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Understanding Suicide Risk Through a One Health Lens: A Scoping Review of Biological, Psychological, Social, and Environmental Factors in Older Adulthood

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1. Abstract

Older adult suicide is a crucial public health problem with distinctive epidemiological characteristics, including high lethality and specific clinical symptoms. Despite the number of identified risk factors for suicidality in older adults, the available data are highly fragmented. Consequently, the present scoping review assessed the biological, psychological, social, and environmental risk factors of suicidality among elderly patients aged 65 years and above using the One Health perspective. A systematic search was conducted in the databases PubMed, Scopus, and Web of Science for the year 2015 - 2025. The eligibility criteria for the studies were that they should have assessed suicidality risk among elderly patients, and at least one biological, psychological, social, or environmental risk factor should be studied. Consequently, a total of 23 articles met the criteria for the present study. The selected articles' data were collected and analyzed using four One Health domains. It was found that suicidality in older adults is caused by multiple intertwined risk factors. Social factors such as marital status, financial difficulties, education, and housing type were the most prevalent and the ones most often associated with suicidality. Biological factors like chronic illnesses, non-communicable diseases, and advanced cancer stage were thoroughly studied and acted as risk multipliers interacting with psychosocial factors. Psychological factors like depression, anxiety, hopelessness, and loss of meaning in life played a major role and were key drivers in both clinical and community samples. Environmental factors like variations in ambient temperature, extreme heat exposure, and air pollution were mentioned in a few articles and were almost always considered without regard to clinical and psychosocial variables. All in all, the present review shows the complex nature of suicidality in later life and reveals some gaps in research such as the isolation of environmental factors and lack of human-animal relationship studies.

Keywords: older adulthood suicidality; One Health; late-life suicide; suicide risk factors; psychosocial determinants; environmental health; scoping review.

2. Introduction

Suicide is a major public health issue across the world, contributing to the leading cause of avoidable deaths in all age groups. It is not only harmful for individuals but also causes tremendous burdens on health care facilities, weakens community networks, and leads to prolonged mental trauma in families. According to World Health Organization (WHO, 2023) statistics on global health, more than 720 000 people commit suicide annually. As defined by public health organizations, such as the Centers for Disease Control and Prevention in the USA (CDCP, 2024), suicide can be described as death resulting from self-directed injurious behavior executed with an explicit or implicit intent to die. Although the majority of studies focus on adolescents and young adults, the data show that high suicide mortality rates are also observed among older adults.

2.1. Suicidal Tendencies in Older Adults

Although suicidal acts take place at all ages, suicidality among older adults, defined as people over 65 years old, is characterized by unique epidemiology and clinical features, such as extremely high mortality rate. In the past, suicide in later life was sometimes erroneously perceived as a natural consequence of physical degeneration or illness. However, modern psychiatric and psychological studies prove that the mentioned type of behavior is not the norm and is caused by various factors that can be altered (Conejero et al., 2018; Szanto et al., 2020).

Suicidal tendencies in older adults manifest within a specific bio-developmental context. The older people make less non-lethal attempts of suicide prior to suicide and use more lethal methods along with greater desire to die compared to other generations (Fazel & Runeson, 2020). The ratio of the number of suicidal attempts to completed suicides sharply decreases from about 20:1 in the general population to as low as 4:1 or even 2:1 in the case of older people (De Leo et al., 2013; Szanto et al., 2020). Lethality is explained by increased physiological fragility, vulnerability of the body to harm, meticulousness, and lack of assistance because of social isolation (Conejero et al., 2018).

Indeed, the aging process is typically accompanied by the accumulation of systemic general factors which increase the risk of dying by suicide. Chronic physical conditions, including

cardiovascular diseases, chronic obstructive pulmonary disease, cancers, and pain, are normally linked to functional impairment and loss of independence (Fairman & Buckley, 2022; Juan et al., 2024). Furthermore, somatic conditions are often comorbid with mental disorders, such as major depression, anxiety, hopelessness, and cognitive decline, playing the role of primary psychopathological risk factors for suicide (Borges et al., 2015; Heisel & Flett, 2016). The social determinants include small social networks, widowed status, isolation, and financial troubles that impair significantly the capacity of elderly people to face difficulties (Abdel-Rahman, 2019; Grande et al., 2022; Neufeld et al., 2015). In addition, macro environmental stress factors, such as variations in ambient temperature and air pollution, also influence the physiological state of older people, who are vulnerable to external changes (Bär et al., 2022; Kim S. et al., 2024; Wu et al., 2024).

However, even despite the fast global growth of the aging population, the scientific literature on the problem of suicidality among the elderly is still fragmented between disciplines. Although many studies analyze various clinical, demographic, or meteorological factors, the models taking into account physical environmental determinants together with clinical and socio-economic factors are still few. For this reason, it is important to use a multi-system approach, such as One Health, to understand the complex interaction of factors leading to suicide among older adults.

2.2. One Health Framework

One Health is an approach that recognizes that the health and well-being of individuals are influenced by the interactions between multiple biological, social, and environmental factors. Closely focusing on the connection between the health of people, the health of animals, and our environment (WHO, 2026). The concept has existed for several decades, although it has been applied primarily to infectious diseases and environmental health. One Health emerged in response to the findings that many infectious diseases originate directly from animals and are influenced by human activities such as changes in land use, urbanization, and international travel. These developments pointed out the need for collaboration between human, animal, and environmental health sectors for a better understanding of the health challenges (Mackenzie & Jeggo, 2019).

Recently, the One Health framework has gained relevance in psychology. From a psychological perspective, the approach emphasizes that health and well-being are not only influenced by biological factors but also by social and environmental factors. Researchers have recognized that psychological well-being is interconnected to the health of the surrounding environment and that, to understand new health challenges, they need to understand human behavior first. The application of the One Health perspective might be particularly helpful in understanding complex mental health issues. Rather than connecting health conditions to a single cause, it acknowledges that health and well-being are shaped by multiple interacting factors at different levels. The One Health perspective is particularly useful in adulthood suicidality, which has been associated with a wide range of biological, psychological, social, and environmental factors (Gilli et al. 2022).

2.3. Risk Factors for Suicide in Older Adults

Suicidal behavior in older adults is a complex, multifactorial phenomenon resulting from the interaction of numerous interrelated factors. Research experience shows that suicidality of the elderly are affected by complicated interactions within biological, psychological, social, and environmental domains. Previous studies found high connections between late-life suicidality and the presence of psychiatric disorders, somatic diseases, cognitive impairments, functional limitations, bereavement, financial difficulties, and social isolation (Conejero et al., 2018; Fazel & Runeson, 2020; Szanto et al., 2020). Even though suicide attempts of older people have a high rate of success, late-life suicidality is relatively unstudied compared to suicides committed by adolescents and younger adults. Conejero et al. (2018) pointed out the relative lack of longitudinal, multi-systemic studies involving older patients since age-specific symptomatology such as somatization of depression or mild cognitive impairments usually result in under-recognition of suicidal risk during the primary health care visit. Similarly, Szanto et al. (2020) pointed to the relative underresearched status of neurobiological and environmental factors causing suicidal intentions in later life.

Although numerous individual risk factors have been identified, existing findings remain fragmented across specialized medical and psychiatric disciplines. A vast majority of the available

literature considers risk factors within the domain in isolation rather than looking at their interactions within the aging process. It is necessary for there to be an integrative analysis of the existing knowledge base from a systemic perspective like that provided by the One Health approach in order to gain more insight into the issue of suicide risk in old age and identify significant conceptual gaps.

2.4. Aim and Objectives

Although numerous risk factors for older age suicidality have been identified, research often examines each factor separately, and they usually overlook the environmental determinants, such as pollution or climate stress. As a result of this, the understanding of how these factors interact remains limited. Using the One Health framework allows us to treat biological, psychological, social, and environmental risk factors as equal, helping us with the understanding of suicide in older adulthood. This scoping review aims to answer the following research question: What are the biological, psychological, social, and environmental risk factors associated with older adulthood suicidality when examined through a One Health lens?

More specifically, this review aimed to: (1) To identify risk factors associated with older adulthood suicidality. (2) To classify identified risk factors into four domains: biological, psychological, social, and environmental. (3) To highlight gaps and limitations in the literature.

3. Methods

3.1. Protocol and Registration

This scoping review (ScR) was conducted in accordance with the JBI guidelines for scoping review (Peters et al., 2020) and is reported following the PRISMA-ScR checklist (Tricco et al., 2018) (Figure 1). This study represents the older adulthood-focused component of a broader study, meaning biological, psychological, social, and environmental risk factors for suicide across the human life span through a One Health lens. The wider project is structured around four life stages: childhood, adolescence/early adulthood, adulthood, and older adulthood. This study focuses specifically on older adulthood defined as ages 65+, consistent with the age threshold used by Eurostat (2020) to classify older people.

3.2. Eligibility Criteria

This study included peer-reviewed primary research studies written in English and published within the last 10 years that examined risk factors associated with suicide-related outcomes among elderly people 65+ years. Suicide-related outcomes included suicidal ideation, suicide attempts, death by suicide, or a composite measure of suicidality. Moreover, eligible studies must investigate at least one risk factor within the following domains: biological factors (e.g., genetic vulnerability, neurological illness, or chronic physical conditions), psychological factors (e.g., mental illness, trauma, hopelessness, others), social factors (e.g., socioeconomic disadvantages, family relationships, social support, discrimination, or interpersonal adversity), and environmental factors (e.g., pollution, climate-related exposures, housing instability, access to green or blue spaces, etc). Studies conducted in any setting were considered. For instance, community, clinical, institutional, urban, rural, and low, middle, or high-income contexts. Quantitative, qualitative, and mixed-methods primary studies and retrospective studies were considered. Studies were excluded if they were reviews, meta-analyses, theoretical papers, book chapters, editorials, opinion pieces, conference abstracts, grey literature, or if they did not provide primary empirical data. Studies including mixed-age samples were excluded unless childhood-specific data were reported separately.

3.3. Information Sources and Search Strategy

The search strategy was developed and piloted in PubMed and then adapted for Scopus and Web of Science. Searches focused on literature published from 2015 to 2025 to capture the recent data on suicide. The strategy combined terms related to suicide, risk factors, older adulthood, and environmental or One Health-related exposures, as seen in Table 1.

Table 1 PubMed Search String

Search component	Terms
PubMed (152)	("Suicide"[MeSH] OR suicid*[tiab]) AND ("Risk Factors"[MeSH] OR risk factor*[tiab] OR predictor*[tiab] OR associated factor*[tiab]) AND ("Aged"[MeSH] OR "older adult*[tiab] OR elder*[tiab] OR geriatric[tiab]) AND ("Environment"[MeSH] OR environmental[tiab] OR "climate"[tiab] OR "pollution"[tiab] OR "urban"[tiab] OR "green space"[tiab] OR "One Health"[tiab])
Scopus (152)	(TITLE-ABS-KEY (suicid*) OR TITLE-ABS-KEY ("suicide")) AND (TITLE-ABS-KEY ("risk factor*") OR TITLE-ABS-KEY (predictor*) OR TITLE-ABS-KEY ("associated factor*")) AND (TITLE-ABS-KEY ("older adult*") OR TITLE-ABS-KEY (elder*) OR TITLE-ABS-KEY (geriatric)) AND (TITLE-ABS-KEY (environment*) OR TITLE-ABS-KEY ("climate") OR TITLE-ABS-KEY ("pollution") OR TITLE-ABS-KEY ("urban") OR TITLE-ABS-KEY ("green space") OR TITLE-ABS-KEY ("One Health")) AND PUBYEAR > 2014 AND PUBYEAR < 2026

WOS (84) (TS=(suicid*) OR TS=("suicide"))
 AND (TS=("risk factor*") OR TS=(predictor*) OR TS=("associated factor*"))
 AND (TS=("older adult*") OR TS=(elder*) OR TS=(geriatric))
 AND (TS=(environment*) OR TS=("climate") OR TS=("pollution")
 OR TS=("urban") OR TS=("green space") OR TS=("One Health"))

3.4. Study Selection

All retrieved references were downloaded as CSV or RIS files and uploaded into Rayyan (Ouzzani et al., 2016), where duplicates were automatically removed. Two reviewers, M.K. and L.K., independently screened titles and abstracts against the predefined inclusion and exclusion criteria. Full texts of potentially eligible studies were assessed independently by the same reviewers. In case of disagreements, a third reviewer, M.E.R., was included in the screening process. The study selection process is reported in the PRISMA flowchart (Figure 1).

3.5. Data Charting and Synthesis

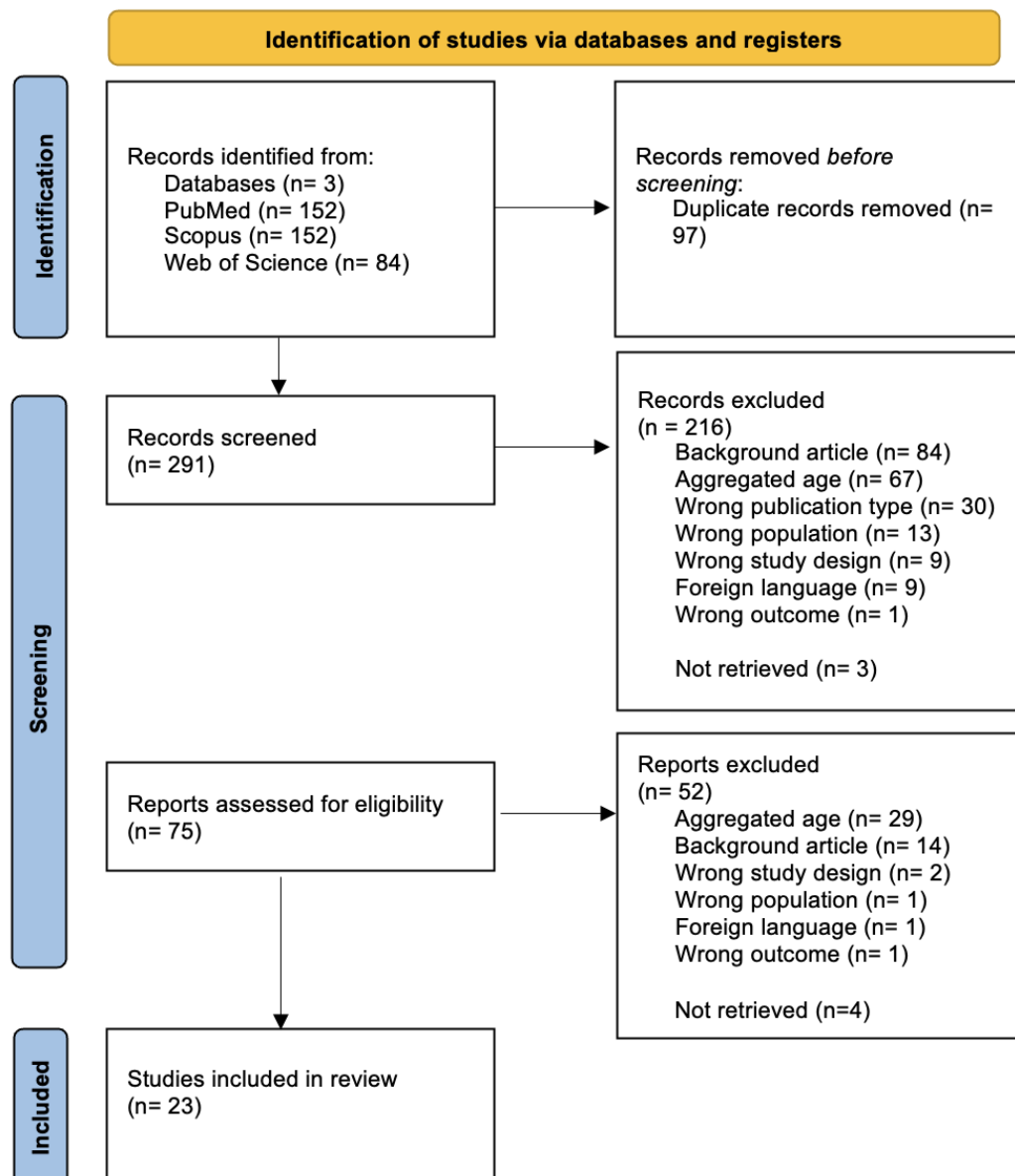
A standardized data-charting form was developed and piloted before extraction. Extracted information included author, year, country, study design, sample size, population characteristics, suicide-related outcome, and risk factor examined. Risk factors were categorized into One Health domains: biological, psychological, social, and environmental. To ensure consistency, studies were first assigned to the domain most prominently reflected in their objective outcomes. When studies addressed more than one domain, secondary domains were also recorded. Any uncertainty regarding domain allocation was resolved through discussion between three reviewers.

4. Results

4.1. Search Results

As shown in the PRISMA-ScR flow diagram (Figure 1), this study initially included 388 articles across 3 databases (Scopus: 152; PubMed: 152; Web of Science: 84). After automatically removing 97 duplicates, we were left with 291 papers. After following strict exclusion criteria, the title and abstract selection excluded 214 articles, and the full-text selection excluded 51 of the studies. We were left with 23 studies that matched the inclusion criteria.

Figure 1 PRISMA-ScR Flow Diagram for Identification, Screening, Eligibility and Inclusion.



4.2. Study Characteristics

A total of 23 studies were included in this scoping review (ScR). Publication years ranged from 2015 to 2024, articles were published evenly throughout the analysis period. The data was collected from populations from 11 different countries (Figure 2), while most studies were conducted in the United States and China (n=5; 22%), others were from countries such as Canada (n=2; 9%) (Neufeld et al., 2015; Heisel M.J. and Flett G.L., 2016), South Korea (n=2; 9%) (Kim S. et al., 2024; Lee et al., 2017), Sweden (n=2; 9%) (Gemmill et al., 2015; Tuveesson et. al., 2017), Taiwan (n=2; 9%) (Hung et al., 2016; Juan et al., 2024), Australia (n=1; 4%) (Koo et al., 2017), Italy (n=1; 4%) (Grande et al., 2022), Japan (n=1; 4%) (Sim et al., 2020); Mexico (n=1; 4%) (Borges et al., 2015), and Switzerland (n=1; 4%) (Bär et al., 2022).

Study designs were mostly cross-sectional (n=6) (Borges et al., 2015; Fairman & Buckley, 2022; Lee et al., 2017; Tuveesson et al., 2017; Koo et al., 2017; Zhu et al., 2022), cross-sectional with path analysis (n=1) (Ge et al., 2016), and time-series/ecological time-series studies (n=5) (Bär et al., 2022; Gemmill et al., 2015; Sim et al., 2020; Wu et al., 2024; Zhou et al., 2023). These were followed by retrospective cohort studies (n=4) (Abdel-Rahman, 2019; Grande et al., 2022; Rhee et al., 2021; Zhou et al., 2024), longitudinal/prospective cohort studies (n=3) (Heisel & Flett, 2016; Hung et al., 2016; Neufeld et al., 2015), case-crossover studies (n=2) (Guo-Zhen Lin et al., 2016; Kim S. et al., 2024), population-based case-control studies (n=1) (Juan et al., 2024), and spatial ecological studies (n=1) (Graetz et al., 2020).

The included studies demonstrated large variability in sample size, ranging from 173 to 9,686,698 participants, with a median of 703,348 participants. Across the included studies, both male and female participants were represented. Several studies reported a higher proportion of male participants (e.g. Zhou et al., 2024, Bär et al., 2022), but at the same time, other studies show a predominance of female sex participants (e.g. Rhee et al., 2021, Neufeld et al., 2015). Thus, in general, we can say that sex distribution depends on the specific study and there is no clear trend. Participants were predominantly older adults aged 65 and older (e.g., Tuveesson et al., 2017; Zhu et

al., 2022), with several studies focusing specifically on elderly people 75 years and above (Grande et al., 2022; Koo et al., 2017; Juan et al., 2024). In some studies, the older population was part of the analysis within age-disaggregated data (e.g., Gemmill et al., 2015; Sim et al., 2020; Fairman & Buckley, 2022) or general population analyses.

Moreover, Table 2 summarizes the characteristics of the studies included in this review.

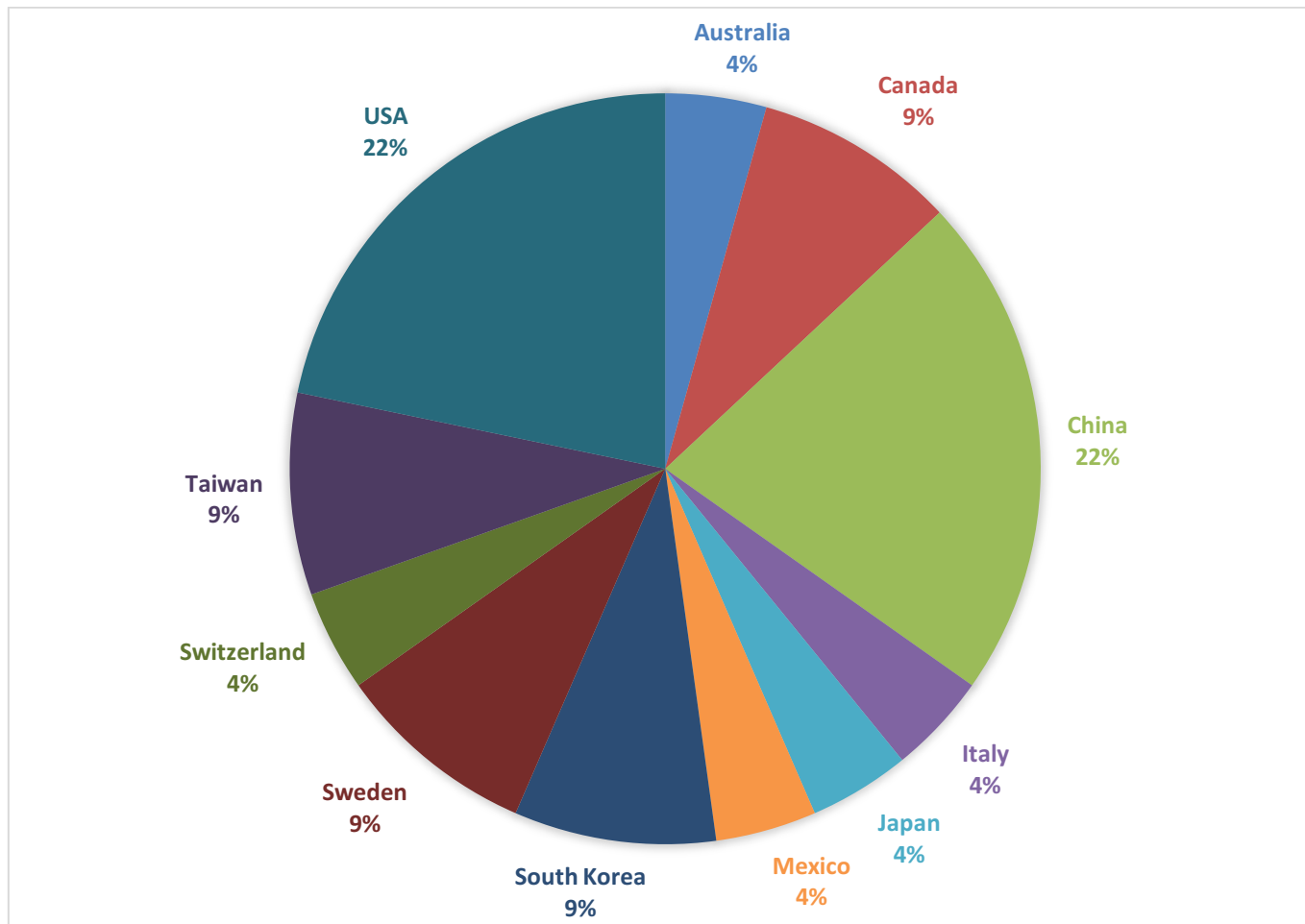


Figure 2 Countries and Percentage of Papers Included in this ScR.

Table 2 *Characteristics of the Included Studies*

First author surname and year of publication	Country	Study Design	Sample Size	Population Characteristics	Life Stage(s) Covered	Suicide Outcome
Bär et al., 2022	Switzerland	Time-series study	24,067 in total (65+ yo - 6,188)	74.3% (17,873) were male, 53.5% (12,870) were aged between 35 and 65 years, 20.8% (5,009) were younger than 35 years and 25.7% (6,188) were older than 65 years.	Adolescence/Early Adulthood, Adulthood, and Older Adulthood	Death
Rhee et al., 2021	USA	Retrospective cohort study	41620	Medicare-insured psychiatric inpatients; mean age 74.7 (SD 7.09); 65.4% female; primary diagnosis mostly major depressive disorder (70.5%-70.6%). 10,460 in the ECT group and 31,160 in the control group.	Older Adulthood	Death
Grande et al., 2022	Italy	Retrospective cohort study	9,686,698	Individuals aged 75 years or older. The cohort consisted of 41% men and 59% women.	Older Adulthood	Death
Gemmil et al., 2015	Sweden	Time-series study	Not found for individual participants	The study analyzed aggregate national monthly suicide counts over 144 months. Working age (20–64 years old) men and women, and older (aged 65 years and older) men and women	Adulthood and Older Adulthood	Death
Koo et al., 2017	Australia	Cross-sectional study	1086	Adults aged 65 years and over, mean age 75.5 years, 79.7% male	Older Adulthood	Death

Fairman, K. A., & Buckley, K., 2022	USA	Cross-sectional study	201,846	U.S. community-dwelling adults aged 19 years and older; includes both civilians and military veterans separated or retired from service.	Early Adulthood, Adulthood, and Older Adulthood	Ideation
Sim et al., 2020	Japan	Multi-city time-series study	1,067,333	Suicide deaths recorded in 47 prefectures of Japan between 1972–2015; analyses conducted by sex and age groups (15–64 years and ≥65 years)	Early adulthood, Adulthood, and Older adulthood	Death
Zhou et al., 2023	China	Time-series study	432 008	Individuals who died by suicide in China (N = 432,008), mean age 57.6 years, 68.9% male; analyses stratified by age groups	Adulthood and Older adulthood	Death
Guo-Zhen Lin et al., 2016	China	Case-crossover study	1550	The sample consisted of 56.8% males and 43.2% females.	Adulthood and Older adulthood	Death
Abdel-Rahman O., 2019	USA	Population-based retrospective cohort study (based on SEER)	3,149,235	Cancer patients diagnosed between 2000-2010, the cohort is 51.8% male, 82.8% white, with 47.9% presenting localized disease	Adulthood and Older adulthood	Death
Ge et al., 2016	China	Cross-sectional study	3,313	The sample includes both male and female, rural and urban residents, single and couple marital statuses, and individuals living alone or with children.	Older Adulthood	Suicidal ideation
Kim S. et al., 2024	South Korea	Case-crossover study with a distributed lag nonlinear model	48,934	Male and female patients who visited emergency rooms for intentional self-harm or died by suicide (35,518 non-fatal intentional self-harm visits and 13,416 suicide deaths)	Childhood, Adolescence/Early Adulthood, Adulthood, and Older Adulthood	Intentional self-harm and suicide death

Juan et al., 2024	Taiwan	Population-based case-control study	9,136 suicide cases and 89,439 matched controls	Older adults aged ≥ 65 years; mean age 75.7 years. The mean age of suicide cases was 75.7 ± 7.4 years, and 64.9 % of the cases were men. Among the cases, 42.5 % lived in urban areas, 38.8 % in suburban areas, and 18.7 % in rural areas.	Older Adulthood	Suicide deaths
Graetz et al., 2020	USA	Ecological spatial study	704 commuting zones	Non-Hispanic White population in the United States; analyses stratified by sex and age groups (20–64 and ≥ 65 years)	Adolescence/Early Adulthood, Adulthood, and Older Adulthood	Suicide mortality
Neufeld et al., 2015	Canada	Prospective cohort study	219,723	Home care clients aged 60 years and older assessed using the Resident Assessment Instrument-Home Care (RAI-HC); includes individuals with and without intentional self-harm events	Adulthood and Older Adulthood	Intentional self-harm
Heisel M.J. and Flett G.L., 2016	Canada	Longitudinal study	173	Community-residing older adults, mean age 73.9 years, 73% women.	Older Adulthood	Suicide ideation
Turesson et. al., 2017	Sweden	National cross-sectional study	7913	Older adults aged 60 years and older , including men and women , living in communities and residential care facilities.	Adulthood and Older Adulthood	Suicidal thoughts
Zhu et al., 2022	China	Multicenter cross-sectional study	769	Older adults attending primary care clinics, 65 years old or over (average age 72.9 years), 53.8% women	Older Adulthood	Suicidal ideation
Borges et al., 2015	Mexico	Community-based cross-sectional study	2003	Suicide ideation, dementia and mental disorders among a community sample of older people in Mexico	Older Adulthood	Suicide ideation

Hung et al., 2016	Taiwan	Community-based prospective cohort study	101,764	Taipei City residents aged ≥ 65 years participating in an elderly health examination program; both sexes included; categorized into 65–74, 75–84, and ≥ 85 years	Older Adulthood	Suicide deaths
Zhou et al., 2024	USA	Retrospective cohort study with landmarking analysis	455,708	Lung cancer patients from SEER database; mixed-age population including individuals aged >65 (55.6% of sample); both sexes; majority white; various cancer stages and histological types	Older Adulthood and 65 and under	Suicide deaths
Wu et al., 2024	China	Time-series study	9, 642	Suicide decedents from death surveillance data (2016–2020); mean age 62.4 years; 58.0% male; includes both <65 and ≥ 65 age groups; majority from rural areas	Older Adulthood and 65 and under	Suicide deaths
Lee et al., 2017	South Korea	Cross-sectional study	93 151 – total, 8441 – the high suicide-risk group	Older adults with depressive symptoms; 2,064 males and 6,377 females	Adulthood, Older Adulthood	Suicide ideation and suicide attempts

4.3. Main Findings

The included literature revealed that older adulthood suicidality is associated with a wide range of risk factors, including psychological, social, biological, and environmental risk factors, as in the One Health approach. Social and environmental risk factors were the most frequently examined across the included studies, with a strong focus on macroeconomic stability, demographic conditions, and environmental determinants such as ambient temperature or air pollution. Biological (physical comorbidities, cancer, and age-related somatic disorders) and psychological risk factors (depression, dementia, loss of meaning in life, and life weariness) were also extensively evaluated, particularly in cohort and cross-sectional analyses targeting older populations. The findings are presented in the following paragraphs and in Table 3.

Notably, all studies exhibiting an explicit connection to the One Health framework operate through the "Environmental/Climate/Ecological Factors > Biological/Social Determinants > Human Mental Health" pathway. None of the included studies explored the human-animal interaction vector of the One Health triad.

Table 3 *Main Findings and One Health Relevance of Included Studies*

First author surname and year of publication	One Health Relevance	Main Findings
Bär et al., 2022	Explicit connection	Between 1995 and 2016, there were a total of 24,067 suicides in Switzerland. Overall, we found a positive and non-linear temperature–suicide association in all regions. On average, the risk of suicide increased by 34% (1.34 relative risk [95% confidence interval: 1.19–1.52]) from the 10th to the 99th temperature percentile in Switzerland. Indications of larger risks were mostly found in females, younger individuals (<35years) and with non-violent methods. Regional risks ranged from 24% (East region) to 55%(North-West region).
Rhee et al., 2021	Weak connection	A total of 41,620 patients were included in the analysis (65.4% female, mean age 74.7 [SD 7.09]) including 10,460 in the ECT group and 31,160 in the control group. Compared to the control group, patients receiving ECT had lower all-cause mortality for up to 1 year following hospital discharge (adjusted hazard ratio [HR]=0.61, 95% CI:0.56–0.66). For death by suicide, one-year survival analysis showed no group difference. A significant association was observed in the first months following ECT, but this pattern waned over time (1 month: HR=0.44, 95% CI:0.21–0.91; 2 months: HR=0.52, 95% CI:0.29–0.92; 3 months: HR=0.56, 95% CI:0.37–0.92; 6 months: 0.87, 95% CI:0.59–1.28; 12 months: 0.92, 95% CI:0.68–1.25).
Grande et al., 2022	Implicit connection	Compared to living alone, living with children or partners reduced suicide mortality, especially among men. Having high or medium educational levels was associated with lower mortality than low educational levels among men. Foreign citizens had lower mortality among men, but not among women. Living in urban areas was associated with lower suicide rates in men and higher rates in women. Methods of suicide significantly differed by gender: leading methods were hanging, strangulation, and suffocation in men, and falling from height in women. Mental comorbidity was significantly more frequent among women, especially at ages 75–84 years.

Gemmill et al., 2015	Implicit connection	Displacement appeared among older men and women; an unexpected rise in unemployment predicted an increase in suicides 6 months later, followed by a significant decrease 8 months later. Induction appeared among working age men, but not among working age women; an unexpected rise in unemployment predicted an increase in suicides 4–6 months later.
Koo et al., 2017	Weak connection	Most common methods were hanging (21.5%), firearms (20.9%), and drug poisoning (18.5%). Firearms were associated with male gender and rural residence, while drug poisoning was more common among females and those experiencing interpersonal conflict.
Fairman, K. A., & Buckley, K., 2022	Implicit connection	Indicators were strongly and consistently age-associated, with ≥ 1 indicator experienced by 45.5% of respondents aged 19-25 years and 10.7% of those aged ≥ 65 years ($P < .01$). After age stratification, service-era effects were modest and occurred only among adults aged ≥ 35 years. The largest service-associated increase was among adults aged 35-49 years; service beginning or after 1975 was associated ($P < .01$), with increased prevalence of ≥ 1 indicator (30.2%-34.2% for veterans and 25.2% for nonveterans) or ≥ 2 indicators (6.4%-8.2% for veterans and 5.4% for nonveterans). Covariate-adjusted results were similar, with adjusted probabilities of ≥ 1 indicator declining steadily with increasing age: among those 19-34 years, 39.9% of nonveterans and 42.2% of Persian Gulf/Afghanistan veterans; among those aged ≥ 65 years, 10.3% of nonveterans, 9.2% of World War II/Korea veterans, and 14.4% of Vietnam veterans.
Sim et al., 2020	Explicit connection	Suicide risk increased with higher ambient temperature; the association was stronger among elderly individuals (≥ 65 years; $RR = 1.51$) compared with non-elderly individuals ($RR = 1.18$).
Zhou et al., 2023	Explicit connection	Nonoptimal temperature was associated with increased suicide deaths, and the association was stronger among older adults, especially those ≥ 75 years

Guo-Zhen Lin et al., 2016	Explicit connection	Between 2003 and 2012, there were a total of 1 550 registered suicide deaths in Guangzhou. A significant increase in suicide risk were associated with interquartile-range increases in the concentration of air pollutant, with an odds ratio of 1.13 (95 % confidence interval (CI): 1.01, 1.27) and 1.15 (95 % CI: 1.03, 1.28) for PM10 and NO2 at lag 02, and 1.12 (95 % CI: 1.02, 1.23) for SO2 at lag 01, respectively. The suicide risks related to air pollution for males and people with high education level were higher than for females and those with low education level, respectively. Significant air pollution effects were found on violent suicide mortality and in cool season but not on non-violent suicide mortality or in warm season.
Abdel-Rahman O., 2019	Implicit connection	The current study reviews a total of 3,149,235 cancer patients (diagnosed 2000–2010) with in the SEER database. Regarding socioeconomic county attributes, higher risk of suicide seems to be associated with lower educational attainment (O/E for counties with >20% individuals with less than high school education: 1.41; 95% CI: 1.35–1.47), poverty rates (O/E for counties with >5% individuals below poverty line: 1.39; 95% CI: 1.34–1.43), unemployment rates (O/E for counties with >5% families below poverty line: 1.36; 95% CI: 1.31–1.41) and less people living in urban areas (O/E for counties with < 50% individuals living in urban areas: 1.63; 95% CI: 1.50–1.77). On the other hand, risk of suicide seems to be inversely related to a higher representation of foreign-born individuals (O/E for counties with < 5% foreign-born individuals: 1.56; 95% CI: 1.47–1.65); and inversely related to a higher representation with recent immigrants to the US (O/E for counties with < 5% recent immigrants: 1.33; 95% CI: 1.29–1.38).
Ge et al., 2016	Weak connection	The prevalence of suicidal ideation among the seniors in Shandong, China was 4.2%. Depression had the strongest direct ($\beta=0.303$, $p\text{-value}<0.05$) and total effect ($\beta=0.303$), life satisfaction ($\beta=-0.103$, $p\text{-value}<0.05$; $\beta=-0.136$, $p\text{-value}<0.05$), economic status ($\beta=-0.046$, $p\text{-value}<0.05$; $\beta=-0.040$, $p\text{-value}<0.05$) had both direct and indirect impacts on suicidal ideation. Social support ($\beta=-0.040$, $p\text{-value}<0.05$) had indirect influence on suicidal ideation. Depression was a mediator between life satisfaction, economic status, social support and suicidal ideation.

Kim S. et al., 2024	Explicit connection	Positive associations were observed between temperature and both ISH and suicide deaths. For ISH, the relative risk (RR) was high at 1.17 (95% confidence interval (CI): 1.03, 1.34) for a temperature of 25.7 °C compared with 14.8 °C. The RR for suicide death was higher than those for ISH, at 1.43 (95% CI: 1.03, 2.00) for a temperature of 33.7 °C. These associations varied by age and sex, with males and females aged 35–64 years showing increased susceptibility to suicide deaths. This study provides detailed evidence that unusually high temperatures, both anomalous and out of season, may trigger suicidal behaviors, including both ISH and suicide deaths.
Juan et al., 2024	Implicit connection	Depressive disorders, sleep disorders, and anxiety disorders were the strongest psychiatric risk factors for suicide. Physical disorders such as hypertension, cancer, and peptic ulcer disorder also contributed significantly. The combined population-attributable fraction of psychiatric disorders (38.4%) was comparable to physical disorders (36.5%), with differences across age and sex groups.
Graetz et al., 2020	Explicit connection	Lower manufacturing employment and higher opioid prescription rates were the strongest predictors of increased suicide mortality. Gun availability increased suicide risk (especially in men), while religious participation reduced suicide mortality, particularly among older adults.
Neufeld et al., 2015	Explicit connection	Psychiatric diagnosis, alcohol use, depression symptoms, and loneliness significantly increased risk of intentional self-harm. Rural status and sex also influenced risk, with a significant interaction showing reduced risk among rural men. Functional and cognitive impairments were associated with decreased risk.
Heisel M.J. and Flett G.L., 2016	Weak connection	MIL at baseline was negatively associated with the onset and/or exacerbation of suicide ideation over time, controlling for risk factors and intervening precipitating factors. The extent and relative significance of this finding differed with the manner in which MIL and suicide ideation were operationalized.
Turesson et. al., 2017	Weak connection	Living in urban and semi-urban areas, being of advanced age, being divorced and having lower educational levels were related to life weariness. Living in a residential care facility, being widowed or unmarried, being born in a non-Nordic European country and experiencing financial difficulties were related to both life weariness and suicidal thoughts. Sex was found to be unrelated to either life weariness or suicidal thoughts.

Zhu et al., 2022	Weak connection	The 12-month prevalence of suicidal ideation in older primary care patients was 16.6%. Significant correlates of suicidal ideation were poor economic status (vs. good, OR= 2.80, P= 0.008), heart disease (OR= 2.48, P = 0.005), chronic gastric ulcer (OR= 3.55, P= 0.012), arthritis (OR= 2.10, P= 0.042), and depressive symptoms (OR= 11.29, P 0.001).
Borges et al., 2015	Implicit connection	Depression, anxiety, psychosis, and a higher number of physical disorders were significantly associated with increased prevalence of suicide ideation. Dementia was not significantly associated after adjustment, with its effect largely explained by co-occurring mental disorders.
Hung et al., 2016	Weak connection	Male sex, lower education, and lower income were the strongest predictors of suicide. Depressed mood and insomnia were also significantly associated with increased suicide risk. Socioeconomic factors contributed more strongly to prediction than psychological variables.
Zhou et al., 2024	Explicit connection	In individuals aged >65, male sex, unmarried status, and advanced cancer stage were associated with higher suicide risk. Certain primary tumor sites were also significant predictors. Meteorological factors showed weaker or non-significant associations in older adults compared to younger groups.
Wu et al., 2024	Explicit connection	Extreme heat exposure significantly increased suicide risk, with a stronger and statistically significant effect among individuals aged ≥ 65 compared to younger groups. Heat exposure accounted for approximately 31.7% of suicides and was associated with reduced life expectancy.
Lee et al., 2017	Weak connection	Residence in an urban area was identified as a risk factor for both male and female elderly in their 60s and 70s and female elderly in their 80s. Marital status showed a different influence on suicide ideation depending on age and sex. A negative perception of one's own health status was a significant risk factor that increased the likelihood of suicide ideation in all ages, except the female elderly in their 60s. No factor was identified that significantly influenced suicide attempts in the male elderly. However, in the female elderly, residence in an urban area and a negative perception of one's own health status were identified as significant risk factors.

4.4. Risk Factors Associated with Suicide

Risk factors in this scoping review are divided into biological, psychological, social, and environmental (see Table 4).

4.4.1. Biological Factors

Biological risk factors were not studied in all included articles as often as social risk factors, but they might be divided to demographic-biological variables, somatic health conditions, and some disease-specific parameters. For demographic-biological risk factors, the variable of older age was found (Abdel-Rahman, 2019; Rhee et al., 2021; Tuvevsson et al., 2017), sex (Abdel-Rahman, 2019; Bär et al., 2022; Fairman & Buckley, 2022), and race (Fairman & Buckley, 2022; Rhee et al., 2021). Somatic health condition risk factors included common physical illnesses or comorbidities and non-communicable chronic diseases. Another subcategory of the reviewed literature emphasizes the importance of somatic pathology in increased risk of suicide. These studies identified a wide range of chronic diseases as risk factors, ranging from high-prevalence cardiovascular and metabolic disorders, including heart disease, hypertension, and diabetes; to respiratory, hepatic-related, and infectious diseases (COPD; asthma; cirrhosis; hepatitis B/C or HIV) (Abdel-Rahman, 2019; Ge et al., 2016; Fairman & Buckley, 2022; Grande et al., 2022; Juan et al., 2024; Lee et al., 2017; Rhee et al., 2021; Koo et al., 2017; Zhu et al., 2022). Lastly, disease-specific biological factors, such as cancer stage, were observed (Abdel-Rahman, 2019; Zhou et al., 2024). Some studies contain no biological risk factors and focus more on other risk factors (Gemmell et al., 2015; Graetz et al., 2020; Guo-Zhen Lin et al., 2016; Heisel & Flett, 2016; Kim S. et al., 2024; Sim et al., 2020; Wu et al., 2024; Zhou et al., 2023; Neufeld et al., 2015). Overall, the available evidence in part of the included studies indicates that biological factors, specifically chronic physical illnesses, demographic-biological attributes, and disease stages, contribute to the risk of suicidal ideation or attempts in older age.

4.4.2. Psychological Factors

Psychological risk factors were also observed across the included studies. Among the most frequently reported factors were depression as formal clinical diagnoses (such as major depressive

disorder) as well as subclinical depressive symptoms and depressed mood (Rhee et al., 2021; Grande et al., 2022; Fairman, K. A., & Buckley, K., 2022; Ge et al., 2016; Juan et al., 2024; Neufeld et al., 2015; Heisel M.J. and Flett G.L., 2016; Zhu et al., 2022; Borges et al., 2015; Hung et al., 2016; Lee et al., 2017). Several studies also examined anxiety conditions and psychological distress include anxiety disorders, high psychological distress, and psychological vulnerability (Gemmill et al., 2015; Fairman & Buckley, 2022; Juan et al., 2024; Borges et al., 2015; Hung et al., 2016.). Also variables reflecting subjective quality of life and internal distress were important research target such as: hopelessness, low life satisfaction, feelings of loneliness, lack of meaning in life (Gemmill et al., 2015; Ge et al., 2016; Heisel & Flett, 2016; Zhu et al., 2022; Hung et al., 2016). Researchers also looked at several cognitive and neurological factors, such as dementia, mild cognitive impairment, and how well people can perform daily tasks (ADL) (Borges et al., 2015; Hung et al., 2016; Lee et al., 2017; Neufeld et al., 2015). Sleep disturbances were examined less frequently (Juan et al., 2024; Borges et al., 2015; Hung et al., 2016), psychotic spectrum disorders and schizophrenia (Rhee et al., 2021; Juan et al., 2024; Borges et al., 2015), and substance and alcohol abuse (Fairman & Buckley, 2022; Juan et al., 2024). 10 out of 23 studies did not analyze the psychological component and focused more on other types of older adulthood suicidality risk factors. Overall, depression, anxiety, and variables reflecting subjective quality of life and internal distress were among the most correlated risk factors associated with older adulthood suicidality.

4.4.3. Social Factors

Social risk factors are the most commonly assessed domain in the selected articles, studied in a much more thorough manner than both biological and environmental risks. The following are some of the ways in which the social constructs were operationalized: marital and familial structure, socioeconomic status, education, geographical distribution, labor force involvement, and social integration. Demographic and family structures were very much at the forefront in many studies. Marital status such as single, married, divorced was a primary variable in many articles (Abdel-Rahman, 2019; Borges et al., 2015; Fairman & Buckley, 2022; Graetz et al., 2020; Grande et al.,

2022; Hung et al., 2016; Lee et al., 2017; Neufeld et al., 2015; Tuveesson et al., 2017; Wu et al., 2024; Zhou et al., 2024; Zhu et al., 2022), and wider focus like housing and other forms of residence (Grande et al., 2022; Tuveesson et al., 2017; Zhu et al., 2022). Socioeconomic vulnerability constituted another dominant cluster. Authors regularly accounted for household income metrics, poverty rates, and objective or self-rated financial distress (Ge et al., 2016; Fairman & Buckley, 2022; Juan et al., 2024; Lee et al., 2017; Rhee et al., 2021; Tuveesson et al., 2017). Educational attainment was also common risk factor and was assessed as low, moderate, or high levels of formal education level (Guo-Zhen Lin et al., 2016; Graetz et al., 2020; Grande et al., 2022; Hung et al., 2016). Occupational status and employment instability, including job loss and long-term unemployment also were considered as risk factors (Gemmell et al., 2015; Graetz et al., 2020; Zhu et al., 2022). Geographical and housing characteristics such as rural versus urban living as well as population density were assessed in a substantial number of studies (Abdel-Rahman, 2019; Juan et al., 2024; Neufeld et al., 2015; Rhee et al., 2021). Additionally, a few articles incorporated sociodemographic identity variables including gender, race/ethnicity, citizenship, birthplace, and immigration status (Abdel-Rahman, 2019; Grande et al., 2022; Tuveesson et al., 2017; Zhou et al., 2024). In couple of studies the scope of the research has been broadened to include structural or institutional aspects, including involvement in religious activities (Fairman & Buckley, 2022; Graetz et al., 2020), military service (Fairman & Buckley, 2022), and availability of resources that may cause death, like guns and prescribed opioids (Graetz et al., 2020). Only four included studies did not observe social risk factors entirely (Bär et al., 2022; Kim S. et al., 2024; Sim et al., 2020; Zhou et al., 2023). In general, the above evidence shows that social risk factors such as marital status, financial problems, education, and rural or urban area have an exceptionally high prevalence in vulnerability models than other risk factors.

4.4.4. Environmental Factors

There was a significant representation shortfall in the data regarding environmental risk factors compared to social, biological, and psychological ones, where only eight out of twenty-three

chosen sources covered this type of risk factors (Bär et al., 2022; Kim S. et al., 2024; Sim et al., 2020; Wu et al., 2024; Zhou et al., 2023; Zhou et al., 2024; Guo-Zhen Lin et al., 2016; Grande et al., 2022). When used, such variables mainly relate to ambient climate conditions, meteorological fluctuations, air quality, and location. Thermal metrics formed the overwhelming majority of environmental evaluations. While some studies considered temperature generally, others have looked at nonoptimal temperature or the effects of extreme heat exposure and 95th percentile daily mean temperature (Bär et al., 2022; Sim et al., 2020; Wu et al., 2024; Zhou et al., 2023). Some research has also considered specific temperature variables, like mean, minimum, maximum, and monthly average temperatures (Kim S. et al., 2024; Zhou et al., 2024). In addition to temperature, some studies looked at more comprehensive atmospheric and seasonal factors. These were factors like sunlight in the form of sunshine duration and solar radiation on a monthly basis (Guo-Zhen Lin et al., 2016; Zhou et al., 2024), together with relative humidity, dew point temperature, barometric pressure, and seasonality effects (Guo-Zhen Lin et al., 2016; Kim S. et al., 2024). Environmental air pollutants and geographical location have been considered in individual studies (Grande et al., 2022; Guo-Zhen Lin et al., 2016). Taken together, the evidence indicates that while ambient thermal conditions and meteorological factors are recognized as potential risk drivers, environmental indicators remain substantially less examined than individual-level psychosocial or clinical variables.

Table 4 *Risk Factors Associated with Older Adulthood Suicidality*

First author surname and year of publication	Biological Risk Factors	Psychological Risk Factors	Social Risk Factors	Environmental Risk Factors
Bär et al., 2022	Sex	none	none	Ambient temperature
Rhee et al., 2021	Medical comorbidity, older age, psychotropic medication use in prior year, race	Mood disorders (major depressive disorder, bipolar disorder), psychotic depression, schizophrenia/schizoaffective disorder, past year psychiatric hospitalizations, past year medically injurious suicide attempts.	Median income of zip code, rural-urban continuum code	none
Grande et al., 2022	Presence of physical diseases (non-traumatic causes of death identified as comorbidities).	Mental diseases, specifically mood disorders, organic mental disorders, and other mental disorders	Living arrangement (living alone, single parent, couples), educational level (low, medium, high), marital status (single, married, divorced, widowed), and citizenship. Degree of urbanization of the municipality of residence (densely populated urban areas, intermediate-density peri-urban areas, and thinly populated rural areas)	Geographic area of residence.
Gemmill et al., 2015	none	Underlying psychological vulnerability, self-destructive behavior, hopelessness, suicidal ideation, anomie	Macroeconomic contractions, unexpected changes in unemployment, job loss, loss of stable employment, fear of economic adversity, fear of burdening children	none

Koo et al., 2017	Physical illness	Mental illness; history of suicide attempts	Gender; rural vs urban residence; country of birth; interpersonal conflict; financial problems; bereavement; suicide note; alcohol consumption	none
Fairman, K. A., & Buckley, K., 2022	Chronic physical conditions (e.g., asthma, cancer, chronic obstructive pulmonary disease, liver cirrhosis, diabetes, hepatitis B or C, heart disease, HIV, hypertension, kidney disease)	Serious psychological distress, active substance use disorder, lifetime major depressive disorder	Military service era (e.g., Vietnam, Persian Gulf, OEF/OIF), lack of religious service attendance, being unmarried, unemployment, low income; female sex white non-hispanic race	none
Sim et al., 2020	none	none	none	Ambient temperature
Zhou et al., 2023	none	none	none	Nonoptimal ambient temperature
Guo-Zhen Lin et al., 2016	none	none	Educational attainment	Ambient air pollution, daily mean temperature, relative humidity, atmospheric pressure, sunshine duration, and seasonality
Abdel-Rahman O., 2019	Older age (> 70 years), male sex, specific primary tumors (pancreatic and lung cancer), and distant cancer stage	none	Lower educational attainment, high poverty rates, high unemployment rates, divorced/single/widowed marital status, and lower representation of foreign-born individuals or recent immigrants in the county, rurality	none
Ge et al., 2016	Non-communicable chronic diseases	Depression, poor life satisfaction	Poor self-reported economic status, low social support	none

Kim S. et al., 2024	none	none	none	Ambient temperature (daily mean, minimum, maximum) and mean dewpoint temperature
Juan et al., 2024	Cancer, hypertension, diabetes mellitus, stroke, chronic obstructive pulmonary disease, peptic ulcer disorder, osteoporosis, and chronic kidney disease	Depressive disorder, anxiety disorder, sleep disorder, bipolar disorder, schizophrenia, substance and alcohol use disorder	Monthly income level and urbanicity	none
Graetz et al., 2020	none	none	Marital status, educational attainment, religious participation, unemployment, manufacturing employment, access to lethal means: gun availability, opioid prescription rates	none
Neufeld et al., 2015	none	Psychiatric diagnosis, depression symptoms; Functional impairment (ADL), cognitive performance (CPS)	Age, sex, marital status, rural vs urban residence	none
Heisel M.J. and Flett G.L., 2016	none	Depression, hopelessness, lack of meaning in life, and lack of life satisfaction	Social support, interpersonal well-being, and social isolation	none
Turesson et. al., 2017	Age	none	Living in a residential care facility, experiencing financial difficulties, being widowed, unmarried, or divorced, having lower educational levels, being born in a non-Nordic European country, living in urban and semi-urban areas	none

Zhu et al., 2022	Somatic diseases: heart disease, chronic gastric ulcer, arthritis etc.	Depressive symptoms, feelings of loneliness	Educational attainment, marital status, self-rated financial/economic status, main occupation before older adulthood, self-rated family and non-family relationship, living alone, number of living adult children, smoking, physical activity	none
Borges et al., 2015	Number of physical disorders (e.g., paralysis, respiratory problems, heart problems, arthritis, sensory impairments)	Depression, anxiety, psychosis, sleep problems; dementia and mild cognitive impairment	Sex, education level, occupational status, marital status, economic resources (assets and food insecurity), rural vs urban residence	none
Hung et al., 2016	Physical disorders (chronic conditions requiring medication)	Depressed mood, anxiety, hostility, inferiority, insomnia; cognitive impairment	Sex, marital status, education level, income level, living alone	none
Zhou et al., 2024	Cancer stage	none	Sex, marital status, race	Monthly average temperature, monthly average daily sunlight
Wu et al., 2024	none	none	Marital status	Ambient heat exposure (extreme temperature, 95th percentile of daily mean temperature)
Lee et al., 2017	Chronic physical diseases	Depressive symptoms; subjective negative perception of one's own health status	Marital status, education level, lower income, drinking behavior, religion, area of residence (urban vs. rural)	none

5. Discussion

This scoping review synthesized current knowledge on the biological, psychological, social, and environmental risk factors associated with older adulthood suicidality through the One Health perspective. The findings demonstrated that multiple interacting factors influence older age suicidality. Across the 23 included studies, biological and social factors were the most commonly investigated domains, whereas the psychological and environmental factors received less attention. Overall, the findings suggest that a single cause cannot explain older adulthood suicidality, but rather it has a multifactorial nature and supports the importance of considering interconnectedness when talking about older adulthood suicidality and risk factors.

In relation to the broader literature on suicidal behavior among older adults, the patterns observed through this review correspond with conventional psychiatric and epidemiological paradigms while also contributing some new integrative knowledge. Indeed, according to literature reviews connected with the topic, the role of the psychiatric morbidity, in particular, the major depressive disorder, in the development of suicide among older people has been consistently emphasized (Conejero et al., 2018; Fazel & Runeson, 2020). The prominent role played by the presence of physical illnesses, pain, and functional and physical limitations in our sample is consistent with the classic work by Szanto et al. (2018) and De Leo & Giannotti (2021) indicating that the physical health becomes the important vulnerability factor in old age. Likewise, the prominent share of social factors in the form of living alone, bereavement, low socioeconomic status, and the absence of social networks confirms the classical socio-ecological models of mental health (Kirkbride et al., 2024).

However, what this scoping review brings to the table above all else, in comparison to other existing reviews, is the systematic identification of macro-environmental and climate-related stressors (such as heat exposure and air pollution), together with other conventional factors. While classic reviews treat psychiatric, somatic, and social domains as self-contained spheres, our findings demonstrate that structural and ecological environments directly interface with human physiological

and psychological vulnerability, expanding the boundary of late-life suicide research.

Speaking of the One Health perspective, the available literature does not reflect a balanced One Health approach. Rather than demonstrating a fully integrated triad, our synthesis reveals that the current body of evidence is only partially compatible with One Health principles. On the one hand, studies have presented both explicit and implicit connections; on the other hand, however, we see a pronounced bias toward implicit or weak connections, with a focus on social and biological factors strictly related to a person's physical condition, in isolation from the environment and animals. Importantly, none of the 23 included studies analyzed the human-animal interaction construct, including pet ownership, animal-assisted therapy, and human-animal bonding, which constitutes a critical omission in terms of theory because there is clear evidence that the presence of animals is helpful in alleviating loneliness, depression, and social isolation of older adults (Gilli et al., 2022; Brooks et al., 2018).

This gap highlights a fundamental theoretical question: Why is One Health the most appropriate interpretative framework for late-life suicidality, and what does it offer beyond conventional biopsychosocial or socio-ecological models? Biopsychosocial models generally look at psychological well-being from the point of interconnection of biological components, psychological aspects, and social environments of individuals, while socio-ecological frameworks emphasize nested social structures (individual, interpersonal, community, societal). Even though both models manage to accurately describe connection between different human being aspects, they are still anthropocentric and ignore the influence of the non-human environment.

However, the One Health approach is different from these models in that it recognizes that the psychological resilience of humans occurs in the context of shared ecosystems (WHO, 2026). It claims that the ecological, thermal, atmospheric risks and changes in interaction between human beings, animals, and the environment have direct implications for the well-being of the people (Bär et al., 2022; Guo-Zhen Lin et al., 2016). Human beings develop and exist in climatic, socio-economic, interpersonal and medical environment, and risk in one domain leads to risks in the other domain. In

other words, for example, neuro-biological or psychological vulnerabilities (such as depression, anxiety, or physical illnesses) become very evident as a result of the presence of environmental risks like heat and air pollution (Bär et al., 2022; Guo-Zhen Lin et al., 2016). In a similar way, socio-economic risks like poverty, unemployment, distress in urban environment and social isolation, coupled with environmental stressors, lead to mental distress (Abdel-Rahman, 2019; Kim S. et al., 2024).

Considering late-life suicidality in the context of the One Health implies that the phenomenon should not be seen simply as a psychiatric or sociological effect but rather as one resulting from imbalance in interaction between human, ecological, and environmental domains. As a result, there is a need for multi-faceted preventive measures beyond conventional clinical approaches.

The category of social determinants was identified as the one that was mentioned the most frequently reported among all reviewed studies. Nearly every publications mentioned at least one social risk factor. Poor education, social hardships, unemployment, poverty, and being alone without social connections increased the probability of dying by suicide (Abdel-Rahman, 2019; Gemmill et al., 2015; Grande et al., 2022; Zhu et al., 2022). The factors of interpersonal stress, low social support, and geographical differences (urban vs. rural settings) played an additional role in increasing the susceptibility (Ge et al., 2016; Neufeld et al., 2015; Koo et al., 2017). Thus, the suicidality of people should not be explained only in terms of their personal mental disorders since it is affected by social factors related to the person's place in society. Human stability is determined by functioning support systems that are affected by family problems, financial instability, and social environment. From the One Health perspective, these social dynamics show that individual mental health outcomes are tied to social environment.

In comparison, biological risk factors was the second most common domain in the analyzed literature, occurring more often than psychological factors. The focus of biological variables included physical health condition, age, and somatic comorbidity. Chronic physical diseases, such as cardiovascular disease, cancer, chronic obstructive pulmonary disease, diabetes, and sensory

disabilities were found to be associated with an increase in suicides, especially among the elderly participants (Fairman & Buckley, 2022; Juan et al., 2024; Zhou et al., 2024; Zhu et al., 2022). Nevertheless, biological variables in general were not sufficient enough to explain the phenomenon of suicide. Physical illness played a role of a risk multiplier since the risk of suicide among physically ill people was heightened when there were some functional disability, psychological problems, or economic hardships (Borges et al., 2015; Rhee et al., 2021).

Talking about psychological risk factors that were observed in a less common but equally important aspect in the included papers. Major depressive disorder, anxiety, sleep disorders, feelings of hopelessness, and previous suicidal attempts were listed as primary risk factors that caused suicide (Borges et al., 2015; Heisel & Flett, 2016; Juan et al., 2024; Rhee et al., 2021). Depression was found in several data sets, which supported the significance of emotional distress for the formation of suicidal thoughts. In addition, cognitive changes, disability in performing activities of daily living, and psychotic features contributed to the increased risk in cases of mood instability (Borges et al., 2015; Neufeld et al., 2015). The data indicated the necessity to identify risks on time and provide necessary support to patients.

Lastly, environmental risk factors have been identified through a specific group of studies that have examined physical environmental variables. The association between variations in ambient temperature, heat waves, poor weather, and ambient air pollution with suicide deaths and suicidal ideation was evident in various studies (Bär et al., 2022; Guo-Zhen Lin et al., 2016; Kim S. et al., 2024; Wu et al., 2024; Zhou et al., 2023). While physical environmental variables are not as common an area of study in psychiatry as demographic or clinical variables, there is evidence to support the influence of macro-level environmental factors on mental stability. In the context of One Health, including these physical variables becomes vital since the human mind is not independent of its environment.

However, evaluating the dataset through the One Health framework, shows up a fundamental methodological dichotomy: The presence of variables from multiple domains within a single study

does not automatically denote tested cross-domain interactions. In analyzing the literature, we must explicitly distinguish between studies that merely measured variables from different domains simultaneously and those that formally tested statistical moderation, mediation, or structural interaction effects across domains.

The vast majority of included multi-domain studies (e.g., Borges et al., 2015; Fairman & Buckley, 2022; Juan et al., 2024) treated multi-domain parameters as independent covariates in multivariable models rather than evaluating cross-domain synergies. Only a small subset of studies formally evaluated cross-domain pathways such as Ge et al. (2017), who demonstrated through path analysis that depression mediated the relationship between economic status/social support and suicidal ideation, or Neufeld et al. (2015), who tested interactions between geographic rurality, sex, and cognitive impairment. Identifying this reliance on variable co-occurrence rather than cross-domain interaction testing represents a key analytical finding of this review, highlighting a critical methodological gap in existing late-life suicidality research.

Furthermore, environmental studies exhibited severe domain segregation: studies examining physical environmental parameters (such as ambient temperature and air pollution) analyzed these factors almost entirely in isolation from individual clinical, psychological, or social variables (Bär et al., 2022; Kim et al., 2024; Sim et al., 2020; Zhou et al., 2023). Macro-ecological stressors continue to be treated as independent population-level drivers rather than integrated into individual vulnerability models, underscoring the necessity of adopting an operationalized One Health research paradigm. Only in rare cases were environmental risk factors analyzed alongside social factors, such as educational attainment (Guo-Zhen Lin et al., 2016). This segregation of parameters from the environment highlights a significant limitation of the current scientific literature and highlights the importance of adopting the One Health approach. Despite some studies evidence that biological, psychological, and social risk factors are interconnected, macroecological risk factors continue to be considered in isolation. This gap can only be bridged through the One Health approach, as it is important to recognize that the environment does not function in a vacuum.

Several methodological and conceptual limitations should be discussed during interpretation the synthesized findings of this review. A primary limitation arises from the pronounced heterogeneity in suicide-related outcomes across the included literature. The reviewed articles examined separate behaviors existing on the continuum of suicidality, from suicidal ideation (passive and active), non-lethal self-harm, suicide attempts, to death by suicide. The problem with accounting for different outcomes within a single conceptual model is that the risk factors for suicidal thoughts, as well as the mechanisms through which they manifest and the extent of their impact, are different from the factors that determine suicide mortality. This is especially important in case of geriatric population in which the characteristics of suicidal behavior are high lethality, high intent, and low survival rate among people who made an attempt to commit suicide.

Moreover, the structural and methodological limitations of the existing empirical body of evidence make it difficult to establish causal associations. While the reviewed literature provides evidence across various international settings, including Switzerland, China, Sweden, and the United States, a large number of the studies used cross-sectional research designs or population-wide data. Such design limits the possibility of establishing temporal sequence of events between certain exposures and outcomes of interest. The next limitation is severe segregation between the domains of research. The vast majority of studies investigating physical environment parameters, including temperature, heat waves, adverse weather conditions, and air pollution considered these parameters separately from individual-related clinical, psychosocial, and sociodemographic variables. Consequently, the precise interaction between macro-environmental risks and individual susceptibility has not yet been thoroughly investigated. Furthermore, as the aim of this article was to summarise the risk factors identified across four areas of research, this review reflects existing vulnerabilities but does not assess the effectiveness or feasibility of possible measures to mitigate the effects of these factors.

Finally, the inclusion criteria of this review as well as search strategy may have acted as limitations as well. Firstly, the search was confined to the articles published in the English language

from 2015 to 2025, thus, it is possible that certain information that is available in other languages, or information related to any historical trends predating the mentioned period of time might be overlooked. Even after conducting a thorough search for literature in all relevant databases, certain articles, which were eligible for analysis, may have been overlooked. Last but not least, even though this literature review concentrates on suicidality among late-life individuals, the effect of risk factors on suicidal behavior among other distinct age groups is an area which needs further investigation.

Conclusions of the current review showed that the risk of suicide can be defined as a result of influence of multiple biological, psychological, social, and environmental factors. While biological and social factors prevail in the reviewed literature, the outcomes of the review demonstrated that a more comprehensive approach should be applied to gain insight into the risk of suicide among older adults. Applying the operationalized approach of One Health, it becomes possible to shift from the segregated domain approach and to link macro-environmental stressors with personal mental health.

6. Conclusion

This scoping review examined the biological, psychological, social, and environmental risk factors associated with older adulthood suicidality through the One Health lens. The findings suggest that suicidality in older age is a complex phenomenon influenced by the interconnection of these factors. Social and biological domains were the most frequently examined, with financial hardship, social isolation, living alone, chronic physical conditions, and somatic comorbidities being strongly associated with suicidal thoughts and behaviors. Psychological factors received relatively less attention, and environmental factors such as ambient temperature variations and air pollution were primarily evaluated in isolation from other domains. The findings suggest that when looking at older adulthood suicidality, we need to consider a broad perspective and the interactions between biological, psychological, social, and environmental domains. Although the currently available data only partially support the One Health concept due to a clear bias toward implicit associations and the distinction between macroecological variables they highlight the multifactorial nature of suicide risk. Overall, this review adds to the understanding of older adulthood suicidality by providing a synthesis of the current evidence and identifying critical gaps in the existing literature. Future research should continue to explore the systemic connections between risk factors, particularly integrating environmental risk factors with individual clinical and socio-demographic parameters, for a better understanding of suicide development in older populations and the design of comprehensive prevention and intervention strategies.

7. References

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