



## Suicidal behaviour in older age: A systematic review of risk factors associated to suicide attempts and completed suicides

Massimiliano Beghi<sup>a</sup>, Elisa Butera<sup>b</sup>, Cesare Giuseppe Cerri<sup>b</sup>, Cesare Maria Cornaggia<sup>b</sup>, Francesca Febbo<sup>b</sup>, Anita Mollica<sup>c</sup>, Giuseppe Berardino<sup>c</sup>, Daniele Piscitelli<sup>b,d</sup>, Emanuela Resta<sup>e</sup>, Giancarlo Logroscino<sup>f,g</sup>, Antonio Daniele<sup>h,i</sup>, Mario Altamura<sup>c</sup>, Antonello Bellomo<sup>c</sup>, Francesco Panza<sup>j,\*</sup>, Madia Lozupone<sup>f,\*\*</sup>

<sup>a</sup> Department of Mental Health, AUSL Romagna, Cesena, Italy

<sup>b</sup> School of Medicine and Surgery, University of Milano Bicocca, Milan, Italy

<sup>c</sup> Psychiatric Unit, Department of Clinical and Experimental Medicine, University of Foggia, Foggia, Italy

<sup>d</sup> School of Physical and Occupational Therapy, McGill University, Montreal, Canada

<sup>e</sup> Translational Medicine and Management of Health Systems, University of Foggia, Foggia, Italy

<sup>f</sup> Center for Neurodegenerative Diseases and the Aging Brain, Department of Basic Medical Sciences, Neuroscience and Sense Organs, University of Bari Aldo Moro, Bari, Italy

<sup>g</sup> Department of Clinical Research in Neurology, Pia Fondazione Cardinale G. Panico, Tricase, Lecce, Italy

<sup>h</sup> Institute of Neurology, Catholic University of Sacred Heart, Rome, Italy

<sup>i</sup> Institute of Neurology, Fondazione Policlinico Universitario A. Gemelli IRCCS, Rome, Italy

<sup>j</sup> Healthy Aging Phenotypes Research Unit, "Salus in Apulia Study", National Institute of Gastroenterology "Saverio de Bellis" Research Hospital, Castellana Grotte, Bari, Italy

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### ABSTRACT

In older age, several observational studies investigated risk factors for suicide attempts/completed suicides; however, contrasting evidence came from population-based setting. In the present systematic review, we described through a narrative synthesis the significant associations existing among risk factors and suicide attempts/completed suicides in subjects aged  $\geq 65$  years. From the 39 population-based studies selected in six different databases until February 15, 2021, we analyzed the most frequent 28 risk factors for suicidal behaviour. The risk factors more associated to suicide attempts than other variables frequently related to suicidal behavior in older age were: depressive disorders, methods employed to self-harm (particularly poisoning), and psychotropic drug utilization followed by psychological factors and disability. Moreover, male sex, violent methods to self-harm, any psychiatric disorder (depression, anxiety and bipolar disorders), a poor medical condition, stressors/bereavement, and living alone appeared to be more significant for predicting completed suicides in late life. In older age, efforts for suicide prevention should be based on strategies to assess and treat psychiatric disorders along with psychological interventions, particularly in males.

### 1. Introduction

Suicide is a global public health issue. It was estimated that suicide is the 14th leading cause of death worldwide (GBD, 2017 Causes of Death Collaborators, 2018) and was among the top 10 leading causes in eastern Europe, central Europe, western Europe, central Asia, Australasia,

southern Latin America, and in high income North America (Naghavi, 2019). Data from World Health Organization (2016) suggested that there were an estimated 793 000 suicide deaths worldwide in 2016. This indicates an annual global age-standardized suicide rate of 10.5 per 100 000 population.

Furthermore, data suggested that suicide rate increases with age and

\* Corresponding author at: Healthy Aging Phenotypes Research Unit - "Salus in Apulia Study", National Institute of Gastroenterology "Saverio de Bellis" Research Hospital, Castellana Grotte, Bari, Italy.

\*\* Corresponding author at: Neurodegenerative Disease Unit, Department of Basic Medicine, Neuroscience, and Sense Organs, University of Bari Aldo Moro, Bari, Italy.

E-mail addresses: [f.panza@hotmail.com](mailto:f.panza@hotmail.com) (F. Panza), [madia.lozupone@gmail.com](mailto:madia.lozupone@gmail.com) (M. Lozupone).

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is extremely high among older people. Data from the Global Burden of Diseases estimated the annual rate for suicide in the population aged 70+ in 27.45 per 100000 compared to 16.17/100000 in people aged 50–69 and 11.6 in people aged 15–49 (GBD 2017 Causes of Death Collaborators, 2018). The investigation of suicidal behavior in older age is of increasing interest since the number of people aged 65 years or more is significantly increasing in high-income countries. In Italy, for example, this population raised from 11.7 million in 2007 to 13.5 million in 2017, and the number of people aged 90+ raised from 466000 to 727000 (Istituto Nazionale di Statistica, 2020). Innamorati and colleagues (2014) found that in European Union suicide rates in older people slightly decreased (around 2%) in all countries between 1980 and 2006 without sex differences and without significant changes during the economic crisis but rates are still higher than in other age classes. Suicide attempts among older people (more than 65 years old) is a topic that is scarcely studied despite its prevalence. In recent years, several studies tried to single out suicide risk factors in older people, focusing particularly on the neurobiological alterations linked to the aging process (van Heeringen and Mann, 2014). Themes emerging from the analysis of studies of people who had self-neglected included control, impaired decision-making and coping skills and threats to self-identity and continuity. In those who had suicidal behavior, themes related to loss of and regaining control, alienation, disconnectedness and invisibility, meaningless and *raison d'être*, and accumulated suffering and a 'painful life' (Wand et al., 2018).

Suicide attempt has been recognized as a significant risk factor for completed suicides (Beghi and Rosenbaum, 2010; Beghi et al., 2013). There are indications that for each adult who died by suicide there may have been more than 20 others attempting suicide (World Health Organization, 2016). In the 65+ year age group, each advancing year was associated with a 4% increase in the odds of overdose among men (Choi et al., 2017). In older age, the transition between suicide attempts and completed suicides has been known to be more frequent (Dennis and Owens, 2012) and given the close relationship between self-harm and suicide in older people, insights and opportunities for suicide prevention may be gleaned by in-depth interviews with those who survive self-harm (Wand et al., 2019). Much research has also been devoted to understanding risk factors for suicides in older population. These studies suggested that factors such as being widowed or single, lower social economic status, depressive disorders, increased obsessive and anxious traits, physical illness, functional impairment, pain, family discord, financial trouble, fear of moving into residential care, and access to firearms were associated with increased risk for suicide in older individuals (Conwell et al., 2000, 2002; Harwood et al., 2001; Rubenowitz et al., 2001; Waern et al., 2003). A risk factor highly associated with completed suicide in older individuals has been affective illness and, in particular, depression (Conwell et al., 1990, 1996; Pfaff and Almeida, 2005). However, a clear recognition on the risk factors for suicide attempts and completed suicides in older age has not been done yet. In the present systematic review, we aimed to identify variables more frequently associated to suicide attempts and completed suicides in population-based studies conducted in older people aged 65 years and over.

## 2. Methods

### 2.1. Search strategy and data extraction

In the present systematic review article, we followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines, adhering to the PRISMA 27-item checklist (Moher et al., 2009). An a priori protocol was established and registered on PROSPERO,

an international prospective register of systematic reviews (CRD42021231469). This systematic review was based upon searches of US National Library of Medicine (PubMed), Ovid MEDLINE, EMBASE,

Google Scholar, Web of Science, and Scopus databases. Two of the authors (MB and ML) identified the risk factors exposure for attempted and completed suicide. The exposure factors were selected as to include any variables associated to suicidal behaviour, regardless of the measurement method (i.e., scales, indexes, scores, questionnaires, instruments, evaluations, screening, indicators, psychological autopsy), while the outcome(s) as to include any validated suicidal behavior tools (clinical examination or self-reported). To be included in the present systematic review, studies should be published from the inception of different databases to February 15, 2021 and including only subjects aged 65 years and older. There were no language restrictions on the search. Studies regarding specific populations (i.e., veterans), specific psychiatric conditions (e.g., schizophrenia, bipolar disorder, anxiety disorders, etc), case reports or studies about treatment or prevention, or about suicide ideation only were excluded. The search strategy used in PubMed and MEDLINE and adapted to the other four electronic sources is shown in Table 1. We used a narrative synthesis to summarize the findings of the included studies, subdividing the articles for attempted and completed suicides specifying sample size and the variables with a significant effect on attempted and completed suicide of the included studies and the quality assessment of various study (Tables 2 and 3).

### 2.2. Quality assessment within and across studies and overall quality assessment

The methodological quality of included studies was independently appraised by pairs investigators (MB and ML or FP), using the National Institutes of Health quality assessment toolkits for quantitative studies (National Institutes of Health, 2018). Ratings of high (good), moderate (fair), or poor were given to studies according to the criteria stated in the toolkit (i.e., study question, population, participation rate, inclusion criteria, sample size justification, time of measurement of exposure/outcomes, time frame, levels of the exposure, defined exposure, blinded assessors, repeated exposure, defined outcomes, loss to follow-up, and confounding). Disagreements regarding methodological quality of the included studies were resolved through discussion until consensus was reached or resolved by a fourth investigator (FP). Furthermore, a modified version of the Grading of Recommendations

**Table 1**

Search strategy used in the US National Library of Medicine (PubMed) and Medical Literature Analysis and Retrieval System Online (MEDLINE) and adapted to the other sources, according to selected descriptors.

Strategy	Descriptors used
# 1	(aged[tiab]) OR (aged, 60 and over[tiab]) OR (older age[tiab]) OR (aging [tiab]) OR (older[tiab]) OR (elder[tiab]) OR (elderly[tiab]) OR (older adults[tiab]) OR (late-life[tiab]) OR (older people[tiab])
# 2	(suicide [tiab]) OR (suicidal behavior [tiab]) OR (suicide attempts[tiab]) OR (completed suicide [tiab]) OR (self-harm[tiab])
# 3	(risk factor [tiab]) OR (variables [tiab]) OR (association[tiab]) OR (age [tiab]) OR (gender [tiab]) OR (education [tiab]) OR (depression [tiab]) OR (drug [tiab]) OR (alcohol abuse [tiab]) (anxiety [tiab]) OR (insomnia [tiab]) OR (depression [tiab]) OR (cognitive impairment [tiab]) OR (dementia [tiab]) OR (bipolar disorder [tiab]) OR (psychosis [tiab]) OR (personality [tiab]) OR (psychiatric disorder [tiab]) OR (physical disorder [tiab]) OR (medical condition [tiab]) OR (marital status [tiab]) OR (marital status [tiab]) OR (living status [tiab]) OR (previous suicide attempts [tiab]) OR (social isolation [tiab]) OR (suicide ideation [tiab]) OR (methods employed to self-harm [tiab]) OR (economic status [tiab]) OR (stressors [tiab]) OR (bereavement [tiab]) OR (ethnicity[tiab]) OR (race [tiab]) OR (psychotropic drug [tiab]) OR (recent hospital admission [tiab]) OR (medical consultant [tiab]) OR (disability [tiab]) OR (quality of life [tiab]) OR (tobacco [tiab]) OR (psychological factors [tiab]) OR (aftercare[tiab]) OR (discharge [tiab]) OR (resilience [tiab]) OR (resilience [tiab]) OR (psychological distress [tiab]) OR (hopelessness [tiab]) OR (sense of control [tiab]) OR (lack of affect [tiab]) OR (meaning in life [tiab])
# 4	(population-based[tiab]) OR (epidemiology [tiab])
# 5	#1 AND #2 AND #3 AND #4

**Table 2**  
Selected population-based studies investigating suicide attempts in older age (people 65 years and older, N 17).

SUICIDE ATTEMPTS					
References (country)	Study design	Study sample	Variables studied	Main findings	Quality
Almeida et al., 2016 (Australia)	Prospective cohort study	38,170 subjects aged 65–85 years, 16-year follow-up	Methods employed to self-harm, depression, bipolar disorder, psychotic disorders, dementia, alcohol and substances abuse disorder, organic disorders, diagnosed with ICD, previous suicide attempts, age	The rates of new suicide attempts over the 16 years of follow-up increased with increasing age. History of bipolar or depressive disorders, alcohol or substance related disorders, and the number of systems affected by medical diseases were all independently associated with past suicide attempt. With the exception of cancer, diseases of all individual health systems were associated with increased odds of suicide attempt. Poisoning (n = 204; 85%) had been the most frequent method employed in the past suicide attempt. The baseline variables associated with a novel suicide attempt were past suicide attempt, bipolar disorder, alcohol use disorder and substance use disorder	High
Artero et al., 2006 (France)	Cross-sectional study	Representative sample of 1843 non-institutionalized persons aged 65+ (58.5% women). Mean age: 73 years	Age, sex, education, tobacco use, heart diseases, lifetime major depressive episode (actual or recurrent), life time generalized anxiety, psychotropic medication use, marital status, suicidal ideation	Women carried out 79.7 % of the suicide attempts. Suicide attempts have higher rates of divorce/separation (53.6 % vs 28 %), history of major depression (71 % vs 29 %) or general anxiety (26 % vs 10 %), and 75.4 % of attempters have received treatment for major depression and 67.7 % were hospitalized for treatment. Attempters consumed significantly more psychotropic drugs, significantly higher rates of angina pectoris and coronary surgery were observed in attempters. After correction for several variables, suicide attempts were found to be associated with depression, co-morbid anxiety and depression, and cardiovascular disease	Moderate
Cabello et al., 2020 (Multi-countries)	Cross-sectional study	A total of 53,287 participants were jointly collected in SAGE and COURAGE in Europe. Of these, 4,308 participants (8.26 %) were positive for the depression Screening	Sex, education, marital status, food insufficiency, high household income, number of chronic health conditions, alcohol use, global, positive and negative affect, and social isolation	Higher negative affect, higher disability, and presence of food insecurity were associated with 12-month suicide attempts for older adults.	High
Calati et al., 2017 (France)	Case-control study	1965 subjects from a cohort of community-dwelling persons aged 65 years and over without dementia (the ESPRIT study), divided in two groups: those with (n = 75), and those without a lifetime suicide attempt (n = 1890)	Current life events, insomnia, lifetime major depressive episode, lifetime manic/hypomanic episode, lifetime anxiety disorders, current suicidal ideation, current suicidal plan, organic disorders, traumatic brain injury, MMSE, headache, age, sex, living status, marital status, education, tobacco, alcohol consumption	After adjusting for sex, living alone, tobacco and alcohol consumption, depressive, manic/hypomanic and anxiety disorders, lifetime headache frequency was significantly higher in subjects with a lifetime suicide attempts compared with controls. Female sex, a lower level of high-density lipoprotein cholesterol, insomnia, lifetime major depression, associated with suicide attempts in participants with lifetime headache versus participants without headache (glycemia and lifetime major depression)	Moderate
Crandall et al., 2007 (USA)	Retrospective cohort study	449,333 records reported in a national trauma database from 1995 to 2002. 1,812 persons aged 65+ with previous suicide attempts during the study period, mean age 70.2, 88 % male	Age, sex, ethnicity, shock at admission, any psychiatric history, medical history, insurance status, firearm use, hospital charges, illicit drug use, and/or alcohol use.	Older subjects were statistically more likely to have a preexisting medical condition than those <65 years old. Suicidal older people were more likely to have a preexisting psychiatric diagnosis, were more likely to be male, white ethnicity, to have used a firearm and lethal means, and to have insurance than younger patients and less likely to have a psychiatric condition and alcohol presence. Mortality was higher for older	Moderate

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Table 2 (continued)

SUICIDE ATTEMPTS					
References (country)	Study design	Study sample	Variables studied	Main findings	Quality
De Leo et al., 2001 (Europe)	Cross-sectional study	1518 subjects aged 65 and plus; 64.5 % females (n.979); mean age 74.7 years	Age, sex, suicidal method (self-poisoning, cutting, jumping, hanging), marital status, living status, referral to health facilities, non-fatal suicidal behavior, previous attempted suicide, ICD-9 psychiatric disorders	subjects. Suicidal older people were less likely to be discharged to home. Rates decreased across the 5 years both in the total sample (fall of 4.9 %). Women committed 65.1 % of attempted suicides and men 34.9 % with an F/M ratio 1.9. Attempters are more widowed, live alone. In 11.9 % of those who repeated suicide attempt, the previous suicide attempt had occurred during the previous year. In 38.7 % a psychiatric disorder was present. There was a preponderance of depressive disorders (two-thirds of all diagnoses) with a relatively low number of personality, substance abuse and schizophrenia-spectrum illnesses. Hospital admission was recommended in 64.3 % of cases. A high prevalence (57.2 % of all suicide attempts) of drug overdoses emerged (especially benzodiazepines and hypnotics). The second method in order of frequency was self-injury with sharp objects (especially wrist cutting) (11.2 %), followed by poisoning with non-steroid anti-inflammatory agents (6.4%) and other unspecified drugs (5.5%)	Moderate
Hedna et al., 2020 (Sweden)	Case-control study	Register data from a total cohort of all Swedish residents aged ≥75 years (mean age 80.5 years; range 75–114) between 2006 and 2014 (N = 1,413,806)	Sex, age group (75–79, 80–84, 85–89, and ≥ 90 years), marital status, country of birth (Sweden, other Nordic countries, and outside of Nordic countries), highest level of education (primary, secondary, and higher education), category of employment at retirement, residence in institution at baseline; antidepressant users; methods employed to self-harm	Being unmarried was a risk factor for non-fatal self-harm in men but not in women. Among users of antidepressants, higher non-fatal suicide attempt risk was observed in those born outside the Nordic countries, whereas in antidepressant non-users increased risk was seen in those from Nordic countries other than Sweden. Antidepressant users with higher education had an increased risk of non-fatal self-harm in both men and women	Moderate
Jackson et al., 2020 (Australia)	Prospective cohort study	(n = 157) older-aged (65+ years) and (n = 925) middle-aged adults people (45–64 years) presenting to a regional referral centre for deliberate self-poisoning (Calvary Mater Newcastle, Australia) over a 10-year period (2003–2013)	Sex, marital status, employment, housing, support at home, currently prescribed drugs by major drug groups, ingestions by major drug groups and medical morbidity, cognitive impairment, selected DSM-IV major diagnostic groups, suicidality at the time of psychiatric assessment, past suicide attempt, past psychiatric treatment, professional who completed psychiatric assessment, life events prior to suicide attempt and discharge destination. Any mood, anxiety or psychotic disorder, substance use disorders, relational problems, recent life events	The older-aged group was different to the middle-aged group for greater proportion with cognitive impairment, higher medical morbidity, longer length of stay, and greater prescription and ingestion of benzodiazepines in the deliberate self-poisoning event. There were significant differences between the older- and middle-aged groups for marital, employment and housing status. Older-aged adults commonly lived in their own home (68 %) and were commonly separated, divorced or widowed (47 %). the older-aged adult were significantly more likely to be prescribed benzodiazepines (54 % vs 37 %) and drugs for treatment of medical conditions (65 % vs 40 %) in the period preceding the suicide attempt event. A substantial proportion of the older-aged adults presented with DSM-IV mood, anxiety or psychotic disorders (68%), lower support at home (living alone) (49%), and an active suicide plan and/or high suicidal ideation (20%), which might require interventions to reduce exposure to these risk factors. The prescribed medications in the older aged subjects included antidepressants (47%) and	High

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Table 2 (continued)

SUICIDE ATTEMPTS					
References (country)	Study design	Study sample	Variables studied	Main findings	Quality
Menghini and Evans, 2000 (USA)	Retrospective cohort study	Nursing home residents attempting or completing suicide in Olmsted County and surrounding communities (846 nursing home beds) between 1981 and 1997, mean age 78.6 years	Sex, age, duration of nursing home residence, cognitive function, depression, decline in physical health, prior suicidal behaviour, suicidal method	antipsychotics (13%), which flag necessary points of review. Previous suicide attempts were more common in the middle-aged group. Three suicide attempts were identified, including two men and one woman. Half have a loss related to their spouse. No deaths occurred in patients with severe cognitive impairment. Depression was documented in six patients. Half have an history of previous suicidal behavior.	Poor
Mokhtari et al., 2019 (Iran)	Cross-sectional study	299 suicide attempts in people aged 65 years and above between 2011 and 2016	Cause of suicide, previous attempts, family history of suicide, history of any psychiatric disease or somatic disorder, suicide method, suicide outcome, sex	Family conflicts were the most frequent cause of suicide attempts in the subjects. Of these, 5.7 % had at least one physical disease, and 8.4 % had a history of at least one psychiatric disorder. Besides, 57.7 % suicides were committed using drug overdose	Moderate
Nowers, 1993 (UK)	Retrospective cohort study	Community-based retrospective survey on the Tower Hamlets District Health Authority, one of London's inner city districts with a total population of 140000. All cases over the age of 65 years with a proven episode of deliberate self-harm were included	Sex, age, marital status, living situation, methods employed to self-harm, suicidal ideation, physical status, psychiatric status, and previous suicide attempts	Over one-third of the patients were over 75 years. Fifty-seven per cent of the sample had a depressive illness, most commonly found in the younger females and the older males. Over 50 % of the sample had evidence of multiple health problems, particularly heart disease and arthritis. Over 90 % of cases used self-poisoning as the means of self-harm. Sixty-one per cent used benzodiazepines and 25 % salicylates. Over 30 % used multiple drug combinations. Thirty-eight per cent of the sample had evidence of previous self-harm, 17 % had repeated self-harm within a year and 6% were dead through suicide	High
Ojagbemi et al., 2013 (Nigeria)	Retrospective cohort study	Community-based survey of the mental and physical health status of older persons (aged 65 years and over). 2149 patients, conducted between 2003 and 2004	Lifetime depression (Composite International Diagnostic Interview), social network; chronic health conditions, economic status, marital status, age, sex, education	About 20 % and 6 % of those with ideation proceed to plans and attempts, respectively. The associations between suicidal behaviour and age, sex or level of education were not significant. Similarly, the relationship between suicidal behaviour and economic status and lifetime depression was not significant.	High
Scocco et al., 2006 (Italy)	Prospective cohort study	Data on attempted suicides in the Veneto general and older population derived from local health units and from the Italian National Institute of Statistics, which are gathered on a routine basis (26875 residents) aged 65+, over 1-year period	History of mental disorders, Structured interviews were completed with nursing home managers, inquiring about nursing home, staff and management characteristics, mental health care available and the number of attempted suicides, method employed to self-harm, sex	Of the eight reported suicide attempts, five were by males and three by females; the age range was 65–85 years. All but one suicides and one attempted suicide had a history of mental disorders. Seven subjects had been living in a nursing home for less than one year	Poor
Soriano Barceló et al., 2020 (Spain)	Retrospective cohort study	The average of the population over age 65 during those three years was 75,538 people (74.85 ± 7 years). The number of treatments for suicide attempt in those over 65 years in the period from 2015 to 2017 was n = 80, corresponding to 78 individuals	Sex, age, ethnicity, marital status, living status, education, general practitioners visit, psychiatric visit, other specialist visit; main reason for last consultation in primary care (physical problems, mental problems, physical and mental problems, social problems, physical, mental, and social problems), data on prior contact with health services; psychotropic medication	Ratio between male: female was 2: 3; 61.3 % had visited their general practitioner the month prior to the attempt (but in this last consultation, the main health request of the majority was physical problems), 72.5 % had visited a health center. 41.3 % were not under the follow up of Mental Health services; low percentage of people in mental health monitoring who received psychotherapy in a regulated manner. Among these older subjects, 66.3% had prescribed antidepressants, benzodiazepine prescription was 78.8%. The intake of neuroleptics was 21.3%;	Moderate

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Table 2 (continued)

SUICIDE ATTEMPTS					
References (country)	Study design	Study sample	Variables studied	Main findings	Quality
Tsoh et al., 2005 (China)	Case-control study	66 suicide attempters, 67 suicide completer, and 91 controls from the community, chosen randomly from a sample derived from the General Household Survey (GHS)	Sex, age, marital status, living status, current DSM-III-R mood disorders, current major depression, dementia, number of physical illnesses; personality factors (neuroticism, extraversion, openness-to- experience, agreeableness, and conscientiousness on NEO-FFI), previous suicide attempts, social network, suicide ideation	underdiagnosis and under- treatment of depressive symptoms A current diagnosis of major depression was associated with a nearly 60-fold increased risk for attempted, past suicide attempts, poorer function of self-care, arthritis, and specific personality dispositions, particularly low conscientiousness were associated with suicide attempts. Co-residence with children decreased risk	Moderate
Wyart et al., 2016 (France)	Case-control study	Longitudinal population study of psychiatric disorders in French older people aged 65+ years, 35 with lifetime history of suicide attempt and depression, 52 with a past history of depression but no history of suicide attempt, 43 controls	Decision-making (IGT); anxiety symptoms (STAI), and depression symptoms (BDI); impulsivity (BIS-11); executive functioning (TMT); lifetime axis I psychiatric diagnoses were made according to DSM-IV criteria using MINI-5.0, psychotropic medication	Suicide attempters were on average 2.5 years younger. The majority of patients experienced their first depressive episode before the age of 60. BIS-c were higher in suicide attempters relative to non-patients. Suicide attempters were more likely to be taking antidepressants and benzodiazepines than non-attempters. Global cognitive functioning was not different across the three groups. Similarly, there was no significant difference between the groups in executive functioning as measured by the TMT. Suicide attempters from the community study were significantly older, but they non differed about gender, violent act or previous suicide attempt. Suicide attempt from the community had higher mean IGT scores than those from the clinical study. Violent- suicide attempt performed worse than non-violent suicide attempt. The group of suicide attempt exhibited a significant heterogeneity, with those using violent means performed worse than non-violent attempters.	Moderate
Zhang et al., 2016 (China)	Cross-sectional study	Using a multi-stage cluster sampling approach, a cross-sectional survey of 8,399 older house-dwelling residents was conducted in Shanghai, China	Socio-demographic information, which included age, sex, living arrangement, and caregiver details, psychiatric symptoms, ADL and IADL scores	In the bivariate analysis, having no caregivers, depressive, anxiety, sad, fear, obsessive-compulsive and anger symptom, and lower scores on the Barthel Index of ADL and the IADL Scale were significantly associated with an increased risk of attempted suicide in older age. In the multivariate analysis, sad and fear symptoms were significantly and independently associated with a higher risk of attempted suicide in older age	High

ADL: Activities of Daily Living; BIS-11: Barrat Impulsivity Scale; BDI: Beck Depression Inventory scale; DSM: Diagnostic and Statistical Manual of Psychiatric Disorders; IADL: Lawton instrumental activities of daily living; ICD: International Classification Diseases; IGT: Iowa Gambling Task; MINI: Mini-International Neuropsychiatric Interview; MMSE: Mini-Mental State Examination; NEO-FFI: NEO Five Factor Inventory; STAI: Spielberger State Trait Anxiety Inventory; TMT: Trail Making Test.

Assessment, Development and Evaluation (GRADE) rating system was used to assess the overall quality of evidence for the various risk factors for suicide attempt and completed suicide of the studies included in the present systematic review (Atkins et al., 2004). The following factors were extracted and considered: the strength of association for each risk factor, methodological quality/design of the studies, consistency, directedness, precision, size, (where possible) dose-response gradient of the estimates of effects across the evidence base, main results, and conclusions. Evidence was graded as very low, low, moderate, and high, similar to a GRADE rating system.

### 3. Results

After a first search, 6691 studies were selected. 2696 were excluded

for covering an irrelevant topic or repeated articles in different searches, 3285 were excluded because they were not selected for age strata of older age, 72 were on suicide ideation, 236 were on selected samples and more specifically 171 on specific target populations (i.e. veterans, females only, people with dementia), 65 were on specific psychiatric population (i.e. patients with psychosis, bipolar disorder) and 190 were case reports, 33 were on treatment and 33 were on prevention. We were left with 145 studies and then we decided to excluded also reports that included samples without a selective age stratum of 65 years and plus ( $n = 23$ ). We subdivided also studies into population-based samples ( $n = 39$ ) and hospital-based samples ( $n = 83$ ), respectively. We thus focused the present systematic review only on population -based reports, selecting 39 studies (Fig. 1).

Among these studies conducted in a community setting, 17 were

**Table 3**  
Selected population-based studies investigating completed suicides in older age (people 65 years and older, N 28).

COMPLETED SUICIDES					
References (country)	Study design	Study sample	Variables studied	Main findings	Quality
Almeida et al., 2016 (Australia)	Prospective cohort study	38,170 aged 65–85 years, 16-year follow-up	Methods employed to self-harm, depression, bipolar disorder, psychotic disorders, dementia, alcohol and substances abuse disorder, organic disorders, diagnosed with ICD, previous suicide attempts, age	Sixty-nine men died by suicide during follow up – they were 3.6 years younger than men who did not die by suicide. The method most frequently used to complete suicide was hanging (n = 35, 50.7 %), followed by poisoning. An age-adjusted competing risks regression model showed that past suicide attempt was not a robust predictor of future suicide completion, nor were the diagnoses of schizophrenia-related disorders or of alcohol and substance use disorders. Both bipolar and depressive disorders were associated with increased risk of suicide completion, as were the number of health systems affected by disease. The rates of suicide completion over the 16 years of follow up increased with increasing age, albeit less markedly than suicide attempts	High
Altınöz et al., 2019 (Turkey)	Retrospective cohort study	Between 2002 and 2013, 978 completed suicides in the group 65–69 years; 75.4% men, 855 completed suicides in the group 70–74 years; 73.7 % men 1617 completed suicides in the age group 75+; 72.9% men	Sex, age, method employed to self-harm, reason (illness, marital conflict, financial difficulties, romantic relationships, education failure and other)	In all age groups, suicide rates were threefold more frequent among men than among women. In both sexes, the most frequent suicide cause was mental illness. In the group aged 65–69 years, the most common cause of suicide was financial difficulty for men and marital conflict for women. The most frequent suicide method among older adults of both sexes was hanging. In all age groups, firearms use was more common among men and jumping from a high place was more common among women. It is important to diagnose mental disorders, such as mood disorders and substance abuse, and to treat them quickly	Moderate
Barak et al., 2020 (New Zealand)	Retrospective cohort study	New Zealand Coronial Services website for the period 2011–2019, aged 85+ (three youth and young adult male cohorts identified by the Coroner) (15–19 years, 20–24 years and 25–29 years)	Age	Rates of death by suicide of older males remained consistently high never overlapping female suicide rates. Mean suicide deaths/100,000 population for all four age cohorts were comparable; 15–19 years: 23.5; 20–24 years: 29.0; 25–29 years: 27.0; 85+ years: 27.9	Moderate
Carlsten et al., 1999 (Sweden)	Retrospective cohort study	Data on the number of suicides and suicide rates during 1969 ± 1996 were obtained from the Cause of Death Register, Statistics Sweden for older people (65+)	Sex, age, main type of drug used, e.g. antidepressants (969.0), neuroleptics (969.1, 969.2, 969.3), analgesics (965.0 ± 965.9), other analgesics (mainly dextropropoxyphene) (965.7) and benzodiazepines (969.4), according to ICD	Rates of suicide by drug poisoning decreased in all age groups for both sexes between the years 1969 and 1996. The reduction was, however, less pronounced among older people. Benzodiazepines were the dominant drug type used by older persons who committed suicide by drug poisoning. Rates of suicide using benzodiazepines increased despite decreasing prescription sales	Moderate
Choi et al., 2021 (Korea)	Retrospective cohort study	The 528 655 people from the National Health Insurance Service–Senior Cohort between 2004 and 2012, were divided into adults with dementia (n = 37 404) and adults without dementia (n = 491 251). National Health Insurance Service Senior Cohort data and included 36 541 older adults with newly diagnosed dementia from 2004 to 2012 also subdivided in young-old adults (60–74 years) and old-old adults (≥ 75 years)	Dementia was classified as Alzheimer disease (ICD-10), vascular dementia (ICD-10) or other/unspecified dementia (ICD-10). According to relatively strict criteria, dementia was diagnosed based on evidence for cognitive dysfunction (MMSE score of 26 or less and a Clinical Dementia Rating score of 1 or more, or a Global Deterioration Scale score of 3 or more); residential area, household income, disability, insurance type and other mental disorders.	Older adults with dementia had an increased risk of suicide death compared to those without dementia. Older adults with Alzheimer disease or other/unspecified dementia had an increased risk of suicide death compared to those without dementia. Patients with dementia but without other mental disorders and patients with dementia and other mental disorders had an increased risk of suicide death compared to patients without dementia. Patients with	Moderate

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Table 3 (continued)

COMPLETED SUICIDES					
References (country)	Study design	Study sample	Variables studied	Main findings	Quality
Crestani et al., 2019 (Italy)	Retrospective cohort study	538 suicides (394 male cases and 144 female cases) in subjects aged 60 years and over and stratified in four age groups (60–69 years, 70–79 years, 80–89 years and 90 years and over), over a 37-year period	Age, sex, marital status, physical state, mental illness (any psychiatric disorders), method of suicide	dementia and schizophrenia, mood disorders or anxiety or somatoform disorders, respectively, had an increased risk of suicide death compared to patients with those conditions but without dementia. In particular, both young-old adults with dementia and old-old adults with dementia had an increased risk of suicide death compared to those without dementia Male sex correlated to a higher suicidal risk, with a male-female ratio of 2.74:1. The highest risk of suicide was observed in the age between 70 and 79 years. Mental illness was related significantly to suicidal risk	Moderate
De Leo et al., 2001. (Europe)	Cross-sectional study	1518 subjects aged 65 and plus; 64.5 % females (n.979); mean age 74.7 years	Age, sex, suicidal method (self-poisoning, cutting, jumping, hanging), marital status, living status, referral to health facilities, non-fatal suicidal behavior, previous attempted suicide, ICD-9 psychiatric disorders	Mean suicide rate of 29.3 for the total sample, 49.5 for males and 19.3 for females (ratio F/M.0.39). Completed suicides by older males are twofold those of females and the male/female ratio increases with age. The ratio between fatal and non-fatal behaviours was 1:2, that for males/females almost 1:1. The majority of the sample was composed of widow(er)s (44.9%). The sample exhibited a predominance of subjects who lived alone (40.9%). The most frequently observed diagnosis was manic-depressive psychosis, depressive type (17.8% of cases), followed by neurotic depression (15.8%), depressive disorders not classified elsewhere (10.1%), manic-depressive psychosis, manic type (9.3%), anxiety states (9.3%). There were differences in mean age among different centers.	Moderate
Hedna et al., 2021 (Sweden)	Case-control study	A national population-based register study, including all Swedish residents aged 75 years between 2006 and 2014 (N 1/4 1 413 806).	Sociodemographic factors associated with suicide among users and non-users of antidepressants	In all, 1305 individuals died by suicide (70 % men). The suicide rate in men who used antidepressants was over four times higher than women with such treatment. Being unmarried was a risk factor for suicide in men but not in women. Being born outside of Nordic countries was associated with increased suicide risk; a 3-fold risk increase was observed in non-Nordic women without AD treatment. Lower suicide risk was observed in blue-collar women who used antidepressants, whereas a higher risk was found in blue-collar men who did not	Moderate
Juurink et al., 2004 (Canada)	Case-control study	All Ontario residents 66 years or older who committed suicide between January 1, 1992, and December 31, 2000, were identified from provincial coroners' records	Age, sex, suicidal method, household income, use of health care services, somatic and psychiatric chronic illnesses	During the 9-year study period, 1354 older subjects who died of suicide were identified. The most common mechanisms involved firearms (28 %), hanging (24 %), and self-poisoning (21 %). Specific chronic illnesses associated with suicide included congestive heart failure, chronic obstructive lung disease, seizure disorder, urinary incontinence, anxiety disorders, depression, psychotic disorders, bipolar disorder, moderate pain, and severe pain. Treatment for multiple illnesses was strongly related to a higher risk of suicide. Almost half the patients who committed suicide had visited a physician in the preceding week	High

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Table 3 (continued)

COMPLETED SUICIDES					
References (country)	Study design	Study sample	Variables studied	Main findings	Quality
Kaya et al., 2020 (Turkey)	Retrospective cohort study	17,942 forensic autopsies reports of individuals aged 60 and older who committed suicide in Turkey during the 10-year period between 2005 and 2014 and stratified in four age groups	Age subgroup classification was made based on the accepted definitions of young old (ages 65–74), middle old (ages 75–84) and old old (ages 85 and over), sex, year, suicidal month, location, season, suicidal methods	Of these, 77.3 % were men and the mean age was 71.26 ± 8.16 (range, 60–94) years. There were statistically significant differences in suicide method according to sex and age subgroups. For both sexes, hanging was the most common suicide method (59.4 %) and the majority of suicides occurred at home (73.1 %). The suicides occurred more frequently in the 65–74 age subgroup, in the summer, and in the months of June and July	High
Lindesay, 1986 (UK)	Retrospective cohort study	Raw are taken from the official Mortality Statistics (Office of Population Censuses and Surveys, 1974–1983) in England and Wales for the following age groups: 19 years or less; 20–24 years; 25–44 years; 45–64 years; and 65 years and over	Sex, age, methods employed to self-harm, and drugs used for self-poisoning	While analgesics were the commonest means of suicidal self-poisoning in both sexes and at all ages, barbiturates still accounted for a significant proportion of suicides in older age. Tricyclics and benzodiazepines were implicated in a relatively small proportion of suicides in older age. There is an increase with age in the rate of suicide by self-poisoning	High
Menghini and Evans, 2000 (USA)	Retrospective cohort study	Nursing home residents attempting or completing suicide in Olmsted County and surrounding communities (846 nursing home beds) between 1981 and 1997, mean age 78.6 years	Sex, age, duration of nursing home residence, cognitive function, depression, decline in physical health, prior suicidal behaviour, suicidal method	Five cases of completed suicide and three suicide attempts were identified, including six men and two women. Deaths were the result of drowning, hanging, or medication overdose (the latter following a period of intentional hoarding). Those who died ranged in age from 69 to 87 years. Most had been nursing home residents for less than 6 months. No deaths occurred in patients with severe cognitive impairment	Poor
Miller et al., 2008 (USA)	Case-control study	In 1,408 New Jersey residents age 65 years or older, 128 subjects committed suicide, while control subjects (n = 1,280) were matched on age and sex	Sex, ethnicity, medical condition, affective disorder, anxiety and personality disorder, dementia and other organic psychosis defined with ICD-9-CM diagnostic categories, prescription medication within 180 days before the index date, suicidal method.	In multivariate analyses, the only chronic somatic illness that remained associated with suicide was malignancy. Suicide also remained associated with a diagnosis of affective disorder, anxiety/personality disorder, treatment with antidepressants, and treatment with opioid analgesics	High
Mokhtari et al., 2019 (Iran)	Cross-sectional study	299 suicide attempts in people aged 65 years and above between 2011 and 2016	Demographic information, medical and psychological histories, former suicide attempts, and data about the cause, method, and outcome of the suicide	The mean age of subjects was 73.11 ± 6.43 years. 69.6 % of those who committed suicide were urban residents, and 64.9 % were male. The suicide death rates were also higher in men and rural residents; 57.7 % suicides were committed using drug overdose; Family conflicts were the most frequent cause of suicide.	Moderate
Özer et al., 2016 (Turkey)	Retrospective cohort study	1723 suicides in people aged 65+ were determined in Turkey between 2009 and 2013, 74.5 % males using the data of the Turkish Statistics Institute	Sex, suicidal method, reason (illness, financial difficulties)	The most common method of suicide in both sexes was hanging. In the majority of cases of geriatric suicide of both sexes, the reason could not be determined. In those cases where the reason was known, the most common reason was illness	Moderate
Park et al., 2016 (Korea and Japan)	Retrospective cohort study	The World Health Organization data on rates and methods of suicide from 2000 to 2011 in South Korea and Japan in subjects 65+, over a 11-year period	Suicidal method, sex, and cause of death, as reported annually by member states through civil registration systems	Suicide rates for males increased from 55.6–128.6 suicides per 100,000, and suicide rates for females increased from 23.6–46.1 suicides per 100,000. For males, there was a correlation between suicide and hanging and jumping, and a negative correlation between with poisoning. For Korea females, there was a significant positive correlation between suicide and jumping, and a negative correlation with poisoning. Suicide rates of Japanese adults aged 65 years or older were steadily decreased from	Moderate

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Table 3 (continued)

COMPLETED SUICIDES					
References (country)	Study design	Study sample	Variables studied	Main findings	Quality
Schmutte and Wilkinson, 2020 (USA)	Retrospective cohort study	Suicide deaths for adults aged $\geq 65$ years from the National Violent Death Reporting System, 2003 – 2016 (n = 26,884)	Age, sex, race/ethnicity, and marital status. Depression at the time of death (not a clinical diagnosis), substance use problems, past mental health or substance abuse treatment, and prior suicide attempt. Precipitating circumstances included: physical health problems, relationship problems, recent deaths of family/friends, legal problems, job/financial problems, disclosure of suicide intent, and leaving a suicide note. Suicide methods: firearms; hanging/strangulation/ suffocation; poisoning by medicine, alcohol/drug, or gas; laceration/ sharp object; jumping from heights; or other. Known mental illness was defined as whether a decedent was identified as having a current mental health problem	46.8–38.5 suicides per 100,000 individuals for males and from 23.3–18.6 suicides per 100,000 individuals for females; no correlation was found between the proportion of specific suicide methods and suicide rates Most older male (69.1 %) and female (50.2 %) suicide decedents did not have a known mental illness. A physical health problem was the most prevalent precipitating circumstance but was more common among older adults without known mental illness. Past suicide attempt, disclosure of suicidal intent, depressed mood, and substance use were more common among those with a known mental illness. More than three fourths of suicide decedents did not disclose their suicidal intent. Most suicide deaths involved firearms, which were disproportionately used by decedents without known mental illness (81.6 % of male and 44.6 % of female decedents) compared with those with known mental illness (70.5 % of male and 30.0 % of female decedents)	Moderate
Scocco et al., 2006 (Italy)	1-year follow-up prospective cohort study	Data on completed suicides in the Veneto general and older population derived from local health units and from the Italian National Institute of Statistics (NIS), which are gathered on a routine basis (26875 residents) aged 65+, over 1-year period	History of mental disorders, structured interviews were completed with nursing home managers, inquiring about nursing home, staff and management characteristics, mental health care available and the number of completed suicides, suicidal method	Five completed suicides (3 females, age range 65–80). The two most common suicidal methods were hanging and jumping, but no method prevailed over the others in this study	Poor
Shah, 2007 (Worldwide)	Retrospective cohort study	Trends in older suicide rates over a 24-year period, 1979–2002. Data available for men and women and for the age groups 65–74 years and for those over 75 years. from the WHO website	Age, sex	Suicide rates for men and women for the age groups 65–74 years and 75+ years declined over the 24-year study period. Suicide rates were higher in men than women for both the age groups. In men, suicide rates were higher in the 75+ age group than in the 65–74 years age group	Moderate
Shah, 2009 (Worldwide)	Cross-sectional study	Data on older suicide rates for males and females in the age groups 65–74 years and over 75 years were ascertained from the WHO website	Data on mean household size and family structure was ascertained from a report from the Inter-American Development Bank	The significant correlations between suicide rates, in both sexes in both the older age groups, and mean household size (negative), percentage of extended families (negative) and percentage of single person households (positive). The impact of mean household size and family structure on older suicides may be mediated and modified through cultural factors	Moderate
Shah et al., 2014 (Worldwide)	Retrospective cohort study	All suicide cases in 17 countries aged 100+ (n=154), 58 % men	Data on the number of suicides vs data on the corresponding population at risk Nations website	Suicide rate: 57 per 100000 person years in men and 6.8 per 100,000 person years in women. no suicides amongst male centenarians in Denmark, Iceland, Luxembourg, Romania, Slovakia and Sweden and no suicides amongst female centenarians in Austria, Bulgaria, Iceland, Luxembourg, Norway, Romania, Serbia, Slovakia and Ukraine	Moderate
Shah et al., 2016 (Worldwide)	Retrospective cohort study	Data on the number of suicides (ICD-10 codes, X60–84) in the age groups 60–64 years and 95–99 years	Age groups	In men and women, suicide rates increased with increasing age in five-year age groups between the ages of 60–64 years and 90–94 years and declined in the 95–99 years age group	Moderate
Shao et al., 2016 (China)	Retrospective cohort study	956 deaths due to suicide aged 65+ vs 291 deaths due to suicide aged $\geq 65$ years	Sex, multimorbidity including psychiatric disorders	The older age group had a higher crude mortality for suicide with psychiatric history than the younger group (14.31/100 000 vs 1.19/100	Moderate

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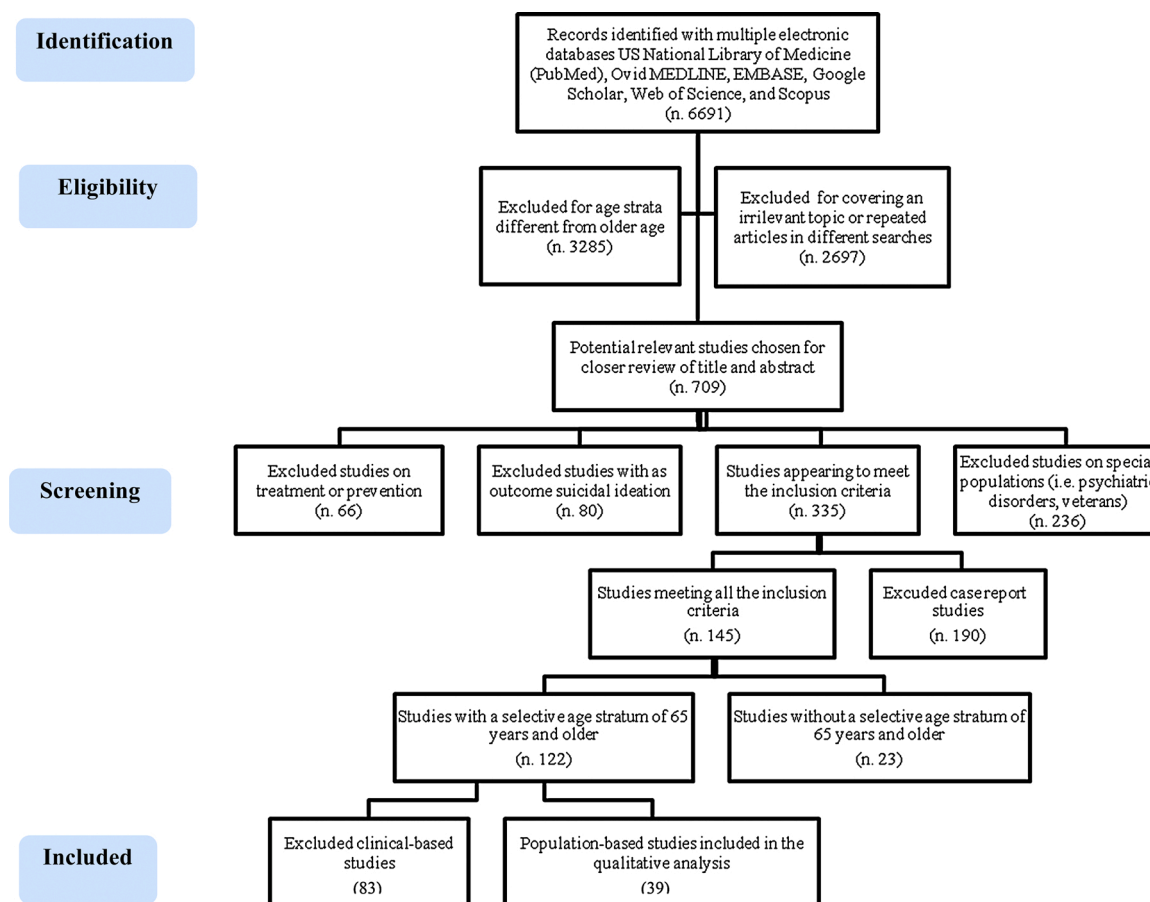
Table 3 (continued)

COMPLETED SUICIDES					
References (country)	Study design	Study sample	Variables studied	Main findings	Quality
Terranova et al., 2012 (Italy)	Retrospective cohort study	Suicide rates per 100,000, in men aged 75 years or over and aged 65–74 for the period 1993–2010	Sex, education, region of Italy, method, reason, mental-physical illness	000); The older age group had a higher crude mortality for suicide with psychiatric history than the younger group (14.31/100 000 vs 1.19/100 000). Among the 956 people with suicide deaths, 88.7% (848/956) had a history of a psychiatric condition. Suicide decedents in the elderly were mostly female, especially for suicide deaths in those people with a psychiatric history. The rates for men were three times higher than those for women. The north-east and north-west regions of Italy had the highest rates of suicide in older age. Education was inversely related to the risk of suicide. Hanging was the most frequent method of suicide in men, and precipitation in women. The reasons for suicide, as inferred from available data, were predominantly mental-physical illnesses	Moderate
Torresani et al., 2014 (Italy)	Retrospective cohort study	Data on people who died by suicide in the South Tyrol (Alto Adige) region from January to December 2000–2009 were gathered from the records of the local Provincial Mortality Register in different age groups until 85 years and over	Age, sex, marital status, education, living status, economic status, ethnicity, psychological treatment, psychiatric treatment, psychiatric disorders (depression and others), family history of suicide attempt, method, having seen a doctor in the last month, residential setting at the time of the death	Suicide in older age was associated with low education level, living in a one-person household, not having economic troubles, having seen a doctor in the past month and living in a residential facility. 17.9 % were in a residential facility/hospital at the time of the death. They were more women, not married, and to die by jumping from a height. About one-third of the suicides ( $n = 191$ , 36.4%) occurred in the 60 years and older age group (10-year rate: 18.0/100 000 vs 8.9/100 000 in the age group <60 years, $P < 0.001$ ; men: 29.7/100 000 vs 13.8/100 000, $P < 0.001$ ; women: 9.1/100 000 vs 3.8/100 000, $P < 0.001$ ).	Moderate
Tsoh et al., 2005 (China)	Case-control study	66 suicide attempters, 67 suicide completer, and 91 controls from the community, chosen randomly from a sample derived from the General Household Survey (GHS)	Sex, age, marital status, living status, current DSM-III-R mood disorders, current major depression, dementia, number of physical illnesses; personality factors (neuroticism, extraversion, openness-to- experience, agreeableness, and conscientiousness on NEO-FFI), previous suicide attempts, social network, suicide ideation	Suicide completers were more likely to have recent hospitalization (aftercare), experienced more life events, scored higher on the conscientiousness scale, worshipped ancestors, and been afflicted with chronic obstructive airway disease; the mean suicide ideation score was also higher in the suicide completers.	Moderate
Turvey et al., 2002 (USA)	Prospective cohort study	14,456 patients aged 65+, 21 committed suicide over the 10-year observation period	Sleep quality, social support, alcohol used, medical illness, physical impairment, mental status (10-item SPMSQ); depressive symptoms (CES-D)	Depressive symptoms, perceived health status, sleep quality, and absence of a relative or friend to confide in predicted late-life suicide	High
Wu and Bond, 2006	Retrospective cohort study	World Health Organization–World Health Organisation Information System (WHOIS, 1996–2002)	Age, sex, the psychological measures called “citizen scores,” the average scores on culturally equivalent psychological measures (life satisfaction, home satisfaction, happiness, sense of family importance, trust in family, perceived state of health, and sense of free choice = control.), marital status (divorce rate), economic status	The average suicide rates 20.87 ( $\pm 13.75$ ) per 100,000 were major for older people. More societal and psychological variables significantly correlated with elderly suicide rates (sex, marital status, psychological variables)	Moderate

CES-D: Center for Epidemiologic Studies–Depression Scale; DSM: Diagnostic and Statistical Manual of Psychiatric Disorders; ICD: International Classification Diseases; MMSE: Mini-Mental State Examination; NEO-FFI: NEO Five Factor Inventory; SPMSQ: Short Portable Mental Status Questionnaire.

focused on suicide attempts (Nowers, 1993; De Leo et al., 2001; Tsoh et al., 2005; Artero et al., 2006; Scocco et al., 2006; Crandall et al., 2007; Ojagbemi et al., 2013; Almeida et al., 2016; Wyart et al., 2016; Calati et al., 2017; Zhang et al., 2017; Cabello et al., 2020; Menghini and

Evans, 2000; Mokhtari et al., 2019; Soriano Barceló et al., 2020; Hedna et al., 2020; Jackson et al., 2020) (Table 2), 28 on completed suicides (Lindesay, 1986; Carlsten et al., 1999; De Leo et al., 2001; Turvey et al., 2002; Juurlink et al., 2004; Tsoh et al., 2005; Scocco et al., 2006; Wu and



**Fig. 1.** Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) Flow Diagram of retrieved and selected studies published in the past twenty years (2000–2020) exploring the association of multiple risk factors with attempted and completed suicide in older age.

Bond, 2006; Shah, 2007; Miller et al., 2008; Shah, 2009; Terranova et al., 2012; Torresani et al., 2014; Almeida et al., 2016; Özer et al., 2016; Park et al., 2016; Menghini and Evans, 2000; Shah et al., 2014, 2016; Shao et al., 2016; Mokhtari et al., 2019; Altunöz et al., 2019; Crestani et al., 2019; Barak et al., 2020; Choi et al., 2021; Kaya et al., 2020; Schmutte and Wilkinson, 2020; Hedna et al., 2021) (Table 3), and 6 studies investigated both attempted and completed suicides (Menghini and Evans, 2000; De Leo et al., 2001; Tsoh et al., 2005; Scocco et al., 2006; Almeida et al., 2016; Mokhtari et al., 2019). Of these selected studies, 4 had a prospective cohort design, 7 were case-control studies, 22 were retrospective cohort studies, and 6 were cross-sectional.

The variables considered as risk factors for both suicide attempts and completed suicides in older age were recognized and grouped for each study and 28 variables were identified in Table 4. For each variable, the number of studies that considered the risk factor as significant was also specified. Some variable such as sex, age, education, marital and living status, psychiatric disorders (specifically depression, substances abuse and cognitive impairment), physical disorders and previous suicide attempts were more investigated than other risk factors for suicide attempts. Sex, age, methods employed to self-arm, any psychiatric and physical disorders were more studied for completed suicides. Although largely investigated, previous suicide attempts seemed to be less relevant than previously evaluated.

### 3.1. Suicide attempts

As showed in Table 4 and in Fig. 2, the risk factors more associated to suicide attempts in older age were depressive disorders (significant in 10/10 studies), psychological factors when assessed (significant in 3/3 studies), disability (significant in 3/3 studies), followed by methods

employed to self-harm (particularly poisoning) (significant in 6/7 studies) and psychotropic drug utilization (significant in 5/6 studies). Also, having any psychiatric disorder (significant in 5/9 studies), having a poor medical condition (significant in 7/10 studies), living status (significant in 4/8 studies) and marital status (significant in 6/10 studies) (particularly being widowed) were considered relevant. Although the most studied risk factors were socio-demographic variables, sex (significant in 1/15 studies for males and 5/15 studies for females), education (significant in 1/8 studies) and age (significant in 4/9 studies, of these, 3 were on younger old, i.e., subjects 65–80 years old) did not influence in a significant way the risk of suicide attempts in older age. Cognitive impairment (significant in 1/5 studies) and stressors (significant in 1/4 studies), economic status (significant in 1/3 studies) and social isolation (explored in 4 studies, without significance) influenced suicide attempts to a lesser extent. Previous suicide attempts (significant in 4/9 studies), suicidal ideation (significant in 3/5 studies), and ethnicity (significant in 3/4 studies) appeared to have a moderate impact on suicide attempt risk in older age.

#### 3.1.1. Sex

There is not clear agreement among studies, in fact only 5 of included studies (15) for suicide attempts reached meaningful conclusions (Artero et al., 2006; Calati et al., 2017; De Leo et al., 2001; Soriano Barceló et al., 2020; Nowers, 1993). Artero and colleagues (2006) and Nowers (1993) found respectively that 79.7 %, and 63 % of the suicide attempts were carried out by women. Confirming this finding, De Leo and colleagues (2001) found a F/M ratio of 1.9. However, Crandall and colleagues (2007) and Menghini and Evans (2000) found that older patients who attempted suicide were more likely to be male in 88 % of the suicide attempts. Jackson and colleagues (2020) found difference in

**Table 4**  
Risk factors analyzed for suicide attempts and completed suicides in older age (people 65 years and older) according to the 39 selected population-based studies.

Risk factors	Suicide attempts		Completed suicides	
	Number of studies that analyzed the risk factor considered	Studies that obtained significant findings	Number of studies that analyzed the risk factor considered	Studies that obtained significant findings
Sex	15	1 males, 5 females	26	16 males, 3 females
Age (older old vs. younger old)	9	1 older old (> 80 years old) 3 younger old (65–80 years old)	20	4 older old (> 80 years old) 10 younger old (65–80 years old)
Education	8	1	4	3 low
Depression	10	10 (also when clinically evaluated)	8	7
Drug/alcohol abuse	7	1 (1 both)	3	2
Anxiety and/or insomnia	7 (1 both, 6 only anxiety)	3 (3 anxiety)	3	3
Cognitive impairment/dementia	5	1	5	1
Bipolar disorder	7	2	4	3
Psychosis	4	1	3	1
Personality disorders	2	0	1	1
Any psychiatric disorder	9	5	9	9
Organic disorders/medical conditions	10	7	8	8 (pain and cancer)
Marital status	10	6 (divorced-widower-unmarried)	8	1 (married) 1 (divorced)
Living status	8	4 (alone)	5	4 (alone)
Previous suicide attempts	9	4	7	1
Suicidal ideation	5	3	1	1
Social isolation (network)	4	0	2	0
Methods employed to self-harm	7	6 poisoning (or drug ingestion)	18	9 (hanging) 4 (firearm) 2 (poisoning) 1 (violent-not specified) 2 (low)
Economic status	3	1 (low)	6	2 (low)
Stressors/bereavement	4	1	4	4
Ethnicity/race	4	3	6	2
Psychotropic drug utilization	6	5	5	3
Recent hospital admission	0	0	2	2
Recent clinical consultant	1	1	3	3
Disability	3	3	3	2
Tobacco use	2	1	0	0
Psychological factors (resilience, psychological distress, feelings of hopelessness, personal and interpersonal)	3	3	2	2

**Table 4 (continued)**

Risk factors	Suicide attempts		Completed suicides	
	Number of studies that analyzed the risk factor considered	Studies that obtained significant findings	Number of studies that analyzed the risk factor considered	Studies that obtained significant findings
control, lack of affect, meaning in life)				
Aftercare/discharge	3	1 (1 hospital)	0	0

sex in middle-aged adults, but not older adults.

**3.1.2. Psychiatric conditions and depressive disorders**

For attempted suicide, the rate was 5.8 times higher in males and 6.5 times higher in females with prior contact with mental health services in people over 60 years of age (Lawrence et al., 2000). According to some study cohorts based on an urban older population with deliberate self-harm (Nowers, 1993; De Leo et al., 2001; Jackson et al., 2020; Almeida et al., 2016), the older group suffered more from depressive episode, adjustment disorder and dementia, whereas the younger group had been more frequently diagnosed with personality disorders, schizophrenia and drug/alcohol use disorders. Conversely, personality disorders and psychoses were poorly correlated to suicide attempts in older age (De Leo et al., 2001).

Depressive and anxiety disorders appeared to have the major load on suicide attempts in older age (Bartels et al., 2002). Mental illness in the form of depression was predominant among the younger females (68 % of cases) and the older males (75 % of cases) (Nowers, 1993). In the present systematic review, all the studies investigating depression (10) found a significant association with suicide attempt (Nowers, 1993; De Leo et al., 2001; Tsoh et al., 2005; Artero et al., 2006; Almeida et al., 2016; Calati et al., 2017; Wyart et al., 2016; Zhang et al., 2016; Soriano Barceló et al., 2020; Jackson et al., 2020). Artero and colleagues (2006) found that 71 % of attempters reported having at least one previous episode of major depression (compared to 29 % in non-attempters) and 26.1 % reported an episode of generalized anxiety (compared to 10.2 % in non-attempters), even though anxiety without depression was no longer significant. Among attempters, 75.4 % have received treatment for major depression and 67.7 % were hospitalized for treatment. Also, depression and anxiety measured with symptom scales such as Beck Depression Inventory Scale and Spielberger State Trait Anxiety Inventory were associated to suicide attempts (Wyart et al., 2016). Adjusting for the synergistic effects of depression and suicidal ideation, the most significant independent factor associated with attempting suicides was a current diagnosis of major depression (Tsoh et al., 2005). The population-attributable risk of suicide attempts in older age for major depression was 67.0 % (Tsoh et al., 2005).

**3.1.3. Psychological factors**

Resilience, psychological distress, feelings of hopelessness, personal and interpersonal control, lack of affect were the major psychological factors assessed and significantly influenced suicide attempts in all the studies that investigated them (Tsoh et al., 2005; Zhang et al., 2016; Cabello et al., 2020). The attempters were also found to be more neurotic and less extraverted (Tsoh et al., 2005). They may have been less resilient in times of stress or more likely to adopt maladaptive coping strategies such as deliberate self-harm.

**3.1.4. Psychotropic drugs and methods employed to self-harm**

Six studies analyzed psychotropic drugs utilization and five found significant results (Menghini and Evans, 2000, Artero et al., 2006; Wyart et al., 2016; Soriano Barceló et al., 2020; Jackson et al., 2020). As

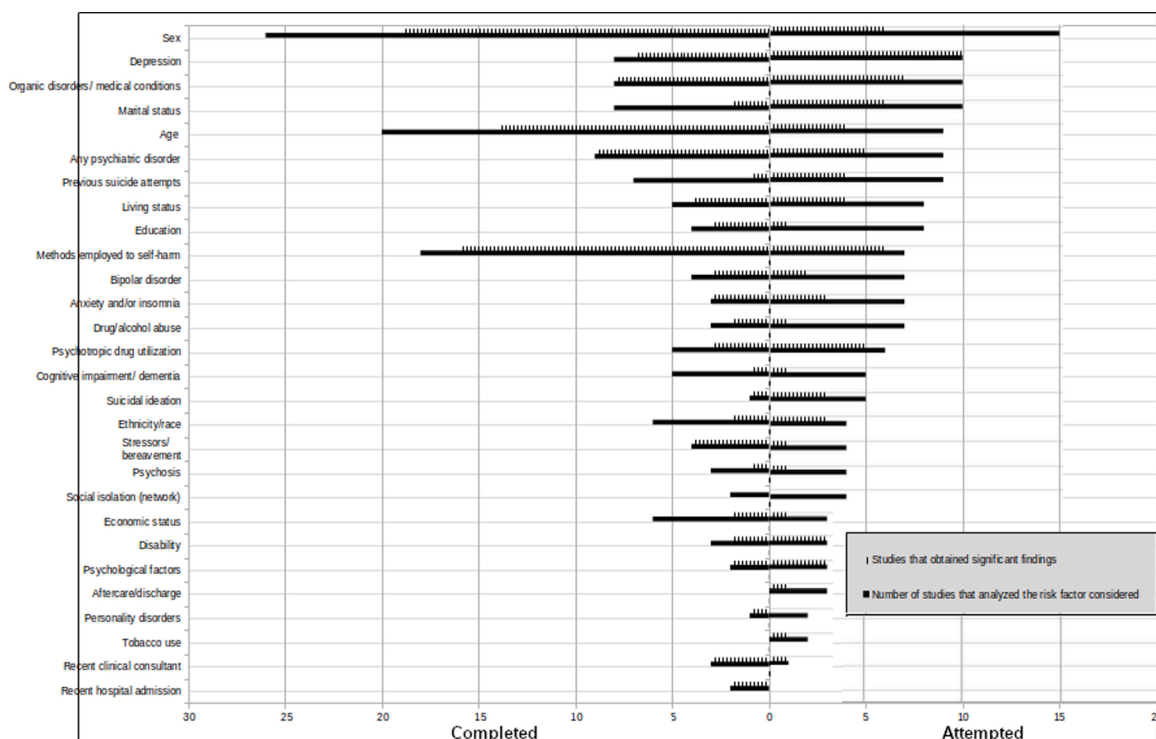


Fig. 2. Number of studies that have investigated the risk factor (the outcomes are subdivided in attempted suicides – on the right- and completed suicides - on the left) and percentage of studies that have found significant findings of association between each risk factor and suicide attempts or completed suicides (barbed tracts).

described by Soriano Barceló and colleagues (2020), benzodiazepine prescription was 78.8 %, while 66.3 % had prescribed antidepressants. A larger than expected number of older subjects (88 % vs. 70.7 %) used prescription medication (sedatives and hypnotics) for attempting suicides (Soriano Barceló et al., 2020). This ready availability is linked to the ingestion in the suicide attempts event also considered the most frequent method of self-harm (Jackson et al., 2020). Benzodiazepine prescription has been also associated with older adult suicide death, beyond the attempts (Carlsten et al., 1999; Jackson et al., 2020). Poisoning was found significant in 6/7 studies (Nowers, 1993; De Leo et al., 2001; Almeida et al., 2016; Mokhtari et al., 2019; Hedna et al., 2020; Jackson et al., 2020).

### 3.1.5. Medical conditions and disability

A poor physical health is correlated to higher risk for suicide attempts in 7/10 studies (Nowers, 1993; Tsoh et al., 2005; Artero et al., 2006; Crandall et al., 2007; Almeida et al., 2016; Calati et al., 2017; Cabello et al., 2020). Older subjects were slightly more likely to have a preexisting medical condition [odds ratio (OR): 1.03, 95 % confidence interval (CI): 1.00–1.06] than those <65 years old (Crandall et al., 2007). Also, arthritis is considered a distressing medical condition associated to suicide attempts (Tsoh et al., 2005). Artero and colleagues (2006) found that older attempters had significantly higher rates of angina pectoris and coronary surgery, but not of myocardial infarction. Inversely, Calati and colleagues (2017) observed that lifetime headache frequency was significantly higher in subjects with a lifetime suicide attempt compared with controls (OR: 1.92, 95 % CI: 1.17–3.15). People with more than two health conditions (OR: 2.69) also showed a higher likelihood for reporting suicide attempts in the group of 65 years and older (Cabello et al., 2020). Two clear groups emerged, i.e., younger males, that is, males aged 65–74 years, and older females, that is, females 75 years and over, both having high levels of physical illness and both statistically significantly different from the other same-sex groups (Nowers, 1993). Also, higher disability (as measured with Activity of Daily Living, ADL and Instrumental Activities of Daily Living, IADL or

quality of life scales) was associated to suicide attempts (Tsoh et al., 2005; Zhang et al., 2016; Cabello et al., 2020), more than to completed suicide.

### 3.1.6. Socio-economic status

Furthermore, older people with no income or with no paid activity were more prone to attempt suicides, but economic status did not appear significant in a greater number of studies (1/3). Only Cabello and co-authors (2020) found that presence of food insecurity was associated with 12-month suicidal attempts. Also, the relationship between suicidal behaviour and social status was not significant in 4/4 studies analyzed (Tsoh et al., 2005; Ojagbemi et al., 2013; Cabello et al., 2020; Soriano Barceló et al., 2020). Higher social isolation was related to 12-month suicidal ideation in both age (young and older) groups and with 12-month suicide attempts in the young-and-middle age group (Cabello et al., 2020), not in late-life.

### 3.1.7. Marital and living status

Marital status was found significant in 6/10 studies (Nowers, 1993; De Leo et al., 2001; Artero et al., 2006; Calati et al., 2017; Jackson et al., 2020; Hedna 2020). Over 50 % of the suicide attempters were widowed and lived alone in the study of Nowers (1993), but not in the study of Soriano Barceló and colleagues (2020) and Zhang and colleagues (2016). Lower support at home (living alone) is considered a strong risk factor for half of the studies (4/8) (Nowers, 1993; De Leo et al., 2001; Calati et al., 2017; Jackson et al., 2020). Co-residence with children decreased risk (Tsoh et al., 2005; Soriano Barceló et al., 2020).

### 3.1.8. Previous suicide attempts and suicide ideation

Past suicide attempts appeared more linked to suicide attempts than to completed suicides (Tsoh et al., 2005). They appeared significant in 4/9 studies (Nowers, 1993; De Leo et al., 2001; Tsoh et al., 2005; Almeida et al., 2016). In 11.9 % of those who repeated suicide attempt, the previous suicide attempt had occurred during the previous year (De Leo et al., 2001). Suicide ideation was found significant in 3/5 studies

(Artero et al., 2006; Calati et al., 2017; Jackson et al., 2020).

### 3.1.9. Cognitive impairment

Although evaluated by 5 studies, cognitive impairment gave contrasting results. Menghini and Evans (2000) found that the rate of suicide attempts was higher among less cognitively impaired older resident in nursing home. Only Jackson and colleagues (2020) found a greater amount of cognitive impairment in the group of suicide attempters in a prospective, longitudinal, cohort study of people presenting to a regional referral center for deliberate self-poisoning (Calvary Mater Newcastle, Australia) over a 10-year period.

## 3.2. Completed suicides

As showed in Table 4 and in Fig. 2, the variables more associated with completed suicides were male sex (significant in 16/26 studies), a violent method to self-harm [significant in 14 (hanging and firearms)/18 studies], having any psychiatric disorder (depression, anxiety and bipolar disorders) (significant in 9/9 studies), having a poor medical condition (significant in 8/8 studies), and stressors/bereavement (significant in 4/4 studies). Fourteen reports on 20 studies confirmed that older age was a significant variable. Social isolation seemed not to influence completed suicides, but living status and household arrangement appeared significant in 4/5 studies. Psychological variables such as home satisfaction, perceived state of health, sense of free choice/control, life satisfaction, and happiness appeared to be moderate contributors (significant in 2/2 studies). Marital status (significant in 2/8 studies), economic status (significant in 2/6 studies) and cognitive impairment (significant in 1/5 studies) influenced the risk of completed suicide in a minor way.

### 3.2.1. Sex and age

The sex disparity in suicide mortality was greater in older people than in younger people. A mean M/F ratio amounted at 2.52 (Özer et al., 2016). Male sex was correlated to completed suicides in over half of the studies that analyzed this risk factor (significant in 16/26 studies) (Lindesay, 1986; De Leo et al., 2001; Menghini and Evans, 2000; Juurlink et al., 2004; Shah, 2007; Terranova et al., 2012; Almeida et al., 2016; Özer et al., 2016; Park et al., 2016; Altınöz et al., 2019; Crestani et al., 2019; Mokhtari et al., 2019; Barak et al., 2020; Hedna et al., 2021; Kaya et al., 2020; Schmutte and Wilkinson, 2020). In Europe, the population aged 65 years and over showed a mean suicide rate of 29.3 for the total sample, 49.5 for males and 19.3 for females (ratio F/M: 0.39) and the M/F ratio increased with age (De Leo et al., 2001). A recent Italian study found a M/F ratio of 2.74:1 (Crestani et al., 2019), in line with a previous European large study (De Leo et al., 2001). This trend was confirmed also in studies carried out in Korea (128.6/100,000 in men and 46.1/100,000 in women) (Park et al., 2016), Japan (38.5/100,000 in men and 18.6/100,000 in women) (Park et al., 2016), and in nursing home residents (29.7/100,000 in men and of 18.6/100,000 in women) (Scocco et al., 2006). In men, suicide risk was higher in those who were unmarried, in both users and nonusers of antidepressants (Hedna et al., 2020). The older age group had a higher crude mortality for suicide with psychiatric history than the younger group (14.31/100 000 vs. 1.19/100 000), although suicide decedents in older people were mostly females, especially for suicide deaths in those people with a psychiatric history (Shao et al., 2016; Wu and Bond, 2006). Among centenarians, suicide rate was 57 per 100 000 person years in men and 6.8 per 100 000 person years in women (Shah et al., 2014). The general decrease in suicides by drug poisoning in Sweden during the past two decades is less pronounced in older people (Carlsten et al., 1999). Older age stratum appeared to be a predictor of completed suicides in 14/20 studies (Lindesay, 1986; Menghini and Evans, 2000; De Leo et al., 2001; Wu and Bond, 2006; Tsoh et al., 2005; Shah, 2007; Torresani et al., 2014; Almeida et al., 2016; Shah et al., 2016; Altınöz et al., 2019; Crestani et al., 2019; Kaya et al., 2020; Schmutte and Wilkinson, 2020;

Hedna et al., 2021).

### 3.2.2. Psychiatric conditions

Having a psychiatric disorder seemed thus a risk factor for completed suicides significant in 9/9 studies (Menghini and Evans, 2000; De Leo et al., 2001; Turvey et al., 2002; Tsoh et al., 2005; Juurlink et al., 2004; Almeida et al., 2016; Shao et al., 2016; Altınöz et al., 2019; Schmutte and Wilkinson, 2020). Shao and colleagues (2016) found that 88.7 % had a history of a psychiatric condition.

Some studies investigated particular psychiatric conditions. In fact, Miller and colleagues (2008) found that suicide remained associated with a diagnosis of affective disorders (bipolar and unipolar depression) (OR:2.3; 95 % CI:1.3–4.2). According to Almeida and colleagues (2016), both bipolar [sub-distribution hazard ratio (SHR): 7.82, 95 % CI:3.08–19.90] and depressive disorders (SHR:2.26, 95 % CI:1.14–4.51) were associated with increased risk of suicide completion. Bipolar disorder (significant in 3/4 studies) (De Leo et al., 2001; Juurlink et al., 2004; Almeida et al., 2016), major depression (significant in 7/8 studies) (Menghini and Evans, 2000; De Leo et al., 2001; Turvey et al., 2002; Juurlink et al., 2004; Tsoh et al., 2005; Almeida et al., 2016; Schmutte and Wilkinson, 2020), and severe pain (Juurlink et al., 2004) were associated with the largest increases in suicide risk. Specifically, anxiety disorders (OR:4.65, 95 % CI:4.07–5.32), depression (OR:6.44, 95 % CI:5.45–7.61), psychotic disorders (OR:5.09, 95 % CI:3.94–6.59), bipolar disorder (OR:9.20, 95 % CI:4.38–19.33) were highly associated to completed suicide in older age (Juurlink et al., 2004).

### 3.2.3. Medical conditions

Organic and medical illnesses were considered significant in 8/8 studies (Menghini and Evans 2000; Turvey et al., 2002; Juurlink et al., 2004; Miller et al., 2008; Tsoh et al., 2005; Almeida et al., 2016; Altınöz et al., 2019; Crestani et al., 2019). Almeida and colleagues (2016) found a correlation between completed suicide and the number of health systems affected by disease (for 3–4 health systems, SHR: 6.02, 95 % CI:2.69–13.47; for  $\geq 5$  health systems, SHR: 11.18, 95 % CI: 4.89–25.53). Suicide completers were more likely to have been afflicted with chronic obstructive airway disease (Tsoh et al., 2005). As far as the single conditions are concerned, Miller and colleagues (2008) found that the only medical condition that remained associated with suicide was cancer (OR:2.3, 95 % CI:1.1–4.8). Menghini and Evans (2000) reported that four of the five completed suicides (80 %) exhibited impaired mobility and all of those who suicide had serious illnesses such as metastatic cancer or cirrhosis of the liver. Specific illnesses associated with suicide included congestive heart failure (OR:1.73, 95 % CI:1.33–2.24), chronic obstructive lung disease (OR:1.62, 95 % CI:1.37–1.92), seizure disorder (OR:2.95, 95 % CI:1.89–4.61), urinary incontinence (OR:2.02, 95 % CI:1.29–3.17) (Juurlink et al., 2004). Disability was less important in completed suicides compared to suicide attempts, Tsoh and colleagues (2005) found that IADL score was higher in suicide attempters than in completers.

### 3.2.4. Methods employed to self-harm

According to Altınöz and colleagues (2019), the most frequent suicide method among older adults of both sexes was hanging. Furthermore, in another large study, death by firearm was the single most frequent method, comprising over a quarter of all cases (Juurlink et al., 2004). Hanging was the most frequent method used to complete suicide in the study of Almeida and colleagues (2016) (50.7 %). Violent methods employed to self-harm was one of the most studied variables in completed suicides resulting significant in 14/18 studies (Lindesay, 1986; Menghini and Evans, 2000; Juurlink et al., 2004; Scocco et al., 2006; Terranova et al., 2012; Torresani et al., 2014; Almeida et al., 2016; Özer et al., 2016; Park et al., 2016; Altınöz et al., 2019; Crestani et al., 2019; Mokhtari et al., 2019; Kaya et al., 2020; Schmutte and Wilkinson, 2020).

### 3.2.5. Stressors/bereavement

Medical problems, loss of loved one, marital problems or separation, legal issues, other family conflicts, homelessness, significant anniversaries, financial problems were the most frequent stressors identified and considered significant in completed suicide studies in older age (4/4), also in nursing homes (Menghini and Evans, 2000, Tsoh et al., 2005, Altınöz et al. 2019; Schmutte and Wilkinson, 2020). The total number of recent life events among the suicide completers was higher than for the attempters (Tsoh et al., 2005).

### 3.2.6. Social isolation, marital and living status

From the studies selected, social isolation was poor significantly associated to both completed suicides and suicide attempts in older age. When compared with younger suicides, social isolation or interpersonal loss was not more common among older suicide victims (Turvey et al., 2002). Furthermore, social network measured with the Lubben Social Network Scale was higher (better score) in suicide completers (Tsoh et al., 2005). The sample of completed suicides in older age exhibited a predominance of subjects who lived alone (De Leo et al., 2001; Tsoh et al., 2005; Shah, 2009; Torresani et al., 2014). Social losses such as widowhood were also considered to be a risk factor for suicide in older population, especially among men (Menghini and Evans, 2000; De Leo et al., 2001). The impact of mean household size and family structure on older suicides may be mediated and modified through cultural factors (Shah, 2009).

### 3.2.7. Economic status

A significantly lower prevalence of economic distress on older suicides was found. Economic status did not play an important role in the studies selected in the present systematic review. Suicides in older age were associated with not having economic troubles (Torresani et al., 2014). Only 2/6 studies found significant results (Wu and Bond, 2006; Hedna et al., 2021).

### 3.3. Risk of bias across studies and overall quality of evidence for risk factors for suicide attempts and completed suicides in older age

Examining all the 39 included studies in the present systematic review (Tables 2 and 3), for the 17 studies that focused on suicide attempts, bias was detected predominantly in the domains of sample size justification (selection bias) (14/17 studies, 82 % of studies with higher risk of bias) and blinded assessors (detection bias) (15/17 studies, 88 % of studies with higher risk of bias), and at a lower extent in the domains of participation rate (4/17 studies, 23 % of studies with higher risk of bias) and levels of exposure (4/17 studies, 23 % of studies with higher risk of bias). For the 28 studies that focused on completed suicides, again, bias was detected predominantly in the domains of sample size justification (selection bias) (24/28 studies, 85 % of studies with higher risk of bias) and blinded assessors (detection bias) (25/28 studies, 96 % of studies with higher risk of bias), and at a lower extent in the domain of levels of exposure (9/28 studies, 32 % of studies with higher risk of bias).

Using the GRADE approach, the overall quality of evidence was judged as moderate for suicide attempts and for completed suicides. Overall, the variables more associated to suicide attempts in older age were depressive disorder (moderate quality of evidence), methods employed to self-harm (particularly poisoning) (moderate quality of evidence), and psychotropic drugs utilization (moderate quality of evidence) followed by psychological factors (low quality of evidence), and disability (low quality of evidence). Also, having any psychiatric disorder (moderate quality of evidence), having a poor medical condition (moderate quality of evidence), living status (low quality of evidence) and marital status (low quality of evidence) were considered relevant. Other factors, such as socio-demographic characteristics (i.e. female sex, socio-economic status) and previous suicide attempts, were also associated with attempted suicide, but the overall quality of evidence for these factors was low. Overall, based on a moderate quality of evidence,

the risk factors more associated with completed suicides were male sex, a violent method to self-harm, having any psychiatric disorder, having a poor medical condition, while the overall quality of evidence for stressors/bereavement, and living alone was low. Older age and psychological variables appeared to be moderate contributors (low quality of evidence).

## 4. Discussion

In the present systematic review, among 28 risk factors identified in predicting older age suicidal behavior, socio-demographic variables (age, sex, and education), somatic and psychiatric disorders, and methods employed to self-harm were the most frequent analyzed for both completed and suicide attempts, although the findings were contrasting. The existence of a substantial heterogeneity in the population-based studies investigating suicidal behavior in older age underlines that this phenomenon would be amplified by an analysis done on a whole set of contrasting variables and, at last, along with the approximations originated by the standardization of the methodologies adopted. In the present systematic review, the risk factors more associated to suicide attempts in older age were depressive disorders, methods employed to self-harm (particularly poisoning), and psychotropic drug utilization followed by psychological factors and disability. Moreover, the risk factors more associated with completed suicides were male sex, a violent method to self-harm, having any psychiatric disorder (depression, anxiety and bipolar disorders), having a poor medical condition, stressors/bereavement, and living alone. Marital status, previous suicide attempts and suicidal ideation had a moderate impact for suicide attempts, and economic status for completed suicides. Social isolation and cognitive impairment appeared to be less relevant than other risk factors for both suicide attempts and completed suicides.

In older age, a series of systematic reviews on suicidal behavior exist, but these studies had a different focus, i.e., self-harm in older adults (Wand et al., 2018; Troya et al., 2019), investigated only a risk factor, i.e., personality disorders (Brezo et al., 2006; Szücs et al., 2018), functional disability (Fässberg et al., 2016; Lutz and Fiske, 2018), or physical illness (Fässberg et al., 2016), or a specific setting (e.g., nursing homes) (Murphy et al., 2015), included also suicidal ideation as an outcome (Simon et al., 2013), or only qualitative studies (Wand et al., 2018). Therefore, we did not compare directly the present selected findings with those of these previous systematic reviews on similar topics.

The present systematic review suggested that the most significant independent factor associated with attempting suicide was a current diagnosis of major depression, followed by methods employed to self-harm (particularly poisoning), psychotropic drug utilization, psychological factors, and disability. Female sex appeared to be contrasting as risk factor for suicide attempts. Suicide completers were more likely to have any psychiatric disorder (particularly depression and bipolar disorders), to have somatic conditions (cancer, arthritis, pneumonia), to experience more stressful life events and to use violent methods for self-harm (hanging or firearms). Male sex was unequivocally linked to complete suicides. In the reviewed studies, social isolation was heterogeneously assessed and appeared to be poorly significant for both completed suicides and suicide attempts. Although sufficiently studied, also, cognitive impairment had no significant findings. Living status appeared to be a risk factor for both attempted and completed suicides, marital status (widowed) in particular for attempted suicides.

Although the rates of completed suicides among older people reported by the World Health Organization showed a steady rise in prevalence with age, the consideration of suicidality among older adults has lagged behind that of younger age groups (Preventing suicide - World Health Organization, 2020). Male sex was the most associated risk factor to completed suicides. Confirming this finding, whereas the rate of suicide per 100,000 people in the United States was 11.26 for the general population, it was 14.22 for people older than 65 years and 28.51 for men older than 65 years. Furthermore, the suicide rates for



men were highest among those 75 years or older (36.1/100,000) (CDC, 2012).

The mean suicide attempt rate in Europe in people aged 65+ is 61.4/100,000 total, 57.7/100,000 for males and 64/100,000 for female (CDC, 2012). So, female sex was the most studied risk factor for suicide attempts, but also the most controversial. A mediated analysis showed that psychological factors (associated to both suicide attempts and completed suicides), like home satisfaction and happiness, could mediate the impact of socio-demographic variables, like the sex ratio or social isolation, in predicting suicide rates (Wu and Bond, 2006) and could explain in some cases these contradictory results. Older people are more prone than their younger counterparts to be affected by the level of life satisfaction condition in their suicidal behavior.

About the relationship between mental health and suicidal behaviour, it is possible that a large proportion of the subjects not in contact with mental health services display significant psychiatric symptoms. In fact, a retrospective evaluation (psychological autopsy) of 141 persons aged 21–92 years who completed suicide in the Monroe County of New York, USA, between August 1989 and February 1992, indicated that over 90 % of the victims had a diagnosable axis I disorder (Conwell et al., 1996). Mood disorder was significantly more common in older victims. Given the pivotal role of depression as a risk factor for suicide, improvements must be made in the detection and proper treatment of this disorder. In addition, older Australian men with multimorbidity had the highest risk of death by suicide, even after taking into account the presence of mood disorders (Almeida et al., 2016). Unrecognized depression is common in older age (Conwell et al., 2011), and the present analysis likely underestimated the true magnitude of the association between depression and suicide.

Stressful life events were common for the rural older adults who completed suicides, especially long-term stressful life events. Illnesses in family members and friends, and separation from or conflict with family members or friends were the main stressful life events experienced by older people (Murphy et al., 2015). Personal loss was a major risk factor reported, where many people who suicided had experienced one or more major losses proximate to their suicide. The nature of major personal losses included loss of a spouse, child, or pet, loss of physical or cognitive function, loss of personal dignity or self-esteem, and financial loss, although it was unclear how recently the loss occurred.

Some considerations about men death for suicides is how male sex deals with adversity like divorce or widowhood. The apparent effect of divorce on men, in terms of suicide, is greater than the effect seen in women even though women are often financially worse off after divorce (Mann and Kuehn, 2014). Regarding marital status, an index of the phenomenon of social integration within social structures, one partial explanation of a differential association with suicides may be that the oldest men lacking partners may be more prone to social isolation, and loneliness. According to the results of a recent stratified analysis by sex, non-married men exhibited a greater risk of suicides than their married counterparts in all sub-analyses, but women aged 65 years or older showed no significant association between marital status and suicides (Kyung-Sook et al., 2018). A spouse is always the most important and available caregiver during older age. Another issue might be the interaction of male stereotypes (being strong and stoical) and mental illness stereotypes, leading to the exacerbation of the effect of stigma on seeking mental health services (Judd et al., 2008). So, for older people, the death of a spouse, bringing economic and emotional losses, social isolation, and changes in the social roles are main social risk factors for suicide, but some differences according to sex (Levy et al., 2011). Family poverty, work problems, and family discord were more commonly reported among male suicide cases in Western society (Zhang et al., 2016).

Although suicide completers and attempters' groups performed poorly on ADL functioning compared with the community comparison subjects, the completers were more able in this regard (Tsoh et al., 2005). In particular, healthcare professionals should be vigilant about the psychological repercussions of distressful physical ailments,

especially in the cases of arthritis and chronic obstructive airway disease, associated functional impairments and hospitalization itself. With the exception of cancer (more associated to completed suicides), diseases of all individual health systems were associated with increased odds of suicide attempts (Almeida et al., 2016).

Another controversial aspect is cognitive impairment in suicidal behavior. Reduced cognitive performance might have impacted on problem-solving skills, contributing to the seriousness of the suicidal process. It is not clear whether reduced cognitive function might be related to the attempt itself. Inversely even though there have been several efforts to predict the clinical factors of suicidal death in people with dementia, most participants were either psychiatric inpatients or had severe medical comorbidity (Harwood et al., 2001; Seyfried et al., 2011). Two studies who provided quantitative data on the cognitive function of those who had suicided, found that the majority (75–80 %) of residents who suicided were cognitively functional (Menghini and Evans, 2000; Scocco et al., 2006). Patients with dementia had an increased risk of suicide death within 1 year after diagnosis compared to those without dementia (Choi et al., 2021).

The greater use of benzodiazepines in older age (75 and plus years), only hides a poor identification of depressive syndromes and, accordingly, under-treatment with antidepressant (Assem-Hilger et al., 2009). As demonstrated in previous studies (De Leo et al., 2001), the majority of older adults use non-violent means in suicide attempts. Several studies (Conwell et al., 2011; Soriano Barcelo et al., 2020) suggested that it was more common among older adults to swallow prescribed drugs, perhaps because they have more accessibility to prescribed medications due to their physical illnesses and a more lethal intent of their suicide attempt or self-harm. Taking psychotropic drugs reflects how the individuals suffered from some mental disorder. A large proportion of the suicide cases (71.3 %) used tranquilizers, sedatives, or hypnotics during the 2-week period preceding their suicide, suggesting that their healthcare providers were aware of their psychological distress (Preville et al., 2005).

A framework targeting the “Five Ds” of late-life suicide was suggested (Conwell et al., 2011): Depression, functional impairment (Disability), physical illness and pain (Disease), social isolation (Disconnectedness), and access to lethal (Deadly) means. Among these, social isolation was the most controversial, maybe for the different instruments of assessment used in the different studies and the several aspects of social isolation considered (loneliness and social network). Risk for suicides associated with social isolation could be mediated by depressive illness, that those who lack social support are more vulnerable to depression, which in turn leads to suicide (Turvey et al., 2002).

In the present study, the heterogeneity of different variables in suicide risk assessment would make the meta-analysis poorly reliable in quantitative terms. Some other limitations of the present systematic review should also take in account. Firstly, study designs were different in the selected studies. The way of statistical survey of risk factors, even with equality of definition was different between studies both in terms of rating scales used and in the concrete definition of the risk factor (i.e., social support could be defined as number of friends, number of control visits in the last year, institutions in support). Furthermore, the statistical analyses vary with use of ORs, relative risks, and differences between means, multivariate models differed in the various selected studies both qualitatively and as for number of considered variables, and the sample size varies significantly between reports. Moreover, the variables combinations varied substantially between studies. Finally, existing research in this area has been largely dominated by a risk factor approach. This is of limited usefulness since only a minority of those at risk go on to make an attempt. Risk factors identified in the selected studies were often absent or constructed by participants as not relevant to their attempt (Crocker et al., 2006). Therefore, prediction, prevention and the management of risk for suicidal behaviour in older age remained challenging.

However, although suicide attempts and completed suicides are in

most cases unpredictable, when facing aged patients, clinicians should keep into consideration male gender, the severity of depressive symptoms, the degree of disability, the presence of multimorbid somatic diseases and pain, living status, and access to lethal means. Old age psychiatrists have a crucial role in suicide prevention, by contributing to the understanding of late-life mental health disorders and their interaction with physical health (Cheung, 2015). People with serious mental disorders aged 65 or over, newly presenting to local mental health services or have not been under the care of other local mental health services, should be cared with a multidimensional assistance. Assessment is the foundation of high-quality prevention in old age psychiatry, particularly from a scientific and research point of view (Hemsley et al., 2015). In the next future, the present findings could help old age psychiatrists to target the prevention of suicidal behavior in late life in people with serious mental disorders and significant age-related multimorbidity and frailty that often complicates the management of mental health in older age (Panza et al., 2019).

### Author contributions

Conceptualization: M.B. and M.L.; Methodology: M.B., M.L., and F.P.; Writing—Original Draft Preparation, M.B., M.L. and F.P.; Data collection: E.B., F.F., A.M., G.B. D.P., E.R., and A.D.; Writing—Review & Editing, F.P., C.G.C., C.M.C., A.B., M.A. and A.D.; Supervision: M.L. and F.P. All authors have read and agreed to the published version of the manuscript.

### Data availability statement

The data that support the findings of the present study are available from the corresponding authors (FP and ML) upon reasonable request.

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