turp, 2002), we decided to include undetermined cases in this study. This definition is in keeping with previous studies (Chai et al., 2020; Geulayov et al., 2019).

The New Zealand version of interRAI-HC assessment covers more than 250 items measuring demographic profile, clinical characteristics, functional and psychosocial status, and service utilization. There are also several embedded summary scales, which are constructed by using validated algorithms on pre-determined interRAI items, and can be used to track changes in clinical status longitudinally. Many of these scales have been validated and showed high reliability (Hirdes et al., 2011).

According to previous studies of self-harm in older adults (Cheung et al., 2017a; Hawton and Harriss, 2006; Neufeld et al., 2015; Troya et al., 2019a), the following variables and scales in the baseline interRAI assessment were selected as predictors in this study.

Demographic variables: Age was recoded into a binary variable with values 0 (80+ years) and 1 (60-79 years). Female gender was treated as the reference group. Four dummy variables, i.e., Asian (1), Maori (2), Pacific island (3), and Middle Eastern/Latin American/African/Others (4), were created to categorize respondent's ethnicity, with European as the reference group (0). Marital status was classified as married/civil union/de facto (0; reference), never married (1), widowed (2), separated & divorced (3), and others (4).

Psychosocial variables. Loneliness, major life stressors in the last 90 days, and strong and supportive relationship with family were measured by binary variables with values 0 (no) and 1 (yes). Participation in social activities, conflict or anger with family or friends, being neglected, abused, or mistreated were measured by six categories and recoded into the

For Review Only

following categorical variables: no (0; never; reference), yes (1; more than 30 days ago, 8-30 days ago, 4-7 days ago, and in the last 3 days), and missing value (2; unable to determine).

Clinical variables. Self-rated health was classified as excellent and good (0; reference), fair (1), poor (2) and could not (would not) respond (3). They were recoded into dummy variables in the analyses. Daily tobacco consumption was recoded into a binary variable: did not smoke tobacco daily were coded as 0 (no), did not smoke in the last 3 days, but is usually a daily smoker and smokes tobacco daily were coded as 1 (yes). At-risk alcohol use was evaluated by the highest number of drinks in any "single sitting" in the last 14 days. It is treated as a binary variable. None, 1, and 2-4 drinks were combined and recoded as no (0), while 5 or more drinks was coded as yes (1). Binary variables were also created for the diagnosis of depression, bipolar disorder, anxiety disorder, schizophrenia, cancer, and stroke: did not present was coded as no (0) and primary diagnosis/diagnoses for current stay, diagnosis present (receiving active treatment) and diagnosis present (monitored but no active treatment) were coded as yes (1).

Summary Scales. Activities of Daily Living (ADL) Hierarchy Scale is used to evaluate the loss of people's ADL ability, with scores ranging from 0 (independent) to 6 (totally dependent).(Morris et al., 1999) ADL Hierarchy Scale was categorized into three levels: independent (0; reference), mild-moderate (1-2), and total dependent (3+). Scores of Depression Rating Scale (DRS) range from 0 to 14, with a higher score representing a higher likelihood of depression (Burrows et al., 2000). A categorical variable was created for DRS: no-minimal (0-2) as the reference group, moderate (3-5) and severe (6+). Note that the binary variable depression is an indicator of the presence of depression diagnosis, while the DRS measures the severity of depressive symptoms. Our preliminary analysis showed that only 27.10 % (n=3701) of older adults with a DRS score of 3 or above (moderate to severe) had a depression diagnosis, and the correlation coefficient between depression diagnosis and DRS score was relatively low (0.18; $p < 0.0001$). Therefore, we decided to include both of these

For Review Only

variables in the analysis. Cognitive function is evaluated by the Cognitive Performance Scale (CPS), with scores ranging from 0 (intact) to 6 (very severe impairment) (Morris et al., 1994). CPS was recoded as a categorical variable: intact (0; reference), mild-moderate impairment (1-2), and very severe impairment (3+). Changes in Health, End-stage disease, Signs, and Symptoms (CHESS) Scale measures the health stability and medical complexity. Scores of CHESS Scale range from 0 (stable) to 5 (highly unstable) (Hirdes et al., 2003). A three-level categorical variable was created for CHESS Scale with stable (0-1; reference), unstable (2-3), and highly unstable (4-5). The Pain Scale examines the frequency and intensity of pain, with scores ranging from 0 (none) to 4 (excruciating) (Fries et al., 2001). Pain Scale was recoded as a categorical variable: none (0; reference), less than severe (1-2), and severe-excruciating (3-4).

Statistical Analysis

All study participants were followed up from the index assessment date, until the self-harm diagnosis, death, or the end of the study (Dec 31, 2016), whichever came first. Descriptive statistics of the baseline characteristics for the total sample, as well as people with and without self-harm diagnosis, were tabulated. Demographic, clinical, and psychosocial factors of people with and without self-harm diagnosis were compared using Person's χ^2 test for categorical variables. Fisher's exact test was used for predictors with low cell counts.

The crude incidence of non-fatal self-harm per 100,000 person-years during the total follow-up period and each single follow-up year (the 4th and 5th year were combined due to the small number of events) were calculated using the Poisson distribution with exact 95% confidence intervals (CIs). In addition, the number of self-harm cases observed in the interRAI-HC cohort was divided by the number of expected self-harm cases to estimate the standardised incidence ratios (SIRs). The SIRs measure the increased or decreased self-harm rate in the study cohort

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compared to the rate in the general population. The population-based, gender and age-adjusted expected self-harm cases were calculated according to most recent publicly available data on self-harm hospitalisations between 2009 and 2013 in New Zealand (Ministry of Health, 2020). The 95% CIs of SIRs were estimated using the Vandenbroucke method (Vandenbroucke, 1982). The same analyses were further performed for subgroups stratified by age (60-79 years; 80+ years) and gender (Female; Male).

Given that death is a competing risk of self-harm, the Fine and Gray competing risk regression model was fitted to estimate the hazard ratios (HRs) and 95% CI of self-harm associated with various predictors (Fine and Gray, 1999). Statistical significance was set as 5% (two-sided $p < 0.05$). All selected variables were separately fitted in the bivariate regression model to investigate the significance of the relationship between potential variables and self-harm. Significant variables were included in the subsequent multivariate regression model. If the missing value of one variable accounts for less than 5% of the total sample, all assessment records that include this missing value variable were excluded. Otherwise, the missing value was coded as one independent category. The Fine and Gray competing risk regression model was estimated using the cmprsk package of the statistical software R (version 3.5.2) (Gray, 2020; R Core Team, 2019). The SIRs were plotted using the ggplot2 package (Wickham, 2016). The remaining analyses were conducted using the dplyr package (Wickham et al., 2020).

For Review Only

Results

A total of 93,501 participants were included in this study (Figure 1). During the study period, 251 (0.27%) people had a non-fatal self-harm diagnosis and 36,333 (38.86%) people died. Baseline characteristics of the study cohort were summarized in Table 1. The mean age was 82.28 years (SD, 8.08 years) and 62,151 (66.47%) people in the cohort were aged 80 years or older at baseline. The majority of the cohort were female (60.52%), European (87.72%), and widowed (47.43%). Compared with the group without self-harm, the self-harm group was younger with a mean age of 77.45 years (SD, 8.87 years).

The crude incidence of non-fatal self-harm for the total sample during the study period was 160.39 (95% CI, 141.36-181.06) per 100,000 person-years. The SIR of self-harm was 5.12 (4.51-5.78). Table 2 summarizes the gender and age specific incidences and SIRs. The incidence was substantially higher for people age 60-79 years (263.88, 223.09-309.35) than people aged 80 years or older (104.98, 86.33-126.15).

The non-fatal self-harm risk in the study cohort was significantly higher than in the general population, irrespective of gender and age at baseline, with SIRs ranging from 3.42 (2.81-4.10) for people aged 80 years to 8.12 (6.85-9.50) for people aged 60-79 years. Concerning the incidence per follow-up year, all groups demonstrated the highest incidence rate in the first follow-up year (Total: incidence, 196.17, 95% CI, 165.85-229.98; 60-79 years: 342.76, 275.96-420.87; 80+ years: 121.38, 92.99-155.04; Female: 185.82, 149.06-228.17) except for the male group (Figure 2).

Table 3 shows the results from bivariate and multivariate competing risk regression models. Based on the crude hazard ratios in the bivariate model, substantially higher risks of self-harm were observed in people who were younger and separated or divorced. Regarding the psychosocial factors, people who felt lonely, had conflict or anger with family or friends, and were neglected, abused or mistreated had a higher risk of self-harm. From the perspective of

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clinical factors and scales, fair and poor self-rated health, daily tobacco consumption, at-risk alcohol use, the diagnosis of depression, bipolar disorder, anxiety disorder, and schizophrenia, moderate and severe depressive symptoms measured by DRS, and severe to excruciating pain measured by Pain Scale were significantly associated with an elevated risk of self-harm. The significant protective effect can be observed in Pacific Island ethnicity, strong supportive family relationships, diagnosis of cancer, total dependent of ADL measured by ADL Hierarchy Scale, very severe impairment of cognitive performance measured by CPS, as well as highly unstable health status measured by CHESS Scale.

Results from the multivariate model shows that the highest risk of non-fatal self-harm was observed in depression (HR, 3.02, 95% CI, 2.26-4.03), followed by at-risk alcohol use (2.38, 1.30-4.35) and bipolar disorder 2.18 (1.25-3.80). Younger age, separated & divorced marital status, fair and poor self-rated health, daily tobacco consumption, and moderate and severe depressive symptoms measured by DRS were all significant risk factors for self-harm. Conversely, cancer (0.57, 0.36-0.89) and total dependent of ADL measured by ADL Hierarchy Scale (0.56, 0.35-0.89) were significantly associated with decreased self-harm risk.

For Review Only

Discussion

This study included a national sample of community-dwelling older adults who were assessed for support services in a 5-year period in New Zealand. We found an overall non-fatal self-harm incidence of 160.39 per 100,000 patient-years and a SIR of 5.12. Older adults assessed with interRAI-HC typically have pre-existing physical illnesses and/or functional impairment. Our finding of an increased SIR is therefore aligned with previous studies that physical illnesses and functional impairment are associated with an elevated risk of suicidal behaviour in older adults (Fässberg et al., 2016). We also observed the highest incidence of self-harm is in the first year of follow-up, a finding similar to previous observations that half of the suicide among nursing home residents occurred within the first 12 months of their admission to nursing home (Murphy et al. 2015; Murphy et al. 2018).

Older adults in the younger age (60-79 years) group had a higher risk for non-fatal self-harm and a substantially higher SIR (8.12) than the older age (80+ years) group. We found depression, bipolar disorder and at-risk alcohol use had the largest hazard ratios amongst all risk factors and will therefore discuss them further.

Depression is a well-recognised risk factor for late-life suicidal behaviour (Cheung et al., 2017a; Hawton and Harriss, 2006; Lapierre et al., 2011; Murphy et al., 2012; Salib et al., 2001; Schmutte et al., 2019; Troya et al., 2019a; Tsoh et al., 2005). In this study, the depression diagnosis (HR=3.02) included people with a depression diagnosis for their current stay, receiving active treatment, or monitored but no active treatment. However, the HRs for significant depressive symptoms measured by DRS were lower (moderate depression: HR=1.89; severe depression: HR=1.81). It is possible that our heterogeneous grouping of depression diagnoses has over-estimated it as a risk factor. Many of the evidence based late-life suicide prevention programs target on better screening and treatment of depression. For example, a systematic review of interventions for preventing suicidal behaviours in older adults

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identified four main areas: (1) Primary care-based depression screening and management programs; (2) Pharmacological and psychological treatment interventions; (3) Telephone counselling for vulnerable older adults; and (4) community-based multilevel programs incorporating education, gatekeeper training, depression screening, group activities, and referral for treatment (Okolie et al., 2017). More recently, an educational intervention found significantly improved clinicians' knowledge, confidence and attitudes regarding self-harm in later life. This educational intervention included a combination of didactic/theoretical information, including individualizing care-plans and psychosocial responses (Wand et al., 2020).

Bipolar disorder has one of the highest suicide rates among all psychiatric disorders. It has been estimated that suicide rates in bipolar disorder are 10 to 30-fold greater than in the general population (Plans et al., 2019; Schaffer, Isometsä, Tondo et al., 2015). Men with bipolar disorder have higher suicide rates than women with a ratio of 1.7:1 (Schaffer, Isometsä, Tondo et al., 2015). More significantly, about a quarter to a third of people with bipolar disorder attempt suicide in their lifetime (Schaffer, Isometsä, Tondo et al., 2015; Tondo et al., 2016). The relationship between age and risk of suicide in bipolar disorder is mixed (Schaffer, Isometsä, Azorin et al., 2015) but there is evidence that bipolar disorder suicide attempters are significantly younger than non-attempters (Schaffer, Isometsä, Azorin et al., 2015). The risk factors for suicide in bipolar disorder include living alone, divorced, previous suicide attempt, substance abuse or dependence, anxiety disorder, cluster B personality, early onset of illness, more major depressive episodes and more frequent hospitalisations (Plans et al., 2019). A recent study suggested an association between bipolar disorder and suicide in older adults (Yeh et al., 2020), although a previous study reported that only 10.5% of people with bipolar disorder died by suicide were older than 65 years (Clements et al., 2013).

For Review Only

It has been suggested that bipolar disorder is often under-recognised and under-treated in older adults, and the use of clinical guidelines and protocols could be useful for this age group (Rise et al., 2016). Lithium, a first generation mood stabiliser, has been consistently shown to be effective in preventing suicide attempts and deaths (Schaffer, Isometsä, Tondo et al., 2015; Tondo et al., 2016). Electroconvulsive therapy could be effective in treating acute suicidality, while psychological therapy such as cognitive behaviour therapy can be used in combination with pharmacological treatment of suicidal patients (Plans et al., 2019). Suicide prevention strategies in bipolar disorder can also include psychoeducation, to the patients and their family and friends, monitoring of early warning signs, adherence to treatment, avoiding social isolation and seeking help in emergency (Dome et al., 2019).

interRAI-HC routinely screens for alcohol use by recording the highest number of drinks in any 'single sitting' in the last 14 days: none, 1, 2-4, 5 or more. For low-risk alcohol drinking in adults, the New Zealand Health Promotion Agency recommends two standard drinks a day for women and no more than 10 standard drinks a week, three standard drinks a day for men and no more than 15 standard drinks a week, and at least two alcohol-free days every week (1 standard drink=10 grams of pure alcohol) (Health Promotion Agency, 2018). There is no separate recommendation for older adults but their vulnerability factors of increasing sensitivity to alcohol, existing physical problems and functional disabilities, and interaction with medications are highlighted. The Health Promotion Agency also advises on reducing the risk of injury by drinking no more than four standard drinks for women and five standard drinks for men on any single occasion. Based on this advice and the lack of a separate recommendation for older adults, we decided not to classify the interRAI rating of 2-4 drinks in any single setting as 'at-risk alcohol use'. We found five or more drinks in any single setting ('at-risk alcohol use') was a risk factor for non-fatal self-harm. However, not including the category of 2-4 drinks in any single setting could have under-estimated alcohol use as a risk factor for self-

For Review Only

harm in this study. The main issue is that interRAI-HC does not capture enough information to determine whether a person has high-risk drinking or an alcohol use disorder. A previous New Zealand study has already established that a lifetime history of substance misuse disorder was significantly elevated in suicide and near fatal suicide attempts in people aged 55+ years (Beautrais, 2002). Another New Zealand study found a positive blood alcohol reading at the time of self-harm are at high risk of repeat self-harm/suicide in older adults within 12 months (Cheung et al., 2017a). Given the literature on alcohol and substance use in self-harm, additional screening and assessment for alcohol and substance use should be encouraged as part of an effort to prevent self-harm and suicide in the interRAI-HC populations.

Our findings that cancer and severe ADLs impairment were significant protective factors for non-fatal self-harm in this interRAI sample were unexpected. There is an existing body of literature to support an association between cancer, physical disability and suicidal behaviour in older adults (Fässberg et al., 2016; Henson et al., 2019; Yeh et al., 2020). A recent study found the risk of suicide in older adults with cancer was significantly higher (AdjOR = 8.5) than the control group (Yeh et al., 2020). Another study found that a 20% increased suicide risk existed in adult patients with cancer compared to the general population (Henson et al., 2019). Our finding that cancer was a protective factor is at odds with an Australian study where they found malignancy was associated with self-harm hospitalisation in older adults (Mitchell et al., 2017). However, they used a different methodology including defining older people as 50 years or older and participants were recruited into the study at the time of their admission to a hospital for self-harm. Our study defined older people as 60 years or older and our participants were identified when they had an interRAI-HC assessment and we followed them up until an episode of non-fatal self-harm, death or end of the study period. Results of other studies investigating the association between cancer/malignancy and suicide attempt were

For Review Only

mixed, but none have reported it as a protective factor (Allebeck and Bolund, 1991; Henson et al., 2019; Takahashi et al., 1995; Tsoh et al., 2005).

At the completion of an interRAI assessment, Clinical Assessment Protocols (CAPs) are generated for each patient and they are used to identify specific clinical conditions or situations and inform care plans to address factors that are amenable to clinical intervention. It is possible that the care and support needs of older adults with cancer and severe functional impairment were better met following their interRAI assessment, which acted as an intervention to improve their quality of life and well-being and to reduce their self-harm risk. Interestingly, a previous Canadian interRAI-HC study also found impaired ADLs was associated with a lower risk of self-harm (Neufeld et al., 2015). To the best of our knowledge, our study is the first study that used an interRAI-HC sample to examine the association between cancer and self-harm. Before we draw on any conclusion, our unexpected findings need to be replicated in other countries where interRAI-HC is routinely used.

In this study, CPS was used to measure the severity of cognitive impairment. We found very severe cognitive impairment (CPS 3+) is a significant protective factor in the bivariate model (HR=0.53). However, its protective effect disappeared in the multivariate model, which included all significant demographic, psychosocial and clinical variables. Our negative finding is consistent with the results of a previous systematic review that there is no increase in the overall suicide risk in people with dementia (Draper, 2015).

This interRAI-HC sample included older adults with physical illnesses and functional impairment who had a higher incidence of self-harm than the general older population. Therefore, interRAI-HC populations could be considered as a high-risk group where selective suicide prevention is needed, in contrast to universal and indicated suicide prevention. Selective suicide prevention typically aims at high-risk groups that generally do not present

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with advance signs of suicidal thoughts or behaviour, but are subjected to important factors such as losses, physical illness and life transitions that can make them vulnerable to depression and suicide (Lapierre et al., 2011). This type of suicide prevention is aimed at reducing risk predictors or improving resilience (Lapierre et al., 2011). interRAI-HC has existing CAPs for identifying various clinical issues such as mood, tobacco and alcohol use. However, there is no CAP for self-harm. Work is currently underway to develop a new clinical algorithm to identify people who are at-risk of self-harm by using the interRAI-HC data in Canada, Hong Kong and New Zealand. Clinicians can then be alerted when an older person presents with self-harm risks and to formulate a person-centred care plan to address potentially reversible risk factors, including those identified in this study.

Strength and limitations

To the best of our knowledge, this study is the first to use a national interRAI-HC sample and explore non-fatal self-harm predictors in older age over a 5-year period. Further strengths to this study include a large sample size of community-dwelling older adults, use of an internationally recognized standardized instrument, and data linkage to national mortality datasets. We used the first interRAI assessment to identify self-harm risk factors in this retrospective cohort. This can provide information on at-risk individuals and an opportunity for early intervention as soon as they are assessed for support services. We need to acknowledge a number of limitations of this study. Firstly, self-harm methods and lethality were not included in the linked data. Previous local studies have already established self-harm methods in older adults are mainly medication overdose (over 60%), laceration and multiple means (Cheung et al., 2017a; Tan and Cheung, 2019). Although self-harm in older adults resembles suicide (Fässberg et al., 2019; Hawton and Harriss, 2008; Salib et al., 2001; Schmutte et al., 2019), recent qualitative studies suggested they occur along a spectrum of no-suicidal intent to high-levels of intent (Troya et al., 2019b; Wand et al., 2018). It has been

For Review Only

estimated that 73.5% of the subjects included in a late-life self-harm review reported suicidal intention (Troya et al., 2019a). Secondly, the linked self-harm hospitalisation data did not include people who self-harmed but did not present to the hospital. We could have missed some of less lethal self-harm cases that did not require medical attention. Thirdly, a past history of self-harm is a known risk factor for repeated self-harm. However, the interRAI assessment does not record this information and we were not able to include this risk factor in our analysis. Fourthly, although interRAI-HC is a comprehensive geriatric assessment used across 30 countries, some of its scales have been criticised for their poor diagnostic accuracy. For example, Penny et al. (2016) concluded that DRS had poor diagnostic accuracy for depression diagnosis and poor to moderate with the Health of the Nation Outcome Scale 65+ depression item score. The authors also commented that the majority of previous studies investigating the performance of DRS have been in long-term care facilities and the existing literature raise concerns about DRS in measuring depression (Penny et al., 2016). Similarly, although it has been suggested that CPS has moderate to strong correlations with the mini-mental state examination, studies were conducted in long term care and hospital settings (Martinez-Ruiz et al. 2020), rather than with community dwelling older adults. CPS also overestimated the severity of cognitive impairment in dependent patients with comorbidities and depressive symptoms, and underestimated in older patients (Bula and Wietlisbach, 2009).

Conclusion

We found elevated non-fatal self-harm incidence rates in this interRAI sample, particularly in the first year of follow-up. These findings suggest this community-dwelling sample of older adults had a higher than expected incidence of self-harm and therefore are at a higher risk of self-harm than the general older population. Psychiatric factors continue to be the most significant predictors for self-harm in older adults, with depression and bipolar diagnoses, as well as at-risk alcohol use being the highest. Wider sociodemographic factors such as younger

For Review Only

age, being separated or divorced, fair and poor self-rated health, daily tobacco consumption were also found to be risk factors for self-harm in older adults in receipt of support services. The present findings highlight the need of timely identification of people at high-risk of self-harm and development of more efficient and targeted prevention strategies, with specific attention to older individuals with depression or depressive symptoms, particularly in the first year of follow-up. Future research with other interRAI-HC populations is needed to clarify the identified protective factors of self-harm, such as cancer and severe functional impairment, in predicting self-harm.

For Review Only

Conflict of interest declaration:

None

Description of authors' roles:

GC, YC, HL designed the study and wrote the paper. YC and HL linked the data and carried out the statistical analysis. MIT reviewed the paper and assisted with writing the discussion.

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Legend:

Table 1. Characteristics of the baseline assessment of the study cohort

Table 2. Incidence of self-harm per 100000 person-years and SIRs in the study cohort

Table 3. Results from the Fine and Gray competing risk regression models

Figure 1. Flowchart of study cohort selection

Figure 2. Incidence of self-harm per 100,000 person-years per follow-up year in (A) total population, (B) 60-79 years, both genders, (C) 80+ years, both genders, (D) female, all age groups, and (E) male, all age groups

Table 1. Characteristics of the baseline assessment of the study cohort

Characteristics	Total, N=93501 n, (%)	Self-harm		p value
		Present, N=251 n, (%)	Absent, N=93250 n, (%)	
Age				
80+ years	62151 (66.47)	107 (42.63)	62044 (66.54)	<0.0001[a]
60-79 years	31350 (33.53)	144 (57.37)	31206 (33.46)	
Mean (SD)	82.28 (8.08)	77.45 (8.87)	82.29 (8.07)	
Gender				
Female	56589 (60.52)	139 (55.38)	56450 (60.54)	0.11[a]
Male	36912 (39.48)	112 (44.62)	36800 (39.46)	
Ethnicity				
European	82015 (87.72)	224 (89.25)	81791 (87.71)	0.034[b]
Asian	2231 (2.39)	5 (1.99)	2226 (2.39)	
Maori	5475 (5.86)	17 (6.77)	5458 (5.85)	
Pacific Island	2924 (3.13)	1 (0.40)	2923 (3.13）	
Middle Eastern/Latin American/ African/Others	856 (0.92)	4 (1.59)	852 (0.92)	
Marital status				
Married/Civil Union/De facto	36356 (38.88)	92 (36.65)	36264 (38.89)	0.0005[b]
Never Married	4582 (4.91)	13 (5.18)	4569 (4.90)	
Widowed	44351 (47.43)	95 (37.85)	44256 (47.46)	
Separated & Divorced	7311 (7.82)	47 (18.73)	7264 (7.79)	
Others	901 (0.96)	4 (1.59)	897 (0.96)	
Loneliness				
No	74180 (79.34)	178 (70.92)	74002 (79.36)	0.0013[a]
Yes	19321 (20.66)	73 (29.08)	19248 (20.64)	
Major life stressors				
No	50212 (53.70)	131 (52.19)	50081 (53.71)	0.68[a]
Yes	43289 (46.30)	120 (47.81)	43169 (46.29)	
Strong supportive family relationships				
No	9722 (10.40)	47 (18.73)	9675 (10.38)	<0.0001[a]
Yes	83779 (89.60)	204 (81.27)	83575 (89.62)	
Participation in social activities				
No	12063 (12.90)	29 (11.55)	12034 (12.91)	0.34[a]
Yes	74283 (79.45)	208 (82.87)	74075 (79.44)	
Unable to determine	7155 (7.65)	14 (5.58)	7141 (7.65)	
Conflict or anger with family or friends				
No	79937 (85.49)	187 (74.50)	79750 (85.52)	<0.0001[a]
Yes	9626 (10.30)	44 (17.53)	9582 (10.28)	

For Review Only

Unable to determine	3938 (4.21)	20 (7.97)	3918 (4.20)	
Neglected, abused, or mistreated				
No	92110 (98.51)	242 (96.41)	91868 (98.52)	0.014[b]
Yes	1391 (1.49)	9 (3.59)	1382 (1.48)	
Self-rated health				
Excellent & Good	39728 (42.49)	81 (32.27)	39647 (42.52)	<0.0001[a]
Fair	32661 (34.93)	109 (43.43)	32552 (34.91)	
Poor	11651 (12.46)	49 (19.52)	11602 (12.44)	
Could not (would not) respond	9461 (10.12)	12 (4.78)	9449 (10.13)	
Daily tobacco consumption				
No	88197 (94.33)	215 (85.66)	87982 (94.35)	<0.0001[a]
Yes	5304 (5.67)	36 (14.34)	5268 (5.65)	
At-risk alcohol use				
No	92345 (98.76)	239 (95.22)	92106 (98.77)	<0.0001[b]
Yes	1156 (1.24)	12 (4.78)	1144 (1.23)	
Depression				
No	81879 (87.57)	146 (58.17)	81733 (87.65)	<0.0001[a]
Yes	11622 (12.43)	105 (41.83)	11517 (12.35)	
Bipolar				
No	92403 (98.83)	237 (94.42)	92166 (98.84)	<0.0001[b]
Yes	1098 (1.17)	14 (5.58)	1084 (1.16)	
Anxiety				
No	84217 (90.07)	185 (73.71)	84032 (90.11)	<0.0001[a]
Yes	9284 (9.93)	66 (26.29)	9218 (9.89)	
Schizophrenia				
No	92768 (99.22)	244 (97.21)	92524 (99.22)	0.0039[b]
Yes	733 (0.78)	7 (2.79)	726 (0.78)	
Cancer				
No	78751 (84.22)	229 (91.24)	78522 (84.21)	0.003[a]
Yes	14750 (15.78)	22 (8.76)	14728 (15.79)	
Stroke				
No	77357 (82.73)	200 (79.68)	77157 (82.74)	0.23[a]
Yes	16144 (17.27)	51 (20.32)	16093 (17.26)	
ADL Hierarchy Scale				
0 (independent)	52076 (55.70)	164 (65.34)	51912 (55.67)	0.00039[a]
1-2 (mild-moderate dependent)	23814 (25.46)	63 (25.10)	23751 (25.47)	
3+ (total dependent)	17611 (18.84)	24 (9.56)	17587 (18.86)	
DRS				
0-2 (no-minimal)	79846 (85.40)	168 (66.93)	79678 (85.45)	<0.0001[a]
3-5 (moderate)	10460 (11.18)	60 (23.90)	10400 (11.15)	
6+ (severe)	3195 (3.42)	23 (9.17)	3172 (3.40)	

For Review Only

CPS				
0 (intact)	31152 (33.32)	92 (36.65)	31060 (33.31)	0.013[a]
1-2 (mild-moderate impairment)	46545 (49.78)	134 (53.39)	46411 (49.77)	
3+ (very severe impairment)	15804 (16.90)	25 (9.96)	15779 (16.92)	
CHESS Scale				
0-1 (stable)	41489 (44.37)	114 (45.42)	41375 (44.37)	0.022[a]
2-3 (unstable)	43234 (46.24)	126 (50.20)	43108 (46.23)	
4-5 (highly unstable)	8778 (9.39)	11 (4.38)	8767 (9.40)	
Pain Scale				
0 (none)	37815 (40.44)	84 (33.47)	37731 (40.46)	0.025[a]
1-2 (less than severe)	43561 (46.59)	123 (49.00)	43438 (46.58)	
3-4 (severe-excruciating)	12125 (12.97)	44 (17.53)	12081 (12.96)	

ADL: Activities of Daily Living

DRS: Depression Rating Scale

CPS: Cognitive Performance Scale

CHESS: Changes in Health, End-stage disease, Signs, and Symptom

[a] Person's χ^2 test

[b] Fisher's exact test

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Table 2. Incidence of self-harm per 100000 person-years and SIRs in the study cohort

	Overall incidence per 100000 patient-years (95% CI)	Observed/Expected	SIR (95% CI)
Total	160.39 (141.36-181.06)	251/48.98	5.12 (4.51-5.78)
Age			
60-79 years	263.88 (223.09-309.35)	144/17.73	8.12 (6.85-9.50)
80+ years	104.98 (86.33-126.15)	107/31.25	3.42 (2.81-4.10)
Gender			
Female	138.63 (116.85-162.97)	139/28.24	4.92 (4.14-5.77)
Male	199.18 (164.53-238.38)	112/20.74	5.40 (4.45-6.45)

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Table 3. Results from the Fine and Gray competing risk regression models

	Bivariate model		Multivariate model	
Characteristic	**HR (95% CI)**	**p value**	**HR (95% CI)**	**p value**
Age				
80+ years	Ref		Ref	
60-79 years	2.72 (2.12-3.50)	<0.0001	1.80 (1.36-2.39)	<0.0001
Gender				
Female	Ref			
Male	1.26 (0.98-1.61)	0.073		
Ethnicity				
European	Ref		Ref	
Asian	0.86 (0.35-2.08)	0.73	0.98 (0.41-2.37)	0.97
Maori	1.18 (0.72-1.93)	0.52	1.01 (0.61-1.67)	0.96
Pacific Island	0.12 (0.02-0.88)	0.04	0.15 (0.02-1.07)	0.058
Middle Eastern/Latin American/ African/Others	1.76 (0.66-4.74)	0.26	1.38 (0.51-3.70)	0.53
Marital status				
Married/Civil Union/De facto	Ref		Ref	
Never Married	1.13 (0.63-2.02)	0.68	0.94 (0.52-1.70)	0.83
Widowed	0.83 (0.62-1.10)	0.2	0.96 (0.71-1.30)	0.80
Separated & Divorced	2.57 (1.81-3.65)	<0.0001	1.47 (1.01-2.13)	0.043
Others	1.85 (0.68-5.03)	0.23	1.36 (0.49-3.78)	0.55
Loneliness				
No	Ref		Ref	
Yes	1.58 (1.20-2.07)	0.001	0.96 (0.71-1.28)	0.76
Major life stressors				
No	Ref			

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Yes	1.12 (0.88-1.44)	0.35		
Strong supportive family relationships				
No	Ref		Ref	
Yes	0.51 (0.37-0.7)	<0.0001	0.89 (0.63-1.27)	0.52
Participation in social activities				
No	Ref			
Yes	1.17 (0.79-1.72)	0.43		
Unable to determine	0.81 (0.43-1.54)	0.52		
Conflict or anger with family or friends				
No	Ref		Ref	
Yes	1.95 (1.40-2.70)	<0.0001	1.11 (0.78-1.58)	0.57
Unable to determine	2.23 (1.41-3.54)	0.00066	1.46 (0.92-2.33)	0.11
Neglected, abused, or mistreated				
No	Ref		Ref	
Yes	2.50 (1.29-4.86)	0.0069	1.06 (0.52-2.16)	0.88
Self-rated health				
Excellent & Good	Ref		Ref	
Fair	1.62 (1.22-2.16)	0.001	1.40 (1.04-1.90)	0.028
Poor	2.05 (1.44-2.93)	<0.0001	1.48 (1.00-2.10)	0.05
Could not (would not) respond	0.61 (0.33-1.12)	0.11	0.82 (0.42-1.60)	0.55
Daily tobacco consumption				
No	Ref		Ref	
Yes	2.84 (1.99-4.04)	<0.0001	1.49 (1.04-2.14)	0.03
At-risk alcohol use				
No	Ref		Ref	
Yes	4.00 (2.24-7.15)	<0.0001	2.38 (1.30-4.35)	0.0049
Depression				

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No	Ref		Ref	
Yes	5.03 (3.91-6.46)	<0.0001	3.02 (2.26-4.03)	<0.0001
Bipolar disorder				
No	Ref		Ref	
Yes	4.98 (2.91-8.53)	<0.0001	2.18 (1.25-3.80)	0.0058
Anxiety disorder				
No	Ref		Ref	
Yes	3.17 (2.39-4.2)	<0.0001	1.31 (0.95-1.80)	0.094
Schizophrenia				
No	Ref		Ref	
Yes	3.68 (1.74-7.8)	0.00067	1.99 (0.94-4.18)	0.072
Cancer				
No	Ref		Ref	
Yes	0.53 (0.34-0.81)	0.0039	0.57 (0.36-0.89)	0.013
Stroke				
No	Ref			
Yes	1.20 (0.88-1.63)	0.24		
ADL Hierarchy Scale				
0 (independent)	Ref		Ref	
1-2 (mild-moderate dependent)	0.82 (0.61-1.09)	0.17	0.93 (0.68-1.26)	0.63
3+ (total dependent)	0.42 (0.27-0.64)	<0.0001	0.56 (0.35-0.89)	0.015
DRS				
0-2 (no-minimal)	Ref		Ref	
3-5 (moderate)	2.75 (2.05-3.69)	<0.0001	1.89 (1.36-2.61)	0.00012
6+ (severe)	3.41 (2.21-5.27)	<0.0001	1.81 (1.13-2.90)	0.014
CPS				
0 (intact)	Ref		Ref	

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1-2 (mild-moderate impairment)	1.00 (0.77-1.31)	0.98	0.94 (0.71-1.25)	0.69
3+ (very severe impairment)	0.53 (0.34-0.83)	0.0052	0.68 (0.41-1.13)	0.13
CHESS Scale				
0-1 (stable)	Ref		Ref	
2-3 (unstable)	1.08 (0.84-1.39)	0.55	1.06 (0.81-1.39)	0.68
4-5 (highly unstable)	0.47 (0.25-0.87)	0.016	0.54 (0.29-1.01)	0.054
Pain Scale				
0 (none)	Ref		Ref	
1-2 (less than severe)	1.29 (0.98-1.70)	0.075	1.13 (0.85-1.51)	0.39
3-4 (severe-excruciating)	1.66 (1.15-2.39)	0.0064	1.14 (0.77-1.68)	0.52

Multivariate model 1 includes significant demographic factors in bivariate model.

Multivariate model 2 includes significant demographic and psychosocial factors in bivariate model.

Multivariate model 3 includes significant all factors in bivariate model.

ADL: Activities of Daily Living

DRS: Depression Rating Scale

CPS: Cognitive Performance Scale

CHESS: Changes in Health, End-stage disease, Signs, and Symptom

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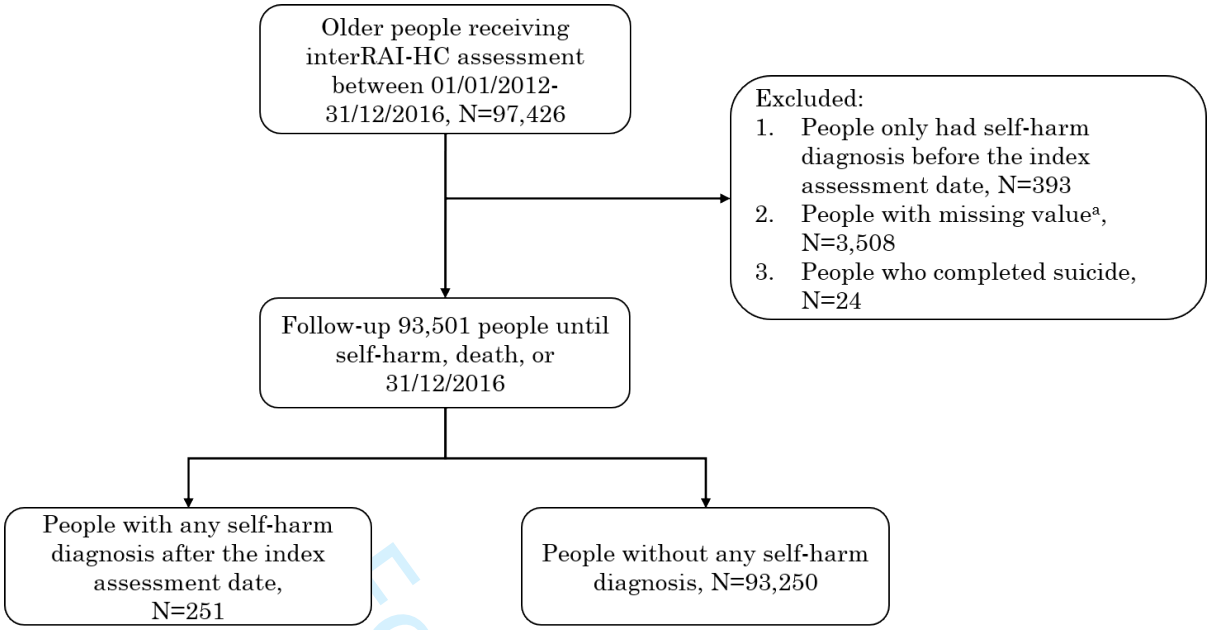


Figure 1. Flowchart of study cohort selection

[a] We excluded people whose baseline assessment that had a missing value on marital status, loneliness, major life stressors, strong supportive family relationships, neglected, abused, or mistreated, daily tobacco consumption, at-risk alcohol use, depression, bipolar, anxiety, schizophrenia, cancer, stroke, Activities of Daily Living Hierarchy Scale, Depression Rating Scale, Cognitive Performance Scale, Changes in Health, End-stage disease, Signs, and Symptom Scale, and Pain Scale.
interRAI-HC: International Residential Assessment Instrument Home Care

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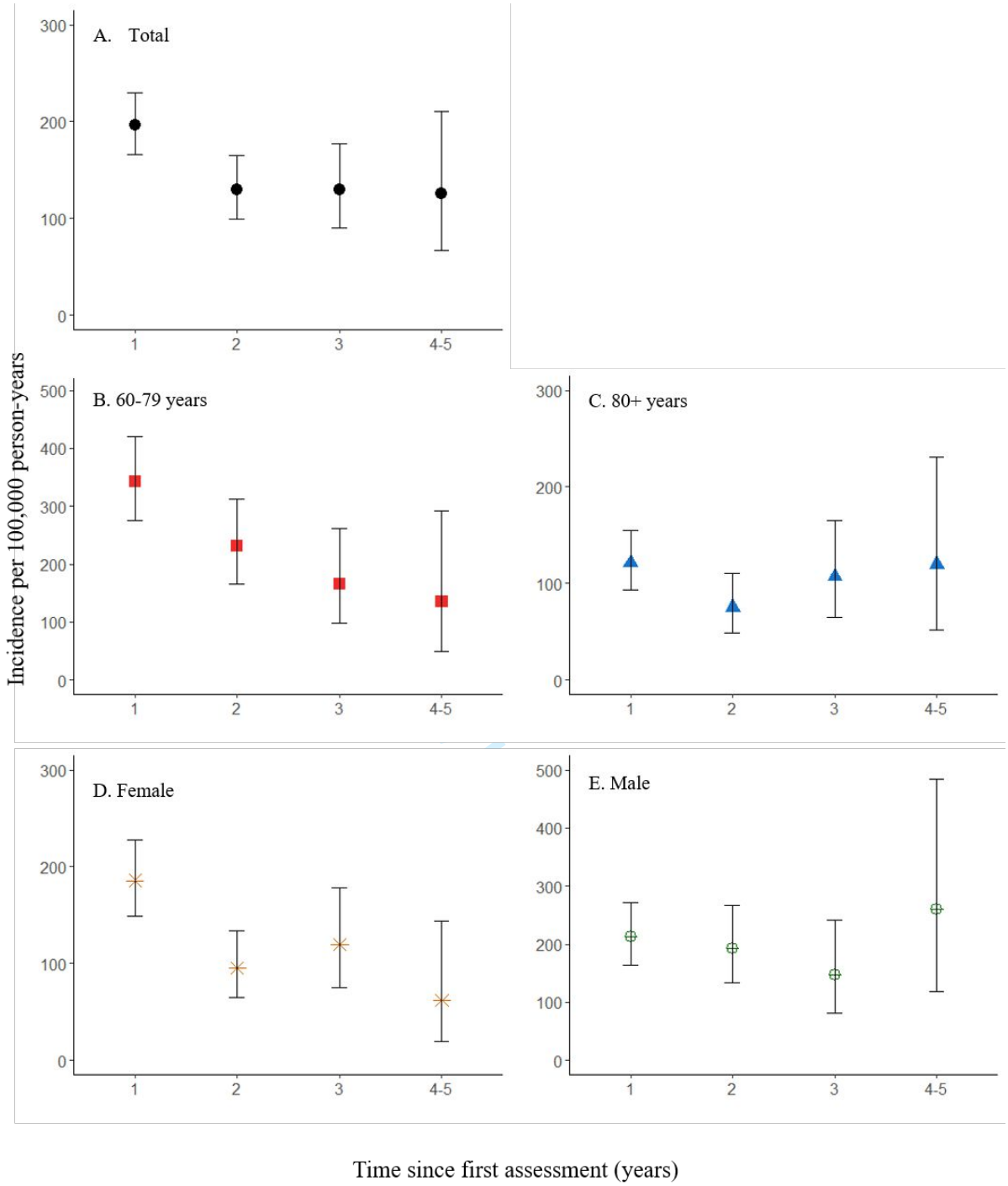


Figure 2. Incidence of self-harm per 100,000 person-years per follow-up year in (A) total population, (B) 60-79 years, both genders, (C) 80+ years, both genders, (D) female, all age groups, and (E) male, all age groups