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CIÊNCIAS DE ENFERMAGEM

Depressive Symptomatology and Functional Dependence of Centenarians Living at Home and in Nursing Homes

Carla Gomes da Rocha

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**DEPRESSIVE SYMPTOMATOLOGY AND FUNCTIONAL
DEPENDENCE OF CENTENARIANS LIVING AT HOME AND IN
NURSING HOMES**

**SINTOMATOLOGIA DEPRESSIVA E DEPENDÊNCIA FUNCIONAL
DE CENTENÁRIOS RESIDENTES NO DOMICÍLIO E EM LARES DE
IDOSOS**

**Thesis submitted in application for the degree of
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To my father,
Manuel

***'Discovery consists of seeing
what everybody has seen and
thinking what nobody has
thought.'***

Albert Szent-Györgyi (1893–1986)

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- Uittenhove, K., Lampraki, C., **da Rocha, C. G.**, Rott, C., von Gunten, A., & Jopp, D. S. (2024). Profiles of centenarians' functioning: linking functional and cognitive capacity with depressive symptoms. *BMC Geriatrics*, 24(1), 451.
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ABSTRACT

Introduction: In the context of demographic ageing, the number of centenarians is increasing significantly, with 588,000 individuals recorded worldwide in 2024 and a projected increase to over 3 million by 2050. While research has primarily focused on their physical health, their mental health remains underexplored, despite depression being common among older adults and potentially leading to severe bio-psycho-socio-spiritual consequences. It is therefore essential to examine its prevalence in centenarians and its impact on their functional independence, as key components of their quality of life, in order to adapt care models to their specific needs.

Objectives: (I) To map and summarize the existing literature on depressive symptoms and functional dependence in near-centenarians and centenarians (aged 95 years and over), focusing on prevalence rates, screening instruments, and the relationship between these two phenomena; (II) To identify and achieve a consensus on the most representative signs and symptoms of depression in near-centenarians and centenarians through an international, interdisciplinary panel of experts; (III) To analyse the prevalence of depressive symptoms in centenarians living in Switzerland, identify their predictors, and explore the role of functional dependence as a contributing factor.

Methods: To achieve the first objective, a scoping review was conducted following the guidelines of the Joanna Briggs Institute (JBI) Manual for Scoping Reviews. For the second objective, a modified e-Delphi study was carried out in accordance with the Conducting and REporting DElphi Studies (CREDES) guidelines. To address the third objective, a cross-sectional study was undertaken using a sample drawn from the broader longitudinal SWISS100 Study.

Results: In the scoping review, 53 studies (1994–2023) were included, with 28.3% conducted in the USA. Most were quantitative and cross-sectional. The prevalence of depressive symptoms ranged from 10.5% to 73%, primarily assessed with the GDS-15. Functional dependence varied from 20.8% to 81.7% (ADLs) and 27.5% to 97% (IADLs), commonly measured using the OARS Multidimensional Functional Assessment Questionnaire and the Katz Index. Only 30.2% of studies examined the association between depressive symptoms and functional dependence, with 56.3% reporting a significant relationship. In the modified e-Delphi study, the expert panel included nurses, medical doctors specializing in old age psychiatry and/or geriatrics, and psychologists from various countries. The most widely agreed-upon dimensions were lack of hope (100%), loss of interest (96.4%), lack of reactivity to pleasant events (96.4%), depressed mood (92.9%), and previous episodes of depression or diagnosed depression (90.5%).

key criteria with full agreement (100%) included despondency/gloom/despair, depressed mood, lack of reactivity to pleasant events, suicidal ideation, and suicide attempts, while others, such as ruminations (96.4%), recurrent thoughts of death or suicide (96.4%), and anhedonia (95.2%), also reached high consensus. Experts emphasized that, in very old age, depression assessment should consider the duration, number, frequency, and severity of symptoms. In the cross-sectional study, functional capacity varied, with ADLs generally better preserved than IADLs. Nearly one-fourth of participants screened positive for possible clinical depression, which was significantly more common among institutionalized centenarians ($p < .05$). Health conditions, anxiety, and lower functional capacity were significant predictors of depressive symptoms, collectively explaining 24.7% of the variance. Mediation analysis showed that functional capacity mediated the relationship between living situation and depressive symptoms, underscoring its critical role in mental health.

Conclusions: This work highlights the need for improved depression screening and targeted interventions in the very old. The scoping review identified research gaps, with studies primarily cross-sectional and U.S.-based. It confirmed a broad prevalence range of depressive symptoms and functional dependence, with limited research on their association. The e-Delphi study established expert consensus on critical depression indicators, highlighting the importance of a multidimensional approach to enhance screening accuracy in the very old and laying the groundwork for the development of a tailored instrument for this age group. The cross-sectional study revealed a significant prevalence of depressive symptoms among centenarians in Switzerland, with functional capacity mediating their relationship with living situation. Overall, these findings highlight the need for tailored screening tools and targeted interventions to enhance mental health care and promote functional independence in late life, a phase marked by multiple transitions, presenting an opportunity for nurses to play a key role in early detection and support.

Keywords: centenarians; near-centenarians; depressive symptoms; functional dependence; mental health; functional health; transitions; nurses' role; interdisciplinary collaboration.

RESUMO

Introdução: No contexto do envelhecimento demográfico, o número de centenários tem vindo a aumentar significativamente, com 588.000 indivíduos documentados no mundo em 2024 e uma projeção de crescimento para mais de 3 milhões até 2050. Embora a investigação se tenha focado principalmente na saúde física desta população, a sua saúde mental continua pouco explorada, apesar da patologia depressiva ser comum entre os idosos e poder levar a consequências bio-psico-sócio-espirituais graves. Assim, torna-se essencial examinar a sua prevalência entre os centenários e o impacto na sua independência funcional, fatores-chave da qualidade de vida, de forma a adaptar os modelos de cuidados às suas necessidades específicas.

Objetivos: (I) Mapear e sintetizar a literatura existente sobre sintomas depressivos e dependência funcional em quase-centenários e centenários (com 95 ou mais anos), com foco nas taxas de prevalência, nos instrumentos de rastreio e na relação entre estes dois fenómenos; (II) Identificar e alcançar um consenso sobre os sinais e sintomas mais representativos da depressão em quase-centenários e centenários, através de um painel internacional e interdisciplinar de especialistas; (III) Analisar a prevalência dos sintomas depressivos em centenários residentes na Suíça, identificar os seus preditores e explorar o papel da dependência funcional como fator contributivo.

Métodos: Para atingir o primeiro objetivo, foi realizada uma *scoping review*, seguindo as diretrizes do *Joanna Briggs Institute (JBI) Manual for Scoping Reviews*. Para o segundo objetivo, foi conduzido um estudo e-Delphi modificado, de acordo com as diretrizes *Conducting and REporting DElphi Studies (CREDES)*. Para atingir o terceiro objetivo, foi realizado um estudo transversal, utilizando uma amostra retirada do estudo longitudinal mais amplo SWISS100.

Resultados: Na *scoping review*, foram incluídos 53 estudos (1994–2023), dos quais 28,3% foram realizados nos Estados Unidos. A maioria dos estudos foi de natureza quantitativa e transversal. A prevalência dos sintomas depressivos variou entre 10,5% e 73%, sendo principalmente avaliada com a GDS-15. A dependência funcional variou entre 20,8% e 81,7% (AVQ) e entre 27,5% e 97% (AIVQ), sendo frequentemente medida com o OARS *Multidimensional Functional Assessment Questionnaire* e o Índice de Katz. Apenas 30,2% dos estudos examinaram a associação entre os sintomas depressivos e a dependência funcional, com 56,3% a reportarem uma relação significativa. No estudo e-Delphi modificado, o painel de especialistas incluiu enfermeiros, médicos especializados em psiquiatria do idoso e/ou geriatria, e psicólogos de vários países. As dimensões com maior consenso foram falta de esperança (100%), perda de interesse (96,4%), falta de

reatividade aos eventos agradáveis (96,4%), humor depressivo (92,9%), e episódios anteriores de depressão ou diagnóstico de depressão (90,5%). Os critérios com consenso total (100%) incluíram desânimo/tristeza/desespero, humor depressivo, falta de reatividade aos eventos agradáveis, ideação suicida e tentativas de suicídio, enquanto outros critérios, como ruminações (96,4%), pensamentos recorrentes de morte ou suicídio (96,4%) e anedonia (95,2%), atingiram igualmente elevado consenso. Os especialistas sublinharam que, em idades muito avançadas, a avaliação da depressão deve considerar a duração, o número, a frequência e a gravidade dos sintomas. No estudo transversal, a capacidade funcional variou, com as AVQ geralmente melhor preservadas do que as AIVQ. Quase um quarto dos participantes obteve resultados positivos para uma possível depressão clínica, sendo significativamente mais comum entre os centenários institucionalizados ($p < .05$). Condições de saúde, ansiedade e menor capacidade funcional foram preditores significativos dos sintomas depressivos, explicando 24,7% da variância. A análise de mediação revelou que a capacidade funcional media a relação entre o local de residência e os sintomas depressivos, destacando o seu papel crítico na saúde mental.

Conclusões: Este trabalho destaca a necessidade de melhorar o rastreio da depressão e de implementar intervenções direcionadas nos indivíduos muito idosos. A *scoping review* identificou lacunas na investigação, com estudos predominantemente transversais e realizados nos Estados Unidos. Confirmou uma ampla variação na prevalência de sintomas depressivos e na dependência funcional, com investigação limitada sobre a sua associação. O estudo e-Delphi estabeleceu um consenso entre especialistas sobre os principais indicadores da depressão, sublinhando a importância de uma abordagem multidimensional para melhorar a precisão do rastreio e lançando as bases para o desenvolvimento de um instrumento adaptado a esta faixa etária. O estudo transversal revelou uma prevalência significativa de sintomas depressivos entre centenários na Suíça, com a capacidade funcional a mediar a relação entre o local de residência e os sintomas depressivos. Globalmente, estes resultados destacam a necessidade de ferramentas de rastreio adaptadas e de intervenções específicas para melhorar os cuidados de saúde mental e promover a independência funcional em idade muito avançada, uma fase marcada por múltiplas transições. Esta necessidade representa uma oportunidade para os enfermeiros desempenharem um papel fundamental na deteção precoce e no acompanhamento.

Palavras-chave: centenários; quase centenários; sintomas depressivos; dependência funcional; saúde mental; saúde funcional; transições; papel dos enfermeiros; colaboração interdisciplinar.

RÉSUMÉ

Introduction: Dans un contexte de vieillissement démographique, le nombre de centenaires augmente significativement, avec 588 000 personnes recensées dans le monde en 2024 et une projection de plus de 3 millions d'ici 2050. Si la recherche s'est surtout concentrée sur leur santé physique, leur santé mentale demeure peu explorée, alors que la dépression, fréquente chez les personnes âgées, peut entraîner des conséquences bio-psycho-socio-spirituelles sévères. Il est donc essentiel d'examiner sa prévalence chez les centenaires et son impact sur l'indépendance fonctionnelle, des éléments clés de leur qualité de vie, afin d'adapter les modèles de soins à leurs besoins spécifiques.

Objectifs: (I) Cartographier et synthétiser la littérature existante sur les symptômes dépressifs et la dépendance fonctionnelle chez les quasi-centenaires et centenaires (âgés de 95 ans et plus), en mettant l'accent sur les taux de prévalence, les outils de dépistage et le lien entre ces deux phénomènes ; (II) Identifier et parvenir à un consensus sur les signes et symptômes les plus représentatifs de la dépression chez les quasi-centenaires et centenaires à travers un panel international et interdisciplinaire d'experts ; (III) Analyser la prévalence des symptômes dépressifs chez les centenaires vivant en Suisse, identifier leurs prédicteurs et explorer le rôle de la dépendance fonctionnelle en tant que facteur contributif.

Méthodes: Pour atteindre le premier objectif, une *scoping review* a été réalisée conformément aux directives du *Joanna Briggs Institute (JBI) Manual for Scoping Reviews*. Pour le deuxième objectif, une étude e-Delphi modifiée a été menée en accord avec les recommandations des *Conducting and REporting DELphi Studies (CREDES) guidelines*. Enfin, pour répondre au troisième objectif, une étude transversale a été effectuée à partir d'un échantillon issu de l'étude longitudinale plus vaste SWISS100.

Résultats: Dans la *scoping review*, 53 études (1994–2023) ont été incluses, dont 28,3% menées aux États-Unis. La majorité étaient quantitatives et transversales. La prévalence des symptômes dépressifs variait de 10,5% à 73%, principalement évaluée à l'aide de la GDS-15. La dépendance fonctionnelle s'échelonnait de 20,8% à 81,7% pour les AVQ et de 27,5% à 97% pour les AIVQ, souvent mesurée avec le *OARS Multidimensional Functional Assessment Questionnaire* et l'Indice de Katz. Seulement 30,2% des études ont examiné l'association entre les symptômes dépressifs et la dépendance fonctionnelle, et parmi elles, 56,3% ont mis en évidence une relation significative. Dans l'étude e-Delphi modifiée, le panel d'experts comprenait des infirmier·ère·s, médecins spécialisés en psychiatrie de l'âge avancé et/ou en gériatrie, ainsi que des psychologues, issus de

différents pays. Les dimensions ayant obtenu le plus large consensus étaient l'absence d'espoir (100%), la perte d'intérêt (96,4%), le manque de réactivité aux événements agréables (96,4%), l'humeur dépressive (92,9%), ainsi que les antécédents d'épisodes dépressifs ou de diagnostic de dépression (90,5%). Les critères ayant obtenu un consensus total (100%) incluaient l'abattement/tristesse/désespoir, l'humeur dépressive, le manque de réactivité aux événements agréables, les idées suicidaires et les tentatives de suicide. D'autres critères ont également atteint un consensus élevé, notamment les ruminations (96,4%), les pensées récurrentes de mort ou de suicide (96,4%) et l'anhédonie (95,2%). Les experts ont souligné que, chez les personnes très âgées, l'évaluation de la dépression devrait tenir compte de la durée, du nombre, de la fréquence et de la gravité des symptômes. Dans l'étude transversale, la capacité fonctionnelle variait, avec une préservation généralement supérieure des AVQ que des AIVQ. Près d'un quart des participants a obtenu un score suggérant une dépression clinique possible, celle-ci étant significativement plus fréquente chez les centenaires institutionnalisés ($p < .05$). Les conditions de santé, l'anxiété et une capacité fonctionnelle réduite étaient des prédicteurs significatifs des symptômes dépressifs, expliquant ensemble 24,7 % de la variance. L'analyse de médiation a montré que la capacité fonctionnelle jouait un rôle de médiateur entre le lieu de vie et les symptômes dépressifs, soulignant son importance dans la santé mentale.

Conclusions: Ce travail met en évidence la nécessité d'améliorer le dépistage de la dépression et de mettre en place des interventions ciblées chez les personnes très âgées. La *scoping review* a identifié des lacunes dans la recherche, avec des études majoritairement transversales et menées aux États-Unis. Elle a confirmé une large variation de la prévalence des symptômes dépressifs et de la dépendance fonctionnelle, avec peu d'études examinant leur association. L'étude e-Delphi a permis d'établir un consensus d'experts sur les indicateurs clés de la dépression, soulignant l'importance d'une approche multidimensionnelle pour améliorer la précision du dépistage chez les très âgés et posant les bases du développement d'un instrument adapté à cette population. L'étude transversale a révélé une prévalence significative des symptômes dépressifs chez les centenaires en Suisse, la capacité fonctionnelle jouant un rôle médiateur entre le lieu de vie et ces symptômes. Dans l'ensemble, ces résultats soulignent la nécessité d'outils de dépistage adaptés et d'interventions ciblées pour améliorer la prise en charge de la santé mentale et promouvoir l'indépendance fonctionnelle à un âge très avancé, une période marquée par de multiples transitions. Cela représente une opportunité pour les infirmier·ère·s de jouer un rôle clé dans la détection précoce et le soutien.

Mots-clés : centenaires ; quasi-centenaires ; symptômes dépressifs ; dépendance fonctionnelle ; santé mentale ; santé fonctionnelle ; transitions ; rôle infirmier ; collaboration interdisciplinaire.

LIST OF ABBREVIATIONS

ADLs	Basic Activities of Daily Living
APNs	Advanced Practice Nurses
CGA	Comprehensive Geriatric Assessment
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, 5th Edition
GDS	Geriatric Depression Scale
GDS-15	Geriatric Depression Scale – 15 items
IADLs	Instrumental Activities of Daily Living
ICC	International Centenarian Consortium
ICD-11	International Classification of Diseases 11th Revision
LLD	Late-life Depression
OARS	Older Americans Resources and Services Multidimensional Functional Assessment Questionnaire
SWISS100	Swiss Centenarian Study: Vulnerability and Resilience at Age 100

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	iv
SCIENTIFIC OUTPUTS WITHIN THE SCOPE OF THE THESIS	vii
ABSTRACT	x
RESUMO.....	xii
RÉSUMÉ	xiv
LIST OF ABBREVIATIONS.....	xvii
LIST OF FIGURES	xx
LIST OF TABLES	xxi
PREAMBLE	xxii
CHAPTER 1 – INTRODUCTION	1
INTRODUCTION	2
Demographic ageing and the centenarian boom	2
Older Adults’ Health and the relevance of depression	3
Definition of depression.....	4
Aetiology of depression.....	4
Treatment of depression	6
Why is this topic important?	7
Overall aims	7
ARTICLE 1.....	8
CHAPTER 2 – THEORETICAL FRAMEWORK.....	12
Transitions Theory	13
Transitions and health: A framework for gerontological nursing.....	15
CHAPTER 3 – DEPRESSIVE SYMPTOMS AND FUNCTIONAL DEPENDENCE IN CENTENARIANS	23
ARTICLE 2.....	27
CHAPTER 4 – SCREENING FOR DEPRESSIVE SYMPTOMS IN CENTENARIANS.....	77
ARTICLE 3.....	81

CHAPTER 5 – FUNCTIONAL DEPENDENCE AS A PREDICTOR OF DEPRESSIVE SYMPTOMS IN CENTENARIANS.....	123
ARTICLE 4.....	125
CHAPTER 6 – GENERAL DISCUSSION	151
Detecting and managing depressive symptoms in the oldest-old: The crucial role of Nurses	152
Enhancing research practices for mental and functional health in centenarians	153
Challenges and opportunities in depression screening among centenarians.....	154
Understanding the role of functional dependence in depressive symptoms among centenarians	155
Relevance of Transitions Theory in clinical practice and research with centenarians	156
CHAPTER 7 – CONCLUSIONS AND FUTURE PERSPECTIVES	160
REFERENCES	165
APPENDIX 1	173
APPENDIX 2	182
APPENDIX 3	191
APPENDIX 4	196
APPENDIX 5	210
APPENDIX 6	212
APPENDIX 7	214
APPENDIX 8	216
APPENDIX 9	218
APPENDIX 10.....	220
APPENDIX 11.....	226
APPENDIX 12.....	228
APPENDIX 13.....	232
APPENDIX 14.....	236
APPENDIX 15.....	239

LIST OF FIGURES

Figure 1: Transitions Theory Framework.....14

Figure 2: Transitions Theory Framework for Gerontological Nursing 19

Figure 3: Components of role insufficiency and probable manifestations 20

Figure 4: Clinical forms of depression in older adults.....79

Figure 5: Practical application of the Transitions Theory Framework in
Gerontological Nursing.....157

LIST OF TABLES

Table 1. Key considerations and future perspectives of the doctoral project 162

PREAMBLE

‘Depressive Symptomatology and Functional Dependence of Centenarians Living at Home and in Nursing Homes’ is a thesis project conducted as part of the Doctoral Programme in Nursing Sciences at the Institute of Biomedical Sciences Abel Salazar (ICBAS), University of Porto, Portugal. This project is integrated into a broader study titled *‘SWISS Centenarian Study (SWISS100): Vulnerability and Resilience at Age 100’*, the first Swiss study focusing on the centenarian population.

The SWISS100 study was funded by the Swiss National Science Foundation through the Sinergia Programme [1], which aims to promote interdisciplinary collaboration (grant FNS Sinergia CRSII5_186239/1). It was carried out between January 2020 and December 2024 as a result of collaboration among several Swiss institutions, including the University of Lausanne (UNIL), Lausanne University Hospital (CHUV), University of Geneva (UNIGE), Geneva University Hospitals (HUG), University of Zurich (UZH), and the University of Applied Sciences and Arts of Southern Switzerland (SUPSI). Various disciplines were represented in the study, such as medicine (geriatrics and old-age psychiatry), biology, psychology, sociology, statistics, and nursing sciences, the latter forming the foundation of this thesis project. Data were collected from the Swiss cantons of Geneva, Vaud, Bern, Basel-City, Zurich, and Ticino. The SWISS100 study pursues multiple objectives. Among them is identifying vulnerability in its various forms, its predictors, and its consequences. The present thesis seeks to contribute to this objective by specifically focusing on the study of centenarians’ mental health (i.e., depressive symptoms) and its relationship with functional health (i.e., the capacity to perform basic and instrumental activities of daily living). An article providing an overview of the SWISS100 study, including its goals and specificities, can be found in Appendix 1 (the original article, published in French, is accompanied by an English translation in the same appendix).

The SWISS100 study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Cantonal Ethics Committees for Research on Human Beings (Project 2021-02509; Appendix 2). The candidate actively participated in all phases of the research process: conceptual, methodological, empirical, analytical, and dissemination.

This doctoral thesis is presented as a compilation of articles, most of which have been submitted for publication in international peer-reviewed, open-access scientific journals. To provide a clear understanding of the progression of the research process and explicitly outline its various stages, the thesis is organized into seven main chapters.

Chapter 1 (*Introduction*) presents the background and rationale of the thesis project, emphasizing the significance of the research topic for the nursing profession (Article 1). Chapter 2 (*Theoretical Framework*) situates this project within the theoretical foundations of the nursing discipline, drawing on the principles of Afaf I. Meleis' Transitions Theory. Chapter 3 (*Depressive Symptoms and Functional Dependence in Centenarians*) is dedicated to the analysis of these two key concepts and their potential relationship, namely by systematically mapping and examining these phenomena through a literature review (Article 2; in peer review). Chapter 4 (*Screening for Depressive Symptoms in Centenarians*) presents a study undertaken to contribute to the debate on the specificities of depression in the oldest-old population, as well as to enhance the effectiveness of depression screening within this age group (Article 3; in press). Chapter 5 (*Functional Dependence as a Predictor of Depressive Symptoms in Centenarians*) highlights the importance of investigating potential predictors of this type of symptoms, by specifically analysing SWISS100 data, with a particular focus on the negative impact of functional decline on mental health in this population (Article 4; in peer-review). Chapter 6 (*General Discussion*) critically synthesizes the key findings within this doctoral thesis, highlighting their relevance and limitations. Finally, Chapter 7 (*Conclusions and Future Perspectives*) builds on this discussion by exploring their implications for clinical practice, nursing education, and research.

To enhance readability and maintain consistency throughout this work, each article included in the main body retains its own tables, figures, and references in a logical sequence. Notably, the reference lists for individual articles follow the formatting guidelines of their respective submission journals. To avoid overburdening the main text and ensure a structured presentation, supplementary materials related to these articles have been placed in the Appendices section.

CHAPTER 1 – INTRODUCTION

INTRODUCTION

This chapter introduces the thesis background, rationale, and overall aims of the thesis. The rationale provides context and emphasizes the importance of addressing depressive symptoms in centenarian individuals. It led to the publication of Article 1, which further underscores the need for nursing professionals to prioritize this issue.

Demographic ageing and the centenarian boom

The rapid and unprecedented growth of the very old population is a significant demographic trend in most economically developed nations, emerging as a key social, political, and economic priority [2]. Between 2015 and 2050, the global population aged 60 and older is projected to double, increasing from 12% to 22% of the total population, according to World Health Organization predictions [3]. The number of individuals aged 80 and older is expected to triple between 2020 and 2050, reaching 426 million [3]. In Europe, the population aged 65 and older is also projected to rise significantly, growing from 90.5 million in 2019 to 129.8 million by 2050. Additionally, more than one in eight Europeans will be 80 years old or older [2, 4].

In this era of demographic transition, the number of centenarians is also rising remarkably, reflecting broader population dynamics driven by declining mortality rates and increasing longevity. In most developed countries, adult longevity has been steadily increasing since the 1930s for women and the 1970s for men [5]. In 2024, the United Nations estimated 588,000 individuals aged 100 years or older worldwide. This number is expected to increase sharply, reaching 3.2 million by 2050 and over 25 million by 2100, representing a population more than 40 times larger than in 2024 [5-8]. In 2011, Europe had 89,156 centenarians, with a ratio of 17.3 per 100,000 inhabitants. Countries such as France, Italy, and Greece exceeded 20 per 100,000, while Portugal, with an also notable high ratio of 14.4 per 100,000, ranked among the top 15 in Europe [9]. Since 2011, this population has continued to grow rapidly, and projections indicate that the number of centenarians in Europe will increase from 176,000 in 2024 to 694,000 by 2050 [7].

Switzerland mirrors this trend. The country is experiencing a significant demographic shift, with an ageing population that continues to grow. Among its 8.6 million inhabitants in 2019, 453,800 were aged 80 or older, accounting for 28.3% of the older adult population [10]. This shift is primarily driven by rising life expectancy, supported by improved living conditions, healthcare, lifestyle, and individual robustness [11, 12]. With one of the highest life expectancies worldwide—82.2 years for men and 85.8 years for women—Switzerland faces mounting challenges in adapting its healthcare system to

meet the needs of an increasingly older population [13]. Within this broader trend, the centenarian population has more than doubled in recent decades, increasing from 787 individuals in 2000 to 2,086 in 2023. The current ratio stands at approximately 19 centenarians per 100,000 inhabitants [10, 14]. This rapid growth underscores the urgent need to better understand and address the unique health challenges and needs of this expanding age group.

Older Adults' Health and the relevance of depression

A central challenge arising from demographic ageing is the increasing duration of multimorbidity, as healthy life expectancy is not keeping pace with overall life expectancy [15]. While people are living longer, they are also more likely to experience the onset or exacerbation of multiple health conditions [16]. Population ageing is not a uniform phenomenon. Older adults follow diverse life trajectories, with some remaining physically, cognitively, and mentally active well into extreme old age, while others face multiple chronic conditions and significant declines in functional and cognitive capacities [17, 18].

Although ageing inevitably involves physiological and cognitive decline, these impairments are not always clinically evident. They typically become noticeable beyond certain thresholds and vary significantly both within and between individuals. As people enter old age, they carry with them a lifetime of experiences that shape their ageing process. This highlights the importance of adopting a life course approach to ageing, which considers the interplay of biological, social, psychological/mental, and environmental factors across the trajectory, including early life events. Such an approach can contribute to promoting healthy ageing by delaying the onset of chronic illnesses and mitigating frailty, included among centenarian individuals [19, 20]. However, this process can be disrupted by various factors, including critical life events, financial difficulties, physical health issues, or psychological distress [19, 21].

Given these disruptions, ageing populations are expected to face a growing burden of chronic illnesses. The SHARE study [22] has highlighted a significant increase in the prevalence of chronic conditions in Switzerland with advancing age. For instance, 38% of individuals aged 55 to 61 suffered from at least one chronic illness, a figure that rose to 70% among those aged 83 to 89. The most common conditions affected the musculoskeletal system or involved symptoms of depression [22], reflecting not only physical issues but also psychological vulnerability.

According to the Swiss Health Observatory [23], 20.1% of men and 27.7% of women aged 65 to 74 exhibited symptoms of depression in 2017, with prevalences increasing with age to 26.7% in men and 35.4% in women aged 75 and older. A

comparison of 2017 and 2012 data suggests that depressive symptoms are rising in Switzerland [23].

Depression in ageing populations is poised to become a major public health issue [24] and should be recognized as a pathological condition rather than a normal aspect of ageing, even in extreme old age [25, 26]. It is crucial to avoid trivializing depression and to take preventive action to mitigate its severe somatic, mental, relational, and social repercussions on individuals and their proxy relatives [25, 27].

Definition of depression

According to the International Classification of Diseases – 11th Revision (ICD-11), depression is a mental health condition characterized by ‘a period of depressed mood or diminished interest in activities occurring most of the day, nearly every day during a period lasting at least two weeks accompanied by other symptoms such as difficulty concentrating, feelings of worthlessness or excessive or inappropriate guilt, hopelessness, recurrent thoughts of death or suicide, changes in appetite or sleep, psychomotor agitation or retardation, and reduced energy or fatigue’ [28].

Similarly, the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) defines major depressive disorder as the presence of at least five symptoms during the same two-week period, with at least one being either depressed mood or loss of interest/pleasure (anhedonia). While the core diagnostic criteria are largely similar in both classifications, the DSM-5 relies on a predefined symptom threshold for diagnosis, whereas the ICD-11 provides a broader and more flexible framework for clinical assessment [29].

While not specifically developed for late-life depression (LLD), these are the most widely used classifications for depression diagnosis worldwide.

Aetiology of depression

Depression is a complex health condition resulting from the interaction of biological, psychological and social factors. Rather than having a single or linear cause, its aetiology involves a network of interrelated elements [27, 30].

From the specific perspective of older adults and the ageing process, several biological factors have been documented as potential contributors to depression. These include decreases in cerebral neurotransmitters (serotonin, noradrenaline and dopamine), increases in the enzyme that degrades these amines (monoamine oxidase B), and neurocognitive conditions such as dementia, Parkinson’s disease, strokes and certain

types of cancer [30-35]. Other health conditions, such as age-related macular degeneration, inflammatory rheumatic disorders, and chronic pain, can also contribute to the onset of a depressive episode in very old age. Vascular issues, including arterial hypertension, diabetes, dyslipidaemia, and atherosclerosis, especially when poorly controlled, have also been implicated [24, 31, 33, 36, 37]. Additionally, the use of certain medications such as beta-blockers, centrally acting antihypertensives, neuroleptics, cimetidine, and benzodiazepines, should be considered as potential risk factors [31, 38].

Psychosocial factors associated with depression in older adults are largely linked to losses and bereavements that frequently occur at this stage of life. These include the deaths of loved ones, physical illness, loss of autonomy and mobility, financial difficulties or changes in socio-economic status, institutionalization, loss of social status or role, and social isolation [24, 30, 32, 33, 39]. Compared to younger individuals, biographical, situational, social, and psychological factors appear to play a particularly significant role in the onset of depression among older adults [31, 39, 40].

The risk factors outlined above will be summarized—though non-exhaustively—as predisposing and precipitating factors of depressive symptomatology in older adults. They will also be complemented by additional elements particularly relevant to the nursing profession.

Several factors have been identified as predisposing to depressive symptomatology, including past episodes of depression; the death of a loved one or declining health, both of which can negatively affect personal identity and life meaning; and physical illnesses such as Parkinson's disease and vascular conditions, which may predispose individuals to depressive symptoms, precipitate their onset, or contribute to their persistence. Additionally, certain medications can have side effects that manifest as depressive symptoms. Functional decline, characterized by increasing incapacities and dependence, is another significant predisposing factor. Alzheimer's disease, especially in its mild to moderate stages, has also been associated with a higher risk of depression. Furthermore, neurotic personality traits, marked by heightened emotional vulnerability to stress, as well as ineffective cognitive coping strategies such as excessive rumination or severe self-criticism, may further contribute to the development of depressive symptomatology [25].

In addition to predisposing factors, several elements may act as precipitating factors of depressive symptomatology. Stressful situations, such as hospitalization, bereavement, financial difficulties, and interpersonal conflicts, can contribute to the onset of depression. Additionally, a persistently depressed mood, insufficient emotional support, and infrequent visits from loved ones may further exacerbate symptoms. Complex informal caregiving situations, particularly when caring for a loved one with dementia and

associated behavioural disorders, can also increase psychological distress. Furthermore, certain attitudes and behaviours displayed by caregivers—such as infantilization, a defeatist outlook on ageing, or perceiving the person as incapable—may foster dependence and reinforce feelings of loss of control or negative thoughts. Transitions to nursing homes, which require individuals to leave their home, proxy relatives, and familiar environment to completely reorganize their way of life, represent another critical precipitating factor. Finally, existential concerns about ageing and the end of life, particularly as death approaches, may further contribute to the development or worsening of depressive symptomatology [25].

Treatment of depression

It is important to distinguish between older adults with a history of depression and those experiencing a first episode later in life, as the latter often respond sub-optimally to treatment and face a higher risk of chronic illness [31, 41]. Before initiating treatment, a comprehensive geriatric assessment is recommended [42].

Experts identify three stages in depression treatment: (I) acute phase (from treatment initiation to symptom remission), (II) continuation phase (stabilization of remission), and (III) maintenance phase (prevention of relapse and restoration of function) [42]. Treatment may integrate a biopsychosocial approach, including psychosocial interventions (e.g., cognitive behavioural therapy, interpersonal therapy), specific psychotherapy and antidepressants. Additionally, biological non-pharmacological treatments, such as chronobiological procedures and electroconvulsive therapy, may also be considered in older adults [42, 43].

Most guidelines do not distinguish between adults and older adults, and evidence on geriatric depression treatment remains limited [42, 43]. General recommendations should, therefore, be applied cautiously, using a gradual, age-appropriate approach that considers overall health, comorbidities, and potential drug interactions [42]. The choice of intervention should be based on individual clinical factors and a proper cost–benefit analysis [44].

Predictors of treatment inefficacy include older age, severe depression, slow improvement, prolonged episode duration, comorbid anxiety, somatic illness, and executive function impairments [45]. Many older adults remain undertreated, and treatment effectiveness declines with age, particularly in nursing home residents [46].

Prognosis remains concerning: only one-third of older adults treated with antidepressants achieve remission, though sequential treatment protocols have shown a 96.3% response rate and 84.0% remission within three years. Factors such as severe

symptoms, prolonged episodes, comorbidities, and recurrent depression contribute to a relapse rate of up to 60%, higher than in younger adults. Without adequate treatment, the prognosis remains guarded [42].

Why is this topic important?

As ageing is linked with a higher prevalence of chronic illnesses in Switzerland, including depression, centenarians are also likely to face significant mental health challenges. However, to the best of our knowledge, specific data on Switzerland's centenarians appeared to be lacking, highlighting a critical research gap. This is particularly concerning given the increasing number of very old individuals who may experience depressive symptoms and require specialized care.

Nurses, due to their close interactions with patients, proxy relatives, and communities, play a key role in preventing, screening, and managing depressive symptoms. Their active involvement is essential for improving mental health outcomes in the very old, despite specific challenges that need to be considered, such as the need for adequate training. Article 1 emphasizes the relevance of this topic for the nursing profession.

Overall aims

This research project aimed to enhance the understanding of mental health trajectories in advanced age, with a particular focus on depressive symptomatology in individuals aged 100 years and older. Importantly, the primary objective was not to advance pure medical knowledge in the field of depression but rather to improve the identification of signs and symptoms that may be linked to this psychopathological condition, emphasizing the critical role of nurses in this process.

More specifically, this thesis focused on examining the prevalence, identification methods, and clinical significance of depressive signs and symptoms among near-centenarians and centenarians. It explored their relationship with functional dependence and addressed challenges in screening and diagnosis. Additionally, it sought to provide a comprehensive perspective on these issues, advocate for their prioritization in healthcare, and contribute to the development of tailored screening and care interventions adapted to the real needs of this unique population.

ARTICLE 1

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Letters to the Editor

Why Centenarians' Depressive Symptoms Must Become a Priority for Nurses



To the Editor:

The world population's rapid aging is a globally recognized phenomenon. The proportion of very old people is also growing fast, notably centenarians: in 2015, there were half a million individuals aged 100 years old or older. According to United Nations predictions, this number will increase to 3.4 million in 2050 and more than 25 million in 2100, representing a population of centenarians 50 times higher than in 2015.¹ However, the aging process is often accompanied by the emergence or worsening of pathologic conditions,² of which depression can be one.

Indeed, depression among aging populations is set to become a significant public health problem and should be identified as a condition that is not a normal part of the aging process.³ One European study has estimated the prevalence of depression among older adults at between 17.0% and 35.0%.⁴ Looking more specifically at centenarian populations, the prevalence of depression may be even higher: the only known systematic review on the topic suggested worldwide rates of up to 65.0%.⁵ The extent to which differences in prevalence are due to the methodological issues of assessing the very old is currently unclear. Similarly, whether centenarians are more strongly affected than younger old individuals remains unknown. In Sweden, for example, the prevalence of depression among near-centenarians and centenarians was almost twice as high (32.3%) as among octogenarians (16.8%).⁵ More systematic research is urgently needed, particularly in the current Coronavirus Disease 2019 pandemic that could lead to the onset or worsening of depression.

Despite its high prevalence, depression remains underdiagnosed and undertreated, partly because its signs and symptoms are sometimes erroneously interpreted as parts of the normal aging process.³ It has been estimated that front-line health care professionals fail to recognize approximately half of the cases of depression that they encounter.⁶

This psychopathology can lead to such devastating outcomes as malnutrition, falls, delirium, functional decline, a worsening of other chronic conditions, an increased risk of subsequent dementia and frailty, institutionalization, and early death.^{5–8} It also represents a substantial burden for family and professional caregivers.⁶

In view of the adverse complications surrounding depression, its early detection and treatment are crucial to maintaining older adults' quality of life, including centenarians.³ Detection and treatment could also reduce the additional burdens on family caregivers and go some way to helping balance the books of over-stretched health care systems.

Nurses are of particular importance in the fight against depression in old age. Because they are in the front lines of primary care, providing care at home, in nursing homes, and in hospital environments, nurses play a critical role in the early identification of depressive symptomatology, mobilizing preventive strategies, and implementing appropriate interventions.³ By encouraging the development of proactive quality care for older adults, nurses can have a truly positive impact on the health and well-being of people at risk of depression.

Adequate training seems essential to enable nurses to detect depressive symptomatology early on.⁹ There is a need for evidence-based training programs integrating the different components of nursing roles and responsibilities. Front-line nurses must develop a deeper knowledge of depressive symptomatology and the clinical skills to identify its risk factors and thus prevent the onset of depression. They should be able to identify the signs and symptoms of depression, screen for them systematically using appropriate tools, track and coordinate interdisciplinary care plans, and ensure that there is high-quality monitoring of their patients' mental health. Nevertheless, training alone is insufficient. Real improvements in treatment and care for very old adults will require that knowledge is transferred to clinical practice.^{3,9}

One systematic review revealed that most of the studies on centenarians were primarily interested in physical, cognitive, and social health.⁵ Research targeting their psychological and mental health has been limited so far, representing a gap in scientific knowledge with a potentially substantial impact on clinical practice.^{5,10} The rapid increase in the number of centenarians has made it essential to understand how much depressive symptomatology affects this specific population group. First, however, it will be crucial to accurately describe depressive symptomatology among centenarians. This is a required step before implementing strategies for the effective prevention, detection, treatment, and monitoring of depression adapted to the real needs of this special population and its caregivers.

Given their extensive interactions with patients and their families, nurses should have a leading role in developing and transferring knowledge about depressive symptomatology among centenarians. More research is urgently needed to provide optimal person-centered care based on the best available evidence.

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CHAPTER 2 – THEORETICAL FRAMEWORK

THEORETICAL FRAMEWORK

This chapter presents a reflective analysis of Afaf I. Meleis' *Transitions Theory*, a conceptual framework in nursing, as it relates to our phenomena of interest: depressive symptomatology and functional dependence in centenarians. It aims to explore and support the theory's relevance in shaping the development of this doctoral project.

Transitions Theory

The development of Transition Theory began when Professor Afaf I. Meleis was working on her doctoral project in the mid-1960s. The conceptual foundations of this theory have evolved over time, with contributions from numerous studies. Initially, Professor Meleis focused on 'unhealthy transitions' related to the concept of 'role insufficiency', defined as any difficulty in understanding or performing a specific role, as perceived by oneself or by significant others. These foundations inspired the development of the Transition Theoretical Framework and, subsequently, the Middle-Range Transitions Theory [47, 48], which is based on the postulates of 'healthy transitions' and the development of 'role supplementation' as a form of 'nursing therapeutics' [47].

The Middle-Range Transitions Theory was officially established in 2000, after many years of conceptualization based on the results of numerous studies grounded in the Transition Theoretical Framework [47]. Since then, the Transitions Theory has continued to be widely used as a conceptual framework in various transitional contexts and among different populations [47, 49].

Transitions Theory key concepts

Transition is defined as 'a passage between two relatively stable periods of time. In this passage, the individual moves from one life phase, situation, or status to another. Transitions are processes that occur over time and have a sense of flow and movement. They are ushered by changes that trigger a period of disequilibrium and upheaval' [50, p.130]. Transitions Theory defines several core concepts: nature of transitions (types, patterns, and properties); transition conditions: facilitators and inhibitors; patterns of response (process indicators and outcome indicators); and nursing therapeutics [47, 49]. These concepts will not be explained in detail, but their relationships are illustrated in Figure 1, which provides an overview of Transitions Theory [51].

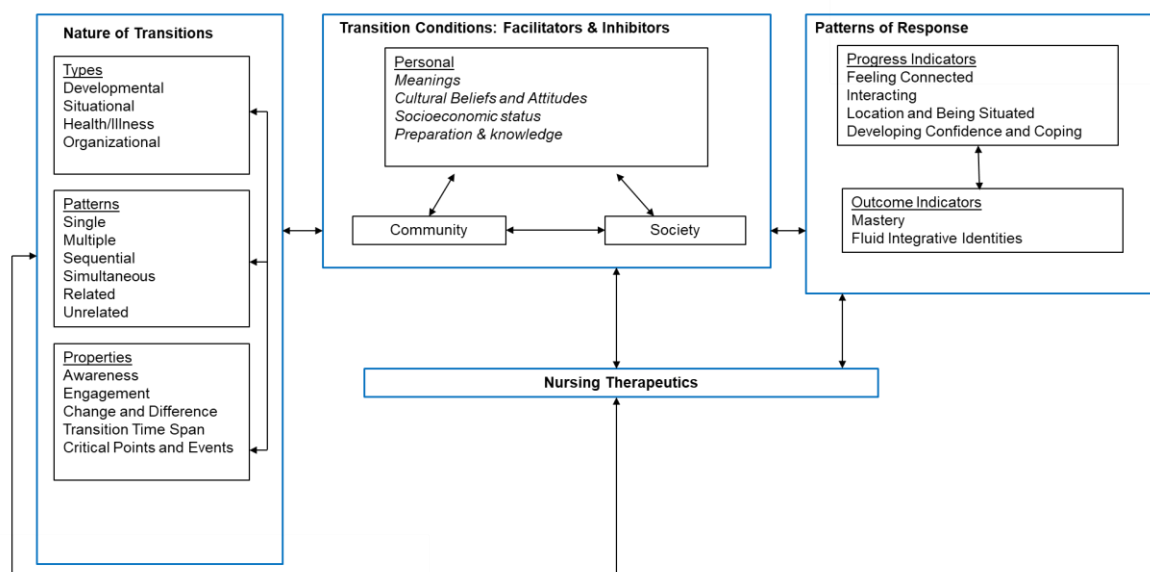


Figure 1: Transitions Theory Framework (adapted from Meleis *et al.*, 2010, p.56) [51]

Transitions Theory is a middle-range theory characterised by a more limited scope and a lower level of abstraction than Grand Theories [49]. It is, therefore, more easily applicable to nursing practice because it deals with concrete phenomena with specific concepts [49, 52].

Professor Meleis emphasizes the processes and experiences that individuals undergo during transitions, drawing on concepts such as a person (client), health, environment, interaction, and nursing therapeutics [53]. Based on this perspective, she defines the focus of the nursing discipline with the following framework: person (client) – health – environment – process – nursing [53]. The propositions related to the nursing metaparadigm in Meleis' framework are briefly outlined below:

- **Person (client):** Transitions are characterized by processes of movement and change at the levels of identity, roles, relationships, abilities, and patterns of behaviour. These changes are common to all individuals. Transition experiences, due to their nature, conditions, and meanings, influence daily life, the environment, and interactions among all human beings [47].
- **Health:** Transitions represent complex and multidimensional processes [47] that can affect an individual's equilibrium and overall health.
- **Environment:** Environmental conditions and interactions are key elements in transition experiences. They can expose individuals to potential harm, prolonged recovery with complications, or delayed and ineffective coping strategies [47].

- *Process*: Events that trigger transitions can be either anticipated or unexpected, short-term or long-term, but they always initiate a process rather than being isolated events [49].
- *Nursing*: Nurses are frontline caregivers for individuals undergoing transition processes, as well as for their families and significant others [47].

Transitions and health: A framework for gerontological nursing

Building on the postulates of Transitions Theory, Schumacher, Jones, and Meleis [50] proposed a framework specific to older adults in transition. The use of a transition-based framework acknowledges the importance of this phenomenon for the health of older individuals. This theoretical framework offers a perspective on ageing with a strong potential to advance both practice and research in geriatric and gerontological nursing: “Growing old is a process of gains and losses that takes time. How this period is viewed by gerontological nurses shapes their work with elderly clients and their families” [50, p.129].

These authors identified the final stages of life as a period of multiple transitions, including spousal and friendship loss, changes in living environments, illness onset, and increasing frailty [50]. These examples of transitions can be categorised by type and pattern. According to this framework, transitions fall into three main categories according to their type: developmental (e.g., birth, adolescence, menopause, ageing, death), health and illness (e.g., recovering, hospital discharge, chronic illness diagnosis), and organisational (e.g., changes in the living environment and conditions affecting patients and staff) [47, 49]. Regarding their patterns, transition models account for the multiplicity and complexity of transitions, which can be simple, multiple, sequential, or simultaneous. Indeed, some individuals experience simultaneous transitions, whether related or unrelated. It is also important to consider the degree of overlap between sequential or simultaneous transitions and any potential associations between the events that trigger them [47, 49].

Healthy transitions

A distinctive feature of this theoretical framework specific to older adults is its emphasis on healthy transition processes, considering the following elements [50]:

- *Redefining meaning/awareness*: This is a complex process that requires time and engagement from the older adult and, potentially, their close relatives. It involves exploring the meaning of the transition and seeking new meanings or a renewed sense

of purpose. When the transition moves in a healthy direction, the person is generally able to carry out this redefinition. Conversely, if the individual resists redefining new meanings, the process tends to evolve toward an unhealthy transition [50].

- *Modifying expectations:* In healthy transitions, the older adult and their relatives can gradually adjust their previous expectations and replace them with new, coherent, and realistic ones that align with the new situation. In unhealthy transitions, unrealistic expectations are maintained, with the person anticipating an outcome that is unlikely to materialize [50].
- *Restructuring of life routines:* When the transition process is healthy, daily routines are adapted to the new situation, allowing the older adult to experience a sense of comfort, predictability, and control over their life. In contrast, during an unhealthy transition, this restructuring does not occur, and the person clings to old routines that no longer fit the new context. If the individual is unable to restructure routines due to personal or environmental difficulties, they may end up without any routines at all, leading to days that feel unpredictable, disorganized, or empty [50].
- *Developing knowledge and skills:* Healthy transitions are marked by the pursuit of new knowledge, skills, and development opportunities. Over time, the older adult's knowledge and abilities align with the demands of the new situation. If the person avoids adopting new knowledge and skills, an unhealthy transition may occur, as past abilities may prove insufficient in the new context [50].
- *Maintaining continuity:* Healthy transitions are characterized by the preservation of as much continuity as possible in terms of identity, relationships, and environment. Continuity supports effective coping, helping the older adult integrate the transition experience into their life. In unhealthy transitions, unnecessary discontinuity and disruption occur, often accompanied by a lack of awareness about opportunities to maintain continuity. This may lead to avoidable losses [50].
- *Creating new choices:* Transition experiences in older adults are often associated with losses. However, gains can also occur, such as the opportunity to make new choices. If the individual is open to exploring new options and creating new opportunities, the transition process will move toward a healthy experience, actively shaped by the person themselves. Conversely, if the individual tends to limit their choices, the transition may become unhealthy. Some older adults may self-limit their available options, but these limitations can also be imposed by others in their environment, preventing the person from exploring possibilities that could have been suitable for their new situation and placing them in a passive role in managing the transition process [50].

- *Finding opportunities for personal growth*: During a transition, new levels of self-awareness, dimensions of identity and relationships, or new skills may emerge. In a healthy transition, the individual seizes these opportunities. In the case of an unhealthy transition, the person tends to reject such opportunities [50].

Process Indicators

Process indicators help measure how the transition is unfolding and determine whether the process is moving toward a healthy or unhealthy experience. The authors identify five types of process indicators in this framework specific to transitions in older adults [50]:

- *Minimal symptoms*: During a transition, older adults may experience new symptoms or an exacerbation of existing ones. These symptoms should be managed as effectively as possible, with a measurable decrease in their frequency and severity over time as the transition progresses. While some physical and behavioural symptoms are inevitable, they should be managed optimally using the most current symptom management strategies [50].
- *Optimal functional status*: Changes in the functional status of older adults can occur during a transition. However, in a healthy transition, the individual should be able to regain the highest possible level of functioning, both physically and cognitively. A functional status that is not optimal compared to the person's usual baseline suggests an unhealthy transition [50].
- *Feelings of connectedness*: In a healthy transition process, there will be measurable evidence of a regained sense of connectedness. If the transition was triggered by one or more relational losses, fostering new relationships during the transition is important to provide the older adult with additional sources of connection. An unhealthy transition is characterized by isolation and feelings of disconnection [50].
- *Sense of empowerment*: A transition typically leads to some form of disruption, which can threaten an older adult's sense of autonomy and self-determination. In a healthy transition, a renewed sense of empowerment is achieved, allowing the individual to maintain these aspects and regain a certain level of control over their life. In cases where severe physical and/or cognitive impairments prevent the person from making important decisions, this sense of empowerment should be transferred to a close relative or significant other. In an unhealthy transition, 'inappropriate disempowerment' may occur, manifesting as a loss of control, an inability to make and implement decisions, or even having control taken over by someone in the older adult's environment who is not a significant person to them [50].

- *Sense of integrity*: As an indicator of a healthy transition, this concept includes a sense of wholeness, coherence, personal growth, and new perspectives for oneself. It also reflects the feeling that the transition meaningfully belongs to one's life story. The loss of this sense of integrity, often manifested through feelings of fragmentation or uselessness, indicates an unhealthy transition process [50].

Nursing Therapeutics

The final concept in this framework is nursing therapeutics. Schumacher and Meleis [54] conceptualized nursing therapeutics through three broadly applicable measures for therapeutic interventions during transition processes: assessment of readiness, preparation for transition, and role supplementation [47], as explained below:

- *Assessment of readiness*: This should be interdisciplinary and based on a comprehensive understanding of the client. To achieve this, each of the transition conditions must be evaluated to create an overview of the client's readiness. The results of this assessment help identify different patterns [47].
- *Preparation for transition*: This refers to education, which is considered the most important means of creating optimal conditions for the individual to feel prepared for the transition process [47].
- *Role supplementation*: Process designed to address role insufficiency by providing clarification, guidance, and support to individuals and their significant others. It involves conveying necessary information and experiences to enhance awareness of expected behaviours, interactions, and responsibilities within a role. This concept applies to both formal and informal roles and can be preventive or therapeutic [49].

The goals of nursing therapeutics are to facilitate healthy transition processes, reduce unhealthy transition processes, and support positive process indicators. In the framework proposed by Schumacher, Jones, and Meleis [50], five key nursing therapeutics are identified: assessment, reminiscence, role supplementation, creation of healthy environments, and mobilization of resources. These therapeutics fall within the autonomous role of nurses and should be implemented to achieve personalized and realistic care goals. Figure 2 illustrates this theoretical framework.

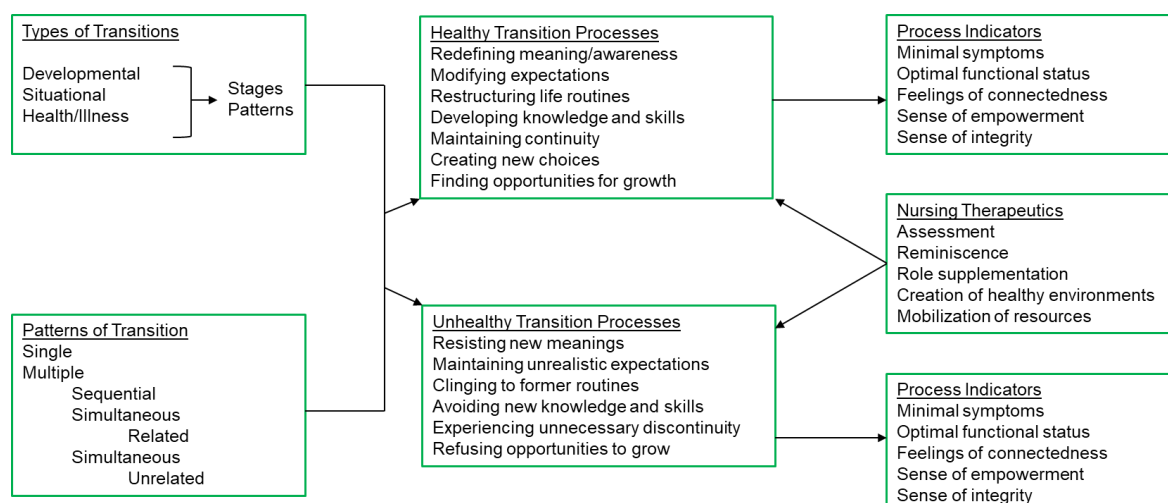


Figure 2: Transitions Theory Framework for Gerontological Nursing (adapted from Schumacher, Jones & Meleis, 2010, p.131) [50]

Transitions Theory's relevance to the doctoral project

Transitions Theory provides a relevant conceptual framework for understanding and analysing our phenomena of interest. It allows consideration of the transition's nature (*type, patterns, and properties*), conditions (facilitators and inhibitors within specific community and societal contexts), and response patterns (*progress and outcome indicators*). Emphasizing the role of nursing interventions (*nursing therapeutics*), this framework supports interventions that promote healthy transitions [49].

The onset of depression in very old age may reflect a developmental, situational or health–illness transition [49]. More specifically, during the transition to ageing, various biological and psychosocial changes occur, such as hearing loss, reduced muscle strength, the death of loved ones, income loss, and changes in living environment [55]. Depending on an individual's ability to adapt, these changes may lead to depressive symptomatology. Transitions Theory, as developed by Schumacher, Jones, and Meleis [50], provides a nuanced framework for studying this phenomenon, recognizing late life as a period of multiple transitions [49]. It also considers depression a trigger for problematic role transitions [50, 51], as illustrated in Figure 3 [49].

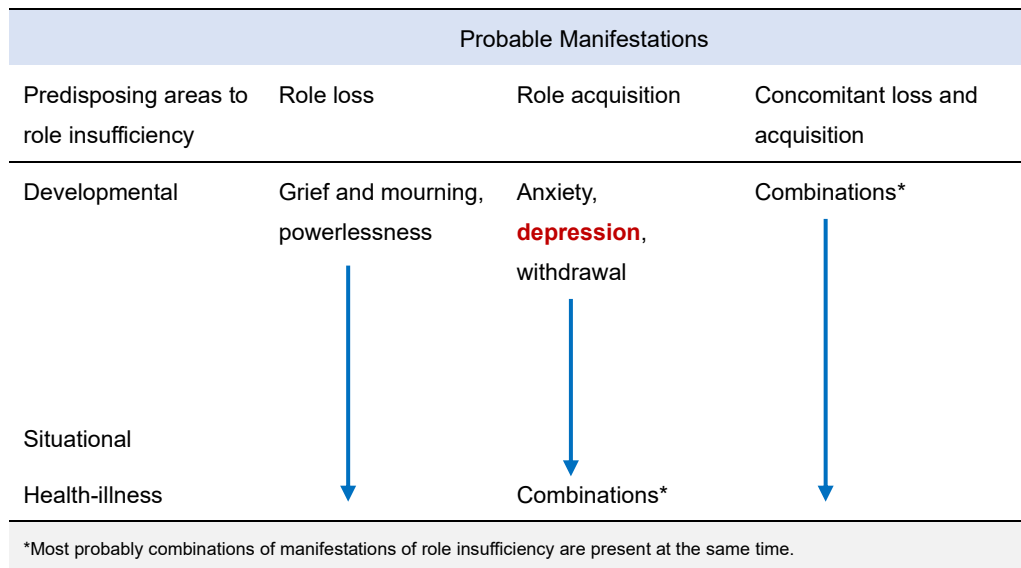


Figure 3: Components of role insufficiency and probable manifestations (adapted from Meleis, 2010, p.15) [56]

Depression can hinder progress toward equilibrium, health, and well-being, preventing a smooth adaptation during role transitions. Another complex transition is the shift to functional dependence, which can be particularly challenging. These factors contribute to increasing vulnerability and frailty. For these reasons, and specifically in the centenarian population, these phenomena must be examined, tested, and empirically verified through deductive analysis [49].

In this context, Transitions Theory provides a valuable framework for understanding and analysing these transitions. It guided this research project by identifying depressive symptomatology as the outcome of an unhealthy transition process, measurable with a reliable and valid minimal-symptoms process-indicator instrument, such as the Geriatric Depression Scale (GDS), which the authors also propose for assessing progress indicators [50]. Longitudinal monitoring of this indicator is essential in nursing practice, as it provides insights into the evolution of depressive symptomatology, the transition process (healthy vs. unhealthy; improvement vs. relapse), the need to adjust care objectives, and the development of nursing interventions to promote healthy transitions. Meleis and colleagues [51, p.63] support that “Knowledge is empowering to those who develop it, those who use it, and those who benefit from it. Understanding the properties and conditions inherent in a transition process will lead to the development of nursing therapeutics that are congruent with the unique experiences of clients and their families, thus promoting healthy responses to transition. Theories provide frameworks for

understanding complex situations such as vulnerable clients' processes and responses to transitions.”.

CHAPTER 3 – DEPRESSIVE SYMPTOMS AND FUNCTIONAL DEPENDENCE IN CENTENARIANS

DEPRESSIVE SYMPTOMS AND FUNCTIONAL DEPENDENCE IN CENTENARIANS

In Chapter 1, the relevance of studying depressive symptoms as a major mental health issue among older adults was established. Depression is the most common mental health pathology among this population [24, 30, 31]. Gaining a deeper understanding of the negative impact of its symptoms is essential. Indeed, depressive symptoms can have severe consequences for those affected, including increased functional dependence, which in turn may exacerbate depressive symptoms. Investigating this relationship is crucial, as it can inform strategies for early detection, treatment, and monitoring to optimize the well-being of the oldest-old.

Depression and functional dependence in older adults

The numerous risks and consequences associated with depression in older adults are well documented in the literature and include malnutrition, falls and fractures, delirium, functional decline and functional dependence, worsening of chronic conditions, and institutionalization [24, 30, 31, 57, 58]. Furthermore, a systematic review incorporating a meta-analysis demonstrated that LLD is associated with a higher risk of mortality [59].

In terms of prevalence, a study estimated the occurrence of mental disorders among adults aged 65 to 84 years (mean age: 73.7) across different European countries. Switzerland had the highest rates of severe depressive episodes, with 23% reporting such episodes over their lifetime, 13% in the past 12 months, and 13% at the time of the study. It should be noted that individuals with severe cognitive disorders were excluded from the sample, meaning these rates may be underestimated [60]. Another European study (mean age: 74 years) estimated depression prevalence at 35% in Southern Europe, 32% in Central and Eastern Europe, 26% in Western Europe, and 17% in Scandinavia [33].

While prevalence rates highlight the burden of depression in older adults, incidence data provide further insight into its progression. A systematic review analysing the incidence of depressive disorders in late life reported substantial variability between studies [61]. However, findings consistently showed that major depression was diagnosed less frequently than mild depression, whereas clinically significant depressive symptoms were at least as common as mild depression. The incidence of major depression ranged from 0.2 to 14.1 per 100 person-years, while the incidence of clinically significant depressive symptoms was 6.8 per 100 person-years, with a higher incidence among women [61].

Depressive psychopathology has devastating effects on the health and quality of life of older adults, as previously mentioned [24, 42, 46]. Moreover, it also imposes a significant additional burden on both professional and family caregivers, as the demand for care and services among the ageing population is expected to continue to rise in the coming years [30, 31, 62, 63]. Studies on healthcare utilization and costs consistently indicate that older adults with depression require more services than their non-depressed counterparts. Therefore, their overall healthcare expenses, including outpatient and inpatient costs, are significantly higher than those of younger depressed patients [62, 64]. Given the severe complications associated with depression, its early detection and treatment in older adults are essential for preserving their functional independence and quality of life [65, 66]. Additionally, timely interventions may help prevent the burden on family caregivers and go a small way to helping balance the books of already overstretched healthcare systems.

Among the many severe consequences of depression, functional dependence is of particular interest to this project. Among the numerous nursing responsibilities, preventing and compensating for a state of dependence remain at the core of caregiving practices. Functional dependence is defined as a reduction or inability in an individual's capacity to perform basic and instrumental activities of daily living (ADLs and IADLs) without assistance, and is associated with increasing physical and psychological impairments [67].

Among older adults, different factors may contribute to the transition towards functional dependence, and distinguishing whether these factors are a cause or a consequence of depression can be complex [67]. On one hand, depression seems to increase the risk of subsequent functional dependence [25, 68, 69]. On the other hand, functional dependence seems to exacerbate depressive symptoms [68, 69]. Moreover, being functionally independent is one of the central elements in enabling older adults to remain in their own homes, as they often wish. Building on this, nurses play a crucial role in assessing and systematically monitoring functional status, particularly in individuals at risk of physical and mental health deterioration [67]. In doing so, they must also consider the potential relationship between functional decline and depressive symptomatology. Thus, a better understanding of this bidirectional relationship could help inform the development of effective interventions to interrupt this potentially vicious cycle [68, 69].

Depression and functional dependence in centenarians

When considering centenarians specifically, depression prevalence seems to vary considerably across countries. Studies comparing centenarian cohorts with

younger older adults have produced mixed findings, with approximately half reporting higher depression rates among centenarians, suggesting divergences in the literature [57]. Nevertheless, the extent to which depressive symptoms and functional dependence affect this population remains largely unexplored. To establish a knowledge base for centenarians, it is essential to examine existing research on these issues, including their prevalence, assessment methods, and potential associations. This, in turn, will guide the most appropriate approach for further investigation. Given these considerations, a scoping review was identified as the most relevant approach to systematically mapping and synthesizing current knowledge on depressive symptoms and functional dependence in near-centenarians and centenarians (see Article 2).

ARTICLE 2

Gomes da Rocha, C., von Gunten, A., Rosselet Amoussou, J., Fernandes, S., Uittenhove, k., Jopp, D. S., Ribeiro, O., & Verloo, H. Depressive symptoms and functional dependence in near-centenarians and centenarians: a scoping review (Submitted to *BMC Geriatrics* on December 18th, 2023).

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Depressive symptoms and functional dependence in near-centenarians and centenarians: a scoping review

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ABSTRACT

Background: The growing population of centenarians faces unique health challenges. Of particular interest may be the co-occurrence of depressive symptoms and functional dependence, requiring comprehensive exploration.

Objective: To map and summarize existing literature on depressive symptoms and functional dependence in near-centenarians and centenarians, focusing on prevalence rates, screening instruments, and the relationship between these two phenomena.

Inclusion criteria: Studies that explored depressive symptoms and functional dependence among individuals aged ≥ 95 years.

Methods: This review was performed in accordance with the JBI Manual for Scoping Reviews. The PRISMA Extension for Scoping Reviews (PRISMA-ScR) standards were followed for reporting. The literature search was conducted in August 2023 in the following bibliographic databases: Embase.com, Medline ALL Ovid, CINAHL with Full Text, APA PsycInfo Ovid, Web of Science Core Collection, Cochrane Database of Systematic Reviews and Cochrane Central Register of Controlled Trials; including a grey literature search and citation tracking strategies.

Results: Fifty-three studies from 1994 to 2023 were included, with 28.3% conducted in the USA. Most studies were quantitative and cross-sectional. Depressive symptoms prevalence ranged from 10.5% to 73%, mainly screened using the GDS–15. Functional dependence ranged from 20.8% to 81.7% (ADLs) and 27.5% to 97% (IADLs), often assessed by The OARS Multidimensional Functional Assessment Questionnaire and the Katz Index. Only 30.2% of studies explored the association between depressive symptoms and functional dependence, with 56.3% finding a significant relationship.

Conclusions: The findings revealed geographical research disparities and underscored the need for diverse research methodologies for deeper insights into the health trajectories of the very old. Additionally, centenarians may not inherently have higher depressive symptoms than ‘younger’ seniors, indicating possible resilience mechanisms. The relationship between depressive symptoms and functional dependence highlighted their mutual influence and potential to increase the risk of adverse outcomes.

Implications: Diversifying research methodologies and expanding geographical scope are critical for a holistic understanding and international comparisons. Standardized guidelines for assessment instruments could facilitate consistent conclusions. Development and implementation of multifaceted interventions, such as preventive measures, professional competency enhancement, and caregiver support are paramount for addressing the needs of this population effectively.

Keywords: *centenarians; near-centenarians; depressive symptoms; functional dependence; activities of daily living; scoping review.*

BACKGROUND

The 21st century is witnessing a dramatic increase in the population of centenarians. Predictions from the United Nations suggest an increase from half a million centenarians in 2015 to 3.4 million by 2050 and an astonishing 25 million by 2100 (1-3). Europe is not an exception to this trend, with a notable increase in centenarians in recent decades. Census data from 2011 estimated that there were approximately 89,156 individuals aged 100 and over in 32 European countries (4), and this number has likely increased since then.

While the growth in the centenarian population underscores the positive strides made in medical advancements and improved quality of life, it might also give rise to concerns for both physical and mental well-being, potentially leading to unique health challenges. These may include the manifestation of depressive symptoms, maybe as a consequence but also a reason for functional dependence. In the absence of notable systematic investigation in very old age, the present paper aims at reviewing the actual findings to build a basis for further comprehensive investigation.

Aging trajectories can differ substantially between individuals. Some remain robust in physical, cognitive, and mental health domains, while others experience varying degrees of physical and cognitive decline (5, 6). This variability brings forward significant challenges in understanding and addressing the specific needs of the very old, especially with an observed increase in multiple health conditions, including mental illnesses (7), within this growing population. Depression, in particular, stands out as a major public health concern in younger older age groups (7, 8), yet the situation is less clear in very old age.

As defined by the ICD-11, depression is characterized by a period of depressed mood or diminished interest in activities, occurring most of the day, nearly every day, for at least two weeks. This condition encompasses a range of symptoms including difficulty concentrating, feelings of worthlessness or guilt, hopelessness, changes in appetite or sleep, reduced energy or fatigue, and recurrent thoughts of death or suicide (9). Crucially important, depression is not a normal part of aging, even at very advanced ages (10-12). Clinically relevant depressive symptomatology has important negative consequences: it is associated with several risks, such as functional decline, falls and bone fractures, malnutrition, deterioration of other chronic conditions, delirium, increased risk of neurocognitive disorders, increased burdens on informal caregivers and healthcare professionals, frailty, institutionalization, and early death (13-17).

In the context of this review, the term 'depressive symptoms' may be more apt as it encompasses a broader spectrum of emotional states that can range from mild to severe. For older adults, manifestations of these symptoms might be subtle or concealed, making

detection a challenge (18-21). Yet, depressive symptoms in this demographic often blur with what is perceived as 'normal aging', leading to frequent under-diagnoses (7, 19, 22-24). Approximately half of these cases go unnoticed by healthcare professionals (14, 22) and when identified, about half remain untreated (14). This discrepancy highlights the urgent need for further investigation and insight in this domain.

A factor that may be of central importance in the context of the developing depressive symptoms in very older age is the reduction of everyday life functional capacity, ultimately leading to becoming dependent. Functional dependence is defined as a reduction in a person's capacity to perform basic activities of daily living (ADLs) or instrumental activities of daily living (IADLs) independently (25). This condition is closely related to depressive symptoms and can emerge both as a potential risk factor and a consequence of these symptoms (10). Understanding this complex relationship is of high importance. Particularly among the very old, several factors can influence the transition towards a state of functional dependence, making it difficult to determine whether they are the causes or consequences of depressive symptoms (25). Studies show that functional dependence can intensify depressive symptoms (26, 27). Depressive symptoms were also found to escalate the risk of functional dependence, impairing the ability to perform ADLs or IADLs (10, 26, 28). Nevertheless, despite the importance of better understanding the development of both, functional impairment and depressive symptoms for quality of life, this reciprocal detrimental relationship does not seem to be among the priority domains of research on centenarians (13).

When trying to synthesize research investigating depressive symptoms and functional dependence, various aspects need consideration that could have contributed to the results, including the age range covered in the studies, recruitment approach, or measures used. Therefore, delving into the characteristics of existing studies, including their origin, design, and sample demographics is crucial. Such details also provide insight into the broader context and help us understand cultural or demographic variations.

The present review aims at providing a comprehensive overview of studies on depressive symptoms and functional dependence in very old individuals. To the best of our knowledge, and based on a preliminary search across platforms including Embase.com, the Cochrane Database of Systematic Reviews, Epistemonikos and Prospero, no previous review has synthesized the available evidence on the prevalence of depressive symptoms and functional dependence among near-centenarians and centenarians. This work is part of a larger research initiative that seeks to identify the unique characteristics, challenges, and needs of centenarians (29).

Specifically, this review aims to map and summarize the available studies on these two phenomena in near-centenarians and centenarians. It focused on the following questions:

- I. What types of studies, based on their origin, research design, and key sample characteristics, have explored depressive symptoms and functional dependence in near-centenarians and centenarians?
- II. What are the prevalence rates of depressive symptoms among near-centenarians and centenarians, and which instruments have been employed to screen for these symptoms?
- III. What are the prevalence rates of functional dependence among near-centenarians and centenarians, and which instruments have been employed for its assessment?
- IV. Have any studies documented associations between depressive symptoms and functional dependence in this specific age group?

METHODS

This scoping review was carried out in accordance with the JBI Manual for scoping reviews (30). The PRISMA Extension for Scoping Reviews (PRISMA-ScR) standards were followed for reporting (31).

We chose not to publish a protocol for this scoping review. Due to resource constraints, we prioritized immediate engagement with the review process over protocol publication.

Selection criteria

To ensure a comprehensive understanding of the topics of interest, we established specific criteria to guide the inclusion of studies. Selection criteria regarding types of participants, the concepts of interest, the context of the studies, and the type of studies were as follows:

Types of participants

We considered studies that included near-centenarians and centenarians (i.e., individuals aged 95 or older).

Concepts of interest

This review primarily focuses on two phenomena: depressive symptoms and functional dependence, as described below.

I. Depressive symptoms

For the purposes of this review, the term 'depressive symptoms' is used to capture the spectrum of signs and symptoms associated with depression (9). The literature on the topic is vast, and various terms such as 'low mood', 'depressive affect', and 'dysthymia' are often used. Though these terms carry distinct nuances, for this review, any variations pointing towards a possible state of depression have been brought under the umbrella of "depressive symptoms" and were considered eligible for inclusion (Additional file 1).

II. Functional dependence

'Functional dependence' is defined as an individual's reduced capability to perform ADLs and/or IADLs without assistance (25). Examples include bathing, dressing, toileting, using the telephone, preparing food, and housekeeping (32-34). The literature frequently encompasses terms such as functional decline, disability, limitation, and incapacity. These are recognized as part of the broader dimension of functional health. Thus, for the scope of this review, all these variants were considered eligible for inclusion (Additional file 1).

Study contexts

Studies involving any subgroup of near-centenarians and centenarians were considered, irrespective of their living situation – community living, hospitalization, transitional care unit, or long-term care facilities (e.g., a nursing home). There were no geographical restrictions, meaning studies from any region or country were eligible.

Types of studies

Quantitative (experimental, quasi-experimental, and observational), qualitative, and mixed-methods studies were considered for inclusion in this scoping review. Comprehensive studies such as systematic reviews, meta-analyses, and meta-syntheses were also considered. Due to the potential limited depth of information, abstracts, commentaries, letters to the editor, and book reviews were excluded.

Search strategy

The literature search was conducted in August 2023, in collaboration with a medical librarian (JRA), in six bibliographic databases: Embase.com, Medline ALL Ovid, CINAHL with Full Text, APA PsycInfo Ovid, Web of Science Core Collection, Cochrane Database of Systematic Reviews and Cochrane Central Register of Controlled Trials. All searches were conducted with no language or date restrictions. Additional searches were performed in Google Scholar, ProQuest Dissertations & Theses Global (PQDTGlobal), Dart Europe, and Open Grey, followed by backward and forward citation tracking of the

included studies using the Citationchaser tool (35). The detailed search strategies, keywords, and index terms are presented in Appendix 3.

Screening and selection

Following the search, all identified records were uploaded into Endnote® 20 (36). Two reviewers (CGR and SF) independently checked the titles and abstracts for eligibility using Rayyan® software (37). Any discrepancies between them were resolved via discussions with a third reviewer (HV). The full texts of any relevant identified records were retrieved and analyzed to determine whether they met the inclusion criteria. Again, any issues were discussed and resolved via discussions with the third reviewer. The reasons for why specific full text records were excluded after analysis are provided in Appendix 4.

Data extraction and reporting results

Data extraction was conducted by a single reviewer (CGR) using a standardized data extraction tool aligned with the review's objectives and questions (Additional file 3). Any uncertainties or ambiguities were resolved in consultation with the research team. The data extracted encompassed details such as the year of publication, origin, research design, study objective(s), sample characteristics (sample size, mean age, living situation), concepts identified in relation to the phenomena of interest, instruments used to screen for them, and the key findings relevant to the review questions (Appendix 5).

RESULTS

Search results

Of 2125 records identified in the search and considered for selection in the study, 150 references met our inclusion criteria based on their title and abstract, and their respective full-text articles were then retrieved. Fifty-three full-text articles met the inclusion criteria and were included in the scoping review (Figure 1).

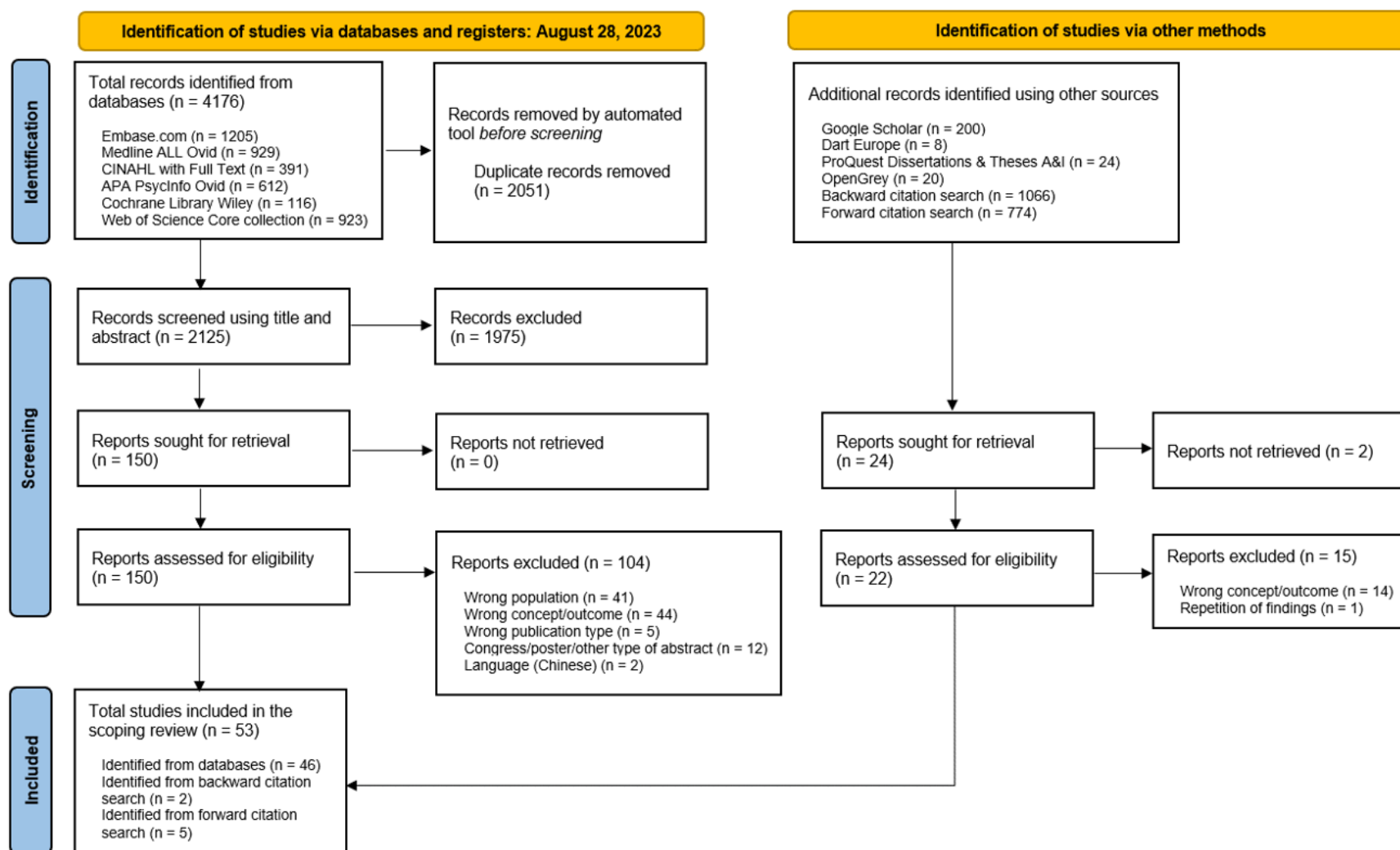


Figure 1. PRISMA 2020 Flow Chart: Search results and the study selection and inclusion process, following the presentation proposal by Page and colleagues (38)

Description of the studies retained

Our first research question focused on understanding the types of studies that have been published on depressive symptomatology and functional dependence among near-centenarians and centenarians. Important study characteristics were year of publication, geographic distribution (place of data collection), research designs employed (e.g., cross-sectional surveys, longitudinal analyses) and sample size and characteristics of the population (i.e., mean age, living situation) (Table 1).

Year of publication

The 53 selected studies were published over a period ranging from 1994 to 2023. It is worth noting that a surge in research occurred between 2016 and 2023, as 54.7% ($n = 29$) of the studies were published during this time frame (12, 39-66). For a visual representation of the distribution of the retained studies by 5-year periods, refer to Appendix 6.

Geographic distribution

Research on the topic spans four continents: North America ($n = 19$, 35.8%) (12, 44, 47, 49, 52, 54, 55, 59, 62, 65, 67-75), Europe ($n = 19$, 35.8%) (39-41, 45, 56, 57, 61, 76-87), Asia ($n = 13$, 24.5%) (42, 43, 46, 50, 51, 53, 58, 60, 63, 64, 66, 88, 89), and Oceania ($n = 1$, 1.9%) (90), whereas no studies were conducted in Africa or South America. Specific countries, such as the USA, China, and Italy, are more frequently represented. The USA accounts for 15 (28.3%) studies (12, 44, 49, 54, 59, 65, 67-75), China for eight (15.1%) (42, 46, 51, 58, 60, 63, 64, 66), and Italy for seven (13.2%) (76, 77, 79, 83-86). Additional research has been conducted in various other countries, providing a diverse geographic perspective on the issue. For a visual representation of the geographic distribution of the studies included in this review, refer to Appendix 7.

Study design

Methodologically, all 53 studies are rooted in a quantitative approach. Yet, within this group, three (5.7%) studies also integrated qualitative techniques, such as theme-based coding to categorize and quantify responses (49, 66, 89). In terms of design, 47 (88.7%) of the studies adopted a cross-sectional design or reported results of cross-sectional analysis within a broader longitudinal study), whereas six (11.3%) studies employed a longitudinal design (45, 53, 62, 67, 78, 85) (Table 1).

Sample size and age characteristics

The sample sizes in the retained studies showcase a wide variability, ranging from as few as 13 participants (62) to as many as 3391 (47) (Table 1). The pooled mean age across these studies is 100.7 years, underscoring the specific focus on the near-centenarian and centenarian populations.

Living situation of the participants (context)

Of the studies reviewed, 28 (52.8%) recruited participants from two main settings: private residences (community-based living) and nursing homes (institutionalized living) (12, 39-41, 43, 45, 47, 49, 50, 52, 53, 55, 56, 59, 61, 65-68, 70, 73, 77, 80, 83, 86, 87, 89, 90). A subset of six (11.3%) studies specifically focused on participants solely from the community-based living category (54, 57, 63, 69, 72, 75). It is of importance to highlight that none of the retained studies recruited participants from hospitals, with one exception, yet hospital residents only represented 1% of its participants (89) (Table 1).

Table 1. Characteristics of the studies retained (n = 53)

1 st Author and year of publication	Country of origin	Study design	Objective(s)	Sample size	Age Metrics*	Concepts**	Living situation (context)***
Ailshire <i>et al.</i> , 2011 (67)	U.S.A.	Quantitative, longitudinal	- Examine social characteristics and physical, functional, mental, and cognitive health.	n = 225 (follow-up)	- 96 y/o: n = 106 - 97 y/o: n = 102 - 98–100 y/o: n = 17	- Mental health - Functional limitations	- Community-based living: 64.8% - Institutionalized living: 37.4%
Araújo <i>et al.</i> , 2016 (39)	Portugal	Quantitative, cross-sectional	- Identify subgroups in successful aging profiles; - Determine the roles of sociodemographic factors and psychological, social, and economic resources on successful aging.	n = 80	M = 101.01 ± 1.31 y/o	- Depression - Functional disability	- Community-based living: 68.8% - Institutionalized living: 31.3%
Bauco <i>et al.</i> , 1996 (76)	Italy	Quantitative cross-sectional	- Analyze physical and psychosocial variables based on a multidimensional conceptualization of health.	n = 109	M = 101.7 ± 1.96 y/o	- Depression level - Functional capacity (ADL independence)	Not reported
Boerner <i>et al.</i> , 2019 (40)	Germany and Portugal	Quantitative, cross-sectional	- Examine how common thinking of and planning for end of life (EOL); - Examine whether patterns of EOL views are shaped by cultural and individual characteristics.	n = 218 • Germany: n = 87 • Portugal: n = 131	• Germany: M = 100.45 ± 0.52 y/o • Portugal: M = 101.21 ± 1.65 y/o	- Depressive symptoms - Functional ability	- Community-based living: • Germany: 34.5% • Portugal: 7% - Community-based living: • Germany: 34.5% • Portugal: 39.1%
Boerner <i>et al.</i> , 2018 (41)	Germany	Quantitative, cross-sectional	- Explore how centenarians think about and plan for end of life (EOL); - Explore to what extent their proxy informants are aware of these thoughts.	n = 78	M = 100.46 ± 0.54 y/o Range: 99.16–103.34 y/o	- Depressive symptoms/depression - Functional ability	- Community-based living: 32.1% - Institutionalized living: 35.9%
Chen <i>et al.</i> , 2020 (42)	China	Quantitative, cross-sectional	- Evaluate health status; - Investigate modifiable factors associated with health-related quality of life.	n = 876 (female subsample):	M = 95.26 ± 9.34 y/o	- Depression - Mobility and self-care	- Community-based living: 16.32%
Cheung & Lau, 2016 (43)	Hong Kong	Quantitative, cross-sectional	- Examine successful aging (SA); - Investigate whether SA is associated with biomedical and psychosocial-demographic factors.	n = 120	M = 97.66 ± 2.26 y/o Range: 95–108 y/o	- Depressive symptoms - Functional independence	- Community-based living: 85% - Institutionalized living: 15%
Cimarolli & Jopp, 2014	U.S.A.	Quantitative, cross-sectional	- Document the prevalence of self-reported vision, hearing, and	n = 119	M = 99 y/o Range: 95–107	- Depressive symptomatology	- Community-based living: 49.6%

(68)			dual sensory impairment; - Explore associations between these impairments and functional disability.		y/o	- Functional disability	- Institutionalized living: 19.3%
Cimarolli <i>et al.</i> , 2018 (44)	U.S.A.	Quantitative, cross-sectional	- Examine the separate and combined effects of self-reported vision and hearing impairment on depressive symptoms.	n = 119	M = 99 y/o Range: 95–107 y/o	- Depressive symptomatology - Functional disability	- Community-based living: 73.9%
Clayton <i>et al.</i> , 1994 (69)	U.S.A.	Quantitative, cross-sectional	- Examine differences between rural and urban participants across the following variables: physical health, ADLs, mental health, and life satisfaction.	n = 84 • Rural: n = 18 • Urban: n = 66	Range (urban participants): 100–106 y/o	- Mental health - Functional Health	Community-based living sample (only community-dwelling individuals were recruited)
Cohen-Mansfield <i>et al.</i> , 2013 (88)	Israel	Quantitative, cross-sectional (+ longitudinal)	- Examine whether old age, old-old age, and oldest-old age comprise distinct categories of demographics, health, function, and well-being.	n = 77	M = 97.8 ± 3 y/o Range: 95–108 y/o	- Depressed affect (as one of the indicators of “well-being”) - ADLs and IADLs (as indicators of “function”)	- Institutionalized living: 24.7%
Davey <i>et al.</i> , 2010 (70)	U.S.A.	Quantitative, cross-sectional	- Provide normative data on cognitive functioning and physical performance, health and health behaviors, and diseases.	n = 244	M = 100.5 y/o Range: 98–108 y/o	- Depression - Physical functional capacity	- Community-based living: 37.3% - Institutionalized living: 62.7%
Deckers <i>et al.</i> , 2018 (45)	U.K.	Quantitative, longitudinal	- Investigate associations between modifiable risk and protective factors and severe cognitive impairment and dementia.	n = 119 • Group 1 “ <i>Incident severe cognitive impairment status</i> ”: n = 44 • Group 2 “ <i>Incident dementia/severe cognitive impairment status</i> ”: n = 75	- Group 1 (at death): M = 96.7 ± 3.9 y/o - Group 2 (at death): M = 95.1 ± 3.9 y/o	- Depression - Disability in ADL and IADL	- Group 1: • Community-based living: 93.2% • Institutionalized living: 6.8% - Group 2: • Community-based living: 92% • Institutionalized living: 8%
Dello Buono <i>et al.</i> , 1998 (77)	Italy	Quantitative, cross-sectional	- Assess the quality of life.	n = 38	M = 101.13 ± 1.52 y/o	- Symptoms of depression - ADLs and IADLs	- Community-based living: 63.2% - Institutionalized living: 36.8%
Feng <i>et al.</i> , 2023 (46)	China	Quantitative, cross-sectional (+ longitudinal)	- Investigate the effects of physical inability, depression and cognitive impairment on the prognosis of centenarians.	n = 170	MED = 102 y/o IQR = 101–104 y/o	- Depression - Physical inability	Not reported
Freeman <i>et al.</i> , 2017 (47)	Canada	Quantitative, cross-sectional	- Describe patterns of health deficits in participants receiving	n = 3391	M = 101.5 ± 1.9 y/o	- Depressive symptoms	- Community-based living: 34.3%

formal care.

Range: 100–114
y/o- Impaired physical
functioning- Institutionalized living:
65.7%

Galenkamp <i>et al.</i> , 2013 (78)	The Netherlands	Quantitative, longitudinal	- Investigate changes in self-rated health; - Examine its sensitivity to changes in chronic conditions and functioning.	n = 21 (wave 4)	MED = 99 y/o Range: 99–106 y/o	- Depression - Functional status	- Community-based living: 61.9%
Garasky <i>et al.</i> , 2012 (71)	U.S.A.	Quantitative, cross-sectional	- Explore whether economic status is related to: (a) ability to manage ADLs; (b) mental abilities/cognition; (c) psychological well-being/depression; (d) ability to handle finances; - Explore whether these relationships vary by institutionalization status.	n = 152	M = 101.6 y/o	- Depressive symptoms - ADLs/functional ability	- Institutionalized living: 81.5%
Herr <i>et al.</i> , 2018 (48)	Japan, France, Switzerland, Denmark, and Sweden	Quantitative, cross-sectional	- Estimate the prevalence of frailty and analyze associated factors.	n = 1228	- Minimum age: 100 y/o	- Depression - Disability for ≥ 2 ADL	- Institutionalized living: 47.6%
Infusino <i>et al.</i> , 1996 (79)	Italy	Quantitative, cross-sectional	- Evaluate the clinical and socio-economic conditions (multidimensional investigation).	n = 40	M = 102.3 ± 1.8 y/o Range: 100–107 y/o	- Mood/depression - Functional status/activity	- Community-based living: 90%
Jang <i>et al.</i> , 2004 (72)	U.S.A.	Quantitative, cross-sectional	- Explore factors responsible for individual differences in experiences with disease and disability.	n = 72	M = 100.7 ± 1.29 y/o	- Depressive symptoms - Disability	Community-based living sample (only community-dwelling individuals were recruited)
Jopp <i>et al.</i> , 2016 (49) ^a	U.S.A.	Quantitative, cross-sectional ^a	- Examine the challenges experienced by very old individuals and their consequences for well-being and mental health.	n = 75	M = 99.01 ± 2.59 y/o Range: 95–107 y/o	- Depressive symptoms - ADL restrictions/disability	- Community-based living: 71% - Institutionalized living: 29%
Jopp, Park <i>et al.</i> , 2016 (12)	U.S.A.	Quantitative, cross-sectional	- Provide a comprehensive picture of key domains of functioning (physical, cognitive, social, and mental function); - Determine predictors of mental health indicators.	n = 119	M = 99.25 y/o Range: 95–107 y/o	- Depressive symptoms - Functional health	- Community-based living: 74% - Institutionalized living: 26%
Lau & Cheung, 2016 (50)	Hong Kong	Quantitative, cross-sectional	- Understand successful aging especially at the extreme of longevity.	n = 153	M = 97.7 ± 2.4 y/o Range: 95–108 y/o	- Depression - Functional capacity	- Community-based living: 81% - Institutionalized living: 19%
Li <i>et al.</i> , 2022 (51)	China	Quantitative, cross-sectional	- Investigate the relationships between dietary diversity scores	n = 38	MED = 101 y/o IQR = 100–102	- Depression - Dependence	Not reported

			and anxiety and depression.		y/o		
Madrigal-Leer <i>et al.</i> , 2020 (52)	Costa Rica	Quantitative, cross-sectional	- Describe clinical, functional, mental, and social profiles.	n = 43	M = 101.93 y/o Range: 100–107 y/o	- Depression - Functional performance	- Community-based living: 95.4% - Institutionalized living: 4.6%
Margrett <i>et al.</i> , 2010 (73)	U.S.A.	Quantitative, cross-sectional	- Examine how cognitive ability and personality explain depression.	n = 158	M = 99.82 y/o Range: 98–109 y/o	- Depressive symptoms - Functional status	- Community-based living: 49.6% - Institutionalized living: 50.4%
Martin <i>et al.</i> , 2012 (74)	U.S.A.	Quantitative, cross-sectional	- Understanding the determinants of exceptional longevity above and beyond health outcomes.	n = 152 (Phase 1)	M = 101.6 ± 2.13 y/o Range: 100–112 y/o	- Depression - Functional capacity/functional health	- Institutionalized living: 81.5%
Martin <i>et al.</i> , 2000 (75)	U.S.A.	Quantitative, cross-sectional	- Assess levels of depression and predictors of depressive symptoms.	n = 136	M = 100.7 y/o Range: 99–110 y/o	- Depression - ADLs	Community-based living sample (only community-dwelling individuals were recruited)
Molander <i>et al.</i> , 2010 (80)	Sweden and Finland	Quantitative, cross-sectional	- Investigate the relationship between blood pressure and cognitive impairment.	n = 158	Not specified	- Depressive symptoms/depression - Dependence in ADLs	- Community-based living: 35.3% - Institutionalized living: 64.7%
Niimura <i>et al.</i> , 2020 (53)	Japan	Quantitative, longitudinal	- Examine the sociopsychological characteristics of the oldest-old in Japan.	n = 26 (group “Full questionnaire with in-home interview and exam”)	M = 97.7 ± 2.1 y/o	- Depression - Functional capacity	- Community-based living: 88.5% - Institutionalized living: 11.5%
Nyqvist <i>et al.</i> , 2006 (81)	Sweden	Quantitative, cross-sectional	- Measure social capital in the oldest old, and its association with different dimensions of health.	Not specifically reported for the 95+ group	Not reported	- Depressive symptoms - Functional ability	Not specifically reported for the 95+ group
Oseland <i>et al.</i> , 2016 (54)	U.S.A.	Quantitative, cross-sectional	- Test how traumatic life events affect the outcomes of physical disability, perceived health impairments, depressive symptoms, and social support.	n = 154	M = 101 ± 1.71 y/o	- Depressive symptoms - Functional health	Community-based living sample (only community-dwelling individuals were recruited)
Pedro <i>et al.</i> , 2017 (55)	Mexico	Quantitative, cross-sectional	- Describe demographic characteristics and health status.	n = 393	M = 101.82 ± 2.02 y/o Range: 100–112 y/o	- Depression - Functional dependence	- Community-based living: 95.4% - Institutionalized living: 4.6%
Rabunal Rey <i>et al.</i> , 2004 (82)	Spain	Quantitative, cross-sectional	- Establish the social, functional and medical status of centenarians.	n = 54	M = 100.9 ± 1.3 y/o	- Depression - Functional status	- Community-based living: 87%
Ravaglia <i>et al.</i> , 1997 (83)	Italy	Quantitative, cross-sectional	- Evaluate physical ability and psychocognitive status regarding sociodemographic, behavioral, and biomedical variables.	n = 84	M = 97.4 ± 3.1 y/o Range: 90–106 y/o	- Symptoms of depression - Physical ability	- Community-based living: 37% - Institutionalized living: 63%
Ribeiro <i>et al.</i> , 2018 (56)	Portugal	Quantitative, cross-sectional	- Characterize the frailty phenotype and the relationships	n = 91	M = 101.0 ± 1.3 y/o	- Depression - Functionality/	- Community-based living: 60.5%

			between frailty and depressive symptoms; - Explore the most characteristic depressive symptoms of the frailty syndrome.		Range: 100–105 y/o	functional status	- Institutionalized living: 39.5%
Richmond <i>et al.</i> , 2011 (90)	Australia	Quantitative, cross-sectional	- Examine quality of life, social, cognitive, and physical function, anxiety and depression, and their associations.	n = 188	- 100 y/o: n = 93 - 101 y/o: n = 39 - 102 y/o: n = 18 - 103 y/o: n = 18 - 104 y/o: n = 7 - ≥ 105 y/o: n = 12	- Depression - Physical functioning	- Community-based living: 48% - Institutionalized living: 52%
Schroyen <i>et al.</i> , 2020 (57)	France	Quantitative, cross-sectional	- Hypothesis: people with sensory impairments (hearing and vision) and disabilities would feel older (subjective age).	n = 75	M = 95.8 ± 2.6 y/o	- Depressive symptomatology/ depression - Disability	Community-based living sample (only community-dwelling individuals were recruited)
Song <i>et al.</i> , 2022 (58)	China	Quantitative, cross-sectional	- Explore the relationship between nutritional status and depression.	n = 1002	MED = 102 y/o IQR = 101–104 y/o	- Depression - Functional status of daily activities	Not reported
Struckmeyer <i>et al.</i> , 2021 (59)	U.S.A.	Quantitative, cross-sectional	- Examine the influences of early and recent traumatic life experiences on loneliness.	n = 154	M = 101.01 ± 1.72 y/o Range: 99–109 y/o	- Depressive affect - Functional health	- Community-based living: 44.8% - Institutionalized living: 55%
Sun <i>et al.</i> , 2023 (60)	China	Quantitative, cross-sectional	- Explore the possible associations between cardiac structure and function and depressive disorder.	n = 682	M = 102.4 ± 2.7 y/o Range: 100–116 y/o	- Depressive disorder - Physical disability	Not reported
Tafaro <i>et al.</i> , 2005 (84)	Italy	Quantitative, cross-sectional	- Determine which are the survival determinants using a neural network.	n = 110	M = 101.6 ± 1.8 y/o Range: 100–108 y/o	- Depression / mood - Functional status / self-sufficiency	- Community-based living: 7.5%
Tafaro <i>et al.</i> , 2002 (85)	Italy	Quantitative, longitudinal	- Describe the relationship between aging and depression.	n = 157	M = 101.7 ± 1.8 y/o Range: 100–108 y/o	- Depression status - Daily activities	Unclear
Teixeira <i>et al.</i> , 2019 (61)	Portugal	Quantitative, cross-sectional	- Explore the recent history of falls, the existence of a fear of falling, and their associated factors.	n = 109	M = 101.0 ± 1.5 y/o Range: 100–107 y/o	- Depression - Functional disability	- Community-based living: 66.1% - Institutionalized living: 33.9%
Tindale <i>et al.</i> , 2019 (62)	Canada	Quantitative, longitudinal	- Determine whether super-seniors showed compression of morbidity; - Test whether the allele frequencies of longevity-associated variants (APOE and FOXO3) were more extreme in this population.	n = 13 (second interview)	M = 100.1 ± 3.3 y/o Range: 96–106 y/o	- GDS score - IADL score	Unclear
Urciuoli <i>et al.</i> , Italy		Quantitative,	- Compare quality of life among	n = 66	M = 95.5 ± 6.8 y/o	- Depression	- Community-based living:

1998 (86)		cross-sectional	participants living in nursing homes and at home.			- Functioning	56.1% - Institutionalized living: 43.9%
von Heideken Wägert <i>et al.</i> , 2006 (87)	Sweden	Quantitative, cross-sectional	- Describe health status and living conditions; - Estimate age and sex differences.	n = 72	Range: 95–103 y/o	- Depression - Independence in ADL	- Community-based living: 21% - Institutionalized living: 79%
Wang <i>et al.</i> , 2020 (63)	China	Quantitative, cross-sectional	- Investigate the sociodemographic characteristics, health profiles, and social relationships.	n = 100	- 100–105 y/o: n = 80 - > 105 y/o: n = 20	- Feelings of depression - Independence	Community-based living sample (only community-dwelling individuals were recruited)
Yang, 2013 (89) ^b	Taiwan	Quantitative, cross-sectional ^b	- Explore participants' living conditions and their care and support systems.	n = 100	M = 102.54 y/o Range: 100–110 y/o	- Depression/depressive symptoms - Functioning	- Community-based living: 72% - Hospital: 1% - Institutionalized living: 27%
Yao <i>et al.</i> , 2018 (64)	China	Quantitative, cross-sectional	- Evaluate the relationship between vitamin D levels and depressive symptoms.	n = 940	M = 102.5 ± 2.7 y/o Range: 100–115 y/o	- Depressive symptoms/depression - ADLs	- Community-based living: 85.7%
Zaccaria <i>et al.</i> , 2022 (65)	U.S.A.	Quantitative, cross-sectional	- Investigate the prevalence of combinations of social isolation and loneliness.	n = 94	M = 99.6 ± 2.4 y/o Range: 95–107 y/o	- Depressive symptomatology - Functional health	- Community-based living: 78.7% - Institutionalized living: 21.3%
Zhang <i>et al.</i> , 2022 (66) ^b	China	Psychometric validation study ^b (cross-sectional analysis)	- Evaluate the psychometric properties of the GDS-15 scale and a simplified version of it.	n = 838	M = 102.48 ± 2.74 y/o	- Depressive symptoms - Physical function	- Community-based living: 99.0% - Institutionalized living: 1%

* **Age metrics:** Mean ± SD; median with IQR; distribution (counts) by age category; minimum age.

** **Concepts of interest:** as defined in the respective studies.

*** **Living situation (context):** **Community-based living:** refers to settings such as private homes, apartments, retirement villages, etc. **Institutionalized living:** refers to places like nursing homes, long-term care facilities, and group homes for dementia patients.

a This study employed theme-based coding for response categorization and quantification.

b These studies adopted a multi-methods approach (quantitative and qualitative techniques)

Depressive symptoms in near-centenarians and centenarians: prevalence rates and instruments used

To address our second research question, we explored the prevalence rates of depressive symptoms and the instruments employed to screen for them in near-centenarian and centenarian populations.

Depressive symptoms in the reviewed studies were examined in two primary ways: by prevalence rates and by mean scores. Regarding prevalence rates, our reporting approach differed based on how frequently a screening instrument was used. If an instrument was employed in only one study, we presented its results individually. For instruments used in multiple studies, we grouped the results. Individual study prevalence rates ranged from approximately 10.5% (45) to 73.0% (67). The computed median prevalence, derived from grouped studies, fell within this range, ranging from approximately 12.7% (48, 70, 82) to 27.1% (12, 50, 51, 55, 58, 60, 64, 80, 87), as can be seen in Table 2.

For the mean scores, we adopted a grouping approach analogous to our method for prevalence. In the case of the GDS, across all its versions, we not only presented the computed median of mean values but also showcased the proportion of positively responded items in Table 2. This approach facilitates a more comprehensive understanding and allows for straightforward comparisons across the various GDS versions. Specifically, among the GDS versions we mapped, the proportions of positively responded items ranged between approximately 21% (GDS-10) and 34% (GDS-30), with the exception of the GDS-5 which stood notably lower at approximately 6%.

A total of 10 instruments (or approaches) for screening depressive symptoms were identified across the included studies and are presented in Table 2, which lists the instruments reported in 50 of the 53 included studies (three studies were omitted from the Table as they did not specifically report prevalence data on depressive symptoms (49, 54, 59); however, they were included in the review due to their exploration of associations between depressive symptoms and functional dependence). The GDS – 15 was the most utilized instrument, featuring in 21 (42.0%) of the included studies. It is important to note that the use of the GDS in these studies primarily underlines its role as an assessment tool. Indeed, none of the studies reported using criteria from the Diagnostic and Statistical Manual of Mental Disorders (DSM) or the International Classification of Diseases (ICD) for a more comprehensive diagnostic process. For a visual representation of the identified instruments to screen for depressive symptoms, refer to Appendix 8.

For the majority of the instruments, all scores aligned with the established cut-offs for either normal or mild symptoms of depression except for the version of the GDS-30 used by Clayton et al. (69) (Table 2).

Additionally, four (8.0%) of the 50 studies not only employed a screening tool for depressive symptoms but also reported having investigated participants' past and current experiences with depression. The sources of this complementary information included health care professionals, medical charts, proxy relatives, or direct clinical assessments by psychiatrists or geriatricians (52, 60, 87, 90). Moreover, three (6.0%) studies focused exclusively on depression diagnosis provided by a physician or medical history assessment (48, 70, 82). One (2.0%) study inquired about participants' history of physician-diagnosed depression (self-reported data) (78), and another study (2.0%) probed whether participants felt upset or depressed in the previous 30 days (63).

Table 2. Instruments employed to screen for depressive symptoms with corresponding prevalence rates and/or associated scores (n=50)

Instruments	Number of studies using the instrument n (%)	Studies (1 st author and year of publication)	Prevalence data [*]	Scores	
				Score data ^{**} (points)	Scoring strategy / interpretation
GDS	21 (42.0%)	Cheung & Lau, 2016 (43); Feng <i>et al.</i> , 2023 (46); Jopp, Park <i>et al.</i> , 2016 (12) ^a ; Lau & Cheung, 2016 (50); Li <i>et al.</i> , 2022 (51); Molander <i>et al.</i> , 2010 (80); Pedro <i>et al.</i> , 2017 (55); Song <i>et al.</i> , 2022 (58); Sun <i>et al.</i> , 2023 (60); von Heideken Wägert <i>et al.</i> , 2006 (87); Yao <i>et al.</i> , 2018 (64)	MED = 27.1% (Range: 13.2% - 38.0%)	§	§
		Araújo <i>et al.</i> , 2016 (39) [†] ; Cimarolli & Jopp, 2014 (68); Cimarolli <i>et al.</i> , 2018 (44); Jopp, Park <i>et al.</i> , 2016 (12); Lau & Cheung, 2016 (50); Margrett <i>et al.</i> , 2010 (73); Niimura <i>et al.</i> , 2020 (53) ^b ; Nyqvist <i>et al.</i> , 2006 (81); Pedro <i>et al.</i> , 2017 (55); Sun <i>et al.</i> , 2023 (60); Teixeira <i>et al.</i> , 2019 (61) [†] ; Tindale <i>et al.</i> , 2019 (62); von Heideken Wägert <i>et al.</i> , 2006 (87); Yao <i>et al.</i> , 2018 (64); Zaccaria <i>et al.</i> , 2022 (65); Zhang <i>et al.</i> , 2022 (66)	§	MED of Means: 4.4 (Range: 2.2 - 5.3) Prop: 0.29 (29%)	• 15 items • 2-point scale (0 = no, 1 = yes, with some reversed items) • Possible score range (sum): 0 – 15 • Score interpretation: • 0 – 4: normal • 5 – 9: mild • 10 – 15: severe <i>Note:</i> Lau & Cheung (2016) (50) considered scores > 5 as indicative of a depressive tendency, while Sun <i>et al.</i> (2023) (60) considered scores > 6 as indicative of a depressive disorder.
GDS-30	10 (20.0%)	Infusino <i>et al.</i> , 1996 (79); Martin <i>et al.</i> , 2012 (74); Martin <i>et al.</i> , 2000 (75); Ravaglia <i>et al.</i> , 1997 (83); Tafaro <i>et al.</i> , 2002 (85); Yang, 2013 (89)	MED = 22.5% (Range: 0% - 45.7%)	§	§
		Bauco <i>et al.</i> , 1996 (76); Garasky <i>et al.</i> , 2012 (71); Jang <i>et al.</i> , 2004 (72); Tafaro <i>et al.</i> , 2005 (84); Tafaro <i>et al.</i> , 2002 (85)	§	MED of Means: 10.1 (Range: 8.2 - 10.4) Prop: 0.34 (34%)	• 30 items • 2-point scale (0 = no, 1 = yes, with some reversed items) • Possible score range (sum): 0 – 30 • Score interpretation: • 0 – 9: normal • 10 – 19: mild • 20 – 30: severe

	1 (2.0%)	Clayton <i>et al.</i> , 1994 (69) [†]	§	M = 37.4	• 30 items • 2-point scale (1 = yes, 2 = no, with some reversed items) • Possible score range (sum) and score interpretation: unclear
GDS ^c	1 (2.0%)	Madrigal-Leer <i>et al.</i> , 2020 (52) ^c	40.5%	§	§
GDS-14	1 (2.0%)	Ribeiro <i>et al.</i> , 2018 (56)	35.2%	M = 4.5 Prop = 0.32 (32%)	• 14 items • 2-point scale (0 = no, 1 = yes, with some reversed items) • Possible score range (sum): 0 – 14 • Score interpretation: Scores ≥ 6 indicate possible depression
GDS-10	1 (2.0%)	Boerner <i>et al.</i> , 2018 (41)	§	M = 2.1 Prop = 0.21 (21%)	• 10 items • 2-point scale (0 = no, 1 = yes) • Possible score range (sum): 0 – 10 • Score interpretation: Higher scores indicated higher depressive symptomatology
GDS-5	1 (2.0%)	Boerner <i>et al.</i> , 2019 (40) [†]	§	M = 0.3 Prop = 0.06 (6%)	• 5 items • 2-point scale (0 = no, 1 = yes) • Possible score range (sum): 0 – 5 • Score interpretation: Higher scores indicated higher depressive symptomatology
CES-D	3 (6.0%)	Cohen-Mansfield <i>et al.</i> , 2013 (88); Niimura <i>et al.</i> , 2020 (53) ^b	§	MED of Means ^f = 5.6 (Range: 0.8 - 10.4)	• 20 items • 4-point scale (0 = none of the time/rarely, 3 = most/all of the time) • Possible score range (sum): 0–60 • Score interpretation: Higher scores indicate increased symptomatology
		Schroyen <i>et al.</i> , 2020 (57)	14.7%	§	§
	CES-D – brief version	Ailshire <i>et al.</i> , 2011 (67)	73%	M = 1.8	• 8 items • 4-point scale (“0 = none of the time or rarely” to “3 = most or all of the time”) • Possible score range (sum): 0–24 • Score interpretation: Higher

					scores indicate increased depressive symptoms
BSI (Depression dimension)	2 (4.0%)	Dello Buono <i>et al.</i> , 1998 (77) ^d ; Urciuoli <i>et al.</i> , 1998 (86) [†]	§	MED of Means ^f = 0.6 (Range: 0.6 – 0.7)	• 6 items • 5-point rating scale (“0 = not at all” to “4 = extremely”) • Possible score range (sum): 0–24 • Score interpretation: Higher scores indicated greater disturbance by certain symptoms.
EQ-5D-3L	1 (2.0%)	Chen <i>et al.</i> , 2020 (42)	13.8%	§	§
CAMDEX	1 (2.0%)	Deckers <i>et al.</i> , 2018 (45) [†]	10.5%	§	§
DRS	1 (2.0%)	Freeman <i>et al.</i> , 2017 (47) [†]	19.1%	§	§
HADS (depression subscale)	1 (2.0%)	Richmond <i>et al.</i> , 2011 (90)	13.5%	M = 4.1	• 7 items • 4-point scale (“0” to “3”, with answering options varying per item) • Possible score range (sum): 0–21 • Score interpretation: • 0-7: normal • 8-10: mild • 11-15: moderate • 16-21: severe
Doctor-diagnosed depression or medical history assessment	3 (6.0%)	Davey <i>et al.</i> , 2010 (70); Herr <i>et al.</i> , 2018 (48); Rabunal Rey <i>et al.</i> , 2004 (82)	MED = 12.7% (Range: 11.1% - 14.0%)	§	§
One question: “ <i>Has your physician told you that you have depression/depressiveness?</i> ”	1 (2.0%)	Galenkamp <i>et al.</i> , 2013 (78)	18.8%	§	§
One question: “ <i>Did you feel upset or depressed in the past 30 days?</i> ”	1 (2.0%)	Wang <i>et al.</i> , 2020 (63)	11.0%	§	§

Abbreviations: BSI = Brief Symptom Inventory; CAMDEX = Cambridge Mental Disorders in the Elderly Depressive Symptoms Scale; CES-D = Center for Epidemiologic Studies Depression Scale; DRS = Depression Rating Scale, from the interRAI-Home Care Assessment instrument; EQ-5D-3L = Three-Level EuroQol-5D Scale; GDS = Geriatric Depression Scale; HADS = Hospital Anxiety and Depression Scale.

* Prevalence data: 'MED' = median prevalence rate for multiple studies using the same instrument. 'Range' = range of prevalence rates for studies using the same instrument.

** Score Data (Means/Proportion for GDS, if applicable): 'M' = mean score. 'MED of Means' = median of mean scores across studies using the same instrument. 'Prop' = proportion of positively responded items (calculated for different GDS versions due to its "yes" or "no" response format; expressed both as a decimal and a percentage).

§ Data that were either not reported by the authors or are not applicable.

† Studies describing depressive symptoms in different subgroups (e.g., home vs. nursing homes). Combined mean prevalence rates and/or scores were computed for this table.

a Prevalence rate from Jopp, Park *et al.* (2016) (12) was an estimated 20% (“Over 80% of the sample did not meet the criteria for clinical depression”).

b The study by Niimura *et al.* (2020) (53) employed two screening instruments for depressive symptoms (GDS-15 and CES-D).

c Madrigal-Leer *et al.* (2020) (52) did not specify which GDS version was used (unknown GDS version).

d Clayton *et al.* (1994) (69) did not specify which GDS version was used. Based on their citations, we inferred the initial 100-item version was employed, which led to the GDS-30 afterwards.

e Dello Buono *et al.* (1998) (77) also employed the Depression and Anxiety Scale from the LEIPAD Quality of Life Assessment Instrument. However, it was excluded from this review as it also pertains to anxiety.

Functional dependence in near-centenarians and centenarians: prevalence rates and instruments used

In response to our third research question, we explored the prevalence rates of functional dependence and the instruments used to assess this issue among near-centenarians and centenarians.

In the reviewed studies, functional dependence was analyzed in two primary ways, mirroring the approach taken with depressive symptoms: through prevalence rates and mean scores. When presenting prevalence data, our approach varied based on the frequency with which a particular screening instrument was employed. For instruments that were employed in a single study, we reported the results individually. For instruments used across multiple studies, we grouped their results.

Regarding “functional dependence” in ADLs—defined as difficulty with one or more ADLs—rates from individual studies showed a range of approximately 24.9% (45) to 81.7% (47), with several studies reporting intermediate rates (12, 48, 83). In one study, restrictions in performing ADLs emerged as the most frequently cited challenge by participants, with a rate of 42.7% (49). The computed median prevalence, obtained from grouped studies, aligned with this range, ranging between approximately 50.6% (46, 51, 60, 64, 66, 82) and 57.4% (50, 55). “Total functional dependence” in ADLs—indicating complete reliance on others for all ADLs—was captured in one study at a rate of 29% (89). The computed median prevalence derived from grouped studies for this category varied from approximately 20.8% (52, 82) to 30.3% (77, 79, 83, 90) (Table 3).

In terms of “functional dependence” in IADLs—defined as difficulty with one or more IADLs—the reported prevalence rates also varied significantly. One study documented a rate of 35% (52), another presented 64.7% (58) and a third indicated that a mere 3% of its participants were ‘fairly independent’ in performing IADLs, thus suggesting that 97% had some level of dependence (89). The median prevalence of 82.1% was computed from two grouped studies using the same instrument (50, 55). For “total functional dependence” in IADLs—indicating complete reliance on others for all IADLs—reported prevalence rates were 27.5% (79), 50% (77) and 63% (52) (Table 3).

Several studies reported mean scores. As illustrated in Table 3, there was a notable variation in scoring strategies, even when employing the same instrument. For instance, while some studies using the OARS clearly differentiated between ADLs and IADLs, each with its own set of items and scoring range, others combined them. Moreover, the interpretation of scores—whether a higher score indicated increased independence or dependence—also varied between studies. Still focusing on the OARS—often used to assess both ADL and IADL domains—the computed median of mean scores, derived from grouped studies, was 9.6 points for ADLs (12, 39-41, 61, 69, 70) and

5.7 points for IADLs (39-41, 61, 65, 69, 70). This suggests a heightened level of functional dependence in the IADLs domain (considering the scoring range of 0 - 14, where a higher value indicated more independence). In summary, the documented mean scores reflecting participants' ability to carry out ADLs and IADLs showed considerable variability across studies, from mild to severe levels of dependence, as detailed in Table 3.

Lastly, some of the studies retained differentiated between general and specific dependence on targeted ADLs and IADLs (e.g., bathing, dressing, toileting, housework, grocery shopping, cooking) (12, 50, 74, 76, 78, 79, 83, 87, 89) (Table 3).

A total of 16 instruments (or approaches) for assessing functional dependence were identified across the included studies and are presented in Table 3, which lists the instruments reported in 48 of the 53 included studies. Although five studies (53, 55, 58, 74, 84) were excluded from the Table due to the absence of specific prevalence data on functional dependence, they were incorporated into the review for their investigation into the associations between depressive symptoms and functional dependence. Notably, two instruments stood out in popularity: the OARS Multidimensional Functional Assessment Questionnaire and the Katz Index. Each was employed in 12 (25.0%) of the reviewed studies. In some studies ($n = 9$, 18.8%), researchers opted to combine two screening instruments (Katz Index and Lawton Scale or Barthel Index and Lawton Scale) to cover both domains of functional health, i.e., ADLs and IADLs (50, 52, 53, 55, 77, 79, 84, 86, 88). For a visual representation of the identified instruments to assess functional dependence, see Appendix 9.

A marked heterogeneity characterized the representation of functional dependence across the studies. Terminologies ranged from overall 'functional dependence' to 'disability' and even gradated expressions such as 'mild,' 'moderate,' or 'severe' dependence. Furthermore, some studies detailed their findings by associating levels of dependence with specific activities. Assessments also varied in their focus—while some exclusively evaluated ADLs (e.g., (43, 47, 51)), others were centered on IADLs (e.g., (58, 65, 73)), and several addressed both domains (e.g., (12, 40, 52)). This variability necessitated a segmented analysis approach to ensure accurate representation and avoid potential conflation of differing outcomes. For a detailed overview of the prevalence rates and mean scores by instrument used, see Table 3.

Table 3. Instruments employed to assess functional dependence with corresponding prevalence rates and/or associated scores (n=48)

Instruments	Number of studies using the instrument n (%)	Studies (1 st author and year of publication)	Prevalence data*	Score data** (points)	Scores Scoring strategy / interpretation
OARS	12 (25.0%)	Araújo <i>et al.</i> , 2016 (39) [†] ; Boerner <i>et al.</i> , 2019 (40) [*] ; Boerner <i>et al.</i> , 2018 (41); Clayton <i>et al.</i> , 1994 (69) [†] ; Davey <i>et al.</i> , 2010 (70); Jopp, Park <i>et al.</i> , 2016 (12); Teixeira <i>et al.</i> , 2019 (61)	§	ADL: MED of means = 9.6 (Range: 8.6 – 12.6)	ADL: 7 items; IADL: 7 items; • Rating: 3-point scale (0 = can't do without help to 2 = no difficulty) • Score range: 0–14 (ADL & IADL each) • Interpretation: Higher scores indicated greater independence
		Araújo <i>et al.</i> , 2016 (39) [†] ; Boerner <i>et al.</i> , 2019 (40) [†] ; Boerner <i>et al.</i> , 2018 (41); Clayton <i>et al.</i> , 1994 (69) [†] ; Davey <i>et al.</i> , 2010 (70); Jopp, Park <i>et al.</i> , 2016 (12); Teixeira <i>et al.</i> , 2019 (61); Zaccaria <i>et al.</i> , 2022 (65)	§	IADL: MED of means = 7.2 (Range: 4.3 – 10.0)	
		Cimarolli & Jopp, 2014 (68); Cimarolli <i>et al.</i> , 2018 (44)	§	ADL + IADL: MED of means = 26.7 (<i>same value for both studies</i>)	ADL + IADL: 14 items; • Rating: 4-point scale (1 = no difficulty to 4 = can't do without help) • Score range: 14–56 • Interpretation: Higher scores indicated greater dependence
		Jang <i>et al.</i> , 2004 (72)	§	ADL + IADL: M = 7.1	ADL + IADL: 14 items; • Rating: 3-point scale (0 = can do without help to 2 = unable to do) • Score range: 0–28 • Interpretation: Higher scores indicated greater dependence.
		Jopp, Park <i>et al.</i> , 2016 (12)		§	§

- 40.0% had difficulties with 1 or 2 ADLs.
- 28.0% were independent in ADLs; 17.0% were independent in IADLs.
- ADL challenges: taking a bath (55.0%), getting dressed (52.0%), moving in and out of bed (48.0%).
- IADL challenges: light housework (77.0%), shopping (76.0%), preparing meals (65.0%), getting around/traveling (64.0%).

Katz Index	12 (25.0%)	Martin <i>et al.</i> , 2012 (74)	• 50.0% were still able to leave their homes. • <10.0% could go to various locations or shop without assistance. • Activities like cooking, housework, and managing money were very difficult.	\$	\$	
		Bauco <i>et al.</i> , 1996 (76); Cheung & Lau, 2016 (43); Lau & Cheung, 2016 (50); Pedro <i>et al.</i> , 2017 (55); Ravaglia <i>et al.</i> , 1997 (83); Richmond <i>et al.</i> , 2011 (90); Schroyen <i>et al.</i> , 2020 (57)	• Functional independence (ADLs): MED = 39.0% (Range : 19.0% – 60.8%)	\$	\$	
		Bauco <i>et al.</i> , 1996 (76); Lau & Cheung, 2016 (50); Ravaglia <i>et al.</i> , 1997 (83)	• Bathing: MED = 65.1% (Range : 26.1% – 65.5%)	\$	\$	
		Bauco <i>et al.</i> , 1996 (76); Infusino <i>et al.</i> , 1996 (79); Lau & Cheung, 2016 (50); Ravaglia <i>et al.</i> , 1997 (83)	Functional dependence (ADLs): • Dressing: MED = 46.8% (Range : 15.0% – 75.0%) • Using the toilet: MED = 40.0% (Range : 9.8% – 80.0%) • Transferring: MED = 37.6% (Range : 10.5% – 39.3%) • Incontinence: MED = 37.9% (Range : 28.1 – 75.0) • Eating: MED = 17.0% (Range : 2.6% – 50.0%)	\$	\$	
		Cohen-Mansfield <i>et al.</i> , 2013 (88)	\$	ADL: M = 3.2		ADL: 7 items; • Rating: 4-point scale (0 = no difficulty to 3 = complete disability) • Score range: 0–21 • Interpretation: Higher scores indicated greater dependence.
		Tafaro <i>et al.</i> , 2005 (84)	\$	ADL: M = 2.5		• Scoring: unclear
		Dello Buono <i>et al.</i> , 1998 (77); Urciuoli <i>et al.</i> , 1998 (86) [†]	\$	ADL: MED of means = 12.1 (Range: 11.0% - 13.2%)		ADL: 6 items; • Rating: 3-point scale (1 = no difficulty to 3 = complete disability) • Score range: 6–18 • Interpretation: Higher scores indicated greater dependence.
		Lau & Cheung, 2016 (50); Pedro <i>et al.</i> , 2017	• Dependence in ≥ 1 ADL: MED = 57.4% (Range : 44.1% – 70.7%)	\$	\$	

(55)					
Lawton Scale	11 (22.9%)	Lau & Cheung, 2016 (50)	§	M = 0.9	The mean score indicated the average number of dependent ADLs.
		Ravaglia <i>et al.</i> , 1997 (83)	• Partial dependence in ADLs: 27.4%	§	§
		Dello Buono <i>et al.</i> , 1998 (77); Infusino <i>et al.</i> , 1996 (79); Ravaglia <i>et al.</i> , 1997 (83); Richmond <i>et al.</i> , 2011 (90)	• Total dependence / Severe functional impairment in ADLs: MED = 30.3% (Range: 18.0% – 53.6%)	§	§
		Richmond <i>et al.</i> , 2011 (90)	§	ADL: M = 3.7	ADL: 6 items; - Interpretation: ≤ 2 = Severe functional impairment 3 = Poor function 4 = Moderate impairment 5 = Good function 6 = Full function - Higher scores indicated greater independence.
		Cohen-Mansfield <i>et al.</i> , 2013 (88)	§	IADL: M = 8.3	IADL: 7 items; - Rating: 4-point scale (0 = no difficulty to 3 = complete disability) - Score range: 0–21 - Interpretation: Higher scores indicated greater dependence.
		Dello Buono <i>et al.</i> , 1998 (77)	• IADLs: 50% were fully dependent	§	§
		Dello Buono <i>et al.</i> , 1998 (77); Niimura <i>et al.</i> , 2020 (53); Urciuoli <i>et al.</i> , 1998 (86) [†]	§	IADL: MED of means = 5.5 (Range: 3.2 – 6.9)	IADL: 8 items; - Rating: 2-point scale (0 = complete disability, 1 = no difficulty) - Score range: 0–8 - Interpretation: Higher scores indicated greater independence.
		Lau & Cheung, 2016 (50)	§	IADL: M = 2.1	The mean score indicated the average number of dependent IADLs.
		Infusino <i>et al.</i> , 1996 (79)	• IADLs: 27.5% were bed-confined and quite dependent for all the activities	§	§
		Madrigal-Leer <i>et al.</i> , 2020 (52)	IADLs: 63% were totally dependent 12% were severely dependent	§	§

Barthel Index	10 (20.8%)		• 16% were moderately dependent • 7% were mildly dependent • 2% were totally independent (35% were partially dependent)			
		Lau & Cheung, 2016 (50); Pedro <i>et al.</i> , 2017 (55)	IADLs: • No dependence: MED = 18.9% (Range : 2.5% – 35.3%) • Dependence in ≥ 1 IADL: MED = 82.1% (Range : 66.7% – 97.4%)	\$		\$
		Lau & Cheung, 2016 (50)	IADLs dependence: • Shopping: 46.7% • Preparing meals: 41.8% • Washing clothes: 28.3% • Using public transport: 64.2% • Telephoning: 17.0% • Handling finances: 15.8%	\$		\$
		Song <i>et al.</i> , 2022 (58)	IADL impairment: 64.7%	\$		\$
		Tindale <i>et al.</i> , 2019 (62)	\$	IADL: M = 15.6		IADL: 8 items; • Scoring: unclear • Max score: 23 • Interpretation: Higher scores indicated greater independence.
		Tafaro <i>et al.</i> , 2005 (84)	\$	IADL: M = 1.4		• Scoring: unclear
		Li <i>et al.</i> , 2022 (51); Madrigal-Leer <i>et al.</i> , 2020 (52); Zhang <i>et al.</i> , 2022 (66)	• Independence in ADLs: MED = 23.7% (Range: 5.0% – 32.2%)	\$		\$
		Feng <i>et al.</i> , 2023 (46); Li <i>et al.</i> , 2022 (51); Rabunal Rey <i>et al.</i> , 2004 (82); Sun <i>et al.</i> , 2023 (60) ; Yao <i>et al.</i> , 2018 (64); Zhang <i>et al.</i> , 2022 (66)	• Dependence/impairment in ADLs: MED = 50.6% (Range: 36.6 – 76.3)	\$		\$
		Madrigal-Leer <i>et al.</i> , 2020 (52); Rabunal Rey <i>et al.</i> , 2004 (82)	ADLs dependence levels: • Totally dependent: MED = 20.8% (Range: 18.5% – 23.0%) • Severely dependent: MED = 21.5% (Range: 13.0% – 30.0%) • Moderately dependent: MED = 23.1% (Range: 11.1% – 35.0%) • Mildly dependent: MED = 32.2% (Range: 7.0% – 57.4%)	\$		\$
		Molander <i>et al.</i> , 2010 (80)	\$	ADL: M = 13.1		ADL: 10 items; • Scoring varies: 0 to 1, 0 to 2, or 0 to 3 points,

					depending on the item
					• Score range: 0–20 • Interpretation: Higher scores indicated greater independence.
		Niimura <i>et al.</i> , 2020 (53)	§	ADL: M = 80.9	ADL: 10 items; • Scoring varies: 0, 5, 10, or 15 points, depending on the item • Score range: 0–100 • Interpretation: Higher scores indicated greater independence.
		Yang, 2013 (89)	ADLs: • Score 0-10 (total dependence): 29.0% Score 91-100 (total independence): 21.0%	§	§
The 13-question ADLs module	1 (2.1%)	Garasky <i>et al.</i> , 2012 (71)	§	ADL: M = 25.5	ADL: 13 items; • Rating: 3-point scale (1 = disability to 3 = no difficulty) • Score range: 13–39 • Interpretation: Higher scores indicated greater functional ability.
Cumulative scale containing 5 personal ADLs and 4 IADLs ^d	1 (2.1%)	Nyqvist <i>et al.</i> , 2006 (81)	§	ADL + IADL: M = 3.3	• Scores range from 0 (independent in all activities) to 9 (dependent in all activities). • The mean score indicated the average number of dependent activities.
6 major life ADLs ^a	1 (2.1%)	Ailshire <i>et al.</i> , 2011 (67)	No ADL limitations: 18.0%	ADL: M = 2.4	ADL: 6 items; • Rating: 2-point scale (0 = no difficulty, 1 = complete disability) • Score range: 0–6 • Interpretation: Higher scores indicated greater dependence.
5 Functional Activities ^b	1 (2.1%)	Galenkamp <i>et al.</i> , 2013 (78)	Functional abilities: • Moving indoors: 10.0% • Walking 400m: 71.4% • Using stairs: 66.7% • Dressing/undressing: 19.0% Getting in/out of bed: 9.5%	§	§
5 ADLs ^c	1 (2.1%)	Herr <i>et al.</i> , 2018 (48)	Disability for ≥ 2 ADL: 58.0%	§	§

DAFS-IADLs	1 (2.1%)	Margrett <i>et al.</i> , 2010 (73)	\$	IADL: M = 58.7	• Item and scoring details: unclear • Observed score range: 9–81 • Interpretation: Higher scores indicate better performance.
DAFS-R	1 (2.1%)	Davey <i>et al.</i> , 2010 (70)	\$	ADL: M = 16.48 IADL: M = 26.04	• Item and scoring details: unclear • Observed score range for ADLs: 0–23 • Observed score range for IADLs: 0–58
ADL-H	1 (2.1%)	Freeman <i>et al.</i> , 2017 (47)	• Functional impairment in ADLs (ADL-H > 1): 81.7%	\$	\$
ADL-staircase	1 (2.1%)	von Heideken Wägert <i>et al.</i> , 2006 (87)	ADLs independence: • Bathing: 20.0% • Continence, transfers, toileting, dressing: 40.0% to 60.0% • Eating: 80% IADLs independence: • Cleaning, grocery shopping, transport: <20.0% • Cooking: 20.0%	\$	\$
EQ-5D-3L	1 (2.1%)	Chen <i>et al.</i> , 2020 (42)	• Mobility: 42.6% had no problems; 52.9% had moderate problems; 4.6% had extreme problems. • Self-care: 59.8% had no problems; 36.0% had moderate problems; 4.2% had extreme problems.	\$	\$
Self-reported independence	1 (2.1%)	Wang <i>et al.</i> , 2020 (63)	• Independence: 46.3% • Light independence: 32.5% • Moderate dependence: 16.3% • Severe dependence: 5.0%	\$	\$
Open question on functional challenges ^e	1 (2.1%)	Jopp <i>et al.</i> , 2016 (49)	Main functional challenges: • Physical health/ADL restrictions: 42.7% • Mobility restrictions: 34.7%	ADL: M = 1.3	• The mean score indicated the average number of functional challenges reported by the participants.
Uclear ^f	2 (4.2%)	Deckers <i>et al.</i> , 2018 (45) [†]	ADLs and IADLs: • No disability: 51.9 % • Disability in only ADLs: 24.9% • Disability in both ADLs and IADLs: 23.3%	\$	\$

Yang, 2013 (89)

IADLs: 3.0% were fairly independent for grocery shopping, meal preparation, house cleaning, laundry, taking medicine, telephoning, and handling finances.

§

§

Abbreviations: ADLs / IADLs = (Personal/Basic) Activities of daily Living / Instrumental Activities of Daily Living; ADL-H = Activities of Daily Living Hierarchy; DAFS-IADLs = Direct Assessment of Functional Status-Instrumental Activities of Daily Living; DAFS-R = Direct Assessment of Functional Status-Revised; EQ-5D-3L = three-level EuroQol-5D scale; OARS = Older Americans Resources and Services Multidimensional Functional Assessment Questionnaire.

* Prevalence data: 'MED' represents the median prevalence rate for multiple studies using the same instrument. 'Range' indicates the range of prevalence rates for studies using the same instrument.

** Score Data: 'M' denotes mean score. 'MED of Means' represents the median of mean scores across studies using the same instrument.

§ Cells marked with this symbol indicate data that were either not reported by the authors or are not applicable..

† Studies that described functional capacity in different subgroups (e.g., those living at home vs. in nursing homes). Combined mean prevalence rates and/or scores were computed for this table.

a Walking across a room, dressing, bathing, eating, getting in and out of bed, and using the toilet.

b Moving indoors, walking 400 m, using stairs, dressing and undressing, and getting in and out of bed.

c Eating, dressing, getting in and out of bed, using the toilet, bathing or showering.

d Bathing, dressing, going to the toilet, transfer, feeding, cleaning, food shopping, transportation and cooking.

e "Now please think for a moment about the things that you find challenging. Are there things that you find challenging or difficult?"

f The instruments used for assessment were not presented by the authors.

Associations between depressive symptoms and functional dependence

Our fourth research question aimed to determine whether studies documented associations between depressive symptoms and functional dependence in near-centenarians and centenarians. Table 4 provides detailed information from the studies specifically addressing these associations.

From the 53 studies included in this scoping review, 16 (30.2%) explored the above-mentioned relationship in this specific age group. Five (31.3%) of these studies found no significant correlation between these phenomena (43, 49, 73, 75, 85). Conversely, nine (56.3%) identified significant relationships between depressive symptoms and functional dependence (12, 44, 54, 56, 58-60, 68, 83). Additionally, two (12.5%) studies observed a higher prevalence of depressive symptoms among those participants showing dependence in IADLs or vice-versa (12, 58) (Table 4).

Moreover, six (37.5%) studies investigated depressive symptoms as a potential predictor of functional dependence or the inverse (12, 44, 56, 60, 64, 83). Of these, four (66.7%) indicated that functional dependence might be a predictive factor for depressive symptoms or vice versa (12, 44, 56, 83), while two (33.3%) did not report significant relationships (12, 75) (Table 4).

Table 4. Relationship between depressive symptoms and functional dependence (n = 16)

Studies (1 st author and year of publication)	Correlation / Relationship	Statistical significance	Additional notes / findings
Cheung & Lau, 2016 (43)	$r = -0.02$	$p > 0.05$	ADL and GDS scores were not correlated.
Cimarolli & Jopp, 2014 (68)	$r = 0.47$	$p < 0.01$	Higher depressive symptomatology contributed to 4.9% of variance in functional disability.
Cimarolli <i>et al.</i> , 2018 (44)	$r = 0.48$	$p < 0.01$	Depressive symptoms were significantly associated with higher functional disability. Functional disability explained 4.0% of the variance in predicting depressive symptoms.
Jopp <i>et al.</i> , 2016 (49)	$r = 0.11$	$p > 0.05$	No significant association between functional challenges and depression.
Jopp, Park <i>et al.</i> , 2016 (12)	$r = -0.37$ (ADL) $r = -0.38$ (IADL)	$p < 0.05$	GDS scores were negatively correlated with ADL and IADL scores. IADL dependence was a significant predictor for depression, explaining 7.1% of variance.
Margrett <i>et al.</i> , 2010 (73)	Not exclusively specified for the target variables.	N/A	Functional indicators played a minor role in mental health outcomes. Objective ADL ratings were not significant predictors of depressive symptoms.
Martin <i>et al.</i> , 2000 (75)	$\beta = 0.14$ (ADL) $\beta = -0.21$ (IADLs)	$p > 0.05$	ADLs and IADLs were not predictors of depression.
Oseland <i>et al.</i> , 2016 (54)	$r = -0.37$	$p \leq 0.001$	Bivariate correlation observed between functional health and depressive symptoms.
Ravaglia <i>et al.</i> , 1997 (83)	$r_{men} = -0.14$ $r_{women} = -0.54$	$p_{men} = 0.404$ $p_{women} = 0.001$	<u>For women:</u> Depressive symptoms and functional dependence showed a strong negative correlation. Functional dependence (ADL) was a significant predictor for depressive symptoms (GDS), explaining 28.0% of variance. Depressive symptoms (GDS) were a significant predictor for functional dependence (ADL), explaining 27.0% of variance. <u>For men:</u> Correlation was weak and not statistically significant.
Ribeiro <i>et al.</i> , 2018 (56)	OR = 0.82	$p = 0.002$	Dependence in ADLs was a predictive factor for depression, with higher ADL scores (indicating better functionality) being associated with lower odds of depression
Richmond <i>et al.</i> , 2011 (90)	$F(1.145) = 2.30$	$p = 0.13$	No significant association observed between depression and physical functioning.
Song <i>et al.</i> , 2022 (58)	$\chi^2 = 26.30$	$p < 0.05$	Higher depression prevalence observed in centenarians with impaired daily activity functioning (34.0% vs. 18.6%).

Struckmeyer <i>et al.</i> , 2021 (59)	$r : -0.37$	$p < 0.01$	Negative correlation observed between functional health and depressive affect.
Sun <i>et al.</i> , 2023 (60)	OR = 2.05	$p < 0.05$	Lower physical disability was associated with higher odds of depressive disorder. Higher physical disability observed in centenarians with depressive disorder (47.4% vs. 32.8%).
Tafaro <i>et al.</i> , 2002 (85)	$r = 0.06$	$p = 0.4$	No correlation between GDS scores and IADL.
Yao <i>et al.</i> , 2018 (64)	$\beta = 0.94$, OR = 2.57	$p < 0.001$	ADL impairments were linked to higher odds of depression. Higher ADL impairment observed in centenarians with depression (72.3% vs. 48.8%).

Abbreviations: ADL = Activities of Daily Living; IADL = Instrumental Activities of Daily Living.

Note 1: for specific measures of depressive symptoms and functional dependence, refer to tables 2 and 3.

Note 2: r = Pearson correlation coefficient; p = p-value indicating significance; β = standardized regression coefficient; OR = Odds Ratio; F = F-statistic from an ANOVA; χ^2 = ki-squared.

DISCUSSION

This scoping review aimed to comprehensively map and summarize the available studies on depressive symptoms and functional dependence in near-centenarians and centenarians. Our main results show a wide range of prevalence rates for these conditions and suggest a significant association between them.

Geographic diversity and research gaps

The research landscape demonstrated geographic and cultural diversity, with studies originating from North America and Europe, each accounting for over one third of the studies, and Asia, accounting for one fourth of the studies. While a notable number of studies came from the USA, China, and Italy, a significant research gap became evident for studies originating from Africa and South America, represented in none of the studies, and Oceania, represented in one study. The WHO (91) reports a healthy life expectancy at birth in Africa of 56 years in 2019, a stark contrast to the European Union's 64.5 years for women and 63.5 years for men in 2020, providing context to this research void (92, 93). Concurrently, in 2019, South America displayed a varied range of average healthy life expectancy at birth, from 57.2 years in Guyana to 70 years in Chile. The relative lack of centenarian-focused studies from these regions could be attributed to multifaceted factors, including economic factors, healthcare infrastructure, and prevailing research priorities, rather than the disparities in life expectancy alone. The USA consistently emerged as a significant contributor to the number of retained studies as previously mentioned. This fact can be attributed to the country's large population of centenarians, which likely influences the larger volume of research originating from the region. Additionally, Italy's frequent representation in European studies might relate to its high ratios of centenarian and the recognized 'blue zone' status of specific regions (94).

Challenges in centenarian mental health research

While research interest in centenarians' mental health and its functional repercussions spans across continents, the volume of published research remains somewhat limited. A previous systematic review has acknowledged a scarcity of literature focusing on centenarian's mental health (13). Potential challenges, such as recruiting very old individuals, especially those with cognitive limitations (95), combined with societal obstacles like ageism, negative stereotypes, and logistical challenges (96, 97), may account for this research disparity. This gap is particularly concerning given the pivotal role older adults play as major consumers of healthcare services (95, 97, 98).

Methodological approaches and research design

While our review highlights the use of quantitative methodologies in studying depressive symptoms among centenarians, incorporating qualitative approaches, such as phenomenological designs, could uncover nuances specific to this age group. Qualitative methods can reveal subtler, age-specific aspects of depression, offering insights into experiences that differ from younger populations (99). The integration of these approaches in future research on centenarians, particularly through mixed-methods designs (100), could offer a more comprehensive understanding of depressive symptomatology in very old age. The predominant use of cross-sectional designs in the reviewed studies highlights their utility in examining variable relationships and prevalence rates in this niche field (99). Yet, there is a notable absence of longitudinal research on centenarians' mental and functional health trajectories (101). As health conditions can undergo rapid changes in advanced age (102, 103), longitudinal studies could offer critical insights not only into incidence rates, health fluctuations, and even determinants of longevity (104), but also in elucidating the evolving relationship between depressive symptoms and functional dependence over time.

Prevalence of depressive symptoms and functional dependence

Our scoping review unveiled a wide range in depressive symptom prevalence with individual study rates ranging from approximately 10.5% to 73%. Notably, when considering the mean prevalence rates derived from grouped studies using similar instruments, this range narrows to approximately 12.7% to 27.1%. This finding suggests that employing consistent screening tools across studies can lead to more reliable and comparable results, despite differences in samples and cultural contexts. This consistency is crucial in accurately understanding and addressing depressive symptoms in very old age, reinforcing the need for standardized approaches in mental health research. This aligns with Luppá *et al.*'s findings (105), who observed prevalence rates spanning from 4.5% to 37.4% in older adults aged ≥ 75 years. The mean scores from various screening instruments highlighted in our findings corroborate the idea that centenarians do not suffer from depressive symptoms more often than their 'younger' older adult counterparts. Despite the considerable variations in prevalence across studies, our findings clearly indicate that depressive symptoms remain a prevalent problem in very old age, and deserving of investment in their prevention, treatment, and support.

In parallel, our results also show a wide range of prevalence rates for functional dependence among the targeted population. For ADLs, rates varied from about 24.9% to 81.7%, with median prevalence in grouped studies between 50.6% and 57.4%. In IADLs, rates were as high as 97%, with a median of 82.1% in grouped studies. This highlights the

significant extent of functional dependence in this age group, underscoring the need for tailored care interventions that are informed by a clear understanding of their everyday care needs. Centenarians exhibited higher functional dependence compared to their 'younger' older adult counterparts—a distinction possibly rooted in the increased frailty observed within centenarian populations (48, 106, 107). A systematic review focusing on older Asian adults determined the pooled prevalence rates of dependence for ADLs and IADLs as 21.5% and 46.8% respectively (108), which falls within the range found in this review.

Hence, a salient aspect of this scoping review is the considerable variability found across studies when examining depressive symptoms and functional dependence in near-centenarians and centenarians. While the use of different measures or instruments could play a role, these differences could further arise from varying methodological approaches, such as sampling techniques (e.g., degree of representativeness of the sample). Cultural contexts might also contribute to differences in prevalences across studies. For instance, variations in cultural norms and values surrounding mental and functional health in aging can result in divergent perceptions and reporting of depressive symptoms and functional dependence.

Screening for depressive symptoms

A diverse array of instruments has been employed to screen for depressive symptoms. However, the Geriatric Depression Scale (GDS) was the predominant instrument used in the retained studies, aligning with existing literature; Cheng et al. (13) noted that the GDS-30 and the GDS-15 have been frequently employed in research involving near-centenarians and centenarians. The popularity of the GDS, specifically designed for geriatric populations (109), is likely attributable to its suitability for very old individuals. Balsamo et al. (110) suggested the GDS-30 might be the most effective self-assessment tool for screening depressive symptoms in this age group. Globally, self-assessment instruments dominate the landscape and serve as valuable tools for both clinical and research purposes in evaluating depressive symptoms' presence and severity. However, for individuals with major neurocognitive impairment, self-assessments may be less reliable. Our review, supported by findings from Cheng et al. (13), highlights a notable lack of utilization of hetero-assessment instruments, such as the Cornell Scale for Depression in Dementia (CSDD), among centenarians. As the global population continues to age, and consequently, the number of cases of neurocognitive disorders increases (111), the consideration of hetero-assessment instruments becomes vital for those suffering from this type of condition. While the DSM and the ICD criteria are gold-standard for the assessment of depressive symptoms, their rigorous application often demands

significant resources (13), which explains their absence in the studies we reviewed. Notably, both the ICD and DSM criteria do not cater specifically to older adults. Furthermore, to our knowledge, no tools have been validated specifically to screen depressive symptoms in centenarians.

Screening for functional dependence

Multiple instruments have been employed to screen for functional dependence. The OARS Multidimensional Functional Assessment Questionnaire (112) and the Katz Index (32, 33) emerged as predominant, and the consistent usage of these instruments underscores their importance in the field. Others, like the Lawton Scale (34) and the Barthel Index (113), were also commonly employed, albeit to a lesser extent. Interestingly, despite the broad application of these tools, the current literature seems to lack universal guidelines that recommend the best methods for measuring functional dependence in centenarians. Nevertheless, originating as a tool for program evaluation and resource allocation, the OARS, with its ADL and IADL subscales, has found consistent application in populations of older adults, including centenarians (40, 56, 59). Moreover, the Katz Index remains one of the most effective instruments for assessing older adults' capacity to perform the basic ADLs. Thus, despite some limitations, such as its restricted ability to measure small changes, this instrument is still used extensively in both community and institutional care settings. Its use has contributed significantly to establishing a common language when discussing functional health internationally (114), which is particularly relevant in the current context of rapid demographic ageing world-wide. It should be noted, however, that it is beneficial to pair the Katz Index with another instrument assessing IADLs for a comprehensive evaluation, as observed in certain analyzed studies.

Association between depressive symptoms and functional dependence

Our review highlights a potential link between depressive symptoms and functional dependence in near-centenarians and centenarians, indicating an association worth further investigation. Research on community-dwelling, cognitively healthy older adults has shown that functional dependence can amplify depressive symptoms, likely due to a diminished sense of purpose and weakened resilience (115). In line with this, a subset of the studies we reviewed revealed a predominantly moderate yet significant association between depressive symptoms and functional dependence. These findings suggest the bidirectional nature of this relationship: not only can depressive symptoms heighten the risk of functional dependence, but the onset of functional dependence can also aggravate depressive symptoms.

Given enhanced physical and social vulnerability in very old age, understanding this interconnected relationship becomes paramount. Breaking this potentially detrimental cycle could halt the cascade of undesirable outcomes that might emerge as a consequence. Interestingly, functional impairments seem to be more pronounced among centenarians, but this does not necessarily translate to a higher prevalence of depressive symptoms compared to their 'younger', mostly healthier, older counterparts.

Less than expected prevalence in depressive symptoms may suggest resilience among centenarians

Building on the previous observation, the concept of resilience among centenarians becomes particularly interesting. Some authors suggested that while 'younger' older adults' emotional well-being may be more adversely affected by functional disabilities, centenarians appear more resilient to these negative influences (72, 116). This resilience, as a vital health determinant, is observed in greater instances among centenarians, suggesting they retain this protective trait longer than 'younger' older adults (117). This resilience might serve as a potential shield against the adverse effects of functional dependence and is worthy of further exploration.

Ultimately, while centenarians may possess unique protective factors, the reported rates of depressive symptoms and functional dependence in this unique population are by no means negligible and must be prevented, detected, and treated using the best available scientific evidence.

Limitations

This scoping review presents some limitations. First, our literature search strategy might have overlooked pertinent information sources, or these might have been inadvertently omitted during the study selection phase. Second, we excluded two studies written in Chinese due to their non-translatable format, potentially sidelining valuable insights they might have offered. Third, potential biases in the findings of the included studies cannot be ruled out. Given that scoping reviews do not necessitate a qualitative evaluation of the sources, we did not appraise the methodological quality of the incorporated evidence. Consequently, we cannot provide graded recommendations based on this review. Fourth, another limitation of our review is the inclusion of papers derived from the same larger studies, resulting in possible non-independent samples. This overlap might have amplified certain findings while underrepresenting others, particularly given the smaller overall number of studies included.

CONCLUSIONS AND SUGGESTIONS

Conclusions

This scoping review, spanning diverse geographies and cultures, examined the existing scientific literature on depressive symptoms and functional dependence in near-centenarians and centenarians. It revealed geographical disparities, as well as a noticeable absence of studies from Africa and South America, and a scarcity in qualitative and mixed-methods research published on the topic. The predominance of quantitative, cross-sectional studies underscores the need for more diversified and longitudinal research approaches to delve into the complex health trajectories and dynamic needs of this demographic.

Our review spotlighted significant variability in the instruments used, with self-assessment tools like the GDS predominating in screening for depressive symptoms, despite their potential limitations in individuals with neurocognitive impairment. Concurrently, a variety of instruments, including the OARS and the Katz Index, were deployed to assess functional dependence. The employment of diverse scoring strategies and thresholds in different studies complicates the synthesis of reported findings, posing challenges in deriving clear and consistent conclusions regarding the functional status of this demographic. These findings underscore the need for the development of harmonized approaches to ensure the comparability of results within this unique population.

A subset of the reviewed studies elucidated the intricate and reciprocal relationship between depressive symptoms and functional dependence, highlighting their mutual influence and potential to escalate adverse outcomes. Our findings unveiled that, despite higher levels of functional dependence, centenarians do not necessarily exhibit elevated depressive symptoms when compared to their 'younger' older counterparts. This suggests the presence of underlying mechanisms, such as resilience, that potentially mitigate the negative implications of functional impairments, marking an important avenue for future studies.

Nevertheless, the significant prevalence of depressive symptoms and functional dependence among near-centenarians and centenarians calls for thoughtful attention, preventive measures, and effective, evidence-based interventions. It could be insightful if such interventions were comprehensive, aiming to address functional challenges, and alleviate depressive symptoms to ultimately improve the overall well-being and quality of life for this very old age group.

Implications for research

The diversification of research methodologies, including longitudinal and qualitative studies, plays a pivotal role in gaining deeper insights into the needs and health trajectories of near-centenarians and centenarians. Broadening the geographical scope may add to a comprehensive understanding of diverse cultures and environments.

Moreover, establishing precise guidelines for frequently employed instruments, or devising refined alternatives, offers a noteworthy avenue for further examination. Standardizing scoring strategies and thresholds will facilitate the synthesis of disparate data, enabling more consistent conclusions and seamless international comparisons regarding depressive symptoms and functional dependence in this population.

Thorough study of the link between depressive symptoms and functional dependence is essential for crafting targeted interventions. In parallel, reaching a consensus on criteria for identifying depressive symptoms in very old individuals holds significant importance. An e-Delphi study could consolidate varied screening concepts through expert consensus, fostering a unified approach to symptom identification.

Implications for practice

The development and implementation of multifaceted, scientifically grounded interventions are necessary to address the prevalent depressive symptoms and functional dependence in this demographic. Proactive, meticulous preventive measures and early identification and management of symptoms are imperative to mitigate the impact of depressive symptoms on functional decline, or vice-versa. Enhancement of professional competency, caregiver support, and educational initiatives can foster age-sensitive care, reduce attitudes of ageism and promote mental and functional well-being. Advocacy for informed policies, enhancement of healthcare infrastructure, and resource allocation are essential to accommodate the unique needs of near-centenarians and centenarians, both in terms of their mental and functional health. Cultivating public awareness and engagement is fundamental to fostering societal inclusion, mitigating stigma, and reinforcing community support for this demographic.

Abbreviations

ADLs: Activities of Daily Living; **APA:** American Psychological Association; **CINAHL:** Cumulative Index to Nursing and Allied Health Literature; **CSDD:** Cornell Scale for Depression in Dementia; **DSM:** Diagnostic and Statistical Manual of Mental Disorders; **GDS:** Geriatric Depression Scale; **IADLs:** Instrumental Activities of Daily Living; **ICD:** International Classification of Diseases; **JBI:** Joanna Briggs Institute; **OARS:** Older Americans Resources and Services Multidimensional Functional Assessment

Questionnaire; **PQDTGlobal**: ProQuest Dissertations & Theses Global; **PRISMA-ScR**: Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews; **USA**: United States of America; **WHO**: World Health Organization.

Appendices

Appendix 3. Bibliographic database search strategies.

Appendix 4. Sources excluded following a full-text review.

Appendix 5. Data extraction instrument.

Appendix 6. Average number of studies by 5-year publication periods.

Appendix 7. Number of studies per country.

Appendix 8. Identified instruments to screen for depressive symptoms.

Appendix 9. Identified instruments to assess functional dependence.

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Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Conceptualization: CGdR, HV, and AvG; methodological input: HV, JRA, and OR; database searches: JRA; selection of studies and data extraction: CGdR, SF, and HV; resources: DSJ, AvG, and HV; writing the original draft: CGdR and HV; reviewing and editing: AvG, OR, SF, KU, and DSJ; supervision: AvG, HV, and OR. All the authors have read and agreed to the manuscript's published version.

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CHAPTER 4 – SCREENING FOR DEPRESSIVE SYMPTOMS IN CENTENARIANS

SCREENING FOR DEPRESSIVE SYMPTOMS IN CENTENARIANS

After rigorously analysing published evidence on the prevalence of depressive symptoms and common screening instruments among near-centenarians and centenarians (Chapter 3), an important question arises: *With numerous screening instruments and criteria available, and given the severe consequences of depression—particularly its probable relationship with functional health—what is the most appropriate approach for effective detection?*

To date, no consensus has been reached on this matter, partly because the signs and symptoms of LLD can be difficult to identify. Indeed, depression in older adults often exhibits distinct characteristics that may not fully align with its presentation in younger individuals. Research has documented age-related differences in the clinical presentation of depression [32, 65]. However, current diagnosis criteria, such as the ICD-11 and the DSM-5, do not fully account for these variations. As a result, experts often reflect on their adequacy, and the topic remains subject to debate [65]. In LLD, atypical characteristics pose challenges for clinicians and researchers in terms of classification, screening, diagnosis, and treatment. Specific features in older adults include: a) the overlap between depression and dementia; b) the co-occurrence of depression with somatic symptoms associated with neurological, arthritic and endocrine diseases; c) the relationship between depression and anxiety, as anxiety may precede depression in this population; and d) the under-detection of depressive symptoms [34-38, 65, 70].

Given the particularities of LLD manifestations, specific geriatric variants have been proposed. One such variant is depletion syndrome, characterized by despair, loss of appetite, gloomy thoughts, and a general lack of interest [65]. Another is depression–executive dysfunction syndrome, marked by an overall alteration of cognitive performance affecting verbal fluency, naming, and initiation/perseveration. This syndrome also presents with psychomotor slowing and anhedonia, whereas vegetative symptoms, agitation, and feelings of guilt are comparatively less pronounced than in other forms of depression [65]. Furthermore, six distinct clinical forms of depression in older adults have been described: hypochondriacal, delusional, hostile, anxious, conative, and cognitive (or ‘pseudodementia’) forms [71]. This terminology appears to be more common among clinicians, and details of these forms are presented in Figure 4. However, it is important to highlight once more that no specific diagnostic criteria exist for depression in older adults [65]. This lack of clear diagnostic guidelines, combined with the atypical presentation of LLD, contributes to significant challenges in its recognition and management.

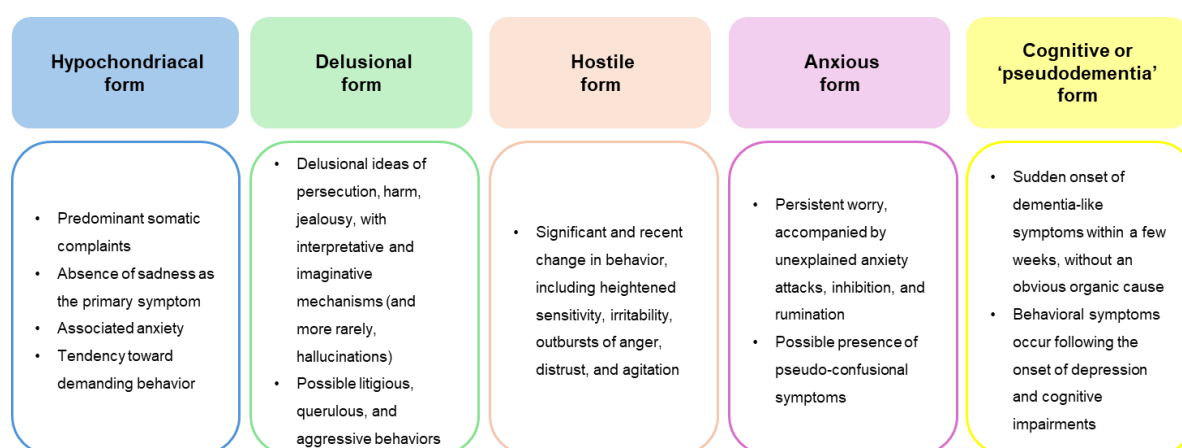


Figure 4: Clinical forms of depression in older adults (created from Roblin, J., 2015 [71]).

Depression is frequently underdiagnosed and undertreated, partly because its signs and symptoms are often misattributed to the normal ageing process [24, 30, 42, 46]. It has been estimated that approximately half of depression cases go unrecognised by frontline healthcare professionals [30, 31], and among those identified, only about half receive appropriate treatment [31].

Detecting depression in older adults can be particularly challenging due to its possibly atypical presentation, which may be subtle or even masked [32, 46]. In cases of major depression, symptoms such as loss of interest and pleasure in life, generalized anxiety or irritability can be more prominent than depressed mood, possibly due to difficulties in expressing emotions [30]. Furthermore, establishing a differential diagnosis between depression and dementia can be complex. Memory and concentration impairments, sometimes accompanied by weight loss, social withdrawal, and reduced engagement in usual activities, can contribute to diagnostic uncertainty [30].

Despite these challenges in depression detection, self-report instruments are widely used worldwide to screen for and assess the severity of depressive symptoms in both clinical and research settings. They are typically brief and easy to administer, either in paper-and-pencil format or using a computer [65, 72]. However, these instruments have well-documented limitations, including interpretation errors and response bias [65]. They may also be insufficient for assessing suicidal ideation and are poorly suited for individuals with cognitive impairments or already severely depressed, who may struggle with concentration. It is important to note that self-report instruments should never be used in isolation to diagnose depression [65, 72]. Nevertheless, they provide valuable insight into symptom severity over a specific period (e.g., the past two weeks) [72]. If a

total score exceeds the instrument's predefined cut-off, a comprehensive mental health evaluation becomes essential. Furthermore, self-report instruments cannot capture certain essential diagnostic information, such as non-verbal indicators of negative emotions or changes in social behaviour. Face-to-face consultation and direct observation remain the most appropriate methods for assessing these aspects [65].

Commonly used instruments for assessing depressive symptoms in centenarians were highlighted in Article 2. The GDS-15 has been widely used, likely due to its design for geriatric populations and its relatively short administration time, which enhances its practicality [73]. Hetero-assessment instruments, such as the Cornell Scale for Depression in Dementia, do not appear to have been used in centenarians. However, with the ageing population, the number of individuals affected by dementia is expected to rise significantly [74]. In this context, hetero-assessment should be considered for individuals with neurocognitive disorders, as some patients may be unable to provide reliable responses, affecting the accuracy and quality of their evaluation [75]. Additionally, in cases of significant cognitive impairment, other observer-assessment tools may be considered to obtain reliable information on depressive symptoms.

However, the wide range of available instruments and their varying applicability complicate the determination of the most effective screening approach for the very old. Despite the availability of these tools, there remains no clear consensus on the most appropriate criteria for screening depressive signs and symptoms in this population. To address this gap, and in the absence of clear guidelines, it is crucial to foster discussions on which criteria should be prioritized in screening strategies. One way to achieve this is by conducting a study involving international experts from various disciplines and backgrounds to gain a broader perspective. The Delphi methodology is particularly well-suited for establishing a common foundation for reflection on this critical issue (see Article 3).

ARTICLE 3

Gomes da Rocha, C., von Gunten, A., Vandel, P., Jopp, D. S., Ribeiro, O., & Verloo, H. (in press). A modified e-Delphi study to build consensus on the relevant criteria to screen for depressive symptoms among near-centenarians and centenarians. *JMIR Aging* (Accepted on February 1st, 2025).

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A modified e-Delphi study to build consensus on the relevant criteria to screen for depressive symptoms among near-centenarians and centenarians

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ABSTRACT

Background: The number of centenarians worldwide is expected to increase dramatically, reaching 3.4 million by 2050 and more than 25 million by 2100. Despite these projections, depression remains a prevalent yet underdiagnosed and undertreated condition among the very old that carries significant health risks.

Objective: This study aimed to identify and achieve consensus on the most representative signs and symptoms of depression in near-centenarians and centenarians (aged 95 years and over) through an e-Delphi study with an international and interdisciplinary panel of experts. Ultimately, the outcomes of this study might help create a screening instrument that is specifically designed for this unique population.

Methods: A modified e-Delphi study was carried out to achieve expert consensus on depressive symptoms in near-centenarians and centenarians. A panel of 28 international experts was recruited. Consensus was defined as 70% agreement on the relevance of each item. Data were collected through an online questionnaire over three rounds.

Experts rated 104 items that were divided into 24 dimensions and 80 criteria to identify the most representative signs and symptoms of depression in this age group.

Results: The panel consisted of experts from various countries, including medical doctors with experience in old age psychiatry and/or geriatrics, as well as nurses and psychologists. The response rate remained consistent over rounds (71-75%). Four new dimensions and eight new criteria were proposed by the experts, and consensus was reached for 24 out of 28 dimensions (85.7%) and 70 out of 88 criteria (79.5%). Most consensual potentially relevant dimensions were Lack of Hope (100%), Loss of interest (96.4%), Lack of reactivity to pleasant events (96.4%), Depressed mood (92.9%), and Previous episodes of depression or diagnosed depression (90.5%). Additionally, most consensual potentially relevant criteria were Despondency, gloom, despair (100%), Depressed (100%), Lack of reactivity to pleasant events or circumstances (100%), Suicidal ideation (100%), Suicide attempt(s) (100%), Ruminations (96.4%), Recurrent thoughts of death or suicide (96.4%), Feelings of worthlessness (96.2%), Critical life events (95.2%), Anhedonia (95.2%), Loss of interest in activities (92.9%), Loss of pleasure in activities (92.9%), and Sadness (92.3%). Moreover, when assessing depression in very old age, the duration, number, frequency, and severity of signs and symptoms should also be taken into account as evidenced by high expert agreement.

Conclusions: The classification of most elements as 'relevant' highlights the importance of a multidimensional approach for an optimal depression screening among the very old. This study offers a first step toward improving depression assessment in near-centenarians and centenarians. The development of a more adapted screening tool could improve early detection and intervention, enhancing the quality of mental health care for the very old.

Keywords: *centenarians; near-centenarians; depressive symptoms; depression diagnosis; screening; assessment; e-Delphi technique; online survey.*

INTRODUCTION

The centenarian population is growing significantly and is projected to increase sharply in the coming decades. As of 2024, there were approximately 722,000 centenarians globally, with Japan, USA, and China having the highest numbers [1]. This figure is expected to rise to 3.4 million by 2050 and exceed 25 million by 2100 [2, 3]. In Europe, notable examples include France, Italy, and Greece, each with more than 20 centenarians per 100,000 inhabitants registered already in 2011. Portugal also stands out with a density of 14.4 centenarians per 100,000 inhabitants that same year, ranking it

among the top 15 in Europe [4]. In Switzerland, the centenarian population more than doubled from 787 in 2000 to 1,948 in 2022, reaching a noteworthy prevalence of 22.1 per 100,000 inhabitants [5].

Amidst extreme longevity, individuals' health experiences vary significantly, from robust health to substantial declines [6-8]. Depression, a prevalent mood disorder among older adults [9], emerges as a major public health concern [10]. The International Classification of Diseases 11th Revision (ICD-11) characterizes a depressive episode as "a period of depressed mood or diminished interest in activities occurring most of the day, nearly every day during a period lasting at least two weeks accompanied by other symptoms such as difficulty concentrating, feelings of worthlessness or excessive or inappropriate guilt, hopelessness, recurrent thoughts of death or suicide, changes in appetite or sleep, psychomotor agitation or retardation, and reduced energy or fatigue" [6]. However, this definition broadly encompasses the general population and may not fully address the possible difference and heterogeneity of depressive symptomatology in older adults, potentially leading to diagnostic imprecision.

Accurate diagnosis is crucial as depression should not be misconstrued as an inherent aspect of aging, even in very advanced age [11, 12]. A systematic literature review reported substantial variations in depression prevalence across countries, such as 12.8% in Italy, 13.5% in Australia, 20.0% in the USA, and 29.0% in Mexico [13]. These differences may reflect cultural, healthcare, and socioeconomic influences, as well as methodological variations in study conduct [13, 14]. Interestingly, comparisons between centenarian cohorts and younger groups have shown inconsistent findings, with half of the studies reporting higher rates of depressive symptoms among centenarians [13]. This highlights the diversity of aging experiences and suggests that mental health may not necessarily worsen with age. Particularly noteworthy are the findings from Sweden, where near-centenarians and centenarians exhibited almost double the depression rates of older adults aged 85, at 32.3% versus 16.8%, respectively. These statistics not only highlight the need for careful mental health evaluations among the very old but also prompt discussion on tailored approaches to support mental well-being in this population [13, 15].

Depression can lead to severe physical, cognitive and psychological effects. Physically, it can cause malnutrition, falls, delirium, functional decline, and increased mortality [13, 16-20]. Cognitively, depression has been connected to cognitive decline and dementia [21-25]. Psychologically, it has been associated with anxiety and suicidal ideation [26, 27]. Furthermore, depression places a significant burden on caregivers and healthcare systems [16-18, 28, 29], increasing costs and resource demands. These consequences underscore the critical need for early detection and intervention. Therefore, proactive measures, such as regular mental health screenings, are essential to prevent

the severe impact of depression on individuals' quality of life and alleviate its wider societal effects [11]; yet these are not part of the current practice in most countries around the world.

Addressing this gap in care is difficult as depression in older adults frequently remains undiagnosed and undertreated, in part because its manifestations are often misinterpreted as natural aspects of ageing [18, 19, 30, 31]. Studies estimated that approximately half of depression cases are not identified by frontline healthcare providers [16, 18], and of those detected, approximately half do not receive adequate treatment [16]. The challenge in detecting late-life depression (LLD) stems from its sometimes subtle, hidden, or atypical signs and symptoms [30, 32]. Physical manifestations like weight loss, psychomotor retardation, and exhaustion, as well as emotional manifestations such as loss of interest in activities, heightened anxiety, or irritability, might overshadow the typical sadness often associated with depression [9, 18]. This complexity requires greater clinical vigilance. Moreover, the possible overlap of symptoms between depression and dementia adds another layer of diagnostic difficulty, as both conditions can present with symptoms such as memory impairment, psychomotor retardation, and reduced motivation [9]. Beyond dementia, several other medical conditions can mimic or exacerbate depressive symptoms. Chronic pain, thyroid dysfunction, Parkinson's disease, stroke, and medication side effects—particularly in polymedicated individuals—can contribute to 'depression-like' symptoms, including fatigue, apathy, functional dependence, memory impairment, and disturbances in mood and sleep [33-38]. These overlapping symptoms underscore the need for a comprehensive assessment to distinguish LLD from other conditions, aiming for an accurate differential diagnosis. The wide range of signs and symptoms associated with LLD can extend beyond the conventional diagnostic criteria for depressive disorders. Symptom clusters not fully meeting the diagnostic criteria for depression may still carry significant clinical importance due to their link with reduced quality of life and increased disability [9, 18].

Given the prevalence of depression among the very old, better detection of early signs and symptoms is crucial. However, despite the availability of various screening tools, to the best of our knowledge, none have been specifically validated for near-centenarians and centenarians (aged 95 years and older). Therefore, our study aimed to compile a comprehensive range of potentially relevant depressive features that have been documented in the scientific literature. These features were then submitted to an international panel of experts to achieve consensus on the most representative signs and symptoms of depression in the very old. The outcomes of this approach are twofold. First, by systematically examining and integrating diverse diagnostic criteria and screening tools, this study aimed to contribute to the ongoing debate about the complexities and

challenges of effectively diagnosing depression in the very old. Second, achieving expert consensus is central to developing a new screening instrument specifically tailored to this unique population. This effort might be an important first step towards early detection and effective intervention, which might lead to better outcomes and enhanced general well-being for this age group. It seeks to contribute to promoting mental health and supporting optimal care for the very old.

METHODS

Study design

We conducted a modified e-Delphi (electronic Delphi) study to systematically combine expert opinions and achieve an informed group consensus on the symptomatology of depression in very old age. The Delphi technique is an established approach where a panel of experts is asked to provide their opinions on a given issue over the course of several rounds [39]. In each round, the questions are informed by the findings of the previous one, allowing the study to evolve over time based on the collected data [39].

Given the prevalence of depression among older adults and the complexities of its diagnosis, the Delphi technique is particularly useful for gathering expert consensus on this issue. In our study, we used an e-Delphi approach to involve experts from different locations and to facilitate efficient data collection through electronic communication methods. To adapt the traditional Delphi approach to the specific requirements of our study, we implemented several modifications (referred to as 'Modified e-Delphi study'). To keep the focus on the items rather than the degree of agreement, experts were informed at the start of each new round about which items had reached consensus without being given the precise consensus rates. Additionally, for items on which consensus had already been reached, experts were unable to review their previous responses. This decision was made to avoid revisiting settled issues and to manage the large number of items efficiently, ensuring the stability of agreed-upon elements. An additional element of our modified methodology was a final evaluation of open issues by the steering committee. This last step took place to discuss the items that had not achieved consensus over the e-Delphi rounds, ensuring a thorough examination of these elements.

The materials presented to the e-Delphi panel were based on a comprehensive analysis of existing literature on depression in very old age (personal communication by Gomes da Rocha et al., 2023). This ensured that the expert panel's input was based on a thorough understanding of the relevant literature, thereby enhancing the validity of the final consensus, which may be seen as a lever to encourage scientific debate and foster new developments towards an effective diagnosis of depression in the very old [40].

The study adhered to the Conducting and REporting DELphi Studies (CREDES) guidelines [41, 42].

Steering Committee

The steering committee for this e-Delphi study, based in Western Switzerland, comprised four members: two physicians who are old age psychiatrists and senior researchers (AvG & PV), one clinical nurse specialist in geriatric care and a senior researcher skilled in the e-Delphi technique (HV), and one clinical nurse specialist in geriatric care who is also a junior researcher (CGdR). The committee was responsible for overseeing the study design, ensuring ethical compliance, and guiding the iterative process of questionnaire refinement and consensus-building. Meetings were held monthly, with methodological decisions made based on discussion. The committee played a crucial role in maintaining the study's rigor, managing data collection and analysis, and addressing any lack of consensus among panellists.

Selection of experts

In the Delphi approach, non-probability sampling methods are utilised through the purposive selection of an expert panel. However, clear selection criteria were applied to limit researcher bias, based on a five-step procedure [43]:

1. *Identifying the most appropriate categories of experts for the panel:* We identified experts from three main professional categories—physicians, nurses, and psychologists—each with a minimum of 5 years of professional experience and competencies in LLD. These professionals were selected for their specific work experience or contact with very old individuals in clinical, research, or teaching domains within the fields of old age psychiatry and/or geriatrics. Additionally, our recruitment strategy aimed for a broad geographical representation by including experts from various continents (i.e., Asia, Australia, Europe, and North America), to enrich the panel with diverse perspectives and thereby enhance the global view on depression screening among the very old.
2. *Identifying experts:* Names were compiled from various sources, including prior research involvement, publications on the subject, professional email lists, professional associations or societies, and boards of professional organizations. This method aimed to create a list of potential panellists, recognized for their expertise and contributions to the field, that is as comprehensive as possible.
3. *Contacting some readily reachable experts from each professional category to nominate other experts:* Initial contacts were made with experts who were easily accessible. These experts were then asked to nominate additional professionals who

they believed could contribute valuable insights to the study, thereby employing a snowball sampling technique to ensure a wide and diverse pool of expertise.

4. *Creating sub-lists for each professional category and ranking experts based on specific criteria:* Experts were organized into sublists by professional category and ranked according to their representation of professional role or specialty, and their field of practice. This was a strategic approach intended to foster a diverse and balanced panel that reflects a broad spectrum of experiences and viewpoints, contributing to the robustness and credibility of the consensus process.
5. *Inviting the experts.*

The Delphi method offers no consensus on an ideal sample size as the focus is on qualitative depth and the utilization of expert judgment for a comprehensive exploration of specific topics rather than on statistical representativeness [44]. Usually, a panel comprises seven to fifteen experts to facilitate effective information processing and decision-making; however, some studies may involve up to thirty experts for broader perspectives [44]. For our study, we aimed to assemble a convenience sample of at least 20 experts from various countries.

Recruitment procedure

Based on the pre-defined selection of potential panellists, we emailed invitation letters to a total of 84 experts. These letters outlined the study's objectives, described the e-Delphi context, detailed the questionnaire (e.g., language, type of questions, estimated completion time), and clarified what was expected from the participants ensuring they understood the significance of their contributions to the study. Interested parties could access the questionnaire through a direct URL link to the survey. Anticipating a 25-30% response rate for the first round's questionnaire, we expected approximately 20-25 experts to participate. We aimed to retain these experts across all subsequent rounds, planning for up to a maximum of four rounds.

Data Collection Procedures

The tool SurveyMonkey® was employed as the survey software as it facilitates secure and efficient data collection. In accordance with literature recommendations [43], each e-Delphi round remained open for a minimum of four weeks, during which up to three automatic reminder emails were dispatched to non-respondents. At the start of each new round, experts were provided access to the overall results from the previous round, including a list of items for which consensus was either 'achieved' ($\geq 70\%$) or 'not achieved' ($< 70\%$) [43]. The items that did not reach consensus were integrated into the

current round for further deliberation, along with any new items that emerged from panel suggestions through open-ended questions.

Measures

The questionnaire was divided into three sections:

- I. *e-Delphi section*: This section aimed to achieve consensus on the topic under study and consisted of 104 items. These were divided into 24 dimensions (e.g., *Impaired concentration*; *Lack of hope*) and 80 criteria (e.g., *Impaired ability to think or concentrate*; *Hopelessness*), which experts rated according to their relevance, using a Likert scale from 1 ('Not relevant') to 4 ('Very relevant'). Experts also had the possibility to comment on their answers and to suggest additional items they considered relevant to the topic for subsequent rounds.

In addition to rating the relevance of each item, experts were asked to indicate the most suitable type of assessment for each criterion: self-assessment, hetero-assessment, or both. This was intended to identify preferred methods of assessing potential depressive signs and symptoms. The aim here was not to achieve a stringent consensus of 70% as with the relevance ratings but to capture a broad spectrum of expert opinions on assessment approaches.

The initial selection of 104 items was based on a comprehensive review of existing instruments widely used in research to screen for and evaluate depressive signs and symptoms among near-centenarians and centenarians [13], supplemented by additional insights from recent analysis (personal communication by Gomes da Rocha et al., 2023). We started with all items available in these measures to be as comprehensive as possible. These instruments included self-assessment tools such as the Geriatric Depression Scale – 30 items (GDS-30) [45], the Center for Epidemiologic Studies Depression Scale (CES-D) [46], the depression-related items from the Brief Symptom Inventory (BSI) [47], and the Hospital Anxiety and Depression Scale (HADS) [48], as well as the Montgomery-Åsberg Depression Rating Scale (MADRS) [49], which is administered by a professional rater. Furthermore, given the significant prevalence of neurocognitive disorders in our aging population and the need for reliable assessment of depressive symptoms in individuals with cognitive impairments, we also considered instruments specifically designed for such assessments: the Cornell Scale for Depression in Dementia (CSDD) [50, 51] and the Neuropsychiatric Inventory (NPI)—Depression section [52, 53]. Additionally, we included the ICD-11 and DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition) diagnostic criteria to anchor our selections in the gold standards for depression diagnosis [6, 54]. To complete the pool of

items, the Depression Rating Scale (DRS) from the Resident Assessment Instrument (RAI) was also retained, given its widespread use among old and very old adults in diverse settings such as private homes (RAI-HC, Home-Care) or Long-Term Care Facilities (RAI-LTCF) [17, 55-57]. After compiling all items from the selected instruments, we checked for overlap and excluded identical items, which led to the final selection of 104 items. For instance, items like '*Do you feel that your situation is hopeless?*' from the GDS-30 and '*Feeling hopeless about the future*' from the BSI necessitated thematic grouping under a unified dimension, 'Lack of Hope' in this example. This process enabled us to construct more general items designated 'dimensions' that reflected the essence of the criteria within each group, thereby streamlining the questionnaire without compromising the depth of depressive symptoms screening. The list of all selected instruments and original items can be found in Appendix 10.

In summary, this strategic selection of items aimed to cover a broad spectrum of relevant criteria for the screening of depressive signs and symptoms, ensuring the questionnaire's comprehensive scope and its applicability to very old adults with varying levels of cognitive functioning.

- II. *Sociodemographic and Professional Characteristics*: This section included questions designed to capture the sociodemographic and professional characteristics of the panellists in Round 1 including age, gender, nationality, profession, years of professional experience, and their country and field of practice. In subsequent rounds, only essential information (age, gender, nationality, profession) was collected to ensure continuity and to accurately link responses from the same panellists across all rounds.

- III. *Contact With Very Old Individuals*: Although this could be considered part of professional characterization, this section specifically gathered information on the frequency of the panellists' experiences or interactions with very old individuals (85+ and 95+). It was specific to the first round, aiming to inform the context of their responses. While the study's target population was defined as near-centenarians and centenarians (95+), there is only a limited number of experts focusing on this exact population. However, most experts working with individuals aged 85 and older have regular contact with near-centenarians and centenarians. Thus, these experts were also invited, provided they felt confident in drawing on their experiences and perceptions relevant to the 95+ population.

Pre-test

Prior to launching Round 1, the questionnaire was pre-tested with a small purposive sample of five professionals (nurses, psychologists, and a medical doctor) to verify its clarity and comprehensibility, with only a minor adjustment made based on one expert's suggestion to include specific examples for certain items. Despite the positive outcomes of the pre-test, experts were invited to rate the questionnaire at the end of Round 1 for comprehensiveness and readability/clarity.

Overall, 92.8% (n = 26) of the experts participating in Round 1 rated the questionnaire as 'Comprehensive' or 'Very comprehensive,' and 85.7% (n = 24) found it 'Easy' or 'Very easy to read and understand'. Due to this positive feedback, no further structural adjustments were implemented before proceeding to the subsequent rounds.

Data Analysis

Data collected via SurveyMonkey® were transferred to an Excel spreadsheet and examined for any potential errors or missing data. They were then imported into IBM SPSS Statistics software, version 29.0 for analysis [58]. Descriptive statistics were computed to characterize the panel from a sociodemographic and professional perspective, using means and standard deviations, as well as medians and ranges for quantitative variables, and frequency distributions and percentages for qualitative variables. The level of agreement between experts required to achieve consensus on a given item was set at 70% for each round. This threshold is commonly used in Delphi studies [59-61] as it allows for the inclusion of minority viewpoints in the early rounds, ensuring that diverse perspectives are considered before achieving final consensus. This is particularly relevant in the context of depressive symptoms screening, given the challenges associated with detecting LLD, as previously mentioned. Hence, this consensus rate is considered acceptable for preserving methodological rigour, as supported by the literature [43], which indicates that such a threshold aligns with norms for ensuring reliability and validity in the context of an iterative, consensus-building approach. The consensus rate for each item was calculated using a four-level Likert scale (1 = 'Not relevant'; 2 = 'Somewhat relevant'; 3 = 'Relevant'; 4 = 'Very relevant'). In the first step, these responses were recoded into two levels: values 1 and 2 were recoded into '0' (Overall not relevant), and values 3 and 4 were recoded into '1' (Overall relevant). Next, we aggregated the recoded responses for each item to determine consensus, which was achieved when the percentage of experts identifying an item as 'Overall relevant' or 'Overall not relevant' met or exceeded the predefined threshold of 70%.

After the first e-Delphi round, items that did not reach the consensus level were carried forward to the subsequent round. At the beginning of each subsequent round, experts were given the opportunity to review the general outcomes from the previous one (i.e., 'consensus achieved' or 'consensus not achieved' for each evaluated item). Items that achieved consensus were not included again in subsequent rounds. After conducting three rounds with the participating panel and observing only limited changes in the consensus rate after the third round (Table 1), we decided to proceed with a last round, which involved a final evaluation of unresolved aspects by the steering committee. This last step aimed to gain a deeper understanding of the reasoning behind the outcomes and to further refine the consensus process. Items that still did not achieve consensus after the three e-Delphi rounds were thoroughly examined during this phase.

Ethical considerations

The local Ethics Committee was consulted and confirmed that this project fell outside the scope of the Swiss Human Research Act (HRA) (Req-2023-00844) (Appendix 11), as the study did not involve the collection of health-related personal data or biological material.

All participants received detailed information about the study, including its aim, relevance, what to expect, a description of the questionnaire, instructions for participation, and contact information for the main researcher, along with the invitation email. The questionnaires for all rounds (1, 2, and 3) included an introductory section emphasizing the voluntary nature of participation in the study, as well as specific information regarding confidentiality, data protection, risks, and benefits, and a statement on ethical considerations. Participants were explicitly informed that by answering the questionnaire, they were implicitly providing consent to participate in the study. Each participant received a survey link for accessing the questionnaire, and their IP addresses were not recorded to ensure confidentiality. Responses stored on SurveyMonkey® were deleted after transferring the data to the Excel spreadsheet. All data are securely stored on a password-protected institutional server to comply with Swiss data protection regulations and will be definitively deleted after five years.

RESULTS

Expert participation and sociodemographic and professional characteristics

Eighty-four experts were invited to this modified e-Delphi study. Of these, 28 (33.3%) participated in the first round, forming the baseline panel. This group (N = 28) was

consequently invited to the second and third rounds, for which the participation rates were 75.0% (n = 21) and 71.4% (n = 20), respectively.

The panel exhibited sociodemographic and professional diversity, including different nationalities, professions, and fields of practice. The average age ranged slightly between 44.1 and 46.7 over the rounds. A majority of women participated in the first and second rounds (60.7% and 61.9%, respectively), while men were more prevalent in the third round (55.0%). Swiss and Portuguese nationalities were the most represented (60.0-64.2%), with the nursing profession being predominant (45.0-57.1%), followed by the medical profession (23.8-40.0%). The average professional experience was 19.4 years, with nearly 80.0% of the experts being engaged in purely clinical activities or a combination of clinical and academic activities, among others (e.g., service organization). More than 80.0% reported having regular or very regular contact (daily, weekly or monthly) with individuals aged 85 and older, and 75.0% with individuals aged 95 and older (Table 1).

Table 1. Sociodemographic and professional characteristics of the experts from the panel

	ROUND 1	ROUND 2	ROUND 3
	N = 28	N = 21	N = 20
Age (years)			
Mean (SD)	44.1 (10.6)	45.2 (11.6)	46.7 (11.4)
Median (Range)	39.5 (29.0-64.0)	39.0 (29.0-64.0)	44.0 (30.0-65.0)
Gender, n (%)			
Men	11 (39.3)	8 (38.1)	11 (55.0)
Women	17 (60.7)	13 (61.9)	9 (45.0)
Nationality, n (%)			
Portuguese	9 (32.1)	6 (28.6)	4 (20.0)
Swiss	9 (32.1)	7 (33.3)	8 (40.0)
French	3 (10.7)	2 (9.5)	3 (15.0)
Swiss & Portuguese	2 (7.1)	2 (9.5)	1 (5.0)
Australian	1 (3.6)	1 (4.8)	1 (5.0)
Belgian	1 (3.6)	1 (4.8)	1 (5.0)
German	1 (3.6)	1 (4.8)	0 (0.0)
Italian	1 (3.6)	0 (0.0)	1 (5.0)
Norwegian	1 (3.6)	1 (4.8)	1 (5.0)
Profession, n (%)			
Nurse	15 (53.6)	12 (57.1)	9 (45.0)
Medical Doctor	8 (28.6)	5 (23.8)	8 (40.0)
Psychologist	4 (14.3)	4 (19.0)	3 (15.0)
Other: Gerontologist	1 (3.6)	0 (0.0)	0 (0.0)
Professional experience (years) (N = 27)			
Mean (SD)	19.4 (8.9)		
Median (Range)	17.0 (7.0-40.0)		
Country of professional practice, n (%)			
Switzerland	15 (53.6)		
Portugal	7 (25.0)		
France	3 (10.7)		
Australia	1 (3.6)		
Norway	1 (3.6)		
Portugal, UK, Saudi Arabia, UAE	1 (3.6)		
Field(s) of professional activity, n (%)			
Clinical activity			
Inpatient care only	6 (21.4)		
Outpatient care only	2 (7.1)		
Long-term care only	2 (7.1)		
Academic activity			
Teaching only	1 (3.6)		
Research only	1 (3.6)		
Teaching & research	3 (10.7)		
Clinical activity ^a & academic activity ^b	9 (32.1)		
Clinical activity ^a , academic activity ^b & other (e.g.: quality improvement, service organization)	3 (10.7)		
Management activity	1 (3.6)		
Contact with individuals aged ≥ 85 y/o, n (%)			
Daily	10 (35.7)		
Weekly	9 (32.1)		
Monthly	4 (14.3)		
Yearly	4 (14.3)		
Previously, but not currently	1 (3.6)		
Contact with individuals aged ≥ 95 y/o, n (%)			
Daily	4 (14.3)		
Weekly	8 (28.6)		
Monthly	9 (32.1)		
Yearly (or less ^c)	6 (21.4)		
Previously, but not currently	1 (3.6)		

^a 'Clinical activity' includes inpatient, outpatient and/or long-term care settings.

^b 'Academic activity' includes teaching and/or research roles.

^c One expert commented "Not yearly, but once in a while".

Questionnaire completion times

The completion dates and the mean time taken for participants to complete the questionnaires in each round are summarized in Table 2. Globally, the e-Delphi rounds took place between August 2023 and February 2024, with an overall weighted mean completion time of 16 minutes and 40 seconds.

Overall consensus achievements

A consensus threshold of $\geq 70.0\%$ was established for both dimensions and criteria, as previously described.

Depression screening: Potentially relevant dimensions

In Round 1, experts assessed 24 dimensions, reaching consensus on 13 (54.2%). Additionally, four new dimensions were suggested by the experts and incorporated in Round 2: *Underlying cognitive disorder* (dim. 25), *Previous episodes of depression or diagnosed depression* (dim. 26), *Personal care (e.g., poor hygiene)* (dim. 27), and *Language / speech (e.g., poor speech)* (dim. 28). Thus, 15 dimensions (11 without consensus and 4 new proposals) were reassessed in Round 2, achieving consensus on 10 (66.7%). In Round 3, five dimensions were revisited, with consensus reached for only one (20.0%) (Table 2).

Table 2. Summary of overall consensus achievements across e-Delphi rounds regarding potential dimensions and criteria for depression screening

	QUESTIONNAIRE COMPLETION (DATES AND MEAN TIME IN MINUTES)	DIMENSIONS ANALYSED	CONSENSUS ACHIEVED (DIMENSIONS)	CONSENSUS NOT ACHIEVED (DIMENSIONS)	NEW DIMENSIONS PROPOSED	CRITERIA ANALYSED	CONSENSUS ACHIEVED (CRITERIA)	CONSENSUS NOT ACHIEVED (CRITERIA)	NEW CRITERIA PROPOSED
		n	n (%)	n (%)	n	n	n (%)	n (%)	n
Round 1	August 15 – October 1, 2023 24:51 (SD = 10:51)	24	13 (54.2)	11 (45.8)	4	80	49 (61.3)	31 (38.8)	8
Round 2	October 26 – December 12, 2023 15:31 (SD = 8:18)	15	10 (66.7)	5 (33.3)	0	39	12 (30.8)	27 (69.2)	0
Round 3	January 31 – February 29, 2024 6:26 (SD = 3:55)	5	1 (20.0)	4 (80.0)	0	27	9 (33.3)	18 (66.7)	0

Table 3 summarizes the consensus rates for the 28 dimensions assessed across the three e-Delphi rounds. Four dimensions failed to reach the $\geq 70\%$ consensus threshold: *Memory problems* (dim. 21), *Mood-congruent delusions* (dim. 22), *Reduced adaptation capacity* (dim. 24), and *Language / speech* (e.g., *poor speech*; dim. 28)—the only newly suggested dimension without consensus. Among the dimensions where consensus was achieved, all were considered 'relevant' for screening depression in individuals aged 95+, except for *Increased appetite* (dim. 8), deemed 'not relevant'. Notably, several 'relevant' dimensions reached $\geq 90\%$ consensus: *Lack of hope* (dim. 20; 100%), *Loss of interest* (dim. 4; 96.4%), *Lack of reactivity to pleasant events* (dim. 5; 96.4%), *Depressed mood* (dim. 1; 92.9%), and *Previous episodes of depression or diagnosed depression* (dim. 26; 90.5%).

Figure 1 (Appendix 12) provides an overview of the consensus rates for the potentially relevant dimensions for depression screening.

Table 3. Consensus level on potential dimensions for depression screening

	Round 1 (N = 28)			Round 2 (N = 21)			Round 3 (N = 20)		
	Level of consensus ≥ 70%	Result	n/N (%)	Level of consensus ≥ 70%	Result	n/N (%)	Level of consensus ≥ 70%	Result	n/N (%)
1. Depressed mood	Achieved	Relevant	26/28 (92.9)						
2. Anxiety	Achieved	Relevant	24/28 (85.7)						
3. Irritability	(Not achieved)			Achieved	Relevant	17/21 (81.0)			
4. Loss of interest	Achieved	Relevant	27/28 (96.4)						
5. Lack of reactivity to pleasant events	Achieved	Relevant	27/28 (96.4)						
6. Psychomotor changes	(Not achieved)			Achieved	Relevant	16/21 (76.2)			
7. Appetite loss	Achieved	Relevant	19/27 (70.4)						
8. Increased appetite	(Not achieved)			Achieved	Not relevant	16/21 (76.2)			
9. Reduced sleep, insomnia	Achieved	Relevant	19/26 (73.1)						
10. Hypersomnia	(Not achieved)			Achieved	Relevant	16/21 (76.2)			
11. Lack of energy	Achieved	Relevant	21/27 (77.8)						
12. Death wishes	Achieved	Relevant	22/28 (78.6)						
13. Suicidal thoughts	Achieved	Relevant	24/28 (85.7)						
14. Poor self-esteem	Achieved	Relevant	23/28 (82.1)						
15. Pessimism	Achieved	Relevant	20/27 (74.1)						
16. Low life satisfaction	Achieved	Relevant	20/28 (71.4)						
17. Impaired concentration	(Not achieved)			(Not achieved)			Achieved	Relevant	14/20 (70.0)
18. Impaired decision-making capacity	(Not achieved)			Achieved	Relevant	15/21 (71.4)			
19. Negative feelings	Achieved	Relevant	24/28 (85.7)						
20. Lack of hope	(Not achieved)			Achieved	Relevant	21/21 (100.0)			
21. Memory problems	(Not achieved)			(Not achieved)			(Not achieved)		
22. Mood-congruent delusions	(Not achieved)			(Not achieved)			(Not achieved)		
23. Repercussions of functional dependence	(Not achieved)			Achieved	Relevant	16/21 (76.2)			
24. Reduced adaptation capacity	(Not achieved)			(Not achieved)			(Not achieved)		
25. [NEW R2] Underlying cognitive disorder				Achieved	Relevant	15/21 (71.4)			
26. [NEW R2] Previous episodes of depression or diagnosed depression				Achieved	Relevant	19/21 (90.5)			
27. [NEW R2] Personal care (e.g., poor hygiene)				Achieved	Relevant	16/21 (76.2)			
28. [NEW R2] Language / speech (e.g., poor speech)				(Not achieved)			(Not achieved)		

Note 1: This list includes four dimensions suggested by the expert participants in Round 1 and incorporated into the subsequent rounds: 25 (*Underlying cognitive disorder*) (*Previous episodes of depression or diagnosed depression*), 27 (*Personal care (e.g., poor hygiene)*), and 28 (*Language / speech (e.g., poor speech)*).

Note 2: Cells shaded in grey denote that data are not available for the corresponding entries.

Depression screening: Potentially relevant criteria

In Round 1, 80 criteria were assessed, with consensus reached for 49 (61.3%). Additionally, eight new criteria emerged from suggestions by the panel and were incorporated in Round 2: *Critical life events* (e.g., *loss of a child or another loved one*) (crit. 81), *Emotional indifference* (crit. 82), *Anhedonia* (crit. 83), *Afraid of being alone* (crit. 84), *Resurfacing of 'old wounds'* (e.g., *long-standing conflicts with children*) (crit. 85), *Feeling of accomplishment throughout life* (crit. 86), *Closeness with family and significant others* (crit. 87) and *Subjective health* (crit. 88). As a result, 39 criteria (31 without consensus and 8 new proposals) were reassessed in Round 2, achieving consensus for 12 (30.8%). In Round 3, 27 criteria were revisited, with consensus reached for nine (33.3%) (Table 2).

Table 4 presents the consensus rates for the 88 criteria assessed across the three e-Delphi rounds. Eighteen criteria failed to reach the $\geq 70\%$ consensus threshold: *Easily annoyed* (crit. 20), *Short-tempered* (crit. 21), *Staying home instead of going out and doing new things* (crit. 26), *Psychomotor agitation* (crit. 29), *Significant unintentional weight gain (more than 5% in a month)* (crit. 33), *Restless sleep* (crit. 35), *Full of energy* (crit. 42), *Feels as good as other people* (crit. 51), *Pessimism* (crit. 52), *Thinks most people are better off than him/her* (crit. 56), *Finding life exciting, wonderful, enjoyable* (crit. 58), *Getting bored often* (crit. 62), *Feeling fearful* (crit. 64), *Feeling that people are unfriendly or disliked him/her* (crit. 66), *Memory problems* (crit. 69), *The mind is as clear as it used to be* (crit. 70), *Having a sense of direction and purpose in life* (crit. 79), and *Afraid of being alone* (crit. 84)—the only newly suggested criteria without consensus. Among the criteria where consensus was achieved, all were considered 'relevant' for screening depression in individuals aged 95+, except *Hard to get started on new projects* (crit. 28), *Fear of dying* (crit. 75), and *Sufficient financial resources* (crit. 77), considered 'not relevant'. Notably, several 'relevant' criteria reached a $\geq 90\%$ consensus: *Despondency, gloom, despair* (crit. 5; 100%), *Depressed* (crit. 6; 100%), *Lack of reactivity to pleasant events or circumstances* (crit. 25; 100%), *Suicidal ideation* (crit. 45; 100%), *Suicide attempt(s)* (crit. 46; 100%), *Ruminations* (crit. 14; 96.4%), *Recurrent thoughts of death or suicide* (crit. 43; 96.4%), *Feelings of worthlessness* (crit. 47; 96.2%), *Critical life events* (crit. 81; 95.2%), *Anhedonia* (crit. 83; 95.2%), *Loss of interest in activities* (crit. 23; 92.9%), *Loss of pleasure in activities* (crit. 24; 92.9%), and *Sadness* (crit. 4; 92.3%).

Figure 2 (Appendix 12) provides an overview of the consensus rates for the potentially relevant criteria for depression screening.

Table 4. Consensus level on potential criteria for depression screening

	Round 1 (N = 28)			Round 2 (N = 21)			Round 3 (N = 20)		
	Level of consensus ≥ 70%	Result	n/N (%)	Level of consensus ≥ 70%	Result	n/N (%)	Level of consensus ≥ 70%	Result	n/N (%)
1. Downhearted, in low spirits, blues	Achieved	Relevant	23/27 (85.2)						
2. Crying		(Not achieved)			(Not achieved)		Achieved	Relevant	14/20 (70.0)
3. Tearfulness, sobbing		(Not achieved)		Achieved	Relevant	16/21 (76.2)			
4. Sadness	Achieved	Relevant	24/26 (92.3)						
5. Despondency, gloom, despair	Achieved	Relevant	25/25 (100.0)						
6. Depressed	Achieved	Relevant	27/27 (100.0)						
7. Diurnal variation of mood (symptoms worse in the morning)	Achieved	Relevant	22/28 (78.6)						
8. May still laugh and see the funny side of things	Achieved	Relevant	21/27 (77.8)						
9. Bothering persistent thoughts	Achieved	Relevant	25/28 (89.3)						
10. Restless, fidgety	Achieved	Relevant	20/27 (74.1)						
11. Worrying	Achieved	Relevant	23/28 (82.1)						
12. Inner tension	Achieved	Relevant	24/28 (85.7)						
13. Anxiety	Achieved	Relevant	24/28 (85.7)						
14. Ruminations	Achieved	Relevant	27/28 (96.4)						
15. Unrealistic fears	Achieved	Relevant	22/27 (81.5)						
16. Repetitive anxious complaints or concerns (non-health related)	Achieved	Relevant	25/28 (89.3)						
17. Multiple physical complaints	Achieved	Relevant	23/28 (82.1)						
18. Repetitive health complaints	Achieved	Relevant	23/28 (82.1)						
19. Upset over little things	Achieved	Relevant	19/27 (70.4)						
20. Easily annoyed		(Not achieved)			(Not achieved)			(Not achieved)	
21. Short-tempered		(Not achieved)			(Not achieved)			(Not achieved)	
22. Persistent anger with self or others	Achieved	Relevant	20/28 (71.4)						
23. Loss of interest in activities	Achieved	Relevant	26/28 (92.9)						
24. Loss of pleasure in activities	Achieved	Relevant	26/28 (92.9)						
25. Lack of reactivity to pleasant events or circumstances	Achieved	Relevant	28/28 (100.0)						
26. Staying home instead of going out and doing new things		(Not achieved)			(Not achieved)			(Not achieved)	
27. Avoiding social gatherings	Achieved	Relevant	20/28 (71.4)						
28. Hard to get started on new projects		(Not achieved)			(Not achieved)		Achieved	Not relevant	17/20 (85.0)
29. Psychomotor agitation		(Not achieved)			(Not achieved)			(Not achieved)	
30. Psychomotor retardation	Achieved	Relevant	19/27 (70.4)						
31. Appetite loss	Achieved	Relevant	19/27 (70.4)						
32. Significant unintentional weight loss (more than 5% in a month)	Achieved	Relevant	19/27 (70.4)						
33. Significant unintentional weight gain (more than 5% in a month)		(Not achieved)			(Not achieved)			(Not achieved)	
34. Reduced sleep, insomnia	Achieved	Relevant	21/27 (77.8)						
35. Restless sleep		(Not achieved)			(Not achieved)			(Not achieved)	
36. Hypersomnia		(Not achieved)		Achieved	Relevant	16/21 (76.2)			
37. Fatigue, tiredness		(Not achieved)		Achieved	Relevant	15/21 (71.4)			
38. Reduced energy, lack of energy	Achieved	Relevant	20/28 (71.4)						

39. Feels that everything he/she did was an effort	(Not achieved)	Achieved	Relevant	15/21 (71.4)	
40. Could not get “going”	Achieved	Relevant	19/26 (73.1)		
41. Lassitude	Achieved	Relevant	23/28 (82.1)		
42. Full of energy	(Not achieved)	(Not achieved)		(Not achieved)	
43. Recurrent thoughts of death or suicide	Achieved	Relevant	27/28 (96.4)		
44. Wish for death	Achieved	Relevant	23/28 (82.1)		
45. Suicidal ideation	Achieved	Relevant	28/28 (100.0)		
46. Suicide attempt(s)	Achieved	Relevant	28/28 (100.0)		
47. Feelings of worthlessness	Achieved	Relevant	25/26 (96.2)		
48. Excessive or inappropriate guilt	Achieved	Relevant	24/28 (85.7)		
49. Poor self-esteem	Achieved	Relevant	22/28 (78.6)		
50. Loss of interest in appearance	Achieved	Relevant	19/27 (70.4)		
51. Feels as good as other people	(Not achieved)	(Not achieved)		(Not achieved)	
52. Pessimism	(Not achieved)	(Not achieved)		(Not achieved)	
53. Feeling helpless	Achieved	Relevant	23/27 (85.2)		
54. Discouraged	Achieved	Relevant	23/28 (82.1)		
55. Negative statements	Achieved	Relevant	22/28 (78.6)		
56. Thinks most people are better off than him/her	(Not achieved)	(Not achieved)		(Not achieved)	
57. Being satisfied with life	(Not achieved)	(Not achieved)		Achieved	Relevant 14/20 (70.0)
58. Finding life exciting, wonderful, enjoyable	(Not achieved)	(Not achieved)		(Not achieved)	
59. Empty life	Achieved	Relevant	21/27 (77.8)		
60. Impaired ability to think or to concentrate	(Not achieved)	(Not achieved)		Achieved	Relevant 14/20 (70.0)
61. Impaired ability to make decisions	(Not achieved)	Achieved	Relevant 15/21 (71.4)		
62. Getting bored often	(Not achieved)	(Not achieved)		(Not achieved)	
63. Being bothered by things that usually don't bother him/her	Achieved	Relevant	19/27 (70.4)		
64. Feeling fearful	(Not achieved)	(Not achieved)		(Not achieved)	
65. Feeling lonely	Achieved	Relevant	23/28 (82.1)		
66. Feeling that people are unfriendly or disliked him/her	(Not achieved)	(Not achieved)		(Not achieved)	
67. Hopelessness	Achieved	Relevant	24/27 (88.9)		
68. Hopeful about the future	(Not achieved)	Achieved	Relevant 16/21 (76.2)		
69. Memory problems	(Not achieved)	(Not achieved)		(Not achieved)	
70. The mind is as clear as it used to be	(Not achieved)	(Not achieved)		(Not achieved)	
71. Talking less than usual	Achieved	Relevant	21/28 (75.0)		
72. Mood-congruent delusions (delusions of poverty, illness or loss)	(Not achieved)	Achieved	Relevant 16/20 (80.0)		
73. Psychological impact of functional limitations (incapacity to perform activities of daily living independently)	Achieved	Relevant	22/27 (81.5)		
74. Pain (acute, chronic)	Achieved	Relevant	23/28 (82.1)		
75. Fear of dying	(Not achieved)	(Not achieved)		Achieved	Not relevant 14/20 (70.0)
76. Social contacts	Achieved	Relevant	21/28 (75.0)		
77. Sufficient financial resources	(Not achieved)	(Not achieved)		Achieved	Not relevant 15/20 (75.0)
78. Participation in activities (reading, using the computer/smartphone,	(Not achieved)	(Not achieved)		Achieved	Relevant 16/20 (80.0)

TV/radio, playing an instrument/games, physical activity, gardening, going to the cinema/theatre/café/restaurant, attending religious services, visiting people, associative activities, etc.)						
79. Having a sense of direction and purpose in life	(Not achieved)			(Not achieved)		(Not achieved)
80. Level of resilience	Achieved	Relevant	20/27 (74.1)			
81. [NEW R2] Critical life events (e.g., loss of a child or another loved one)				Achieved	Relevant	20/21 (95.2)
82. [NEW R2] Emotional indifference				Achieved	Relevant	16/21 (76.2)
83. [NEW R2] Anhedonia				Achieved	Relevant	20/21 (95.2)
84. [NEW R2] Afraid of being alone				(Not achieved)		(Not achieved)
85. [NEW R2] Resurfacing of 'old wounds' (e.g., long-standing conflicts with children)				Achieved	Relevant	15/21 (71.4)
86. [NEW R2] Feeling of accomplishment throughout life				(Not achieved)		Achieved Relevant 14/20 (70.0)
87. [NEW R2] Closeness with family and significant others				(Not achieved)		Achieved Relevant 15/20 (75.0)
88. [NEW R2] Subjective health				Achieved	Relevant	15/20 (75.0)

Note 1: This list includes eight criteria suggested by the expert participants in Round 1 and incorporated into the subsequent rounds: 81 (*Critical life events (e.g., loss of a child or another loved one)*), 82 (*Emotional indifference*), 83 (*Anhedonia*), 84 (*Afraid of being alone*), 85 (*Resurfacing of "old wounds" (e.g., long-standing conflicts with children)*), 86 (*Feeling of accomplishment throughout life*), 87 (*Closeness with family and significant others*), and 88 (*Subjective health*).

Note 2: Cells shaded in grey denote that data are not available for the corresponding entries.

Signs and symptoms of depression: duration, number, frequency, and severity

In Round 1, experts (N = 28) were asked about the importance of considering the duration of depressive signs and/or symptoms, in addition to their presence. It is important to note that for the purpose of this assessment, they were instructed not to consider 'suicidal thoughts or ideation' as these require immediate attention and thus were deliberately excluded from the duration criteria. All participants (n = 28; 100%) agreed on its importance. When specifically asked about the minimum duration for considering these signs and/or symptoms as clinically significant, 25 experts provided their insights; 84.0% (n = 21) suggested a range from 'a few days' (1 to 3) to 'four weeks', with 'two weeks' being the most cited (n = 9; 36%).

Additionally, two experts suggested differentiating the duration of signs and/or symptoms between recurrent episodes in chronic depression and new-onset cases. For this reason, a question addressing this specificity was introduced in Round 2 (N = 21), with 69% (n = 13) supporting the distinction. For recurrent episodes, most favored a minimum duration of 'two weeks' (n = 9; 69.2%), while for a new onset, opinions varied, with 'four weeks' (n = 5; 38.5%) being the most cited.

In Round 2 (N = 21), 61.9% emphasized the importance of considering the number of signs and/or symptoms during screening. Among the 12 experts who specified a threshold, 66.6% (n = 8) favored 3 or 4 symptoms.

Regarding signs and/or symptoms frequency, all 20 experts who provided an opinion in Round 2 (100%) considered it relevant. Among them, 19 specified a particular frequency, where 47.4% (n = 9) suggested a frequency of 'several times per day', 15.8% (n = 3) 'nearly daily', and 31.6% (n = 6) 'several times per week'.

For severity, 90.0% (n = 18) considered it an important factor. Moreover, on a 0-10 severity scale (with level 10 being the most severe), the average threshold for clinical concern was 4.9 (SD = 1.4), with a median of 5.0 (range: 2-7).

Further details regarding the results described above can be found in Appendix 13.

Steering committee's decision on dimensions and criteria lacking consensus after three e-Delphi rounds

The steering committee conducted two additional rounds of discussion to decide on the relevance of the four dimensions and 18 criteria that did not reach a consensus of $\geq 70\%$ among the panellists during the three e-Delphi rounds.

In the first round of discussion, committee members reviewed the panellists' comments and agreement levels for each dimension and criterion, analysing potential reasons for the lack of consensus and considering the clinical implications. Each member shared their perspectives, drawing on their clinical expertise. In the second round, the committee revisited the dimensions and criteria after reflecting on the insights from the first round, aiming to resolve any remaining uncertainties and reach a collective decision. Consensus was prioritized, with majority voting used when necessary.

A summary of the committee's final determinations is provided in Appendix 14, where the rationale behind the inclusion or exclusion of each dimension and criterion is detailed.

Table 5 presents an overview of the consensus levels reached in each e-Delphi round and the final decisions made by the steering committee.

Table 5. Steering committee's decision on dimensions and criteria lacking consensus after three e-Delphi rounds

	ROUND 1 (N = 28)	ROUND 2 (N = 21)	ROUND 3 (N = 20)	STEERING COMMITTEE FINAL DECISION
DIMENSIONS				
21. Memory problems, n/N (%)	Not relevant: 15/27 (55.6) Relevant: 12/27 (44.4)	Not relevant: 11/21 (52.4) Relevant: 10/21 (47.6)	Not relevant: 9/20 (45.0) Relevant: 11/20 (55.0)	Not relevant
22. Mood-congruent delusions, n/N (%)	Not relevant: 12/27 (44.4) Relevant: 15/27 (55.6)	Not relevant: 9/21 (42.9) Relevant: 12/21 (57.1)	Not relevant: 9/20 (45.0) Relevant: 11/20 (55.0)	Relevant
24. Reduced adaptation capacity, n/N (%)	Not relevant: 12/28 (42.9) Relevant: 16/28 (57.1)	Not relevant: 7/21 (33.3) Relevant: 14/21 (66.7)	Not relevant: 8/20 (40.0) Relevant: 12/20 (60.0)	Relevant
28. [NEW R2] Language / speech (e.g., poor speech), n/N (%)		Not relevant: 8/21 (38.1) Relevant: 13/21 (61.9)	Not relevant: 12/20 (60.0) Relevant: 8/20 (40.0)	Not relevant
CRITERIA				
20. Easily annoyed, n/N (%)	Not relevant: 11/28 (39.3) Relevant: 17/28 (60.7)	Not relevant: 12/21 (57.1) Relevant: 9/21 (42.9)	Not relevant: 11/20 (55.0) Relevant: 9/20 (45.0)	Not relevant
21. Short-tempered, n/N (%)	Not relevant: 11/27 (40.7) Relevant: 16/27 (59.3)	Not relevant: 11/19 (57.9) Relevant: 8/19 (42.1)	Not relevant: 10/20 (50.0) Relevant: 10/20 (50.0)	Relevant
26. Staying home instead of going out and doing new things, n/N (%)	Not relevant: 11/28 (39.3) Relevant: 17/28 (60.7)	Not relevant: 9/21 (42.9) Relevant: 12/21 (57.1)	Not relevant: 12/20 (60.0) Relevant: 8/20 (40.0)	Not relevant
29. Psychomotor agitation, n/N (%)	Not relevant: 11/27 (40.7) Relevant: 16/27 (59.3)	Not relevant: 8/21 (38.1) Relevant: 13/21 (61.9)	Not relevant: 9/20 (45.0) Relevant: 11/20 (55.0)	Not relevant
33. Significant unintentional weight gain (more than 5% in a month), n/N (%)	Not relevant: 18/27 (66.7) Relevant: 9/27 (33.3)	Not relevant: 14/21 (66.7) Relevant: 7/21 (33.3)	Not relevant: 11/20 (55.0) Relevant: 9/20 (45.0)	Not relevant
35. Restless sleep, n/N (%)	Not relevant: 10/26 (38.5) Relevant: 16/26 (61.5)	Not relevant: 8/20 (40.0) Relevant: 12/20 (60.0)	Not relevant: 8/20 (40.0) Relevant: 12/20 (60.0)	Relevant
42. Full of energy, n/N (%)	Not relevant: 18/27 (66.7) Relevant: 9/27 (33.3)	Not relevant: 12/21 (57.1) Relevant: 9/21 (42.9)	Not relevant: 12/20 (60.0) Relevant: 8/20 (40.0)	Not relevant
51. Feels as good as other people, n/N (%)	Not relevant: 14/27 (51.9) Relevant: 13/27 (48.1)	Not relevant: 13/20 (65.0) Relevant: 7/20 (35.0)	Not relevant: 8/20 (40.0) Relevant: 12/20 (60.0)	Not relevant
52. Pessimism, n/N (%)	Not relevant: 9/28 (32.1) Relevant: 19 (67.9)	Not relevant: 9/20 (45.0) Relevant: 11/20 (55.0)	Not relevant: 8/20 (40.0) Relevant: 12/20 (60.0)	Relevant
56. Thinks most people are better off than him/her, n/N (%)	Not relevant: 10/27 (37.0) Relevant: 17/27 (63.0)	Not relevant: 9/21 (42.9) Relevant: 12/21 (57.1)	Not relevant: 7/20 (35.0) Relevant: 13/20 (65.0)	Not relevant
58. Finding life exciting, wonderful, enjoyable, n/N (%)	Not relevant: 10/27 (37.0) Relevant: 17/27 (63.0)	Not relevant: 9/20 (45.0) Relevant: 11/20 (55.0)	Not relevant: 9/20 (45.0) Relevant: 11/20 (55.0)	Not relevant
62. Getting bored often, n/N (%)	Not relevant: 11/27 (40.7) Relevant: 16/27 (59.3)	Not relevant: 12/21 (57.1) Relevant: 9/21 (42.9)	Not relevant: 7/19 (36.8) Relevant: 12/19 (63.2)	Not relevant

64. Feeling fearful, n/N (%)	Not relevant: 9/27 (33.3) Relevant: 18/27 (66.7)	Not relevant: 11/21 (52.4) Relevant: 10/21 (47.6)	Not relevant: 10/20 (50.0) Relevant: 10/20 (50.0)	Relevant
66. Feeling that people are unfriendly or disliked him/her, n/N (%)	Not relevant: 15/27 (55.6) Relevant: 12/27 (44.4)	Not relevant: 13/21 (61.9) Relevant: 8/21 (38.1)	Not relevant: 7/20 (35.0) Relevant: 13/20 (65.0)	Not relevant
69. Memory problems, n/N (%)	Not relevant: 14/28 (50.0) Relevant: 14/28 (50.0)	Not relevant: 12/21 (57.1) Relevant: 9/21 (42.9)	Not relevant: 9/20 (45.0) Relevant: 11/20 (55.0)	Not relevant
70. The mind is as clear as it used to be, n/N (%)	Not relevant: 14/27 (51.9) Relevant: 13/27 (48.1)	Not relevant: 11/21 (52.4) Relevant: 10/21 (47.6)	Not relevant: 10/20 (50.0) Relevant: 10/20 (50.0)	Not relevant
79. Having a sense of direction and purpose in life, n/N (%)	Not relevant: 11/27 (40.7) Relevant: 16/27 (59.3)	Not relevant: 7/21 (33.3) Relevant: 14/21 (66.7)	Not relevant: 9/20 (45.0) Relevant: 11/20 (55.0)	Relevant
84. [NEW R2] Afraid of being alone, n/N (%)		Not relevant: 9/21 (42.9) Relevant: 12/21 (57.1)	Not relevant: 8/20 (40.0) Relevant: 12/20 (60.0)	Relevant

Types of assessment for potential depression criteria: self-assessment, hetero-assessment or both?

In addition to assessing the relevance of each criterion, the panel provided opinions on the preferred assessment method (self-assessment, hetero-assessment, or both). Rather than seeking strict consensus, the goal was to identify general trends. Using a 50% threshold as an example, 28 criteria (35.0%) were deemed suitable for 'self-assessment' only, three criteria (3.8%) for 'hetero-assessment' only, and 32 criteria (40.0%) for both methods. Detailed information is available in Table A (Appendix 15), while Figure 3 (Multimedia Appendix 12) provides an overview of the consensus rates for these assessment methods.

DISCUSSION

Principal results

This modified e-Delphi study aimed to identify and achieve consensus on the most representative signs and symptoms of depression in very old age, focusing on near-centenarians and centenarians.

Our results revealed that a majority of the items proposed—24 out of 28 dimensions and 70 out of 88 criteria—which had been assembled based on a literature review, were considered 'relevant' for depression screening in very old age. This highlights the importance of a multidimensional approach and acknowledges the complexity of accurately diagnosing depression in this population.

Most consensual potentially relevant depressive signs and symptoms

Focusing on items with the highest consensus rates ($\geq 90\%$), some overlap between dimensions and criteria was observed, as expected, since dimensions grouped related criteria.

For example, the dimension *Depressed mood* was widely considered 'relevant', aligning with criteria like *Depressed*, *Sadness*, and *Despondency*, *gloom*, *despair*, which reflect the emotional core of depressive disorders [6, 54]. Similarly, *Loss of interest in activities*, *Loss of pleasure in activities*, *Lack of reactivity to pleasant events or circumstances*, and *Anhedonia* also achieved broad consensus as critical indicators of depression [6, 54, 62-64]. Collectively, these signs and symptoms highlight the significant impact of depression on a person's capacity for joy and engagement with life, underscoring their relevance in depression screening.

Criteria such as *Ruminations* and *Feelings of worthlessness* equally achieved a strong consensus due to their role in the negative cognitive and emotional patterns of depression. Previous research showed that *Ruminations* exacerbate psychopathology, including depression, by intensifying and extending negative mood states, thus interfering with problem-solving, and perpetuating physiological stress responses [65]. Similarly, *Feelings of worthlessness* are strongly linked to self-blame, lack of hope, and an increased suicide risk, even after depressive episodes remit [66, 67]. Building on this, the dimension *Lack of hope* achieved unanimous consensus (100%) as a relevant element, reflecting its importance as a significant predictor of psychological well-being [68]. Within this broader dimension, the criteria *Hopelessness* and *Full of Hope* also showed high agreement (88.9% and 76.2%, respectively), emphasizing their important role in depression screening in the very old, whether as a negative indicator or a positive resource.

Furthermore, *Previous episodes of depression or diagnosed depression* were also identified as relevant, highlighting the importance of considering an individual's psychiatric history, as past experiences with depression increase the risk of recurrence [69]. Additionally, *Critical life events* perceived as negative were recognized for their significant association with higher levels of depressive symptoms in a recent meta-analysis [70].

Finally, the strong agreement on severe criteria like Recurrent thoughts of death or suicide, Suicidal ideation, and past Suicide attempt(s) underscores the critical need to address these factors due to their immediate risk to individuals' safety [26].

Most consensual potentially relevant depressive signs and symptoms in the context of old age

Having established the most consensual depressive features, it is essential to explore how these characteristics manifest specifically in older adults, where unique age-related factors may shape their expression and impact.

As individuals age, they may face different challenges, some of which are particularly relevant to LLD. These include ageism, loss of income, the death of loved ones, and the risk of isolation, functional limitations, multimorbidity, cognitive decline, and institutionalization [71]. Such multidimensional challenges can impact the well-being and mental health, contributing to reduced aging satisfaction and increased loneliness, namely in near-centenarians and centenarians [71, 72]. While the cumulative effect of these difficulties can increase the risk of LLD, it is important to note that experiencing them does not necessarily lead to the development of a depressive state [72].

The dimensions and criteria that achieved high consensus as previously discussed, clearly represent central elements in depression screening across all age groups, aligning with current diagnostic standards [6, 54]. Our findings confirm their importance for accurate diagnosis in very old individuals, underscoring their transversality across generations and relevance even in the final stages of life. While depression in very old age may have unique aspects, some of the core signs and symptoms of the disorder remain consistent and should not be overlooked, including in near-centenarians and centenarians. However, these signs and symptoms may carry additional significance due to the unique psychosocial and physical challenges faced by these individuals [72].

For instance, the *Loss of interest in activities*, *Loss of pleasure in activities*, *Lack of reactivity to pleasant events or circumstances*, and *Anhedonia* may highlight a deeper disengagement from life that can be difficult to detect in older adults. These symptoms are often masked by typical aging challenges like physical decline, social isolation or even cognitive issues, complexifying their identification. Additionally, *Feelings of worthlessness* and the negative impact of *Critical life events* may be particularly relevant in late-life contexts, where significant life changes and losses are common [67, 73]. As highlighted in a meta-synthesis [74], older adults often experience declines in physical and cognitive abilities, leading to feelings of disconnection and a perception of being unneeded by their communities. This sense of being unneeded can foster feelings of isolation and insignificance, thereby triggering or exacerbating depressive symptoms. Moreover, societal changes and loss of social roles further deepen these feelings of worthlessness, underscoring the importance of addressing these issues in older populations [74].

While the high consensus on many classic criteria suggests their continued relevance across the life cycle, our findings also point to unique aspects of depression in

very old age that may not be fully captured by current approaches. For example, the unanimous agreement on the relevance of *Lack of hope* highlights its particular significance in this age group. Unlike other factors typically associated with normal aging processes, low levels of hope have been identified as a significant risk factor in older adults, reflecting a deeper sense of despair with potentially serious consequences. A systematic review [75] underscored that lack of hope is closely linked to negative outcomes in older populations, including an increased risk of depression and poorer overall health outcomes.

Moreover, the strong agreement on severe symptoms such as *Recurrent thoughts of death or suicide*, *Suicidal ideation*, and past *Suicide attempt(s)* underscores the importance of also addressing these factors in very old age, where such topics often remain taboo [76]. Reluctance to discuss or acknowledge these symptoms may lead to underdiagnosis and inadequate treatment, emphasizing the need for sensitive and proactive approaches in this age group. Recent qualitative research [76] revealed that suicidal thoughts in later life are often subtly expressed and normalized in everyday conversations, making them difficult to detect. However, the extent to which this applies to centenarians is unclear. Prior research suggests that only a minority of centenarians express a wish to die [77, 78], making explicit suicidal thoughts likely rare and not always linked to depressive states. Nonetheless, feelings of life being ‘completed and no longer worth living’ reflect a deeper disconnection from life, characterized by aching loneliness, feelings of not mattering, and a physical and mental tiredness [79]. Creating safe spaces for informal —yet meaningful—discussions is essential, alongside strategies for timely recognition and management of these symptoms [76].

Potentially not relevant depressive signs and symptoms in the context of old age

The dimension Increased appetite may have been considered ‘not relevant’ as it can result from situational factors, such as attending a day center or moving to a nursing home, where tailored meals and social dining often enhance the willingness to eat, contributing to an increased appetite. Similarly, the criterion Significant unintentional weight gain was likely deemed ‘not relevant’ for related reasons, as previous research found no association between weight gain and incident depressive symptoms in older adults [80].

Certain cognitive dimensions, such as Memory problems and Language/speech (e.g., poor speech), were also classified as ‘not relevant,’ likely due to their overlap with non-depressive phenomena commonly observed in older adults. This highlights the need for tailored screening protocols that can effectively differentiate between depression and cognitive impairment, conditions that often co-exist in very old individuals and require

distinct therapeutic strategies [81, 82]. Similarly, the criterion *The mind is as clear as it used to be* as was likely deemed 'not relevant' for the same reasons.

Criteria such as *Hard to get started on new projects*, *Staying home instead of going out and doing new things*, *Finding life exciting, wonderful, enjoyable*, *Easily annoyed*, and *Getting bored often*, may be more closely related to motivational factors, social involvement, social support or underlying health conditions, rather than directly indicating a depressive state [83, 84]. Similarly, criteria such as *Thinks most people are better off than him/her*, *Feeling that people are unfriendly or disliked him/her*, and *Feels as good as other people*, may reflect personality traits, which are relatively stable over the lifespan and may not necessarily reflect a change in mental health status [85].

Symptoms like *Psychomotor agitation* illustrate the challenge in differentiating between depression-related symptoms and those arising from other geriatric conditions such as dementia or delirium [86], suggesting that certain depressive features may be less applicable or not sufficient for very old individuals [87]. Additionally, the criterion *Full of energy*, typically seen as a positive indicator, was not deemed relevant, possibly because it is rare for a non-depressed near-centenarian or centenarian to report feeling full of energy. This likely reflects their overall physical condition rather than a depressive state, and the absence of this criterion may often be confounded with physical exhaustion linked to frailty [88].

The criterion *Fear of dying* was also classified as 'not relevant'. Although it might be assumed that individuals in the final stage of life would fear death, previous research suggests that death anxiety is generally low among older adults, who are more often concerned with the dying process rather than death itself [89]. Similarly, *Sufficient financial resources* was deemed 'not relevant'. While financial difficulties can impact mental health, their link to psychological distress in older adults appears to be more influenced by underlying factors like mastery and self-esteem, rather than acting as a direct indicator of depression [90].

The specificity of near-centenarians and centenarians

Research on near-centenarians and centenarians has predominantly focused on physical, cognitive, and social health, with less attention given to psychiatric aspects [13]. Studies on depression in this population often rely on overall assessment scores from rather than detailed analysis of individual items [72, 87, 91-94]. This gap, alongside the variety of existing tools for screening depression in very old age, also motivated the present study.

Notably, one study conducted a detailed item-level analysis using a 14-item version of the GDS in Portuguese centenarians [88] and found that 51.4% reported

Feelings of worthlessness, supporting the relevance of this specific criterion in our e-Delphi study. Additionally, only 12.3% reported having more Memory problems; 43.3% expressed a preference for Staying home instead of going out and doing new things; 39.8% reported Getting bored often; and 33.3% agreed with the statement Thinks most people are better off than they are [88]. Globally, these findings align with our results, where these criteria were considered not relevant in this age group.

While these findings suggest reduced presence of symptoms established for younger populations, it remains unclear whether depression in near-centenarians and centenarians significantly differs from that in other older individuals, such as octogenarians; the key features of depression may not vary meaningfully. Therefore, it is worth questioning whether the development of a tool specifically designed for very old age, including the near-centenarian and centenarian population, is truly necessary. Nevertheless, psychological resources such as resilience appear to be particularly strong in near-centenarians and centenarians [77, 95]. These protective characteristics may lead traditional depression screening tools to overlook subtle signs of depression that are masked by these strengths. A tool specifically designed for this age group could better capture the subtle differences and specific needs, enhancing the accuracy and effectiveness of depression screening.

Duration, number, frequency, and severity of depressive signs and symptoms, and type of assessment

Our findings emphasize the importance of considering the duration, number, frequency, and severity of depressive signs and symptoms in near-centenarians and centenarians. Notably, experts differentiated between chronic and new-onset depression, advocating for a nuanced approach that may significantly impact clinical assessments and interventions. This aligns with existing literature documenting distinct clinical profiles for persistent and non-chronic depressive disorders in adults aged 18-79 [96, 97], with persistent cases often involving earlier onset, more severe symptoms and greater treatment resistance [96]. While these findings are based on younger individuals, they reinforce the necessity of a personalized lifespan approach that includes rigorous screening and comprehensive clinical strategies for the oldest age groups.

Furthermore, experts highlighted the potential value of combining self- and hetero-assessment techniques to screen for depressive signs and symptoms in very old age. However, this approach may require further consideration. Cognitive limitations at this age may affect the reliability of self-reports, complicating the integration with caregiver observations. Developing strategies to reconcile these differing perspectives—such as guidelines for interpreting discrepancies—could ensure assessments are accurate and

sensitive to the unique challenges faced by very old individuals. 'Flexible, combined approaches remain relevant, as research suggests they enhance diagnostic accuracy and patient engagement [98].

Further considerations

Given the findings of our study, a more comprehensive approach to depression screening in near-centenarians and centenarians may be advantageous. The high consensus among experts regarding certain depressive features highlights their relevance and significance for this particular age group. Importantly, the diagnosis of LLD in very old adults can be particularly complex due to overlapping symptoms with other mental or somatic conditions, as previously outlined. This overlap necessitates a differential diagnostic approach that integrates a broader perspective. This emphasizes the need for screening tools that are both comprehensive and sensitive to the unique experiences and needs of very old individuals. Implementing such tailored screening methods could contribute to improved mental health outcomes within this population.

Our work extends existing literature by providing a comprehensive overview of a wider range of depressive features, including considerations of their duration, number, frequency, and severity—factors that are less considered in standard depression screenings. This highlights the complexity of diagnosing depression in very old adults and confirms the necessity of incorporating these specific aspects into the screening process.

While the e-Delphi method is valuable for identifying key elements in detecting depressive signs and symptoms in the oldest old, a separate validation study is necessary to confirm whether the extended screening process would be more effective compared to current tools. Nonetheless, this study hopefully represents a meaningful step forward in improving the detection of depressive signs and symptoms in this population.

Limitations

We acknowledge several limitations. First, despite the international and professional diversity of the expert panel, it may not have captured the full spectrum of clinical practices or cultural perceptions related to aging and depression. The relative overrepresentation of nurses among the panellists in Rounds 1 and 2 may have introduced a bias toward nursing-specific priorities, such as a stronger focus on the practical applicability of screening criteria in daily care. However, this also reflects their pivotal role in direct care for very old individuals, making their insights particularly relevant for developing pragmatic screening criteria. Given this, a 'groupthink' effect, where the dominant profession influenced the consensus, cannot be excluded. Additionally, our panel lacked experts from Asian countries, despite notable recruitment efforts, even

though these regions have some of the highest proportions of centenarians globally. This absence may have introduced a bias toward Western perspectives. At the same time, the concept of depression in very old age may be less clearly defined in some Asian cultures due to cultural background. Second, the selection of a 70% consensus threshold may have influenced the interpretation of results, as it reflects a compromise between inclusivity and stringency, subtly shaping the scope of the consensus achieved. Third, the structured nature of the e-Delphi process may have limited the exploration of nuanced symptoms critical to understanding depression in the very old, a population whose cognitive decline may complicate symptom presentation. Fourth, some overlap between dimensions and criteria was observed, which may be perceived as a limitation to some extent. However, the steering committee was aware of this overlap and intentionally decided to retain it in order to confirm certain trends in consensus around specific items.

Despite these challenges, the study's insights have the potential to stimulate discussions on improving mental health strategies for older populations, especially the very old. The diverse and interdisciplinary composition of the panel further contributes to the generalizability of the findings, offering valuable insights to healthcare professionals and researchers globally.

Future research should aim to develop and validate a screening tool specifically designed for depressive signs and symptoms in very old age, including near-centenarians and centenarians. A validation study comparing the extended method with established tools or a 'gold standard' diagnostic reference is crucial to determining its efficacy. Additionally, it is important to assess the tool's effectiveness across different cultural contexts to ensure its broad applicability. The incorporation of Patient Reported Experience Measures (PREMS) in future developments would also be beneficial in capturing the lived experiences and perceptions of this age group.

Conclusions

This expert consensus could significantly contribute to enhance early detection and intervention for depression in the very old, notably by informing the creation of a new screening tool. Findings have the potential to improve diagnostic accuracy and consequently allow for the personalization of treatment plans tailored to the unique needs of very old individuals.

In conclusion, this study used expert consensus to establish a foundational step towards enhancing the detection and treatment of depression among very old individuals, including near-centenarians and centenarians. The study emphasizes the need for cautious, multidimensional, and multidisciplinary approaches to depression screening in

this age group, advocating for the continuous refinement of screening tools to address the complex nature of very old age effectively.

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Conflicts of Interest

None declared.

Authors' Contributions

Conceptualization: CGdR, AvG, and HV; Methodological input: AvG, PV, and HV; Scientific input: AvG, PV, DSJ, OR, and HV; Data collection and analysis: CGdR; Writing the original draft: CGdR; Reviewing and editing: CGdR, AvG, PV, DSJ, OR, and HV; Supervision: AvG and HV.

Abbreviations

CREDES: Conducting and Reporting Delphi Studies

e-Delphi: electronic Delphi

ICD-11: International Classification of Diseases, 11th Revision

LLD: late-life depression

SD: standard deviation

Multimedia Appendices

Appendix 10: Selected instruments and respective items.

Appendix 11: Decision of the Ethics Committee.

Appendix 12: Graphical overview of the consensus rates (dimensions, criteria and type of assessment).

Appendix 13: Aspects of signs and symptoms of depression (duration, number, frequency, and severity).

Appendix 14: Steering Committee's final determinations.

Appendix 15: Table A. Findings on preferred assessment methods for depression screening criteria.

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CHAPTER 5 – FUNCTIONAL DEPENDENCE AS A PREDICTOR OF DEPRESSIVE SYMPTOMS IN CENTENARIANS

FUNCTIONAL DEPENDENCE AS A PREDICTOR OF DEPRESSIVE SYMPTOMS IN CENTENARIANS

This chapter focuses on an empirical analysis of the phenomena of interest—*depressive symptoms and functional dependence*—conducted with a sample of centenarians participating in the SWISS100 study (Project 2021-02509; Appendix 2). It builds upon the knowledge established in the previous chapters of this doctoral project and represents a key component of its overall contribution.

During the conceptualization of the research that will soon be presented (Article 4), the expected outcomes of the proposed work were clearly defined. The research aimed to describe the epidemiology of depressive symptoms among Switzerland's centenarians living either at home or in nursing homes, as well as their levels of functional dependence. Additionally, it sought to compare depressive symptoms based on centenarians' living environments and to contrast these findings with those observed in 'younger' older adults. Lastly, the research aimed to enhance the understanding of the relationship between depressive symptoms and functional dependence.

The expected outcomes were achieved, and our findings significantly enhance the understanding of depressive symptom prevalence in the local context—and potentially beyond—as well as the impact of functional dependence on mental health in this age group. Indeed, functional dependence was identified as a significant predictor of depressive symptoms in the analysed sample. Moreover, functional dependence appears to play a key mediating role in the relationship between living situation and depressive symptoms, underscoring its importance for mental health (Article 4).

Although the mental health of centenarians remains underexplored [57], despite their growing numbers in the general population, this study represents the first of its kind in Switzerland. We hope it will serve as a valuable resource for healthcare professionals, particularly nurses, by underscoring the importance of this issue for the well-being of the very old and the overall quality and safety of care. Furthermore, we also hope that this work will inform policymakers so that current care models can be adapted to better meet the real needs of this population.

ARTICLE 4

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The role of functional dependence in depressive symptoms among centenarians: Findings from the SWISS100 Study

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ABSTRACT

Objective: To analyse the prevalence of depressive symptoms in centenarians, identify their predictors, and explore the role of functional dependence as a contributing factor.

Design, setting, and participants: Cross-sectional baseline data from the Swiss Centenarian Study ($n = 102$), including community-dwelling and institutionalised participants with complete data on depressive symptoms and functional capacity.

Measurements: Functional capacity was assessed using the Older Americans Resources and Services Multidimensional Functional Assessment Questionnaire. Depressive symptoms were measured with the Geriatric Depression Scale – Short Form. Group differences were analyzed using Chi-squared tests; relationships were examined with correlations. Multiple linear regressions identified predictors. Mediation analysis explored the interplay between functional capacity, living situation, and depressive symptoms.

Results: Functional capacity varied, with basic activities of daily living generally better preserved than instrumental activities. Almost one-fourth of participants screened positive for possible clinical depression, which was significantly more common among institutionalised centenarians ($p < .05$). Health conditions, anxiety, and lower functional capacity were significant predictors of depressive symptoms and together explained 24.7% of the variance, with anxiety being the strongest predictor followed by health conditions and functional capacity. Mediation analysis showed that functional capacity fully mediated the relationship between living situation and depressive symptoms, highlighting its critical role in mental health.

Conclusions: A significant proportion of centenarians screened positive for depression, underscoring the need for greater attention to depressive symptoms and systematic screening. Targeted interventions promoting functional independence may play an important role to prevent depression, and strategies are needed to encourage institutionalised very old individuals to re-develop and maintain a certain level of independence.

Key words: *centenarians; depressive symptoms; functional dependence; mental health, Swiss Centenarian Study*

INTRODUCTION

The world population of centenarians is increasing at an unprecedented rate, from an estimated 96,000 in 1990 to 588,000 by 2024, with projections indicating exponential growth to 3.2 million by 2050 (Robine and Cubaynes, 2017; UN, 2015; 2024). In Europe, the centenarian population is expected to increase from 176,000 in 2024 to 694,000 by 2050 (UN, 2024). In Switzerland, this demographic trend is reflected by an approximate doubling of centenarians every decade from 1950 to 2010, reaching 2,086 by 2023 (OFS, 2024b). This remarkable growth is attributed to increased life expectancy due to better living conditions, healthcare, lifestyle and individual robustness (OECD, 2023; WHO, 2022). With one of the highest life expectancies globally—82.2 years for men and 85.8 years for women—Switzerland faces significant challenges in adapting its healthcare system to meet the needs of a growing ageing population (OFS, 2024a). A key challenge is the increasing duration of morbidity, as healthy life expectancy is not keeping pace with overall life expectancy (Scott, 2021).

In other words, unfortunately, longevity is often accompanied by the onset or exacerbation of multiple health issues (Jopp *et al.*, 2016a). While various studies have been conducted worldwide to better understand the unique characteristics of centenarians, research has primarily focused on physical health. Little is known about their mental health (Cheng *et al.*, 2019; Jopp *et al.*, 2016b) and its potential antecedents and impact on critical aspects of daily life. However, an increase in the prevalence of mental health issues among older adults has been reported by the World Health Organization (WHO, 2023), with depression ranking at the top of the list. Although this psychopathological condition is not a normal aspect of ageing, even in very advanced age, it often remains underdiagnosed and undertreated (Gomes da Rocha *et al.*, 2021; WHO, 2023). Depression has devastating consequences that affect individuals biologically, psychologically, and socially. Clinically, its adverse effects include functional dependence, an increased risk of falls and fractures, malnutrition, exacerbation of chronic health conditions, frailty, higher susceptibility to neurocognitive disorders, heightened burden on informal caregivers, healthcare professionals, and healthcare systems, and premature death (Cheng *et al.*, 2019; Hajek *et al.*, 2021; Reppermund *et al.*, 2021). More specifically, functional dependence can be both a consequence of depression and a contributing factor to its development. Independence plays a vital role in life, particularly in older age, when individuals are more vulnerable in the context of transitions, which tend to accumulate in later life. Older adults undergoing a health/illness transition (e.g., stroke, Parkinson's disease) and/or a situational transition (e.g., widowhood, institutionalisation) that may directly or indirectly lead to functional dependence are at greater risk of experiencing a more difficult transition process (Meleis, 2010). If they are unable to

redefine meaning, adjust expectations, restructure daily routines, and develop new skills, this risk is further heightened, much in line with the Model of Selection, Optimization and Compensation that posits such adjustment strategies as key aspects of successful adaptation to changes in resources across the adult lifespan and ageing (Baltes and Baltes, 1990). Consequently, depending on their physical, psychological, and social resources to confront challenges—particularly resource losses—and adapt, older individuals may either maintain good mental health or manifest depressive symptoms (Freund and Baltes, 2002; Schumacher *et al.*, 2010).

Numerous studies have examined the relationship between functional dependence and depressive symptomatology in older adults. However, only few have focused on centenarians. Recent evidence regarding this age group has identified significant associations between these two phenomena, with some researchers reporting higher prevalence rates of depressive symptoms among centenarians with dependence in activities of daily living and, conversely, higher prevalence rates of dependence in these activities among those with depressive symptoms (Jopp *et al.*, 2016b; Song *et al.*, 2022). Furthermore, functional dependence and depressive symptoms may act as mutual predictive factors (Cimarolli *et al.*, 2018; Jopp *et al.*, 2016b; Ribeiro *et al.*, 2018; Song *et al.*, 2022; Sun *et al.*, 2023), underscoring their bidirectional relationship. Nevertheless, other studies did not find significant associations (Cheung and Lau, 2016; Margrett *et al.*, 2010). These divergencies highlight the need for more research to provide additional evidence on this issue.

A study conducted among nonagenarians and centenarians living in Swiss nursing homes (Mall *et al.*, 2014) revealed that depressive symptoms were the most prevalent neuropsychiatric symptoms (e.g., apathy, anxiety, irritability, sleep disorders), as measured by the Neuropsychiatric Inventory (Kaufer *et al.*, 2000). This finding underscores the importance of understanding whether factors beyond functional dependence, such as the living environment, also contribute to the development of depressive symptoms in centenarians. Other contributors may include physical health, particularly multimorbidity, which has been suggested as a correlate of depressive symptoms (Jopp *et al.*, 2016b), and gender, given well-documented differences in depression occurrence in women and men of all ages. Recent national statistics on potential depression revealed that, in 2022, the prevalence among individuals aged 75 and older was around 8% higher in women (35% vs. 27%) (Obsan, 2019). This pattern suggests a gender effect on mental health in older age, which may also extend to centenarians.

Overall, the population of centenarians has been understudied in Switzerland, with their actual needs remaining largely unexplored. The *Swiss Centenarian Study*

(SWISS100): *Vulnerability and Resilience at Age 100* was developed to address this research gap. One of its main objectives is to identify vulnerability in its various forms, along with its predictors and consequences, including in the domains of mental and functional health (Gomes da Rocha *et al.*, 2024; Jopp *et al.*, 2019). Thus, this work is part of the broader SWISS100 project and aims to advance the understanding of depressive symptoms in centenarians by analysing their prevalence, identifying key predictors, and examining the role of functional dependence as a contributing factor. Specifically, we seek to: (i) Analyse the prevalence and characteristics of depressive symptoms in centenarians, focusing on variations by gender and living situation; (ii) Identify key predictors of depressive symptoms, including functional dependence and physical health; and (iii) Examine the relationship between functional dependence and depressive symptoms, including potential mediating factors.

METHODS

Study design and participants

This study employed a cross-sectional design using a sample drawn from the broader longitudinal SWISS100 study (Jopp *et al.*, 2019). The recruitment strategy for SWISS100 involved obtaining the contact information of all individuals born in 1922 or earlier and residing in the Swiss cantons of Geneva, Vaud, Bern, Basel-City, Zurich, and Ticino from the Federal Statistical Office. From this initial eligible population, centenarians were contacted in random order and invited to participate in the study ($n = 1,114$) via mail and follow-up phone calls, with no exclusion criteria applied. Of these, 277 individuals agreed to participate. The primary reasons for declining participation included lack of interest, finding the study too stressful and health or cognitive issues.

For the present work, we selected participants from the SWISS100 baseline sample who had complete data on depressive symptoms and functional capacity ($n = 102$). As no exclusion criteria were applied, different versions of questionnaires were designed to best match the cognitive capacities of participants, based on their scores on the shortened Mini-Mental State Examination (MMSE; maximum score: 21 points) (Folstein *et al.*, 1975; Holtsberg *et al.*, 1995). Participation levels were categorized as follows: 'total proxy replacement' (shortened MMSE total score: 0–5 points), 'low-capacity participation' (6–9 points), 'intermediate-capacity participation' (10–14 points), and 'full-capacity participation' (15–21 points). As prior work had shown that the cognitive capacity of individuals with reduced MMSE scores was too low for reliable answers on longer questionnaires with items using Likert-like response scales (Knäuper *et al.*, 2016), only individuals with the capacity to provide reliable self-report were presented with such self-

report questionnaires. Consequently, only participants with 'intermediate-capacity' or 'full-capacity' participation levels had complete data on depressive symptoms. Comparisons between those included in the analysis and those entirely replaced by proxies or who participated at the 'low-capacity participation' level (with only a reduced number of depression items) revealed that the participants contributing to the actual study were less likely to be institutionalised, and more likely to have a better cognitive status ($ps < .05$), in line with the sample selection. However, no statistically significant differences were found between the groups regarding age, marital status, educational level, or depressive symptoms ($ps \geq .05$).

Data were collected through face-to-face interviews conducted between September 2022 and December 2023, using interviewer-administered questionnaires.

Measures

Sociodemographic characteristics

Information was gathered on participants' age, gender, marital status, living situation (e.g., private residence or institution), and education level.

Physical health

Physical health measures included a single item on subjective health, assessed using the question '*In general, how would you rate your overall health?*'; responses were recorded using a five-point Likert-type scale (1 = 'poor', 2 = 'fair', 3 = 'good', 4 = 'very good', 5 = 'excellent').

Health conditions were reported using a predefined list of medical conditions, including cardiovascular, metabolic, hepatic, renal, urinary, reproductive, gastrointestinal, respiratory, musculoskeletal, sensory, neurological, and oncological disorders. The total number of health conditions was calculated by summing all reported issues resulting in a total count (max. 26).

Physical pain or discomfort was evaluated with the question '*In general, how often do you suffer from physical pain, aches, soreness, or discomfort?*'; responses were also recorded on a five-point Likert-type scale (1 = 'never', 2 = 'seldom', 3 = 'sometimes', 4 = 'often', 5 = 'always').

Functional health

Functional capacity was assessed using the Older Americans Resources and Services (OARS) Multidimensional Functional Assessment Questionnaire (Fillenbaum, 1988). This instrument evaluates participants' levels of independence in performing seven basic activities of daily living (ADLs), including eating, bathing / showering, and

transferring, as well as seven instrumental activities of daily living (IADLs), such as using the telephone, shopping for essentials, and medication management. Each activity was rated on a three-point scale: 0 = 'unable without help', 1 = 'some help needed', and 2 = 'can do without help'. The scores for ADLs and IADLs were summed separately, resulting in total scores ranging from 0 to 14 for each domain, with higher scores indicating greater functional capacity. An overall functional capacity score was calculated as the sum of the ADLs and IADLs total scores, which ranged from 0 to 28.

Cognition

Cognitive status was assessed using the shortened Mini-Mental State Examination (MMSE) (Folstein *et al.*, 1975), which includes items less likely to be affected by sensory impairments commonly observed in centenarians (Holtsberg *et al.*, 1995), and has been employed in previous studies involving centenarians (Araujo *et al.*, 2016; Jopp *et al.*, 2016b; Ribeiro *et al.*, 2016). This version evaluates orientation (range: 0–10 points), registration (range: 0–3 points), attention (range: 0–5 points), and recall (range: 0–3 points), resulting in a total maximum score of 21 points.

Mental health

Depressive symptoms were measured using the 15-item Geriatric Depression Scale – Short Form (GDS-15) (Sheikh and Yesavage, 1986). Items on the GDS-15 were scored as 1 = 'yes' and 0 = 'no', except for items 1, 5, 7, 11, and 13 (see Table 1), which were reverse-scored (i.e., 1 = 'no' and 0 = 'yes'). The scores were summed (range: 0–15), with higher totals indicating a higher number of depressive symptoms (e.g., feelings of emptiness, hopelessness, and worthlessness). A total score greater than 5 was used as the cutoff to indicate a 'positive screening' result (Greenberg, 2023), suggesting possible clinical depression.

Symptoms of anxiety were assessed using the 5-item Geriatric Anxiety Inventory - Short Form (GAI-SF) (Byrne and Pachana, 2011). Items on the GAI-SF were scored as 1 = 'yes' and 0 = 'no'. The total score was obtained by summing the responses (range: 0–5), with higher scores indicating a greater frequency of anxiety symptoms (e.g., worry and nervousness).

Data Analysis

Descriptive statistics were used to characterize the sample in terms of sociodemographics, physical health, functional capacity, cognition, and mental health. Means, standard deviations, minimum, and maximum values were reported for continuous variables, frequency distributions with percentages for dichotomous or count variables. To

compare prevalences between groups (gender: men vs. women; living situation: private vs. institution) regarding a positive screening for depressive symptoms (GDS-15 total score > 5 points), Chi-squared (χ^2) tests were performed. Relationships between continuous variables were analyzed using Pearson correlations; for dichotomous variables, point-biserial correlations were calculated. To explore whether specific variables explained unique variance in depressive symptomatology, we conducted multiple linear regression analyses with depressive symptoms (GDS-15 score) as the dependent variable. To avoid overpowering the model and to mitigate the risk of Type II errors, only variables that correlated with depressive symptoms at $p < .20$ were included in the regression, ensuring an acceptable case-to-predictor ratio. This significance threshold is considered appropriate in exploratory analyses to avoid prematurely excluding variables that could have predictive value (Bursac *et al.*, 2008). For all analyses, statistical significance was set at $p < .05$. All statistical analyses were performed using IBM SPSS Statistics software, version 29.0 (IBM Corp., 2022).

To better understand the interplay between functional capacity, living situation and depressive symptoms, a simple mediation analysis, following a regression-based approach, was conducted using the PROCESS macro for SPSS, version 4.2 (Hayes, 2022). A bootstrap sampling method (5,000 samples) was employed to estimate indirect effects and calculate bias-corrected 95% confidence intervals.

Ethical considerations

The SWISS100 study was approved by the Cantonal Ethics Committees for Research on Human Beings (Project 2021-02509). Participants received detailed information about the study via an information sheet and a phone call with the research team. The information covered the study's aim, procedures, potential risks and benefits, data confidentiality and data protection, the voluntary nature of participation, withdrawal rights, instructions for participation, and contact details for the research team. Participants who agreed to participate provided written informed consent. All data were coded and securely stored on password-protected institutional servers, in compliance with Swiss data protection regulations. Participants received a symbolic gift valued at 20 Swiss francs in appreciation of their time and efforts.

RESULTS

Sociodemographic characteristics

Most participants were women ($n = 72$; 70.6%), widowed ($n = 82$; 80.4%), and community-dwelling ($n = 69$; 67.6%). Regarding educational level, the 'high

school/vocational high school' category was the most often represented ($n = 33$; 32.3%), with few participants holding a university degree ($n = 13$; 12.7%) (Table 1).

Subjective and Physical health

Most participants ($n = 83$; 81.4%) rated their subjective health as 'good', 'very good' or 'excellent', despite reporting an average of seven health conditions ($M = 7.05$; $SD = 2.54$) suggesting high resilience despite high multimorbidity; two-thirds of the sample ($n = 70$; 68.6%) presented 6 to 12 health conditions. Regarding the perception of physical pain or discomfort, 38 participants (37.3%) reported never experiencing them, while 19 (18.6%) indicated experiencing them 'often' or 'always' (Table 1).

Functional capacity

Approximately one-fifth of the sample achieved the highest ADL score of 14 points ($n = 20$, 19.6%), while only one participant had the lowest score of 0 points ($n = 1$, 1.4%). For IADLs, only 4.9% ($n = 5$) achieved the highest score of 14 points, whereas 17.6% ($n = 18$) presented the lowest score of 0 points. IADLs were considerably more impaired compared to ADLs, with mean scores of 5.80 ($SD = 4.53$) and 10.09 ($SD = 3.66$), respectively (Table 1). The ADL more often reported as difficult ('unable without help') was bathing or showering (45.5%), with difficulties in other ADLs reported by approximately 3% to 17% of the sample. Regarding IADLs, the activities most often reported as difficult ('unable without help') were managing transportation (65%), handling finances (62%), and shopping for essentials (59%). Difficulty with other IADLs was reported by approximately 30% to 45% of the sample.

Cognition and mental health

Regarding cognition, the average score on the shortened MMSE was 16.82 ($SD = 3.09$) suggesting mild cognitive impairment. Regarding mental health, participants reported high overall levels. The mean score for anxiety symptoms was relatively low ($M = 1.19$, $SD = 1.29$, out of 5 points), while the mean score for depressive symptoms was higher ($M = 3.89$, $SD = 2.64$, out of 15 points). The most problematic items were: 'Have you dropped many of your activities and interests?' (yes: $n = 73$; 71.6%), 'Do you prefer to stay at home, rather than going out and doing new things?' (yes: $n = 66$; 64.7%), 'Do you feel full of energy?' (no: $n = 42$; 41.2%), and 'Do you feel pretty worthless the way you are now?' (yes: $n = 36$; 35.3%). Most participants reported being satisfied with their life ($n = 94$; 92.2%), 'in good spirits most of the time' ($n = 94$; 92.2%), and feeling 'happy most of the time' ($n = 92$; 90.2%) (Table 1). Using a GDS-15 cut-off score of > 5 points to indicate a positive screening (Greenberg, 2023; Yesavage *et al.*, 1983), 22.5% of participants ($n =$

23) screened positive for potential depression. Among these, 73.9% ($n = 17$) were women, and 52.2% ($n = 12$) were institutionalised. No statistically significant difference was observed between genders in terms of positive or negative screening ($p > .05$). However, a statistically significant difference was identified based on living situation ($p < .05$), indicating that individuals living in institutions were more likely to screen positive on the GDS-15 compared to those living in private residences.

Table 1. Sociodemographic and health characteristics of the sample ($n = 102$)

	<i>n</i> (%)	<i>M</i> (SD)	Min - Max
Sociodemographics			
Age		101.61 (1.16)	100 – 106
Gender (females)	72 (70.6)		
Marital status			
Single	6 (5.9)		
Married	10 (9.8)		
Separated / divorced	4 (3.9)		
Widowed	82 (80.4)		
Living situation			
Private	69 (67.6)		
Institution	33 (32.4)		
Education			
Primary school / Middle school	28 (27.4)		
Basic professional training / apprenticeship	28 (27.5)		
High school / Vocational high school	33 (32.3)		
University	13 (12.7)		
Physical health			
Subjective health ¹		3.17 (0.88)	1 – 5
Poor / Fair	19 (18.6)		
Good /Very good / Excellent	83 (81.4)		
Number of health conditions ²		7.05 (2.54)	2 – 12
2-5	32 (31.4)		
6-9	47 (46.1)		
10-12	23 (22.5)		
Physical pain or discomfort ³		2.33 (1.34)	1 – 5
Never	38 (37.3)		
Seldom / Sometimes	45 (44.1)		
Often / Always	19 (18.6)		
Functional capacity			
ADLs (OARS)		10.09 (3.66)	0 – 14
Independence	20 (19.6)		
Dependence in 1 ADL	14 (13.7)		
Dependence in 2 to 3 ADLs	38 (37.2)		
Dependence in 4 to 6 ADLs	23 (22.5)		
Total dependence	7 (6.9)		
IADLs (OARS)		5.80 (4.53)	0 – 14
Independence	6 (5.9)		
Dependence in 1 IADL	4 (3.9)		
Dependence in 2 to 3 IADLs	21 (20.5)		
Dependence in 4 to 6 IADLs	40 (39.2)		
Total dependence	31 (30.4)		
Overall functional capacity (ADLs and IADLs)		15.89 (7.58)	1 – 28
Cognition			
Cognitive status ⁴ (shortened MMSE)		16.82 (3.09)	9 – 21
Mental health			
Anxiety symptoms (GAI-SF)		1.19 (1.29)	0 – 5
Depressive symptoms (GDS-15) ⁵		3.89 (2.64)	0 – 11
Are you basically satisfied with your life? ⁶	94 (92.2)		
Have you dropped many of your activities and interests?	73 (71.6)		

Do you feel that your life is empty?	16 (15.7)
Do you often get bored?	12 (11.8)
Are you in good spirits most of the time? ⁶	94 (92.2)
Are you afraid that something bad is going to happen to you?	23 (22.5)
Do you feel happy most of the time? ⁶	92 (90.2)
Do you often feel helpless?	22 (21.6)
Do you prefer to stay at home, rather than going out and doing new things?	66 (64.7)
Do you feel you have more problems with memory than most?	20 (19.6)
Do you think it is wonderful to be alive now? ⁶	73 (71.6)
Do you feel pretty worthless the way you are now?	36 (35.3)
Do you feel full of energy? ⁶	60 (58.8)
Do you feel that your situation is hopeless?	9 (8.8)
Do you think that most people are better off than you are?	16 (15.7)

ADLs = Basic Activities of Daily Living (*eating; dressing and undressing; grooming (taking care of own appearance); transferring (getting in and out of bed); walking; bathing or showering; using the toilet, including continence*); IADLs = Instrumental Activities of Daily Living (*using the telephone; managing transportation (getting to places out of walking distance); shopping for essentials; preparing meals; managing housekeeping; managing medications; handling finances*); MMSE = Mini-Mental State Examination – shortened (max. 21 points); GAI-SF = Geriatric Anxiety Inventory – Short Form (max. 5 points); GDS-15 = Geriatric Depression Scale – Short Form (max. 15 points).

¹Item used: 'In general, how would you rate your overall health?'; answering options: 1 = poor to 5 = excellent.

²Health conditions were assessed using a list of 26 conditions.

³Item used: 'In general, how often do you suffer from physical pain, aches, soreness or discomfort?'; answering options: 1 = never to 5 = always.

⁴Cognitive status: shortened Mini-Mental State Examination (max. 21 points; Holtsberg, Poon, Noble, & Martin, 1995). Typically, participants with a score ≥ 10 were included in the analysis. However, one participant with a score of 9 was included due to their demonstrated ability to engage beyond the assessed level.

⁵For each GDS-15 item, the reported values correspond to the 'yes' responses.

⁶Items reversed for the calculation of the total GDS-15 score.

Predictors of depressive symptoms

We examined potential predictors of depressive symptomatology, starting with a correlational analysis of the main variables (Table 2). Depressive symptoms (GDS-15) were statistically significantly positively correlated with institutionalisation ($r = 0.20$; $p < .05$), widowhood ($r = 0.21$; $p < .05$), higher number of health conditions ($r = 0.28$; $p < .05$), and symptoms of anxiety (GAI-SF) ($r = 0.28$; $p < .05$). Additionally, they were significantly negatively correlated with subjective health ($r = -0.14$; $p < .20$), ADL ($r = -0.31$; $p < .05$), IADL ($r = -0.30$; $p < .05$), and overall functional capacity (ADLs and IADLs combined) ($r = -0.33$; $p < .001$). In contrast, age ($p > .60$), gender ($p > .85$), education ($p > .95$), physical pain or discomfort ($p > .25$), and cognition ($p > .75$) were not correlated with depressive symptoms.

In the regression analysis, we included only variables as predictors in the regression models which correlated at least at $p < .20$ to avoid overpowering the model (i.e., living situation, widowed, subjective health, health conditions, anxiety, and functional capacity). To prevent multicollinearity due to the strong relationship between ADL and IADL, only the composite score 'overall functional capacity' was used as an indicator of functional health. Table 3 summarizes the results of the regression analysis. The stepwise linear regression indicated that while living situation initially emerged as a significant predictor of depressive symptoms (GDS-15 score) (Model 1; $p < .05$), it became non-

significant when additional variables were included (Models 2, 3, and 4; $p > .05$). Number of health conditions, symptoms of anxiety, and overall functional capacity emerged as significant predictors in the final model (Model 4; $ps < .05$). This model was statistically significant ($F(6, 95) = 5.18, p < .001$) and explained 24.7% of the variance in depressive symptomatology ($R^2 = 0.247$; Table 3). Symptoms of anxiety were the strongest predictor, explaining 4.4% of the unique variance, followed by the number of health conditions (3.7%), and overall functional capacity (3.2%).

Table 2. Correlations between study variables ($n = 102$)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sociodemographics														
1. Age	---													
2. Gender (0 = men, 1 = women)	0.01	---												
3. Living situation (0 = priv, 1 = inst)	0.04	0.22**	---											
4. Widowed (0 = no, 1 = yes)	-0.00	0.22**	0.08	---										
5. Education	-0.05	-0.33***	-0.18*	-0.06	---									
Physical health														
6. Subjective health	0.05	-0.05	-0.13	0.01	0.21**	---								
7. Number of health conditions	0.00	-0.10	-0.01	0.12	0.09	0.06	---							
8. Physical pain or discomfort	-0.13	0.21**	-0.05	0.12	-0.03	-0.15	0.21**	---						
9. ADLs	0.10	-0.24**	-0.41***	-0.20**	0.05	-0.03	-0.21**	-0.05	---					
10. IADLs	-0.03	-0.32***	-0.49***	-0.06	0.17*	0.05	-0.13	-0.04	0.71***	---				
11. Overall functional capacity	0.03	-0.31***	-0.49***	-0.13	0.13	0.02	-0.18*	-0.05	0.91***	0.94***	---			
Cognition														
12. MMSE	0.19*	-0.20**	-0.30**	-0.01	0.20**	-0.03	0.10	0.17*	0.53***	0.56***	0.59***	---		
Mental health														
13. Anxiety symptoms (GAI-SF)	-0.08	-0.01	0.12	-0.13	-0.09	-0.24**	0.13	0.05	-0.19*	-0.10	-0.15	-0.20**	---	
14. Depressive symptoms (GDS-15)	-0.05	0.01	0.20**	0.21**	-0.00	-0.14	0.28**	0.11	-0.31**	-0.30**	-0.33***	-0.03	0.28**	---

Living situation: priv = private, inst = institution. ADLs = Basic Activities of Daily Living; IADLs = Instrumental Activities of Daily Living; MMSE = Mini-Mental State Examination – shortened (max. 21);

GAI-SF = Geriatric Anxiety Inventory – Short Form; GDS-15 = Geriatric Depression Scale – Short Form.

Higher values indicate higher levels / better functioning (except *Number of health conditions*, *Physical pain or discomfort*, *GAI-SF* and *GDS-15*).

* $p < .10$ (2-tailed); ** $p < .05$ (2-tailed); *** $p \leq .001$ (2-tailed).

Table 3. Linear regression models predicting depressive symptoms ($n = 102$)

	Depressive symptoms (GDS-15)			R^2
	B	B	p	
Model 1				0.038*
Living situation (0 = priv, 1 = inst)	1.10	0.20	0.048*	
Model 2				0.075
Living situation (0 = priv, 1 = inst)	1.02	0.18	0.065	
Widowhood (0 = no, 1 = yes)	1.27	0.19	0.051	
Model 3				0.215**
Living situation (0 = priv, 1 = inst)	0.81	0.14	0.122	
Widowhood (0 = no, 1 = yes)	1.32	0.20	0.034*	
Subjective health	-0.23	-0.08	0.423	
Number of health conditions	0.24	0.23	0.013*	
Anxiety (GAI-SF)	0.50	0.25	0.012*	
Model 4				0.247*
Living situation (0 = priv, 1 = inst)	0.24	0.04	0.688	
Widowhood (0 = no, 1 = yes)	1.20	0.18	0.051	
Subjective health	-0.27	-0.09	0.340	
Number of health conditions	0.21	0.20	0.033*	
Anxiety symptoms (GAI-SF)	0.46	0.22	0.021*	
Overall functional capacity (ADLs/IADLs)	-0.07	-0.21	0.048*	

GDS-15 = Geriatric Depression Scale – Short Form. Living situation: priv = private, inst = institution. GAI-SF = Geriatric Anxiety Inventory – Short Form; ADLs = Basic Activities of Daily Living; IADLs = Instrumental Activities of Daily Living.

* $p < .05$; ** $p < .001$.

We then conducted a mediation analysis to better understand the role of the living situation in the occurrence of depressive symptoms. Although living situation emerged as a predictor of depressive symptoms only before controlling for other variables in the regression analysis, the mediation analysis confirmed its relevance. Thus, the overall functional capacity significantly mediated the relationship between living situation and depressive symptoms. Living in an institution was associated with significantly lower functional capacity ($B = -7.90$, $SE = 1.40$, $p < .001$), which, in turn, predicted higher depressive symptoms ($B = -.11$, $SE = .04$, $p = .006$) (Figure 1). The indirect effect of living situation on depressive symptoms through functional capacity was significant ($B = .84$, $SE = .39$, 95% CI [.19, 1.69], whereas the direct effect of living situation on depressive symptoms became non-significant ($B = .26$, $SE = .61$, $p = .670$) when considering functional capacity. These results suggest that the relationship between living situation and depressive symptoms is fully mediated by overall functional capacity. The effect size (k^2) for the indirect effect was 0.32 (95% CI [.07, .63]), indicating a moderate mediation effect.

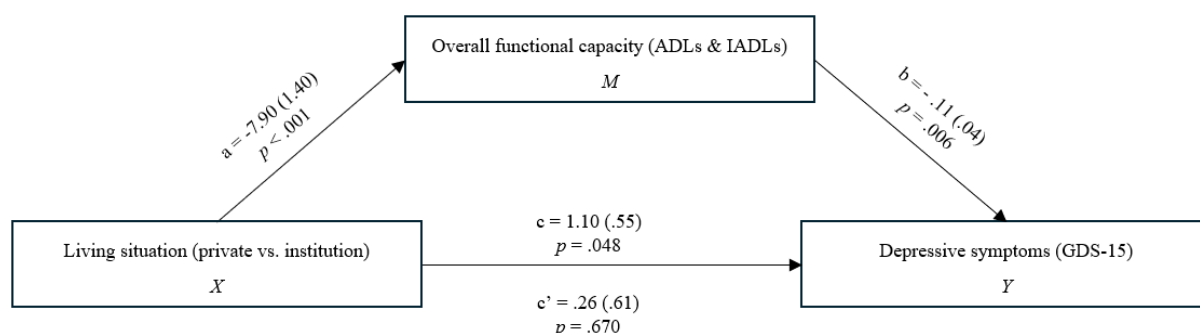


Figure 1: Simple mediation diagram.

Path coefficients a , b , c and c' represent unstandardized regression weights, with standard errors shown in parentheses. The c coefficient reflects the total effect of living situation on depressive symptoms (statistically significant), while the c' coefficient indicates the direct effect of living situation on depressive symptoms after accounting for the mediator—overall functional capacity (not statistically significant).

In addition to overall functional capacity, we tested whether the number of health conditions could also mediate the relationship between living situation and depressive symptoms. However, these analyses showed non-significant results. The indirect effect was small ($B = -.02$, $SE = .17$, 95% CI $[-.37, .30]$), and the confidence interval included zero, indicating that the mediation effect was not statistically significant. This suggests that, in contrast to overall functional capacity, health conditions per se do not mediate the relationship between living situation and depressive symptoms in this sample.

DISCUSSION

The overall goal of this study was to analyse the prevalence of depressive symptoms among centenarians living in Switzerland, to identify key predictors, and to examine the specific role of functional dependence. The findings showed that over 20% of the studied centenarians had depressive symptoms worth considering, with institutionalised individuals more likely to screen positive. Although living situation was initially a significant predictor, its effect became non-significant after controlling for other variables, whereas the number of health conditions, anxiety symptoms, and functional capacity remained significant. Further mediation analysis revealed that living situation indirectly influenced depressive symptoms through overall functional capacity.

Considering overall depressive symptomatology, participants reported an average of four GDS-15 depressive symptoms, which lies below the threshold considered as clinically relevant. This contrasts with recent studies conducted in China, where the pathological threshold of the GDS-15 was exceeded in centenarians (Yao *et al.*, 2018; Zhang *et al.*, 2022). Compared to a European study—culturally closer to Switzerland—that excluded centenarians with cognitive impairment and reported averages within the

normal range, the mean score in our study was observed to be even lower overall (Teixeira *et al.*, 2019).

Nevertheless, it is crucial to highlight that nearly a fourth of the sample screened positive for possible clinical depression, which is a point of concern in the context of mental health for those affected—even though these numbers also indicated that most centenarians showed no heightened depressive symptoms. These findings on centenarians living in Switzerland align with the general trend observed among older adults aged 65 and above living in the country in 2017, where the prevalence of potential depression was estimated between 20% and 28% (Obsan, 2019). These rates increased with age, reaching 27% to 35% for individuals aged 75 and older. At that, since 2012 depressive symptoms are becoming increasingly prevalent among older adults in Switzerland. Whether this is also the case for centenarians is not clear. A systematic review highlighted considerable variation in prevalence rates for potential depression across studies and continents, ranging from 12.8% in Italy to 65% in the United States for near-centenarians and centenarians (Cheng *et al.*, 2019). These differences may be attributed to cultural factors and methodological variations in study design (e.g., different measurement tools, sub-population sampling).

The number of health conditions, anxiety symptoms, and overall functional capacity predicted depressive symptoms in our sample. The study participants presented poor objective health, averaging seven health conditions per individual—higher than reported in previous studies (Araujo *et al.*, 2016; Cheung and Lau, 2016; Jopp *et al.*, 2016b; Pedro *et al.*, 2017). This discrepancy likely stems from the inclusion of prevalent age-related sensory and mobility issues in this study. Nevertheless, health issues can substantially affect mental health, underscoring their role as predictors of depressive symptoms. Pain was significantly associated with depression in older adults (Denkinger *et al.*, 2014), and its prevalence in our sample appeared higher than previously reported (Jopp *et al.*, 2016a). Furthermore, anxiety symptoms emerged as the strongest predictor of depressive symptoms, indicating a close relationship between these mental health issues in our study participants. This was expected, as anxiety and depression are psychiatric conditions that have been shown to be positively correlated in previous centenarian research (Richmond *et al.*, 2011). Anxiety may reduce an individual's coping capacity and contribute to the development or exacerbation of depressive symptoms. While anxiety and depression frequently co-occur in adults, their specific co-existence in centenarians remains under-investigated, although anxiety may be an integral aspect of late-life depression and significantly associated with physical health as centenarians with two or more diseases were approximately five times more likely to experience clinical

anxiety (Ribeiro *et al.*, 2015). This supports the role of both physical health (number of health conditions) and anxiety as predictors of depressive symptoms in our sample.

Functional capacity emerged as a key predictor of depressive symptoms. While participants demonstrated quite high levels of independence in performing ADLs, their ability to manage IADLs was lower, a pattern consistent with findings from recent European studies on centenarians (Araujo *et al.*, 2016; Boerner *et al.*, 2018; Teixeira *et al.*, 2019). Individuals tend to maintain the ability to perform the basic ADLs independently for a longer period, as IADLs require higher levels of physical and cognitive functioning, which are more susceptible to decline with age. Moreover, the finding that institutionalised centenarians were more likely to screen positive for depression compared to those living in private residences highlights the potential impact of living environments in dealing with age-related losses and eventually on mental health (Kato *et al.*, 2016; Margrett *et al.*, 2010). This difference may be attributable to factors such as reduced social interactions, dependency-support behaviours in institutions that may contribute to learned dependence, or the psychological burden associated with institutionalisation (Baltes and Wahl, 1992). However, although previous research has linked institutionalisation to poorer mental health outcomes, including depressive symptoms (Cohen-Mansfield *et al.*, 2013), our findings suggest that depressive symptoms are primarily associated with the higher levels of functional impairments observed among institutionalized individuals rather than the living environment itself. This aligns with previous findings (Uittenhove *et al.*, 2024), which reported that living in an institution was not a significant predictor of depressive symptoms when controlling for other factors, functional capacity included. In Switzerland, institutionalised older adults aged 85 and older tend to exhibit high levels of dependence, with nearly one-third requiring assistance with ADLs and three-quarters with IADLs (Merçay, 2020), and these proportions could be even higher among centenarians (Cohen-Mansfield *et al.*, 2013; Jopp *et al.*, 2016b). Therefore, depressive symptoms in institutionalised centenarians are likely to result primarily from their high levels of functional dependence, which necessitates institutional care to meet their daily support needs, rather than from institutionalisation itself. Thus, preventing functional decline or enhancing functional capacity by fostering independence to the largest degree possible, especially in institutionalised centenarians, appears to be a key strategy for achieving better mental health outcomes in this population. Indeed, care environments may inadvertently follow a ‘dependency-support script’, where caregivers might unintentionally reinforce dependent behaviors while placing less emphasis on promoting independent ones (Baltes *et al.*, 1994). Interventions designed to shift these scripts—by fostering ‘independence-supporting’ behaviors—have provided evidence of increased independent actions among institutionalised individuals. Consequently, providing targeted training and

ongoing support to care teams in implementing such interventions could contribute to preserving or even enhancing residents' functional health, with potential benefits for their mental well-being.

Limitations

Although our findings help reduce the research gap regarding mental and functional health in centenarians in Switzerland, this study has several limitations. First, the selected participants represent only a subsample of the larger SWISS100 study, specifically those with higher cognitive function, and may therefore not fully represent the entire sample. Second, the relatively small sample size in this study may have limited statistical power, reducing the ability to detect relevant but less strong predictors of depressive symptomatology. Additionally, it limited the number of predictors that could be included in the regression model. However, considering the complexity of recruiting this specific age group, our sample size is comparable or larger to that of other studies on centenarians. Third, we used a cross-sectional design, which cannot fully capture the dynamics between depressive symptoms and functional dependence that would instead benefit from longitudinal analysis to better understand their progression over time. Centenarians, particularly those who are more frail, may experience temporary functional decline (e.g., following hospitalization, a fall, or an acute illness). Such events can impact mental health, but once the acute issue is resolved and, if their usual level of independence is regained, depressive symptoms associated with functional dependence may decrease or even disappear, as often observed after critical life events, but mostly studied in younger ages. Therefore, future research on these phenomena should consider analyzing longitudinal data of old and very old individuals.

CONCLUSIONS

Although the centenarians in our sample, on average, were free of marked indicators of depression, reported high levels of subjective health and had relatively preserved cognitive function, nearly one-quarter screened positive for possible depression. This finding underscores that depressive symptoms among centenarians living in Switzerland are not the norm, but are also not uncommon and warrant attention. Functional dependence is a significant and potentially modifiable predictor of depressive symptoms, particularly in institutionalised individuals. This underscores the importance of systematic screening and continuous monitoring of depressive symptomatology, as well as the need for implementation of targeted individual and structural interventions that promote functional independence in the very old—which may play a key role in preventing depression. Exploring ways to encourage this population, especially those who are

institutionalised, to re-develop and maintain a certain level of functional independence is essential. Interdisciplinary collaboration among healthcare professionals—including nurses, geriatricians, old age psychiatrists and psychologists, physical therapists, and activity coordinators—may be crucial in developing and implementing effective strategies to address this important issue.

CONFLICTS OF INTEREST

We have nothing to declare.

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DESCRIPTION OF AUTHORS' ROLES

Conceptualization of the SWISS100 study: DSJ, AvG, SC, and FH; Design of the content of the manuscript: CGdR, AvG, HV, and OR; Data cleaning and analysis: JF, AH, and CGdR; Writing the original draft: CGdR; Reviewing and editing: DSJ, AH, JF, SC, FH, CR, HV, OR, and AvG; Supervision: AvG. All authors read and approved the final manuscript.

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Not applicable.

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During the preparation of this work, the authors used ChatGPT-4® (an AI language model developed by OpenAI) to enhance the language and readability of the paper. Following the use of this tool, the authors reviewed and edited the content as necessary and take full responsibility for the final content of the published article.

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CHAPTER 6 – GENERAL DISCUSSION

GENERAL DISCUSSION

The overall goal of this doctoral project was to advance knowledge on the mental health of centenarians, with a focus on better understanding depressive symptoms in very old age and their relationship with functional dependence. As the findings have been thoroughly discussed in the individual articles that form the core of this work, this chapter will focus on critically synthesizing their key messages and highlighting their implications for nursing practice.

Detecting and managing depressive symptoms in the oldest-old: The crucial role of Nurses

One of the key messages highlighted in Article 1 is the crucial role nurses play in preventing, detecting, treating, and monitoring depressive symptoms in extremely old adults. These professionals, given their proximity to clients and proxies and their presence in diverse settings (e.g., hospitals, rehabilitation centres, long-term care facilities, and home care), are uniquely positioned to enhance the management of this underdetected and undertreated health issue. Their involvement is essential in preventing or mitigating its severe consequences. To achieve this, investment in education, skill development and knowledge transfer is vital, especially in response to the growing needs of an ageing population. The literature highlights training models on depression in older adults that have demonstrated both relevance and effectiveness [46]. Such training also helps boost healthcare professionals' confidence in their skills, which can, in turn, enhance the motivation to improve the quality of care they provide. One key area where nurses should be specifically educated and trained is the implementation and coordination of the Comprehensive Geriatric Assessment (CGA). The CGA is a structured approach designed to identify the medical, psychological, functional, and social problems of older adult patients, while also assessing their resources and evaluating their needs. This multidimensional, interdisciplinary process facilitates the development of a comprehensive, coordinated care plan [76, 77]. In somatic hospital settings, where depressive symptoms may be masked by acute medical conditions and remain largely undetected, the CGA serves as a valuable tool for their early detection, as well as for identifying risks such as functional decline, among others. Equipping nurses with the competencies needed to contribute effectively to CGA can enhance the early detection and management of these complex health issues, ultimately improving patient outcomes.

Enhancing research practices for mental and functional health in centenarians

Our scoping review findings (Article 2) highlighted that research focusing on the mental health of centenarians remains limited overall, in line with previous studies [57]. One contributing factor is the challenge of recruiting very old individuals, particularly those with neurocognitive disorders [78]. However, this population represents a significant proportion of healthcare service users and should be better represented in scientific studies. Identifying strategies to enhance the inclusion of this population in research is essential, as their underrepresentation limits the generalizability of findings. It is important to acknowledge that studying septuagenarians and octogenarians differs significantly from studying near-centenarians and centenarians, and results from the former may not always be generalizable to the latter. Despite this, extrapolations from younger-old populations to centenarians are often made, highlighting the urgent need to address this gap in research. Recent evidence suggests that including proxy relatives as respondents, preferably the centenarians' children, can help ensure data quality and offer a valuable approach to including more vulnerable individuals and those with neurocognitive disorders, thereby reducing sample bias [79].

Additionally, our scoping review (Article 2) showed that among existing studies exploring both depressive symptomatology and functional dependence within the same sample of near-centenarians and centenarians, considerable variability in the prevalence rates of these two issues has been observed globally. While cultural aspects may partly explain this variability, methodological differences in study design must also be considered [57]. For instance, a wide range of instruments was used to screen for depressive symptoms, despite a marked preference for the Geriatric Depression Scale – Short Form (GDS-15). This contributes to the heterogeneity of findings and complicates cross-study comparisons, ultimately affecting conclusions about representative prevalence rates and their impact on functional health. Furthermore, a clear predominance of self-reported instruments was identified. Consequently, the limited use of observer-rated tools may contribute to the underrepresentation of centenarians in research, as previously discussed [78], since it restricts participation to individuals with significant cognitive impairment. Regarding the assessment of functional dependence, the use of a wide range of tools may be less concerning, as functional status is relatively objective (e.g., a person either can or cannot perform transfers without assistance) unlike the assessment of negative emotions. Nevertheless, the use of different instruments can lead to varying scores and interpretations, which also affects the comparison of functional outcomes. Given the relative scarcity of research on these phenomena in centenarians, standardizing measurement practices is all the more important to ensure consistency and comparability, making it a crucial aspect to address. Resources such as the International

Centenarian Consortium (ICC) [80], which brings together researchers from various countries and continents, could play a key role in fostering international reflections on this issue. However, determining the most effective strategy to screen for depressive symptoms in such a heterogeneous population is a significant challenge. This raises the question of whether existing instruments are suitable for centenarians, given that none have been specifically designed and validated for this unique population. Addressing this issue required foundational steps to better identify the most representative signs and symptoms of depression in centenarians, which was the main goal of our modified e-Delphi study (Article 3), discussed in the following sub-chapter.

Challenges and opportunities in depression screening among centenarians

Our modified e-Delphi study (Article 3) found that most depressive features used to screen for depression in the oldest-old—primarily identified in our scoping review (Article 2)—were deemed relevant by an international, interdisciplinary panel of experts. Specifically, 24 out of 28 dimensions and 70 out of 88 criteria were considered important for depression screening. In addition to the dimensions and criteria (e.g., lack of hope, loss of interest in activities, feelings of worthlessness, recurrent thoughts of death or suicide), our study highlighted the importance of also considering the duration, number, frequency, and severity of depressive signs and symptoms. Differentiating between chronic and new episodes of depression also emerged as a key factor, as it can influence both clinical assessment and the choice of interventions. Furthermore, depressive signs and symptoms can be particularly challenging to detect in older adults due to overlaps between depression and dementia, depression and major anxiety disorders, or depression and certain somatic conditions (e.g., chronic pain, endocrine disorders, stroke, Parkinson's disease) [34, 37, 70]. These findings highlight the need for a systematic, multidimensional, lifespan-oriented approach to depression screening among centenarians, reflecting the complexity of this diagnostic process.

However, it remains unclear whether depression in centenarians differs significantly from that in younger older adults. While its core features may not vary substantially between older age groups, centenarians are known to possess particularly strong psychological resources, such as resilience [81, 82], which may make subtle signs of depression harder to detect with traditional screening tools. This underscores the importance of implementing comprehensive screening strategies that are sensitive to the unique experiences and needs of very old individuals. Such an approach is essential to effectively capture the complexity of LLD and improve mental health outcomes within this population.

Nurses, through their expertise in relational care within a holistic approach and their clinical assessment skills—particularly in distinguishing changes related to normal versus pathological ageing—can play a key role in detecting subtle variations in clients' physical, emotional, and cognitive states. Their close and continuous contact with patients and proxy relatives allows them to identify early indicators of depression and facilitate timely interventions in collaboration with old age psychiatrists, geriatricians, and other members of the interdisciplinary team. Moreover, as nurses frequently use screening tools in their clinical practice, their involvement in developing a potential new instrument to screen for depressive signs and symptoms in very old adults could be pivotal. Their practical insights can help ensure that the tool is not only clinically relevant but also reliable, user-friendly, and well-integrated into routine care settings, ultimately enhancing its effectiveness in real-world contexts.

Understanding the role of functional dependence in depressive symptoms among centenarians

Among the mapped studies during our scoping review (Article 2), only a few explored the relationship between depressive symptoms and functional dependence in near-centenarians and centenarians, highlighting a potential association deserving further investigation. However, although centenarians appeared to have relatively high levels of functional dependence in previous research [83-85], this does not necessarily result in a greater prevalence of depressive symptoms. As previously discussed, specific resilience mechanisms may serve as protective factors [81, 82]. Therefore, it was essential to empirically investigate the relationship between these variables using data from a sample of centenarians (Article 4). The aim was to better understand the extent of their association and impact on mental and functional health among the oldest-old, as well as to explore whether other variables (i.e., sociodemographic or health-related) played a role in the development of depressive symptoms. To this end, a subsample was drawn from the broader SWISS100 study (presented in Appendix 1). Depressive symptoms and functional dependence were assessed using the GDS-15 [86] and the Older Americans Resources and Services (OARS) Multidimensional Functional Assessment Questionnaire [87], respectively. These instruments align with the most commonly used measures in studies on near-centenarians and centenarians when exploring these phenomena, as previously outlined in Article 2.

Our findings (Article 4) revealed variability in functional capacity, with centenarians experiencing greater difficulties in IADLs, as only around 6% were fully independent compared to approximately 20% for ADLs. Regarding depressive symptoms, about 23%

screened positive for possible depression, with no gender effect ($p > .05$), but a significant effect of the living environment, as those residing in nursing homes were more likely to screen positive ($p < .05$). Furthermore, functional capacity, along with other predictors such as the number of health conditions and anxiety, explained 24.7% of the variance in depressive symptoms. Interestingly, functional capacity also mediated the relationship between living situation and depressive symptoms, highlighting its key role in the mental health of these individuals. More specifically, this suggests that centenarians living in nursing homes are more likely to develop depressive symptoms not because of institutionalization itself, but rather due to increased functional dependence, which likely contributes significantly to their institutionalization (Article 4). These findings represent an important contribution to the advancement of existing knowledge on this topic and help to reopen the discussion on the critical role of nurses in preventing functional decline and maintaining functional health in very old individuals, including those who are already institutionalized. While their role is central in supporting older individuals to remain at home, it is equally critical in fostering independence among those living in institutional settings, with a significant impact on their quality of life.

Building on this, the work of Baltes and colleagues, mostly published in the 1990s, remains highly relevant today and is particularly significant in addressing this issue. Their observations revealed that independent behaviours in older adults were often met with caregiver responses that inadvertently reinforced dependence rather than promoting independence. Drawing on the concepts of ‘dependency-support’ and ‘independency-ignore’ scripts, these researchers developed an intervention program designed to enhance the independence of older adults by modifying caregiving practices. The program encouraged caregivers to critically reflect on their daily interactions with older individuals, with a focus on identifying and reducing behaviours that unintentionally foster functional dependence. The intervention resulted in a decrease in dependence-supportive behaviours and an increase in independence-supportive behaviours among professional caregivers [88, 89]. The relevance of these findings extends to current nursing practice, particularly in the care of centenarians, whose numbers are steadily increasing in communities and clinical settings. Promoting independence in this population is essential not only for maintaining functional health—a key factor in the quality of life for any individual—but also for supporting mental health and psychological well-being.

Relevance of Transitions Theory in clinical practice and research with centenarians

The Transitions Theory provides a conceptual framework that anchors this thesis within the nursing discipline and guides clinical practice in the care of very old adults, with

the aim of optimizing their mental and functional health. According to this framework, nurses play a central role through their competencies in identifying periods of transition, encompassing various types and patterns. They implement targeted interventions to promote healthy transition processes, which can be monitored using process indicators such as minimal symptoms, optimal functional status, and feelings of connectedness [50].

Given that advanced old age is associated with multiple transitions, nurses, guided by the assumptions of this theoretical framework, must be able to recognize early signs and symptoms of unhealthy transition processes, such as resisting new meanings, maintaining unrealistic expectations, or avoiding the acquisition of new knowledge [50]. If left unaddressed, these processes may lead to negative outcomes, including depressive symptoms and a decline in functional status [56]. Early detection of these signs enables timely interventions, including strategies such as role supplementation and mobilization of resources [50], to support individuals in restoring a new equilibrium. Figure 5 provides a simple example illustrating how this theoretical framework can inform and guide clinical practice.

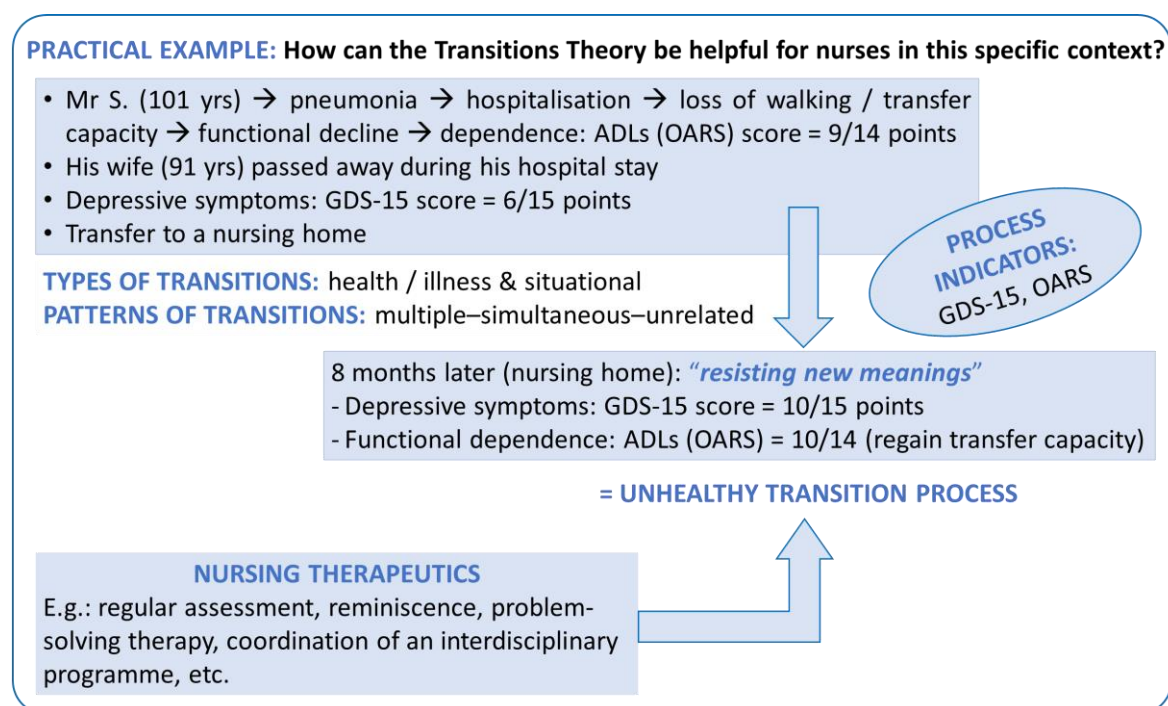


Figure 5: Practical application of the Transitions Theory Framework in Gerontological Nursing

However, traditional care models are well known to focus primarily on health–illness transitions, often neglecting other types of transitions that are equally important in old and very old adults. Transitions Theory offers a comprehensive framework for

understanding a wide range of transitions beyond health–illness, encompassing developmental, situational, and organizational transitions [51]. This is further supported by the work of Coelho and colleagues [90], who recently identified critical gaps in gerontogeriatric nursing, emphasizing that both the literature and clinical practice remain heavily focused on disease management and physical health, with insufficient attention to the broader psychosocial dimensions of ageing. Developmental transitions, such as coping with social isolation, remain underrepresented, potentially compromising the quality of nursing care. These authors [90] advocate for specialized nursing roles that also address developmental transitions, complementing the current focus on health–illness transitions. This shift would support the development of a transformative framework, moving from a fragmented, disease-centred model to a holistic, person-centred approach [90].

In the specific context of our research with centenarians, the Transitions Theory framework provided clear guidance for both the data analysis process and the reporting of results, particularly in Article 4. It highlighted different types of transitions (i.e., developmental, situational, and health/illness-related) experienced by the target population, which were examined as sociodemographic or health-related variables. These transitions included, for example, becoming a centenarian, becoming widowed, adapting to changes in living situation through institutionalization, living with multimorbidity, and becoming functionally dependent. By identifying and analysing these transitions, the framework not only informs research but also provides valuable insights for nursing practice.

In summary, guided by this conceptual framework, nurses can actively support very old adults in moving toward healthy transition processes, positively impacting their mental and functional health and thereby enhancing their quality of life.

CHAPTER 7 – CONCLUSIONS AND FUTURE PERSPECTIVES

CONCLUSIONS AND FUTURE PERSPECTIVES

This chapter presents the main conclusions of this doctoral project and outlines key perspectives for clinical practice, nursing education, and research.

To date, few studies have focused on investigating the mental health of centenarians in general, and even fewer have explored the relationship between depressive symptoms and functional dependence, as well as their potential mutual influence. Existing evidence suggests that while centenarians exhibit a high prevalence of functional dependence, they do not necessarily experience more pronounced depressive symptoms than younger older adults. Protective mechanisms, such as resilience, may contribute to this phenomenon. Nevertheless, the prevalence of depressive symptoms in this age group remains significant across various studies and warrants attention, particularly due to the severe consequences that may arise.

To address this gap, enhancing clinical practices is essential for improving the identification and management of depressive symptoms in this population. In line with this, current screening strategies for depressive symptoms among the oldest-old should be reassessed to ensure their relevance and effectiveness in light of this population's unique characteristics. Depression screening among centenarians requires a comprehensive, multidimensional approach due to the complexity of symptom presentation and the overlap with other conditions. Differentiating between chronic and new episodes, while considering factors such as symptom duration, frequency, and severity, is deemed central for accurate assessment.

In this context, nurses play a pivotal role through their clinical expertise and close contact with very old clients, which enables them to detect subtle signs and symptoms of depression and contribute to timely interventions. Their involvement is also key to preventing functional decline and promoting independence, both in community and institutional settings, which can positively impact centenarians' mental health and psychological well-being. Moreover, should a new screening tool be developed and validated for this population, nurses' practical insights would be essential to ensure its clinical relevance and feasibility in routine healthcare across different settings.

Findings from this thesis further highlight that in a sample of centenarians living in Switzerland, functional dependence appeared to play a significant role in their mental health, with greater dependence associated with an increased risk of depressive symptoms, particularly among those living in nursing homes. Furthermore, caregiving practices that support independent behaviours, rather than inadvertently reinforcing dependence, remain crucial for enhancing both functional and mental health outcomes in this population.

Framing these findings conceptually, the Transitions Theory provided a valuable framework for this thesis, guiding both data analysis and the interpretation of findings related to mental and functional health among near-centenarians and centenarians. It underscores the pivotal role of nurses in identifying and supporting various types of transitions—developmental, situational, health/illness-related, and organizational—through the recognition of unhealthy transition processes and the mobilisation of targeted interventions. By addressing these transitions beyond the traditional focus on disease management, nurses have a better chance of positively impacting very old adults' mental well-being, functional health, and overall quality of life.

In conclusion, we believe that the scientific outputs of this doctoral project provide meaningful opportunities to strengthen nursing roles in supporting the mental health of the oldest-old. The findings encourage further reflection on nursing leadership in coordinating interdisciplinary teams and highlight the discipline's contribution to collaborative care and interdisciplinary health research on very old adults. Building on these insights, implications for clinical practice, nursing education, and research have been established and are presented in Table 1.

Table 1: Key considerations and future perspectives of the doctoral project

What was already known about this topic?
• Most studies have primarily focused on the physical health of centenarians, with limited attention to their mental health, particularly depressive symptoms. • Depressive symptoms and functional dependence are common in older adults, yet their specific impact and interrelationship in near-centenarians and centenarians remain largely unexplored. • The prevalence of depressive symptoms in centenarians remains unclear, with significant variations across studies and a lack of data from Switzerland. • Depressive symptoms in very old adults are often underdiagnosed and undertreated, and commonly used screening tools were not specifically designed for this population. • Depressive symptoms are linked to severe bio-psycho-social-spiritual consequences, significantly affecting functional independence and overall well-being in old and very old adults.
What did this doctoral project add?
• Mapped existing research on depressive symptoms and functional dependence in near-centenarians and centenarians, identifying geographical disparities, methodological gaps, and confirming the lack of Swiss data. • Expanded knowledge on depressive symptoms in centenarians, particularly their relationship with functional dependence. • Provided new evidence that centenarians, despite high levels of functional dependence, do not necessarily experience more pronounced depressive symptoms than younger older adults, suggesting protective mechanisms. • Developed expert consensus on key features of depressive symptoms in centenarians, laying the groundwork for an adapted screening tool tailored to this population. • Demonstrated that functional dependence is a significant predictor of depressive symptoms in a sample of centenarians from Switzerland and highlighted how caregiving practices can either support independence or inadvertently reinforce dependence. • Emphasized the critical role of nurses in identifying, preventing, and managing depressive symptoms in very old adults, advocating for their stronger involvement in promoting mental well-being.

Implications for clinical practice

- Prevention and early detection of depressive symptoms: Systematic screening using validated, standardized tools tailored to this population should become a standard component of nursing assessments across care settings.
- Implementing personalized, evidence-based interventions: Nurses must be equipped to implement individualized, holistic care interventions that address centenarians' specific mental health needs and promote functional independence.
- Strengthening mental health advocacy: Nurses should take leadership roles in improving mental health care policies within nursing homes and other care settings, ensuring that depression prevention, screening, and monitoring are recognized as priorities.
- Enhancing interdisciplinary collaboration: Active coordination of interdisciplinary care plans is essential to ensure comprehensive care that integrates medical, psychological, and social support.
- Expanding the role of advanced practice nurses (APNs): APNs should be integrated into healthcare staff caring for very old adults to provide clinical leadership within intra- and interdisciplinary teams, advocate for policy changes, and implement innovative care models.
- Integrating Transitions Theory into nursing practice: This theoretical framework can guide nursing practice by enhancing person-centred geriatric care, considering not only health-illness transitions but also developmental and situational ones, thus moving beyond traditional biomedical models.

Implications for nursing education

- Strengthening geriatric mental health education: Undergraduate and postgraduate nursing programs should enhance evidence-based education on geriatric mental health, ensuring that nurses develop the knowledge and skills to prevent, assess, and manage depressive symptoms in very old adults.
- Integrating depression screening tools: Nursing education, from the undergraduate to postgraduate level, should incorporate validated depression screening instruments into clinical assessments, equipping nurses to identify depressive symptoms across various care settings accurately.
- Enhancing clinical training: Nursing curricula should integrate simulation-based learning and real-world clinical experiences in geriatric and old age psychiatric settings to strengthen nurses' confidence and competence in mental health assessment and intervention.
- Expanding advanced nursing education: Postgraduate nursing programs should offer specialized training in old age psychiatry to prepare more APNs with expertise in this field.
- Enhancing implementation science training for APNs: Postgraduate nursing programs should integrate implementation science education into APN training, equipping clinical leaders with the skills to translate evidence into practice, overcome barriers to implementation, and drive innovation in healthcare.

Implications for future research

- Advancing qualitative research: Qualitative methods can help explain the significant prevalence rates of depressive symptoms observed in quantitative studies, providing deeper insight into the lived experiences behind the numbers. Additionally, qualitative studies are needed to explore the underlying experiences, contextual factors, and barriers to effective mental health care.
- Conducting longitudinal studies: Longitudinal designs are essential for capturing the evolution of depressive symptoms over time, considering the impact of life events and transitions (e.g., multimorbidity, institutionalization, functional decline) in very old adults.
- Exploring protective mechanisms: Investigating protective factors that mitigate the onset or progression of depressive symptoms is essential for gaining insights into targeted prevention strategies (e.g., resilience mechanisms).
- Developing a new screening tool: A screening instrument specifically designed for very old adults could better capture subtle signs of depression and age-related nuances, enhancing its clinical utility. However, a validation study is needed to determine whether a more comprehensive screening approach improves the accuracy and effectiveness of depression detection compared to existing tools.

DECLARATION OF AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this thesis, the candidate used DeepL Pro®, a neural machine translation service, and ChatGPT-4®, an AI language model developed by OpenAI, to assist with language refinement and readability improvements. The intellectual content, critical analysis, and original contributions remain solely the work of the candidate.

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APPENDIX 1

APPENDIX 1: Overview of the SWISS100 Study (with English translation)

Les Centenaires: Pourquoi s'y Intéresser? Aperçu de l'Étude SWISS100



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Le vieillissement démographique est un sujet à impact majeur et aux enjeux multiples dans le domaine de la santé. Cependant, une moindre attention est accordée à un groupe spécifique: les centenaires. Cette population en rapide expansion nécessite une compréhension approfondie de ses caractéristiques uniques et il est important que les professionnels de la santé soient sensibilisés à ces particularités, étant donné leurs interactions croissantes avec ce groupe d'âge.

Demographic ageing is a subject with a major impact and multiple challenges in the healthcare field. However, less attention is paid to one specific group: centenarians. This rapidly expanding population requires an in-depth understanding of its unique characteristics, and it is important for healthcare professionals to be aware of these particularities, given their increasing interactions with this age group.

Keywords: ageing, centenarians, WHO, Gérontologie SWISS 100,

<https://wp.unil.ch/swiss100/fr/>

Selon les Nations Unies [1], le nombre de personnes âgées de 100 ans ou plus dans le monde s'élevait à un demi-million en 2015, avec des projections à 3,4 millions en 2050 et de plus de 25 millions en 2100. La Suisse suit cette tendance mondiale. D'après l'Office fédéral de la statistique [2], le pays comptait 2086 centenaires au 31 décembre 2023, comparé à seulement 787 en 2000. Cette augmentation remarquable peut être attribuée à une convergence de facteurs, dont les avancées médicales et l'amélioration de la qualité de vie. Il est reconnu que les progrès dans la gestion des maladies chroniques et la prévention jouent un rôle crucial, tout comme les facteurs liés aux modes de vie et à la robustesse individuelle, particulièrement chez les personnes atteignant un âge avancé. Ces développements soulèvent des questions cruciales sur les politiques sociales, les infrastructures de soins, et le soutien nécessaire aux personnes très âgées.

Plusieurs études sur les centenaires ont été réalisées: elles contribuent à enrichir notre compréhension des caractéristiques particulières de cette population. Des résultats de la Fordham Centenarian Study [3], réalisée à New York en 2010 ont mis en évidence qu'une majorité des centenaires vivait à domicile, était veuve et possédait un niveau d'éducation élevé. La plupart des participants maintenait de bonnes capacités cognitives et une perception positive de leur santé, malgré la présence de comorbidités. Bien que confrontés à des difficultés dans au moins une activité de la vie quotidienne, la satisfaction de vivre demeurait élevée. De plus, la majorité d'entre eux présentait des niveaux de symptômes dépressifs inférieurs aux seuils critiques, malgré un risque d'isolement social. Les facteurs contribuant positivement à leur bien-être mental incluaient la santé subjective, les capacités fonctionnelles et le soutien familial, tandis que les caractéristiques démographiques, le nombre de comorbidités et le statut cognitif n'affectaient pas significativement leur santé mentale. Ces résultats suggèrent que les centenaires font preuve de résilience: en effet, malgré la présence de comorbidités et de défis fonctionnels, nombre d'entre eux maintient un niveau élevé de bien-être mental [3]. Ces constats mettent en lumière le "paradoxe du bien-être" qui se manifeste au sein de cette population. Être atteint de maladies et dépendant sur le plan fonctionnel à 100 ans ne se traduit pas forcément par une évaluation négative de sa propre santé. Cet écart entre les indicateurs objectifs et subjectifs témoigne de l'aptitude des centenaires à s'adapter et souligne également l'importance des ressources personnelles dans la gestion de leur santé [4].

Les enfants jouent un rôle central dans le soutien des centenaires, les aidant à rester à domicile malgré des problèmes de santé [5].

Alors que, ceux sans enfants semblent recevoir moins d'aide, même en présence d'amis ou de voisins [6]. Ces centenaires dépendent souvent d'un nombre limité de personnes lorsqu'ils ont des besoins élevés en aide, les rendant plus vulnérables [7]. Le fardeau des aidants des centenaires est un aspect important, avec des répercussions sur leur santé physique et mentale [8]. Une étude comparative entre les États-Unis et le Japon a révélé que le fardeau des aidants des centenaires était significativement influencé par la personnalité de ces derniers [9]. Aux États-Unis, le névrosisme augmentait le fardeau perçu, tandis que l'agréabilité et la conscienciosité le réduisaient. Au Japon, l'ouverture à l'expérience et l'agréabilité diminuaient également le fardeau perçu [9]. Malgré le risque de fardeau, l'évidence scientifique indique que les enfants septuagénaires ayant au moins un parent centenaire présentent des niveaux fonctionnel et cognitif supérieurs, ainsi qu'une prévalence moindre de certaines maladies (AVC, HTA, entre autres) [10].

En outre, il est important de noter que la diversité observée parmi les centenaires découle largement des processus de sélection qu'ils ont surmonté, de leur environnements physique et social, ainsi que de leurs caractéristiques personnelles telles que le sexe, ce qui influence leur parcours individuel en matière de santé et crée des besoins variés [11]. Une approche globale de la santé des centenaires doit tenir compte de cette diversité et de ses déterminants multiples.

L'étude des centenaires en Suisse est d'autant plus pertinente qu'il s'agit de l'un des pays ayant l'espérance de vie et la qualité de vie les plus élevées. L'identification des facteurs favorisant le "vieillesse réussie" permettrait d'approfondir notre compréhension du grand âge et de fournir des orientations à l'échelle nationale et internationale pour faire face aux défis liés à l'augmentation rapide du nombre de personnes très âgées [12].

Toutefois, en Suisse, la population centenaire a été peu étudiée, et les besoins spécifiques de ces personnes restent largement inexplorés. C'est de cette lacune que naît la Swiss Centenarian Study (SWISS100): Vulnerability and Resilience at Age 100 [12, 13], financée par le Fonds national suisse (FNS) de la recherche scientifique. L'étude SWISS100 [12, 13], première étude nationale sur les centenaires, adopte une approche interdisciplinaire en intégrant les domaines de la médecine somatique, de la psychiatrie, de la psychologie, de la sociologie et de la biologie. Elle inclut des centenaires des trois principales régions linguistiques, avec des équipes de recherche à Lausanne et Genève, Zurich et Manno au Tessin, afin d'explorer les spécificités culturelles. Les objectifs de l'étude

SUJET PRINCIPALE



Fig. 1: Madame D., 101 ans, participante de l'étude SWISS100 du canton de Vaud
Photographe: Jos Schmid



Fig. 2: Madame S., 102 ans, participante de l'étude SWISS100 du canton de Vaud
Photographe: Jos Schmid

SWISS100 sont: (1) la création d'une base de connaissances exhaustive sur les caractéristiques, les conditions de vie, les ressources et les besoins des centenaires vivant en Suisse; (2) l'identification de la vulnérabilité dans ses différentes formes, de ses prédicteurs et de ses conséquences; (3) la découverte des mécanismes de résilience qui permettent de faire face à la vulnérabilité; et (4) l'analyse de l'impact des caractéristiques sociétales et culturelles sur la vie des centenaires en Suisse, en comparaison avec d'autres pays et entre les régions linguistiques suisses [13].

Le projet SWISS100 a débuté en janvier 2020, juste avant que l'Organisation mondiale de la santé ne déclare une urgence de santé publique mondiale en raison de la propagation du virus SARS-CoV-2. Pour s'adapter à la situation sanitaire, une première étude téléphonique a été lancée, permettant le recrutement aléatoire de centenaires et de leurs proches dans tous les cantons suisses, sans mettre en danger ces individus potentiellement vulnérables. Cette phase exploratoire, conduite de décembre 2020 à juin 2022, avait pour but de tester la faisabilité de cette approche, d'évaluer la pertinence des questions pour l'étude principale (entretiens face-à-face), et d'identifier les ajustements nécessaires. L'exercice s'est avéré très satisfaisant sur le plan de la faisabilité. Les données recueillies auprès de 169 centenaires ou de leurs proches comprenaient des informations sociodémographiques, des données sur la santé, le réseau social, le bien-être, les émotions, et la présence de symptômes dépressifs. L'âge moyen des participants était de 102 ans; 75% étaient des femmes, 76% étaient veufs, et 64% résidaient dans un établissement médico-social (EMS) [14]. Parmi les 36% habitant à domicile, la moitié vivait seule [14]. La majorité des participants (56%) évaluait sa santé comme bonne, très bonne ou excellente, et presque tous (92%) exprimaient une satisfaction de vie élevée [14]. Le niveau de satisfaction de vie était supérieur en comparaison avec les résultats des études précédentes [3,5], ce qui pourrait refléter une réaction spécifique au contexte de la pandémie de COVID-19. Cette situation a pu favoriser des processus de comparaison particuliers, incitant les centenaires à augmenter leur évaluation personnelle. Il a également été observé que les centenaires résidant en EMS présentaient un risque significativement plus élevé de développer des symptômes dépressifs pendant la pandémie [15].

L'étude principale de SWISS100, de type longitudinal, a débuté en septembre 2022 dans six cantons suisses (Vaud, Genève, Zurich,

Berne, Bâle-Ville et Tessin). L'échantillon initial, sélectionné de manière aléatoire, est composé de 276 centenaires, répartis de manière équitable dans les trois régions linguistiques. Actuellement, la troisième vague de collecte des données est en cours, ce qui permettra d'étudier les trajectoires des centenaires sur une période de 12 mois. Cette étude a visé une collecte des données plus exhaustive sur les aspects socio-démographiques, de soins, de santé physique et fonctionnelle, de cognition, ainsi que divers aspects psychologiques et psychiatriques. Des échantillons biologiques, comprenant l'identification de marqueurs d'inflammation et cardio-métaboliques, sont prélevés auprès des centenaires consentants. L'analyse des données est prévue en 2024, et les résultats seront diffusés à travers des publications scientifiques et des participations à des conférences nationales et internationales.

En conclusion, le projet SWISS100 vise à enrichir notre compréhension du vieillissement en Suisse grâce à une approche interdisciplinaire unique. En explorant le grand âge sous divers angles, ce projet ouvre de nouvelles perspectives sur les défis de la longévité extrême. Cette approche pourrait contribuer à la conception de modèles de services de santé et de politiques publiques adaptés, répondant ainsi aux besoins spécifiques des personnes très âgées et de leurs proches.

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- Falciola J. Les centenaires en Suisse: résultats de l'étude SWISS100. Présentée au: 1er Congrès National Focus Vieillesse de Pro Senectute Suisse; 2024 Jan 18; Bienne, Suisse.
- Gomes da Rocha C, von Gunten A, Falciola J, Uittenhove K, Cavalli S, Herrmann F, Martin M, Jopp D. Depressive Symptoms in Centenarians During the Covid-19 Pandemic: Findings From the SWISS100 Study. *Innovation in Aging*. 2023 Dec;7(Supplement_1):276-277. <https://doi.org/10.1093/geroni/igad104.0919>

ENGLISH TRANSLATION

Centenarians: Why Should We Take an Interest?

Overview of the SWISS100 Study

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2. Institute of Biomedical Sciences Abel Salazar (ICBAS), University of Porto, Porto.
3. School of Health Sciences, HES-SO Valais-Wallis, Sion.
4. Institute of Psychology, University of Lausanne (UNIL), Lausanne.
5. Swiss Centre of Expertise in Life Course Research LIVES, University of Lausanne (UNIL), Lausanne.
6. Centre of Competence on Ageing, University of Applied Sciences and Arts of Southern Switzerland (SUPSI), Manno.
7. Department of Rehabilitation and Geriatrics, Trois-Chêne Hospital, Geneva University Hospitals (HUG), Thônex.

Demographic ageing is a subject with a major impact and multiple challenges in the healthcare field. However, less attention is paid to one specific group: centenarians. This rapidly expanding population requires an in-depth understanding of its unique characteristics, and it is important for healthcare professionals to be aware of these particularities, given their increasing interactions with this age group.

Keywords: *ageing, centenarians, WHO, Gerontology SWISS 100*

<https://wp.unil.ch/swiss100/fr/>

Demographic ageing is a major issue with multiple implications in the field of healthcare. However, one specific group receives relatively little attention: centenarians. This rapidly expanding population requires an in-depth understanding of its unique characteristics, and it is essential for healthcare professionals to be aware of these specificities, given their increasing interactions with this age group.

According to the United Nations [1], the number of people aged 100 or older worldwide was estimated at half a million in 2015, with projections reaching 3.4 million by 2050 and over 25 million by 2100. Switzerland follows this global trend. According to the

Federal Statistical Office, the country had 2,086 centenarians as of 31 December 2023 [2], compared to just 787 in 2000 [3]. This remarkable increase can be attributed to a convergence of factors, including medical advances and improved quality of life. Progress in managing chronic diseases and prevention plays a crucial role, as do lifestyle factors and individual robustness, particularly among those reaching an advanced age. These developments raise critical questions regarding social policies, healthcare infrastructure, and the support required for the very old.

Several studies on centenarians have been conducted, contributing to our understanding of the unique characteristics of this population. Findings from the Fordham Centenarian Study [4], carried out in New York in 2010, highlighted that the majority of centenarians lived at home, were widowed, and had a high level of education. Most participants maintained good cognitive abilities and a positive perception of their health despite comorbidities. Although they faced difficulties in at least one activity of daily living, their overall life satisfaction remained high. Additionally, most centenarians exhibited depressive symptoms below critical thresholds, despite a risk of social isolation. Positive contributors to their mental well-being included subjective health, functional capacity, and family support, while demographic characteristics, the number of comorbidities, and cognitive status did not significantly affect their mental health. These results suggest that centenarians demonstrate resilience: despite comorbidities and functional challenges, many maintain a high level of mental well-being [4]. These findings highlight the "well-being paradox" present in this population. Being afflicted with illnesses and functionally dependent at 100 years old does not necessarily equate to a negative self-assessment of health. This discrepancy between objective and subjective indicators reflects centenarians' adaptability and underscores the importance of personal resources in managing their health [5].

Children play a central role in supporting centenarians, helping them remain at home despite health issues [6]. Conversely, those without children tend to receive less support, even if friends or neighbours are present [7]. These centenarians often rely on a limited number of individuals when they have high assistance needs, making them more vulnerable [8]. The burden on centenarians' caregivers is a significant issue, impacting their physical and mental health [9]. A comparative study between the United States and Japan revealed that the caregiving burden for centenarians was significantly influenced by their personality traits [10]. In the United States, neuroticism increased the perceived burden, whereas agreeableness and conscientiousness reduced it. In Japan, openness to experience and agreeableness also decreased the perceived burden [10]. Despite the risk of caregiver burden, scientific evidence suggests that septuagenarian children with at

least one centenarian parent exhibit better functional and cognitive levels and a lower prevalence of certain diseases (such as strokes and hypertension) [11].

Furthermore, it is important to note that the diversity observed among centenarians largely stems from the selection processes they have undergone, their physical and social environments, and personal characteristics such as gender, all of which influence their individual health trajectories and create diverse needs [12]. A comprehensive approach to centenarian health must consider this diversity and its multiple determinants.

The study of centenarians in Switzerland is particularly relevant, as the country boasts one of the highest life expectancies and quality of life levels. Identifying factors that promote 'successful ageing' would enhance our understanding of extreme longevity and provide national and international guidance on addressing the challenges posed by the rapid rise in the very old population [13].

However, in Switzerland, centenarian populations have been relatively understudied, and their specific needs remain largely unexplored. This gap has led to the creation of the Swiss Centenarian Study (SWISS100): Vulnerability and Resilience at Age 100 [13, 14], funded by the Swiss National Science Foundation (SNSF).

The SWISS100 study [13, 14], the first national study on centenarians, takes an interdisciplinary approach by integrating the fields of somatic medicine, psychiatry, psychology, sociology, and biology. It includes centenarians from the three main linguistic regions, with research teams in Lausanne and Geneva, Zurich, and Manno in Ticino, to explore cultural specificities.

The objectives of the SWISS100 study are: (1) to establish a comprehensive knowledge base on the characteristics, living conditions, resources, and needs of centenarians in Switzerland; (2) to identify different forms of vulnerability, their predictors, and their consequences; (3) to explore the resilience mechanisms that help mitigate vulnerability; and (4) to analyse the impact of societal and cultural characteristics on centenarians' lives in Switzerland, comparing them with other countries and between Swiss linguistic regions [14].

The SWISS100 project commenced in January 2020, just before the World Health Organization declared a global public health emergency due to the spread of the SARS-CoV-2 virus. To adapt to the health situation, an initial telephone study was launched, enabling the random recruitment of centenarians and their proxies across all Swiss cantons without endangering these potentially vulnerable individuals. This exploratory phase, conducted from December 2020 to June 2022, aimed to assess the feasibility of this approach, evaluate the relevance of questions for the main study (face-to-face interviews), and identify necessary adjustments. This process proved highly successful in terms of feasibility. Data collected from 169 centenarians or their proxies included

sociodemographic information, health data, social network details, well-being, emotions, and depressive symptoms. The participants' average age was 102 years; 75% were women, 76% were widowed, and 64% resided in a nursing home [15]. Among the 36% living at home, half lived alone [15]. The majority (56%) rated their health as good, very good, or excellent, and almost all (92%) reported high life satisfaction [15]. This satisfaction level was higher than in previous studies [4, 6], possibly reflecting a specific response to the COVID-19 pandemic, which may have influenced centenarians' self-assessments.

In conclusion, the SWISS100 project aims to enhance our understanding of ageing in Switzerland through a unique interdisciplinary approach. By exploring extreme old age from multiple perspectives, this project offers new insights into the challenges of longevity and could contribute to developing health service models and public policies tailored to the specific needs of the very old and their families.

Conflict of interest: The authors have not declared any conflict of interest in relation to this article.

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15. Gomes da Rocha C, von Gunten A, Falciola J, Uittenhove K, Cavalli S, Herrmann F, Martin M, Jopp D. Depressive Symptoms in Centenarians During the Covid-19 Pandemic: Findings From the SWISS100 Study. *Innovation in Aging*. 2023 Dec;7(Supplement_1):276-277. <https://doi.org/10.1093/geroni/igad104.0919>

APPENDIX 2

APPENDIX 2: SWISS100 Ethical Approval from the Cantonal Human Research Ethics Committees



COMMISSION CANTONALE
D'ÉTHIQUE DE LA RECHERCHE
SUR L'ÊTRE HUMAIN

CER-VD

Av. de Chailly 23
1012 Lausanne

Prof. Daniela Jopp
University of Lausanne
Institute of Psychology
Geopolis
1015 Lausanne

Lausanne, le 20/05/2022
Réf. LS/cog/ac

Décision de la Commission cantonale (VD) d'éthique de la recherche sur l'être humain (CER-VD)

Project-ID	2021-02509
Titre du projet	Centenarians in Switzerland (swiss100) : main study
Direction du projet	Prof.Dr. Daniela Jopp
Promoteur	UNIL - Prof.Dr. Daniela Jopp
Commission directrice	Centres
Commission cantonale d'Éthique de la Recherche sur l'être humain Vaud (CER-VD)	• Prof.Dr. Daniela Jopp, University of Lausanne, Lausanne
Commission(s) d'éthique compétente(s)	Centres
GE	• Prof. Dr. François Herrmann, HUG, Hôpital des Trois-Chêne, Geneva
TI	• Prof. Dr. Stefano Cavalli, University of Applied Sciences and Arts of Southern Switzerland, Manno
ZH	• Prof. Dr. Mike Martin, University of Zurich, Zurich

Décision

Prof.Dr. Daniela Jopp, University of Lausanne, Lausanne
Prof. Dr. François Herrmann, HUG, Hôpital des Trois-Chêne, Geneva
Prof. Dr. Stefano Cavalli, University of Applied Sciences and Arts of Southern Switzerland, Manno
Prof. Dr. Mike Martin, University of Zurich, Zurich

- ☒ Autorisation accordée
☐ Autorisation avec charges
☐ En l'état, l'autorisation ne peut pas être accordée
☐ Autorisation non accordée
☐ Non entrée en matière

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N° de réf. de la CER-VD 2021-02509

Prof. Dr. Daniela Jopp

20/05/2022

La décision se base sur les prises de position des commissions d'éthique :

- Commissione etica del cantone Ticino, en date du 16.05.2022 ;
- Kantonale Ethikkommission Zürich, en date du 20.05.2022.

Classification

☒ Projet de recherche au sens de l'ORH

Catégorie : A

☒ recherche sur des personnes

☐ réutilisation du matériel biologique ou des données personnelles liées à la santé

☐ sur des personnes décédées

☐ sur des embryons et des fœtus

☐ avec rayonnements ionisants

Procédure de décision

☐ Procédure ordinaire

☐ Procédure simplifiée

☒ Procédure présidentielle

La Commission certifie se conformer aux principes ICH GCP.

Taxes et émoluments

Déjà facturé

Voies de recours

La présente décision peut faire l'objet d'un recours au Tribunal cantonal, Cour de droit administratif et public. L'acte de recours doit être déposé auprès du Tribunal cantonal dans les **30 jours** suivant la communication de la décision attaquée ; il doit être signé et indiquer les conclusions et motifs du recours. La décision attaquée est jointe au recours. Le cas échéant, ce dernier est accompagné de la procuration du mandataire.

N° de réf. de la CER-VD 2021-02509

Prof. Dr. Daniela Jopp

20/05/2022

Copie pour information à :

- ☒ Commission(s) Commission Cantonale d'éthique de la recherche Genève (CCER)
d'éthique compétente(s) Comitato etico cantonale Ticino
Kantonale Ethikkommission Zürich

☐ Autre(s)

Signature

p.s. Arthur Zuercher, secrétaire général
Prof. Laurent Schild
Vice-président

- Annexes:** -Obligations du requérant
-Signification des décisions possibles
-Liste des documents soumis les 26.12.2021, 30.03.2022, 12.05.2022 et 13.05.2022

Annexes

Obligations du requérant (promoteur ou direction du projet) :

Soumission de documents : les documents modifiés et les nouveaux documents relatifs à l'étude/au projet de recherche sont soumis via le dossier existant. Les documents qui ne sont plus valides sont effacés et remplacés par les nouveaux. Les documents révisés doivent être soumis une fois en mode « suivi des modifications » et une fois en mode « modifications acceptées » (« track changes » et « clean »). Les documents d'information et de consentement ainsi que le protocole doivent être transmis dans un format permettant la recherche (PDF navigable) ou scannés avec une fonction OCR (Optical Character Recognition). Le cas échéant, les documents révisés sont également mis à disposition des autorités compétentes pour approbation.

Remarque : La commission d'éthique compétente examine, dans le cadre du processus d'autorisation, les feuilles d'information et déclarations de consentement dans une des langues officielles suisses : allemand, français ou italien. La commission d'éthique ne fait qu'accuser réception des feuilles d'information et déclarations de consentement écrites dans d'autres langues. Le promoteur ou la direction du projet est responsable de la traduction correcte des documents.

Obligations d'annonce : Les obligations d'annonce (p. ex. d'événements indésirables, d'interruption d'étude) et de soumission pour autorisation des modifications essentielles obligatoires s'appliquent (Ordonnances). Le rapport final est à remettre à la commission d'éthique compétente dans un délai d'une année à compter de la fin ou de l'arrêt de l'étude.

Devoir d'enregistrement : Le promoteur d'un essai clinique doit procéder à l'enregistrement dans un registre primaire reconnu par l'OMS ou dans le registre de la bibliothèque médicale nationale des Etats-Unis d'Amérique (clinicaltrials.gov) puis indiquer le numéro de l'étude sur le portail BASEC. Le transfert des données vers le Swiss National Clinical Trials Portal (SNCTP) est effectué automatiquement suite à l'autorisation de l'étude par la commission d'éthique, sous réserve de l'accord du requérant. Les données relatives à l'essai clinique figurant sur les deux registres sont accessibles au public. Swissethics publie également sur son site des informations sur chaque étude ayant reçu une autorisation, à l'exception des essais cliniques de phase I.

Signification des décisions possibles

Autorisation accordée : L'étude peut commencer selon le plan de recherche accepté. Elle doit être menée dans le cadre des dispositions légales en vigueur. D'autres obligations d'autorisation (Swissmedic/OFSP) doivent être respectées.

Autorisation avec charges : L'étude peut commencer selon le plan de recherche accepté. Elle doit être menée dans le cadre des dispositions légales en vigueur. Les charges doivent être remplies dans un délai de 30 jours. Les documents modifiés seront réévalués en procédure présidentielle. D'autres obligations d'autorisation (Swissmedic/ OFSP) doivent être respectées.

En l'état, l'autorisation ne peut pas être accordée : L'étude ne peut pas commencer. Prière de répondre point par point aux conditions de la commission d'éthique et de nous faire parvenir les documents révisés avec les modifications apparentes et la mention de la date de la nouvelle version.

Autorisation non accordée : L'étude ne peut pas commencer dans sa forme actuelle. Une nouvelle soumission reste possible.

Non entrée en matière : Justification, voir ci-dessus, par exemple la commission d'éthique n'est pas juridiquement compétente pour accorder une autorisation ou l'étude ne nécessite pas d'autorisation.

N° de réf. de la CER-VD 2021-02509

Prof. Dr. Daniela Jopp

20/05/2022

Liste des documents soumis

Prof. Dr. Daniela Jopp, University of Lausanne, Lausanne		
nom du fichier	date du fichier	version
1. Cover Letter		
swiss100-ethics-letter-letterhead-2021-12-20-dsj.docx	21/12/2021	
swiss100-ethics-revision-2022-05-12.docx	12/05/2022	
swiss100-ethics-revision-2022-03-30.docx	30/03/2022	
3. Participant information sheet and informed consent (ICF)		
1-swiss100-infoconsent-centenarian-additional-explanations-fr-v2-track-changes.docx	22/02/2022	2.0
7-swiss100-info-consent-geriatric-proxy-fr-v3-track.docx	03/05/2022	3.0
3-swiss100-info-consent-centenarian-longitudinal-consent-fr-v3-clean.docx	03/05/2022	3.0
4-swiss100-info-consent-centenarian-proxy-fr-v3-clean.docx	03/05/2022	3.0
5-swiss100-info-consent-centenarian-proxy-longitudinal-consent-fr-v3-clean.docx	03/05/2022	3.0
7-swiss100-info-consent-geriatric-proxy-fr-v3-clean.docx	03/05/2022	3.0
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2-swiss100-info-consent-centenarian-fr-v3-clean.docx	26/04/2022	3.0
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3-swiss100-info-consent-centenarian-longitudinal-consent-fr-v3-track.docx	03/05/2022	3.0
2-swiss100-info-consent-centenarian-fr-v3-track.docx	26/04/2022	3.0
5-swiss100-info-consent-centenarian-proxy-longitudinal-consent-fr-v3-track.docx	03/05/2022	3.0
8-swiss100-info-consent-healthy-fr-v3-track.docx	12/05/2022	3.0
6-swiss100-info-consent-geriatric-fr-v3-track.docx	03/05/2022	3.0
8-swiss100-info-consent-healthy-fr-v3-clean.docx	12/05/2022	3.0
4-swiss100-info-consent-centenarian-proxy-fr-v3-track.docx	03/05/2022	3.0
4. Study plan (protocol), signed and dated		
swiss100-ethicsprotocol-2022-03-22-v2-trackchanges.docx	22/03/2022	2.0
swiss100-wet-ink-signature-pages-v2.pdf	22/03/2022	2.0
swiss100-ethicsprotocol-2022-03-22-v2-clean.pdf	22/02/2022	2.0
6. Investigator's CV, dated		
jopp-cv-7-2020-cer.pdf	20/12/2021	
9. Agreement between sponsor/commissioned institution / grant provider or other third parties and the investigator		
convention-d-herbergement-de-donnees-swiss100-final-signed.pdf	21/12/2021	
11. Other documents handed over to study participants		
swiss100-flyer-fr-2021-12-21.pptx	21/12/2021	1.0
mail-healthy-group-fr-v2-trackchanges.docx	22/03/2022	2.0
flyer-healthy-group-fr-v2-clean.docx	22/03/2022	2.0
mail-healthy-group-fr-v2-clean.docx	22/03/2022	2.0
swiss100-letter-centenarians-fr-v2-clean.docx	22/03/2022	2.0
flyer-geriatric-group-fr-v2-trackchanges.docx	22/03/2022	2.0
flyer-healthy-group-fr-v2-trackchanges.docx	22/03/2022	2.0

N° de réf. de la CER-VD 2021-02509

Prof. Dr. Daniela Jopp

20/05/2022

flyer-geriatric-group-fr-v2-clean.docx	22/03/2022	2.0
swiss100-letter-centenarians-fr-v2-trackchanges.docx	22/03/2022	2.0
12. Details on nature and scope/value of compensation for participants		
There is no compensation for the participation in this study		
14. Information on secure handling of biological material and personal data, and in particular on the storage thereof		
swiss100-data-management-plan-2021-12-24.docx	24/12/2021	
39. Miscellaneous / Varia		
appendix3-medical-history-questionnaires-v2-trackchanges.pdf	30/03/2022	2.0
appendix4-sop-swiss100-01-blood-sampling-and-processing-v2-clean.docx	30/03/2022	2.0
appendix4-sop-swiss100-01-blood-sampling-and-processing-v2-trackchanges.docx	30/03/2022	2.0
certificat-vita-swiss100.pdf	01/03/2022	1.0
appendix3-medical-history-questionnaires-v2-clean.pdf	30/03/2022	2.0
appendix2-swiss100-questions-v2-trackchanges.docx	30/03/2022	2.0
appendix2-swiss100-questions-v2-clean.docx	30/03/2022	2.0
appendix1-swiss100-nh-letter-en-2021-12-21.docx	21/12/2021	1.0

Liste des documents soumis pour centres dans la région de la CE Genève

Prof. Dr. François Herrmann, HUG, Hôpital des Trois-Chêne, Geneva		
nom du fichier	date du fichier	version
2. Synopsis of the study plan		
The synopsis for the project's main site is applicable to this site.		
3. Participant information sheet and informed consent (ICF)		
8-swiss100-info-consent-healthy-fr-v3-clean.docx	12/05/2022	3.0
8-swiss100-info-consent-healthy-fr-v3-track.docx	12/05/2022	3.0
6-swiss100-info-consent-geriatric-fr-v3-clean.docx	03/05/2022	3.0
7-swiss100-info-consent-geriatric-proxy-fr-v3-track.docx	03/05/2022	3.0
6-swiss100-info-consent-geriatric-fr-v3-track.docx	03/05/2022	3.0
7-swiss100-info-consent-geriatric-proxy-fr-v3-clean.docx	03/05/2022	3.0
4. Signed study plan or signature page of the study plan		
swiss100-protocol-francois.pdf	22/03/2022	2.0
6. Local Investigator's / Project Leader's CV, dated2		
cv-herrmann.pdf	30/03/2022	
11. Other documents handed over to study participants		
The information / document(s) provided for the main study site also cover this site.		

Liste des documents soumis pour centres dans la région de la CE Ticino

Prof. Dr. Stefano Cavalli, University of Applied Sciences and Arts of Southern Switzerland, Manno		
nom du fichier	date du fichier	version
2. Synopsis of the study plan		
The synopsis for the project's main site is applicable to this site.		
3. Participant information sheet and informed consent (ICF)		
3-swiss100-infoconsent-centenarian-longitudinal-consent-it-v3-clean.docx	03/05/2022	3.0
5-swiss100-infoconsent-proxy-longitudinal-consent-it-v3-track.docx	03/05/2022	3.0
2-swiss100-infoconsent-centenarian-it-v3-track.docx	03/05/2022	3.0
7-swiss100-info-consent-geriatric-proxy-it-v3-clean.docx	03/05/2022	3.0
5-swiss100-infoconsent-proxy-longitudinal-consent-it-v3-clean.docx	03/05/2022	3.0
8-swiss100-info-consent-healthy-it-v3-track.docx	03/05/2022	3.0
8-swiss100-info-consent-healthy-it-v3-clean.docx	03/05/2022	3.0
6-swiss100-info-consent-geriatric-it-v3-track.docx	03/05/2022	3.0
4-swiss100-infoconsent-centenarian-proxy-it-v3-clean.docx	03/05/2022	3.0
6-swiss100-info-consent-geriatric-it-v3-clean.docx	03/05/2022	3.0
4-swiss100-infoconsent-centenarian-proxy-it-v3-track.docx	03/05/2022	3.0
1-swiss100-infoconsent-centenarian-additional-explanations-it-v2-clean.docx	28/03/2022	2.0
2-swiss100-infoconsent-centenarian-it-v3-clean.docx	03/05/2022	3.0
7-swiss100-info-consent-geriatric-proxy-it-v3-track.docx	03/05/2022	3.0
3-swiss100-infoconsent-centenarian-longitudinal-consent-it-v3-track.docx	03/05/2022	3.0
1-swiss100-infoconsent-centenarian-additional-explanations-it-v2-trackchanges.docx	28/03/2022	2.0
4. Signed study plan or signature page of the study plan		
swiss100-protocol-2022-stefano-sig.pdf	22/03/2022	2.0
6. Local Investigator's / Project Leader's CV, dated2		
cv-english-2020-08-12.pdf	20/12/2021	
11. Other documents handed over to study participants		
mail-healthy-group-it-v2-clean.docx	28/03/2022	2.0
flyer-healthy-group-it-v2-trackchanges.docx	28/03/2022	2.0
flyer-geriatric-group-it-v2-trackchanges.docx	28/03/2022	2.0
swiss100-letter-centenarians-it-v2-trackchanges.docx	28/03/2022	2.0
mail-healthy-group-it-v2-trackchanges.docx	28/03/2022	2.0
swiss100-letter-centenarians-it-v2-clean.docx	28/03/2022	2.0
flyer-geriatric-group-it-v2-clean.docx	28/03/2022	2.0
swiss100-flyer-it-2021-11-09-dz-sc.pptx	21/12/2021	1.0
flyer-healthy-group-it-v2-clean.docx	28/03/2022	2.0

Liste des documents soumis pour centres dans la région de la KEK Zürich

Prof. Dr. Mike Martin, University of Zurich, Zurich		
nom du fichier	date du fichier	version
2. Synopsis of the study plan		
The synopsis for the project's main site is applicable to this site.		
3. Participant information sheet and informed consent (ICF)		
4-swiss100-infoconsent-centenarian-proxy-ge-v3.docx	03/05/2022	3.0
6-swiss100-info-consent-geriatric-ge-v3.docx	03/05/2022	3.0
7-swiss100-info-consent-geriatric-proxy-ge-v3-clean.docx	03/05/2022	3.0
1-swiss100-infoconsent-centenarian-additional-explanations-ge-v2-trackchanges.docx	29/03/2022	2.0
5-swiss100-infoconsent-centenarian-proxy-longitudinal-ge-v3-clean.docx	03/05/2022	3.0
7-swiss100-info-consent-geriatric-proxy-ge-v3.docx	03/05/2022	3.0
3-swiss100-infoconsent-centenarian-longitudinal-ge-v3-clean.docx	03/05/2022	3.0
3-swiss100-infoconsent-centenarian-longitudinal-ge-v3.docx	03/05/2022	3.0
5-swiss100-infoconsent-centenarian-proxy-longitudinal-ge-v3.docx	03/05/2022	3.0
8-swiss100-info-consent-healthy-ge-v3-clean.docx	03/05/2022	3.0
4-swiss100-infoconsent-centenarian-proxy-ge-v3-clean.docx	03/05/2022	3.0
1-swiss100-infoconsent-centenarian-additional-explanations-ge-v2-clean.docx	29/03/2022	2.0
2-swiss100-infoconsent-centenarian-ge-v3-clean.docx	03/05/2022	3.0
2-swiss100-infoconsent-centenarian-ge-v3.docx	03/05/2022	3.0
6-swiss100-info-consent-geriatric-ge-v3-clean.docx	03/05/2022	3.0
8-swiss100-info-consent-healthy-ge-v3.docx	03/05/2022	3.0
4. Signed study plan or signature page of the study plan		
signature-protocol-mm-cb.pdf	12/05/2022	2.0
6. Local Investigator's / Project Leader's CV, dated2		
cv-e-7-2020-kurz.pdf	20/12/2021	
11. Other documents handed over to study participants		
swiss100-flyer-ge-2021-11-10-mn-mb-1.pptx	24/12/2021	1.0
mail-healthy-group-ge-v3-track.docx	12/05/2022	3.0
flyer-geriatric-group-ge-v3-track.docx	12/05/2022	3.0
flyer-healthy-group-ge-v3-track.docx	12/05/2022	3.0
swiss100-letter-centenarians-ge-2021-12-21-mn-mb-v3-clean.docx	12/05/2022	3.0
mail-healthy-group-ge-v3-clean.docx	12/05/2022	3.0
flyer-healthy-group-ge-v3-clean.docx	12/05/2022	3.0
swiss100-letter-centenarians-ge-2021-12-21-mn-mb-v3-track.docx	12/05/2022	3.0
flyer-geriatric-group-ge-v3-clean.docx	12/05/2022	3.0

APPENDIX 3

APPENDIX 3: Bibliographic database search strategies

Depressive symptoms and functional dependence in near-centenarians and centenarians: a scoping review / Carla Gomes da Rocha, Armin von Gunten, Joëlle Rosselet Amoussou, Sofia Fernandes, Kim Uittenhove, Daniela S. Jopp, Olga Ribeiro and Henk Verloo

Bibliographic database search strategies

The research strategies were peer reviewed by another information specialist prior to execution.

Embase.com

1246 references found, 28 August 2023

("90 year*" OR "95 year*" OR nonagenarian* OR centenarian* OR supercentenarian* OR "aged 100" OR "100 year*" OR "oldest old*" OR "very old*" OR super-senior*):ab,ti,kw AND ('depression'/exp OR 'depression assessment'/exp OR (depress* OR "mood decline"):ab,ti,kw) AND ('daily life activity'/exp OR 'independent living'/exp OR 'health status'/exp OR 'walking difficulty'/exp OR 'ADL disability'/exp OR 'locomotion'/de OR 'walking'/exp OR 'amputee'/exp OR 'personal autonomy'/de OR 'quality of life'/exp OR 'functional disease'/exp OR 'physical disability'/exp OR 'community living'/exp OR 'physically disabled person'/exp OR ("daily living" OR "daily activit*" OR "daily life" OR "everyday functioning" OR "limitation of activit*" OR independen* OR autonomy OR "aging in place" OR ((physical* OR functional) NEXT/4 (health OR decline OR disab* OR frailty OR activit* OR inactivit* OR parameter* OR impair* OR condition* OR status OR abilit* OR limit* OR incapacit* OR capacit* OR dependenc* OR performance* OR function* OR deficien*)) OR (functional NEXT/3 disorder*) OR mobility OR ambulation OR walking OR locomotion OR "quality of life" OR "life quality" OR "self-rated health"):ab,ti,kw)

Medline ALL Ovid

Ovid MEDLINE(R) ALL 1946 to August 25, 2023

928 references found, 28 August 2023

(Centenarians/ OR Nonagenarians/ OR ("90 year*" OR "95 year*" OR nonagenarian* OR centenarian* OR supercentenarian* OR "aged 100" OR "100 year*" OR "oldest old*" OR "very old*" OR super-senior*).ab,ti,kf.) AND (Depression/ OR exp Depressive Disorder/ OR Patient Health Questionnaire/ OR (depress* OR "mood decline").ab,ti,kf.) AND ("Activities of Daily Living"/ OR "Independent Living"/ OR exp "Health Status"/ OR "Functional Status"/ OR "Quality of Life"/ OR "Mobility Limitation"/ OR "Locomotion"/ OR exp "Walking"/ OR disabled persons/ OR amputees/ OR persons with hearing impairments/ OR visually impaired persons/ OR ("daily living" OR "daily activit*" OR "daily life" OR "everyday functioning" OR "limitation of activit*" OR independen* OR autonomy OR "aging in place" OR ((physical* OR functional) ADJ4 (health OR decline OR disab* OR frailty OR activit* OR inactivit* OR parameter* OR impair* OR condition* OR status OR abilit* OR limit* OR incapacit* OR capacit* OR dependenc* OR performance* OR function* OR deficien*)) OR (functional ADJ3 disorder*) OR mobility OR ambulation OR walking OR locomotion OR "quality of life" OR "life quality" OR "self-rated health").ab,ti,kf.)

CINAHL with Full Text

399 references found, 28 August 2023

(MH "Centenarians" OR MH "Nonagenarians" OR TI ("90 year*" OR "95 year*" OR nonagenarian* OR centenarian* OR supercentenarian* OR "aged 100" OR "100 year*" OR "oldest old*" OR "very old*" OR super-senior*)) OR AB ("90 year*" OR "95 year*" OR nonagenarian* OR centenarian* OR supercentenarian* OR "aged 100" OR "100 year*" OR "oldest old" OR "very old*" OR super-senior*)) AND (MH "Depression+" OR MH "Geriatric Depression Scale" OR TI (depress* OR "mood decline") OR AB (depress* OR "mood decline")) AND (MH "Activities of Daily Living+" OR MH "Quality of Life+" OR MH "Community Living+" OR MH "Health Status+" OR MH "Functional Status" OR MH "Locomotion+" OR MH "Persons with Disabilities" OR MH "Amputees" OR TI ("daily living" OR "daily activit*" OR "daily life" OR "everyday functioning" OR "limitation of activit*" OR independen* OR autonomy OR "aging in place" OR ((physical* OR functional) W3 (health OR decline OR disab* OR frailty OR activit* OR inactivit* OR parameter* OR impair* OR condition* OR status OR abilit* OR limit* OR incapacit* OR capacit* OR dependenc* OR performance* OR function* OR deficien*)) OR (functional W2 disorder*)) OR mobility OR ambulation OR walking OR locomotion OR "quality of life" OR "life quality" OR "self-rated health") OR AB ("daily living" OR "daily activit*" OR "daily life" OR "everyday functioning" OR "limitation of activit*" OR independen* OR autonomy OR "aging in place" OR ((physical* OR functional) W3 (health OR decline OR disab* OR frailty OR activit* OR inactivit* OR parameter* OR impair* OR condition* OR status OR abilit* OR limit* OR incapacit* OR capacit* OR dependenc* OR performance* OR function* OR deficien*)) OR (functional W2 disorder*)) OR mobility OR ambulation OR walking OR locomotion OR "quality of life" OR "life quality" OR "self-rated health"))

APA PsycInfo Ovid

APA PsycInfo 1806 to August Week 3 2023

639 references found, 28 August 2023

("90 year*" OR "95 year*" OR nonagenarian* OR centenarian* OR supercentenarian* OR "aged 100" OR "100 year*" OR "oldest old*" OR "very old*" OR super-senior*).mp. AND (exp affective disorders/ OR "depression (emotion)"/ OR (depress* OR "mood decline").mp.) AND (exp self-care skills/ OR exp health status/ OR functional status/ OR physical mobility/ OR locomotion/ OR walking/ OR gait/ OR physical disorders/ OR ("daily living" OR "daily activit*" OR "daily life" OR "everyday functioning" OR "limitation of activit*" OR independen* OR autonomy OR "aging in place" OR ((physical* OR functional) ADJ4 (health OR decline OR disab* OR frailty OR activit* OR inactivit* OR parameter* OR impair* OR condition* OR status OR abilit* OR limit* OR incapacit* OR capacit* OR dependenc* OR performance* OR function* OR deficien*)) OR (functional ADJ3 disorder*)) OR mobility OR ambulation OR walking OR locomotion OR "quality of life" OR "life quality" OR "self-rated health").mp.)

Web of Science Core Collection

Science Citation Index Expanded (1900-present), Social Sciences Citation Index (1900-present), Arts & Humanities Citation Index (1975-present), Conference Proceedings Citation Index-Science (1990-present), Book Citation Index (2005-present), Emerging Sources Citation Index (2005-present), Current Chemical Reactions and Index Chemicus

Advanced search > More options > Exact search

972 references found, 28 August 2023

TS=((("90 year*" OR "95 year*" OR nonagenarian* OR centenarian* OR supercentenarian* OR "aged 100" OR "100 year*" OR "oldest old*" OR "very old*" OR super-senior*) AND (depress* OR "mood decline") AND ("daily living" OR "daily activit*" OR "daily life" OR "everyday functioning" OR "limitation of activit*" OR independen* OR "autonomy" OR "aging in place" OR ((physical* OR "functional") NEAR/3 ("health" OR "decline" OR disab* OR "frailty" OR activit* OR inactivit* OR parameter* OR impair* OR condition* OR "status" OR abilit* OR limit* OR incapacit* OR capacit* OR dependenc* OR performance* OR function* OR deficien* OR "status"))) OR ("functional" NEAR/2 disorder*) OR "mobility" OR "ambulation" OR "walking" OR "locomotion" OR "quality of life" OR "life quality" OR "self-rated health"))

Cochrane Database of Systematic Reviews Wiley

Issue 8 of 12, August 2023

0 references found, 28 August 2023

((("90 NEXT year*) OR (95 NEXT year*) OR nonagenarian* OR centenarian* OR supercentenarian* OR "aged 100" OR (100 NEXT year*) OR (oldest NEXT old*) OR (very NEXT old*) OR (super NEXT senior*)):ab,ti,kw AND (depress* OR "mood decline"):ab,ti,kw AND ("daily living" OR (daily NEXT activit*) OR "daily life" OR "everyday functioning" OR (limitation NEXT activit*) OR independen* OR autonomy OR "aging in place" OR ((physical* OR functional) NEXT/4 (health OR decline OR disab* OR frailty OR activit* OR inactivit* OR parameter* OR impair* OR condition* OR status OR abilit* OR limit* OR incapacit* OR capacit* OR dependenc* OR performance* OR function* OR deficien*)) OR (functional NEXT/3 disorder*) OR mobility OR ambulation OR walking OR locomotion OR "quality of life" OR "life quality" OR "self rated health"):ab,ti,kw)

Cochrane Central Register of Controlled Trials Wiley

Issue 7 of 12, July 2023

123 references found, 28 August 2023

((("90 NEXT year*) OR (95 NEXT year*) OR nonagenarian* OR centenarian* OR supercentenarian* OR "aged 100" OR (100 NEXT year*) OR (oldest NEXT old*) OR (very NEXT old*) OR (super NEXT senior*)):ab,ti,kw AND (depress* OR "mood decline"):ab,ti,kw AND ("daily living" OR (daily NEXT activit*) OR "daily life" OR "everyday functioning" OR (limitation NEXT activit*) OR independen* OR autonomy OR "aging in place" OR ((physical* OR functional) NEXT/4 (health OR decline OR disab* OR frailty OR activit* OR inactivit* OR parameter* OR impair* OR condition* OR status OR abilit* OR limit* OR incapacit* OR capacit* OR dependenc* OR performance* OR function* OR deficien*)) OR (functional NEXT/3 disorder*) OR mobility OR ambulation OR walking OR locomotion OR "quality of life" OR "life quality" OR "self rated health"):ab,ti,kw)

Additional searches

Google Scholar

<https://scholar.google.com/>

200 references consulted, February 11, 2021

Centenarian depression|"mood decline" "functional dependence"|"functional status"

Dart Europe

<https://www.dart-europe.org/basic-search.php>

8 references found, January 28, 2021

(centenarian* OR supercentenarian*) AND (functional OR functioning)

ProQuest Dissertations & Theses Global (PQDTGlobal)

<https://www.proquest.com/pqdtglobal>

Search options :

- Doctoral dissertations only
- NOFT - Anywhere except full text

(centenarian* OR supercentenarian* OR super-centenarian* OR near-centenarian* OR super-senior*) AND (functional OR functioning)

18 references found, January 28, 2021

(centenarian* OR supercentenarian* OR super-centenarian* OR near-centenarian* OR super-senior*) AND (depressive OR depression* OR mood)

6 references found, January 28, 2021

Open Grey

<http://www.opengrey.eu/>

20 references found, January 29, 2021

centenarian* OR centenaire*

APPENDIX 4

APPENDIX 4: Sources excluded following a full-text review

Abril Chambo VJ, Musitu Ochoa G. A community study on the health of high risk populations: Social, physical and psychological determinants. *Revista de Psicología Social Aplicada*. 2000;10(2):1-25.

Reason for exclusion: Did not meet the inclusion criteria (population).

Aftab A, Lam JA, Thomas ML, Daly R, Lee EE, Jeste DV. Subjective age and its relationships with physical, mental, and cognitive functioning: A cross-sectional study of 1,004 community-dwelling adults across the lifespan. *J Psychiatr Res*. Aug 2022;152:160-166.

Reason for exclusion: Did not meet the inclusion criteria (population).

Almeida OP, Patel H, Velasquez D, et al. Behavioral Activation in Nursing Homes to Treat Depression (BAN-Dep): Results From a Clustered, Randomized, Single-Blinded, Controlled Clinical Trial. *Am J Geriatr Psychiatry*. May 18 2022;18:18.

Reason for exclusion: Did not meet the inclusion criteria (population).

Antoine V, Edy T, Souid M, Barthelemy F, Saint-Jean O. [Concerning: aging, the beginning of dialysis, the beginning of dependence: repercussions on the psychopathology of the very old dialysis patient]. *Nephrologie*. 2004;25(3):83-88.

Reason for exclusion: Did not meet the inclusion criteria (not a research article).

Arosio B, Ostan R, Mari D, et al. Cognitive status in the oldest old and centenarians: a condition crucial for quality of life methodologically difficult to assess. *Mech Ageing Dev*. Jul 2017;165(Pt B):185-194.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Baltes PB, Mayer KU. The Berlin Aging Study: Aging from 70 to 100. *The Berlin Aging Study: Aging from 70 to 100*. New York, NY: Cambridge University Press; US; 1999: xii, 552.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Barak Y, Leitch S, Glue P. The Great Escape. Centenarians' exceptional health. *Aging Clin Exp Res*. Mar 2021;33(3):513-520.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Barnow S, Linden M. [Psychosocial Risk Factors of the Wish to be Dead in the Elderly]. *Fortschr Neurol Psychiatr*. Apr 2002;70(4):185-191.

Reason for exclusion: Did not meet the inclusion criteria (population).

Barnow S, Linden M, Freyberger HJ. The relation between suicidal feelings and mental disorders in the elderly: results from the Berlin Aging Study (BASE). *Psychol Med*. May 2004;34(4):741-746.

Reason for exclusion: Did not meet the inclusion criteria (population).

Bauman A, Merom D, Bull FC, Buchner DM, Fiatarone Singh MA. Updating the Evidence for Physical Activity: Summative Reviews of the Epidemiological Evidence, Prevalence, and Interventions to Promote "Active Aging". *Gerontologist*. Apr 2016;56 Suppl 2:S268-280.

Reason for exclusion: Did not meet the inclusion criteria (population).

Baztán JJ, Pérez Martínez DA, Fernández Alonso M, Aguado Ortego R, Bellando Álvarez G, de la Fuente González AM. Factores pronósticos de recuperación funcional en pacientes muy ancianos con ictus. Estudio de seguimiento al año. *Revista de Neurología*. 2007;44(10):577-583.

Reason for exclusion: Did not meet the inclusion criteria (population).

Bergdahl E, Allard P, Alex L, Lundman B, Gustafson Y. Gender differences in depression among the very old. *Int Psychogeriatr*. Dec 2007;19(6):1125-1140.

Reason for exclusion: Did not meet the inclusion criteria (population).

Bergdahl E, Allard P, Gustafson Y. Depression among the very old with dementia. *Int Psychogeriatr*. Jun 2011;23(5):756-763.

Reason for exclusion: Did not meet the inclusion criteria (population).

Bergdahl E, Gustavsson JM, Kallin K, et al. Depression among the oldest old: the Umea 85+ study. *Int Psychogeriatr*. Dec 2005;17(4):557-575.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Berlau DJ, Corrada MM, Peltz CB, Kawas CH. Disability in the oldest-old: incidence and risk factors in the 90+ study. *Am J Geriatr Psychiatry*. Feb 2012;20(2):159-168.

Reason for exclusion: Did not meet the inclusion criteria (population).

Bishop AJ, Martin P, Randall GK, MacDonald M, Poon L. Exploring Life Satisfaction in Exceptional Old Age: The Mediating Role of Positive and Negative Affect. *Clin Gerontol*. 2012;35(2):105-125.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Blazer D, Burchett B, Service C, George LK. The association of age and depression among the elderly: an epidemiologic exploration. *J Gerontol*. Nov 1991;46(6):M210-215.

Reason for exclusion: Did not meet the inclusion criteria (population).

Blazer DG. Psychiatry and the oldest old. *Am J Psychiatry*. Dec 2000;157(12):1915-1924.

Reason for exclusion: Did not meet the inclusion criteria (population).

Boffelli S, Cassinadri A, Mercurio F, Rozzini R, Trabucchi M. Post hospital sub acute care: A new model of caring through geriatric methodology. *Giornale di Gerontologia*. 2014;62(1):21-28.

Reason for exclusion: Did not meet the inclusion criteria (population).

Brandstetter K, Ahmadi M, O'Connor K, et al. Depression and Frailty in Community Dwelling Octogenarians, Nonagenarians and Centenarians K. Brandstetter¹, M. Ahmadi¹, K. O'Connor¹, L. Evans¹, J. Ceimo¹ D. Coon², and W. Nieri¹ ¹BSHRI Center for Healthy Aging, Sun City, AZ; ²College of Nursing and Health Innovation, AZ State University, Phoenix, AZ. *Journal of the American Geriatrics Society*. Apr 2013;61:S163-S163.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Calderon KS. Making the Connection Between Depression and Activity Levels Among the Oldest-Old. *Activities, Adaptation & Aging*. 2001;25(2):59-73.

Reason for exclusion: Did not meet the inclusion criteria (population).

Cheng, A., Leung, Y., Harrison, F., & Brodaty, H. (2019). The prevalence and predictors of anxiety and depression in near-centenarians and centenarians: a systematic review [Systematic Review]. *International Psychogeriatrics*, 31(11), 1539-1558. <https://doi.org/10.1017/S1041610219000802>

Reason for exclusion: Did not meet the inclusion criteria (concept).

Cho J, Copeland LA, Stock EM, et al. Protective and Risk Factors for 5-Year Survival in the Oldest Veterans: Data from the Veterans Health Administration. *J Am Geriatr Soc*. Jun 2016;64(6):1250-1257.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Cho J, Martin P, Margrett J, MacDonald M, Poon LW, Johnson MA. Cohort comparisons in resources and functioning among centenarians: Findings from the Georgia Centenarian Study. *International Journal of Behavioral Development*. 2012;36(4):271-8.

Reason for exclusion: Did not meet the inclusion criteria (outcome).

Christensen K, McGue M, Petersen I, Jeune B, Vaupel JW. Exceptional longevity does not result in excessive levels of disability. *Proc Natl Acad Sci U S A*. Sep 9 2008;105(36):13274-13279.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Cicconetti P, Tafaro L, Tedeschi G, Tombolillo MT, Marigliano V. [Cardiovascular risk factors and diseases in centenarians]. *Recenti Prog Med*. Dec 2001;92(12):731-734.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Da Rosa GD, Martin P, Margrett J. Functional Capacity and Personality as Predictors of Depressive Symptoms Among Centenarians. *Gerontologist*. Oct 2010;50:103-104.

Reason for exclusion: Did not meet the inclusion criteria (abstract).

Deiana L, Ferrucci L, Pes GM, Carru C, Delitala G, Ganau A, et al. AKEntAnnos. The Sardinia Study of Extreme Longevity. *Aging (Milano)*. 1999;11(3):142-9.

Reason for exclusion: Did not meet the inclusion criteria (outcome).

Demosthenes B Panagiotakos DB, Chrysohoou C, Siassos G, et al. Poster session 3: The secrets of the very elderly: the Ikaria Island study. *European Journal of Cardiovascular Prevention & Rehabilitation*. 2011;18(1_suppl):S67-S91.

Reason for exclusion: Did not meet the inclusion criteria (abstract).

Drageset J, Eide GE, Ranhoff AH. Cancer Diagnosis and Other Risk Factors for Hospitalization in Cognitive Intact Nursing Home Residents: A 5 Years Follow-Up Study. *Psycho-Oncology*. Oct 2014;23:398-399.

Reason for exclusion: Did not meet the inclusion criteria (abstract).

Duarte N, Teixeira L, Ribeiro O, Paul C. Frailty phenotype criteria in centenarians: Findings from the Oporto Centenarian Study. *European Geriatric Medicine*. 2014;5(6):371-6.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Elinge E, Stenvall M, von Heideken Wagert P, Lofgren B, Gustafson Y, Nyberg L. Daily life among the oldest old with and without previous hip fractures. *Scand J Occup Ther*. Jun 2005;12(2):51-58.

Reason for exclusion: Did not meet the inclusion criteria (population).

Etxeberria I, Etxebarria I, Urdaneta E. Profiles in emotional aging: does age matter? *Aging Ment Health*. Oct 2018;22(10):1304-1312.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Fauth EB, Gerstorf D, Ram N, Malmberg B. Comparing changes in late-life depressive symptoms across aging, disablement, and mortality processes. *Dev Psychol*. May 2014;50(5):1584-1593.

Reason for exclusion: Did not meet the inclusion criteria (population).

Ferreira Agreli B, Aparecida Dias F, Dos Santos Ferreira PC, Candida Gomes N, Dos Santos Tavares DM. Functional disability and morbidities among the elderly people, according to socio-demographic conditions and indicative of depression. *Invest Educ Enferm*. Jan 2017;35(1):48-58.

Reason for exclusion: Did not meet the inclusion criteria (population).

Forsell Y, Jorm AF, von Strauss E, Winblad B. Prevalence and correlates of depression in a population of nonagenarians. *Br J Psychiatry*. 1995;167(1):61-4.

Reason for exclusion: Did not meet the inclusion criteria (outcome).

Gondo Y, Hirose N, Arai Y, et al. Contribution of an affect-associated gene to human longevity: prevalence of the long-allele genotype of the serotonin transporter-linked gene in Japanese centenarians. *Mech Ageing Dev*. Nov 2005;126(11):1178-1184.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Hajek A, Brettschneider C, Luhmann D, et al. [Does an Increase in Depressive Symptoms Lead to an Increase in Functional Impairment or vice versa? Results of the AgeCoDe and AgeQualiDe Study]. *Psychiatr Prax.* Apr 2020;47(3):148-153.

Reason for exclusion: Did not meet the inclusion criteria (population).

Hajek A, Brettschneider C, Mallon T, et al. Depressive Symptoms and Frailty Among the Oldest Old: Evidence from a Multicenter Prospective Study. *J Am Med Dir Assoc.* Mar 2021;22(3):577-582 e572.

Reason for exclusion: Did not meet the inclusion criteria (population).

Halaschek-Wiener J, Tindale LC, Collins JA, et al. The Super-Seniors Study: Phenotypic characterization of a healthy 85+ population. *PLoS ONE.* 2018;13(5):e0197578.

Reason for exclusion: Did not meet the inclusion criteria (population).

Hall WJ. Centenarians: metaphor becomes reality. *Arch Intern Med.* Feb 11 2008;168(3):262-263.

Reason for exclusion: Did not meet the inclusion criteria (not a research article).

Han K, Yang S, Jia W, et al. Health-Related Quality of Life and Its Correlation With Depression Among Chinese Centenarians. *Front Public Health.* 2020;8:580757.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Hartvigsen J, Christensen K. Pain in the back and neck are with us until the end: a nationwide interview-based survey of Danish 100-year-olds. *Spine (Phila Pa 1976).* Apr 15 2008;33(8):909-913.

Reason for exclusion: Did not meet the inclusion criteria (concept).

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Reason for exclusion: Did not meet the inclusion criteria (concept).

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Reason for exclusion: Did not meet the inclusion criteria (concept).

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Reason for exclusion: Did not meet the inclusion criteria (concept).

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Reason for exclusion: Did not meet the inclusion criteria (no methods section).

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Reason for exclusion: Did not meet the inclusion criteria (concept).

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Reason for exclusion: Did not meet the inclusion criteria (concept).

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Reason for exclusion: Did not meet the inclusion criteria (concept).

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Reason for exclusion: Did not meet the inclusion criteria (concept).

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Reason for exclusion: Did not meet the inclusion criteria (paper session).

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Reason for exclusion: Did not meet the inclusion criteria (population).

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Reason for exclusion: Did not meet the inclusion criteria (concept).

Wu H, Flaherty J, Dong B, Liu G, Deng J, Zhang Y, et al. Impact of geriatric conditions versus medical diagnoses on ADL disability among nonagenarians and centenarians. *J Aging Health*. 2012;24(8):1298-319.

Reason for exclusion: Did not meet the inclusion criteria (concept).

Wu YG, Zhang GB, Zhang CL, Li ZB. Mental health investigation of people over 100 years old in Bama County. *Journal of Clinical Rehabilitative Tissue Engineering Research*. 2007;11(52):10572-10575.

Reason for exclusion: Did not meet the inclusion criteria (written in Chinese; untranslatable format).

Xu X, Zhao Y, Xia SY, Cui PP, Tang WM, Hu XL, et al. Quality of Life and Its Influencing Factors Among Centenarians in Nanjing, China: A Cross-Sectional Study. *Social Indicators Research*. 2022;160(2-3):735-55.

Reason for exclusion: Did not meet the inclusion criteria (outcome).

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Reason for exclusion: Did not meet the inclusion criteria (concept).

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Reason for exclusion: Did not meet the inclusion criteria (written in Chinese; untranslatable format).

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Reason for exclusion: Did not meet the inclusion criteria (abstract).

Zhang GF, Wang H, Ye GM, Tan CL, Liu GD, Li CF. Abstracts from the Seventh Chinese Congress on Gerontology and Health Industry: Quality of life of longevously people in Zhongxiang City Hubei province.. *J Am Geriatr Soc.* Sep 2018;66 Suppl 3:S443-S514.

Reason for exclusion: Did not meet the inclusion criteria (abstract).

Zhang Y, Xiong Y, Yu Q, Shen S, Chen L, Lei X. The activity of daily living (ADL) subgroups and health impairment among Chinese elderly: a latent profile analysis. *BMC geriatr.* Jan 7 2021;21(1):30.

Reason for exclusion: Did not meet the inclusion criteria (population).

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Reason for exclusion: Did not meet the inclusion criteria (population).

APPENDIX 5

APPENDIX 5: Data extraction instrument

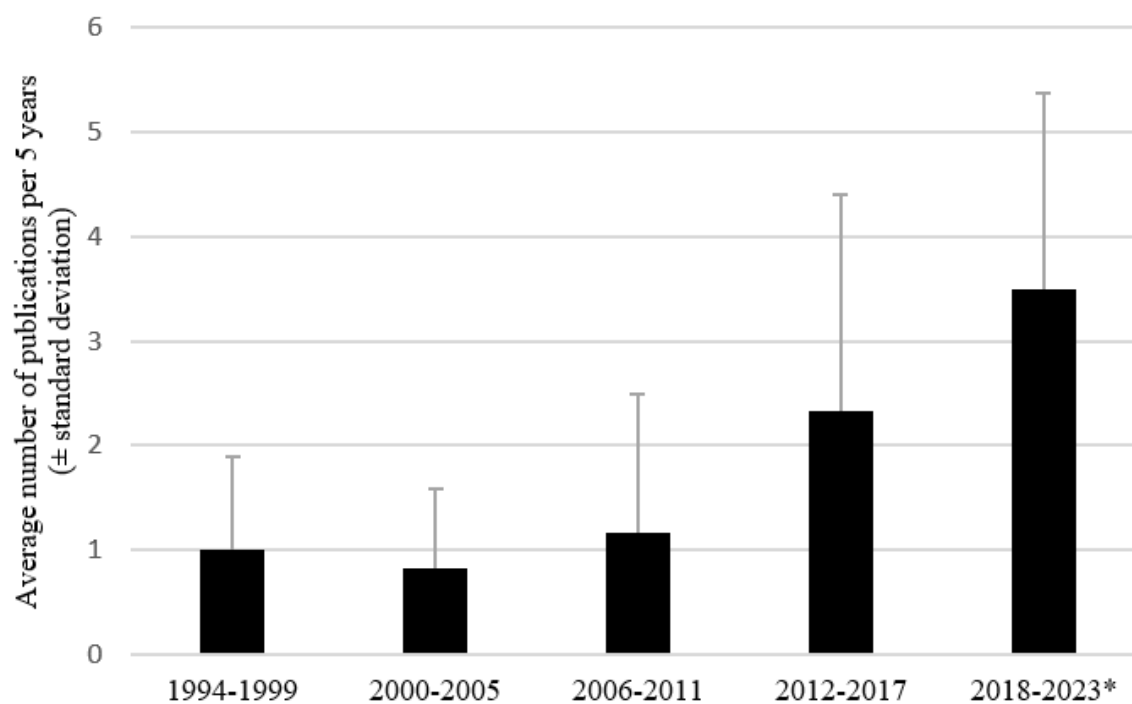
ID	Author(s):	
	Year of publication:	
	Country of origin:	
Methodological aspects (PCC)	Methodological approach (quantitative, qualitative, mixed-methods):	
	Study design:	
	Study aim(s) / research questions(s) / hypothesis:	
	Population:	☐ Near-centenarians (95–99 years old) ☐ Centenarians (≥ 100 years old) ☐ Near-centenarians and centenarians (≥ 95 years old)
	Sample size:	<i>Fill in the relevant options:</i> • General sample: $n =$ _____ • Subsample ≥ 95 years old: $n =$ _____ • Subsample ≥ 95 and ≤ 99 years old: $n =$ _____ • Subsample ≥ 100 years old: $n =$ _____
	Mean or median age / age range:	<i>Fill in the relevant options:</i> • General sample: $\bar{X}$ or Md age = _____ • Subsample ≥ 95 years old: $\bar{X}$ or Md age = _____ • Subsample ≥ 95 and ≤ 99 years old: $\bar{X}$ or Md age = _____ • Subsample ≥ 100 years old: $\bar{X}$ or Md age = _____ • Age range / other: _____
	Context:	☐ Home: _____% ☐ Nursing home or long-term care facility: _____% ☐ Hospital (acute somatic setting): _____% ☐ Hospital (psychiatric setting): _____% ☐ Transitional care unit: _____% ☐ Other: _____%
	Concepts (relating to the phenomena of interest):	
	Instruments / strategies used to screen for depressive symptoms:	
	Is there a medical diagnosis of depression?	☐ Yes ☐ No
	Instruments used to assess functional dependence:	
	Main results	Key findings relating to depressive symptoms:
Key findings relating to functional dependence:		☐ Prevalence rate: _____ ☐ $\bar{X}$ or MED score = _____ ☐ Other: _____
Key findings relating to associations between depressive symptoms and functional dependence		☐ Associations / relationships: _____

Additional comments:

APPENDIX 6

APPENDIX 6: Average number of studies by 5-year publication periods

Average number of studies by 5-year publication periods (n = 53)

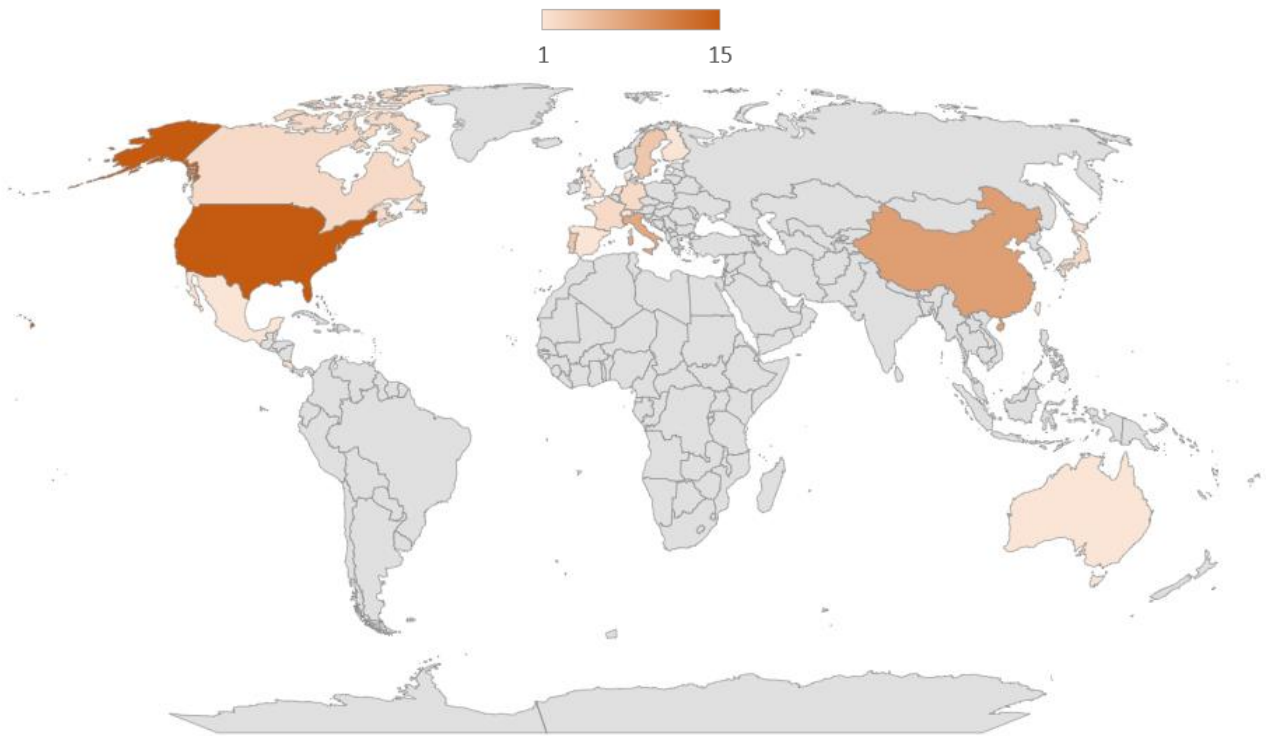


* For the year 2023, only studies published up to August 28th were considered.

APPENDIX 7

APPENDIX 7: Number of studies per country

Number of studies per country* (n = 53)

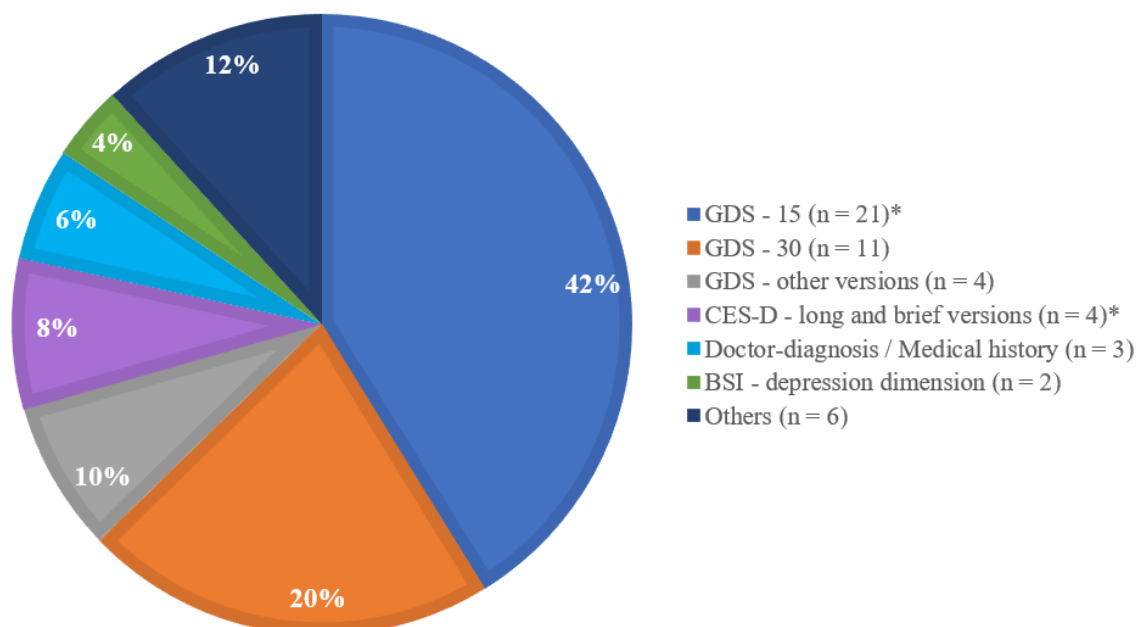


* Three of the retained studies were part of international collaborations; each country involved is represented in the graph (e.g., for a collaboration between Portugal and Germany, both countries are represented).

APPENDIX 8

APPENDIX 8: Identified instruments to screen for depressive symptoms

Identified instruments to screen for depressive symptoms

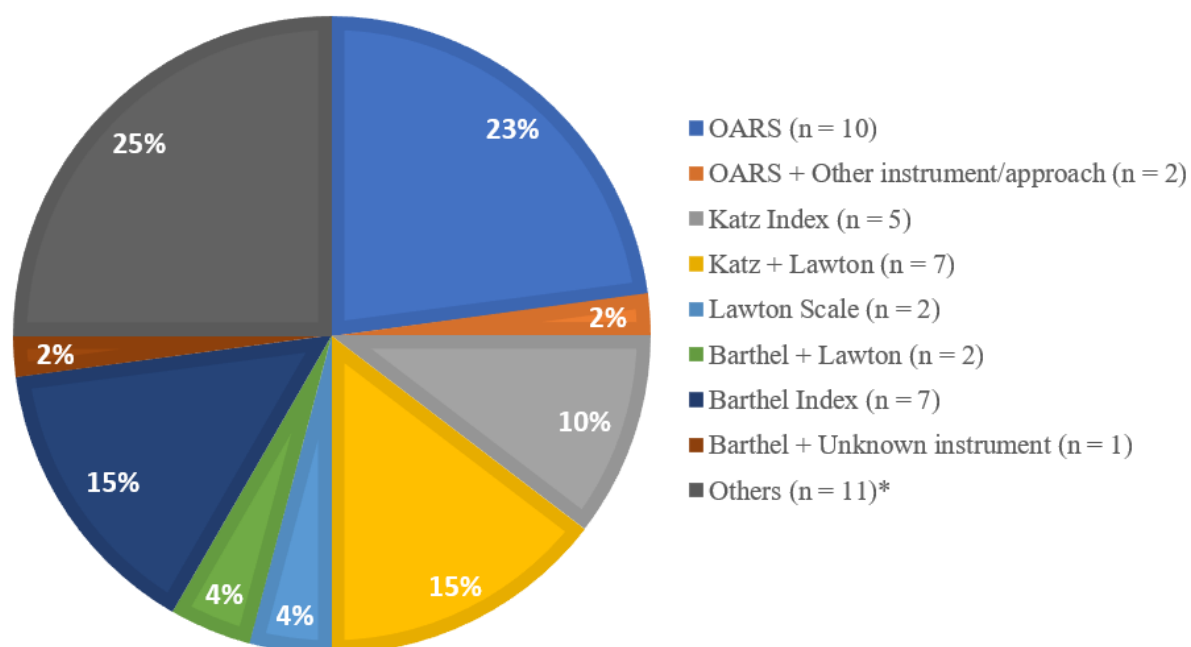


* The total is 102% due to the inclusion of the study by Niimura et al. (2020), which employed both the GDS-15 and the CES-D for screening depressive symptoms, and is therefore counted in both categories. Consequently, the chart represents 51 instances derived from 50 studies.

APPENDIX 9

APPENDIX 9: Identified instruments to assess functional dependence

Identified instruments to assess functional dependence



*Other mapped instruments: The 13-question ADLs module; Cumulative scale (5 ADLs + 4 IADLs); DAFS-IADLs; DAFS-R; ADL-H; ADL-staircase; among others.

Note: Pie chart percentages represent the utilization of instruments either independently or in combination in some cases (e.g., the Katz Index was mapped in 12 (25.0%) different studies: it was used as a single instrument in five (10%), while in seven (15%) it was used in combination with the Lawton Scale).

APPENDIX 10

APPENDIX 10: Selected instruments and respective items

DIAGNOSTIC CRITERIA

- **International Classification of Diseases 11th Revision (ICD-11) criteria [1]**
“A depressive episode is characterised by a period of depressed mood or diminished interest in activities occurring most of the day, nearly every day during a period lasting at least two weeks accompanied by other symptoms such as difficulty concentrating, feelings of worthlessness or excessive or inappropriate guilt, hopelessness, recurrent thoughts of death or suicide, changes in appetite or sleep, psychomotor agitation or retardation, and reduced energy or fatigue.”
 1. Depressed mood [icd_1]
 2. Diminished interest in activities [icd_2]
 3. Concentration difficulties [icd_3]
 4. Feelings of worthlessness [icd_4]
 5. Excessive or inappropriate guilt [icd_5]
 6. Hopelessness [icd_6]
 7. Recurrent thoughts of death or suicide [icd_7]
 8. Changes in appetite [icd_8]
 9. Changes in sleep [icd_9]
 10. Psychomotor agitation or retardation [icd_10]
 11. Reduced energy [icd_11]
 12. Fatigue [icd_12]

- **Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria [2]**
Five or more of the following A criteria (at least one includes A1 or A2):
 - A1. Depressed mood (indicated by subjective report or observation by others) [dsm_a1]
 - A2. Loss of interest or pleasure in almost all activities (indicated by subjective report or observation by others) [dsm_a2]
 - A3. Significant (more than 5% in a month) unintentional weight loss/gain or decrease/increase in appetite [dsm_a3]
 - A4. Sleep disturbance (insomnia or hypersomnia) [dsm_a4]
 - A5. Psychomotor changes (agitation or retardation) severe enough to be observable by others [dsm_a5]
 - A6. Tiredness, fatigue, or low energy, or decreased efficiency with which routine tasks are completed [dsm_a6]
 - A7. A sense of worthlessness or excessive, inappropriate, or delusional guilt (not merely self-reproach or guilt about being sick) [dsm_a7]
 - A8. Impaired ability to think, concentrate, or make decisions (indicated by subjective report or observation by others) [dsm_a8]
 - A9. Recurrent thoughts of death (not just fear of dying), suicidal ideation, or suicide attempts [dsm_a9]
 - Symptoms must persist most of the day, daily, for at least 2 weeks in a row, excluding A3 and A9.

INSTRUMENTS:- **Geriatric Depression Scale – 30 items (GDS-30) [3]**

1. Are you basically satisfied with your life? [gds_1]; 2. Have you dropped many of your activities and interests? [gds_2]; 3. Do you feel that your life is empty? [gds_3]; 4. Do you often get bored? [gds_4]; 5. Are you hopeful about the future? [gds_5]; 6. Are you bothered by thoughts you can't get out of your head? [gds_6]; 7. Are you in good spirits most of the time? [gds_7]; 8. Are you afraid that something bad is going to happen to you? [gds_8]; 9. Do you feel happy most of the time? [gds_9]; 10. Do you often feel helpless? [gds_10]; 11. Do you often get restless and fidgety? [gds_11]; 12. Do you prefer to stay at home, rather than going out and doing new things? [gds_12]; 13. Do you frequently worry about the future? [gds_13]; 14. Do you feel you have more problems with memory than most? [gds_14]; 15. Do you think it is wonderful to be alive now? [gds_15]; 16. Do you often feel downhearted and blue? [gds_16]; 17. Do you feel pretty worthless the way you are now? [gds_17]; 18. Do you worry a lot about the past? [gds_18]; 19. Do you find life very exciting? [gds_19]; 20. Is it hard for you to get started on new projects? [gds_20]; 21. Do you feel full of energy? [gds_21]; 22. Do you feel that your situation is hopeless? [gds_22]; 23. Do you think that most people are better off than you are? [gds_23]; 24. Do you frequently get upset over little things? [gds_24]; 25. Do you frequently feel like crying? [gds_25]; 26. Do you have trouble concentrating? [gds_26]; 27. Do you enjoy getting up in the morning? [gds_27]; 28. Do you prefer to avoid social gatherings? [gds_28]; 29. Is it easy for you to make decisions? [gds_29]; 30. Is your mind as clear as it used to be? [gds_30]

- **Center for Epidemiologic Studies Depression Scale (CES-D) [4]**

1. I was bothered by things that usually don't bother me [ces-d_1]; 2. I did not feel like eating; my appetite was poor [ces-d_2]; 3. I felt that I could not shake off the blues even with help from my family or friends [ces-d_3]; 4. I felt I was just as good as other people [ces-d_4]; 5. I had trouble keeping my mind on what I was doing [ces-d_5]; 6. I felt depressed [ces-d_6]; 7. I felt that everything I did was an effort [ces-d_7]; 8. I felt hopeful about the future [ces-d_8]; 9. I thought my life had been a failure [ces-d_9]; 10. I felt fearful [ces-d_10]; 11. My sleep was restless [ces-d_11]; 12. I was happy [ces-d_12]; 13. I talked less than usual [ces-d_13]; 14. I felt lonely [ces-d_14]; 15. People were unfriendly [ces-d_15]; 16. I enjoyed life [ces-d_16]; 17. I had crying spells [ces-d_17]; 18. I felt sad [ces-d_18]; 19. I felt that people dislike me [ces-d_19]; 20. I could not get "going" [ces-d_20].

- **Brief Symptom Inventory (BSI) [5]**

Depression: items 9-16-17-18-35-50

9. Thoughts of ending your life [bsi_9]
 16. Feeling lonely [bsi_16]
 17. Feeling blue [bsi_17]
 18. Feeling no interest in things [bsi_18]
 35. Feeling hopeless about the future [bsi_35]
 50. Feelings of worthlessness [bsi_50]

- **Hospital Anxiety and Depression Scale (HADS) [6]**

Depression: items 2, 4, 6, 8, 10, 12 and 14.

2. I still enjoy the things I used to enjoy [hads_2]
 4. I can laugh and see the funny side of things [hads_4]

- 6. I feel cheerful [hads_6]
- 8. I feel as if I am slowed down [hads_8]
- 10. I have lost interest in my appearance [hads_10]
- 12. I look forward with enjoyment to things [hads_12]
- 14. I can enjoy a good book or radio or TV program [hads_14]

- **Montgomery-Åsberg Depression Rating Scale (MADRS) [7]**

1. Apparent sadness (Despondency, gloom, and despair (more than just ordinary transient low spirits), reflected in speech, facial expression, and posture; rate by depth and inability to brighten up) [mads_1]; 2. Reported sadness (Reports of depressed mood, regardless of whether it is reflected in appearance or not; includes low spirits, despondency, or the feeling of being beyond help and without hope) [mads_2]; 3. Inner tension (Feelings of ill-defined discomfort, edginess, inner turmoil, mental tension mounting to either panic, dread, or anguish; rate by intensity, frequency, duration, and extent of reassurance called for) [mads_3]; 4. Reduced sleep (Experience of reduced duration or depth of sleep compared to the patient's own normal pattern when well) [mads_4]; 5. Reduced appetite (Feeling of loss of appetite; rate by loss of desire for food or the need to force oneself to eat) [mads_5]; 6. Concentration difficulty (Difficulties in collecting one's thoughts mounting to incapacitating lack of concentration; rate by intensity, frequency, and degree of incapacity produced) [mads_6]; 7. Lassitude (Difficulty getting started or slowness initiating and performing everyday activities) [mads_7]; 8. Inability to feel (Subjective experience of reduced interest in the surroundings or activities that normally give pleasure; the ability to react with adequate emotion to circumstances or people is reduced) [mads_8]; 9. Pessimistic thoughts (Thoughts of guilt, inferiority, self-reproach, sinfulness, remorse, and ruin) [mads_9]; 10. Suicidal thoughts (Feeling that life is not worth living, that a natural death would be welcome, suicidal thoughts, and the preparations for suicide; suicidal attempts should not in themselves influence the rating) [mads_10].

- **Cornell Scale for Depression in Dementia (CSDD) [8]**

- A. Mood-related signs
 - 1. Anxiety (anxious expression, ruminations, worrying) [csdd_a1]
 - 2. Sadness (sad expression, sad voice, tearfulness) [csdd_a2]
 - 3. Lack of reactivity to pleasant events [csdd_a3]
 - 4. Irritability (easily annoyed, short-tempered) [csdd_a4]
- B. Behavioral disturbance
 - 1. Agitation (restlessness, handwringing, hairpulling) [csdd_b1]
 - 2. Retardation (slow movements, slow speech, slow reactions) [csdd_b2]
 - 3. Multiple physical complaints (score 0 if GI symptoms only) [csdd_b3]
 - 4. Loss of interest (less involved in usual activities) (score only if change occurred acutely, i.e., in less than 1 month) [csdd_b4]
- C. Physical signs
 - 1. Appetite loss (eating less than usual) [csdd_c1]
 - 2. Weight loss (score 2 if greater than 5 lb. in one month) [csdd_c2]
 - 3. Lack of energy (fatigues easily, unable to sustain activities) (score only if change occurred acutely, i.e., in less than 1 month) [csdd_c3]
- D. Cyclic functions
 - 1. Diurnal variation of mood (symptoms worse in the morning) [csdd_d1]

2. Difficulty falling asleep (later than usual for this individual) [csdd_d2]
 3. Multiple awakenings during sleep [csdd_d3]
 4. Early-morning awakening (earlier than usual for this individual) [csdd_d4]
 - E. Ideational disturbance
 1. Suicide (feels like is not worth living, has suicidal wishes or makes suicide attempt) [csdd_e1]
 2. Poor self-esteem (self-blame, self-depreciation, feelings of failure) [csdd_e2]
 3. Pessimism (anticipation of the worst) [csdd_e3]
 4. Mood-congruent delusions (delusions of poverty, illness or loss) [csdd_e4]
- **Neuropsychiatric Inventory (NPI)—Depression section** [9, 10]
 Does the patient seem sad or depressed? Does he/she say that he/she feels sad or depressed? (*if yes, proceed to subquestions*): [npi_gen]
1. Does the patient have periods of tearfulness or sobbing that seem to indicate sadness? [npi_1]
 2. Does the patient say or act as if he/she is sad or in low spirits? [npi_2]
 3. Does the patient put him/herself down or say that he/she feels like a failure? [npi_3]
 4. Does the patient say that he/she is a bad person or deserves to be punished? [npi_4]
 5. Does the patient seem very discouraged or say that he/she has no future? [npi_5]
 6. Does the patient say he/she is a burden to the family or that the family would be better off without him/her? [npi_6]
 7. Does the patient express a wish for death or talk about killing him/herself? [npi_7]
 8. Does the patient show any other signs of depression or sadness? [npi_8]
- **Depression Rating Scale (DRS) from the Resident Assessment Instrument (RAI)** [11, 12]
1. Made negative statements [drs_1]
 2. Persistent anger with self or others [drs_2]
 3. Expressions (including nonverbal) of what appear to be unrealistic fears [drs_3]
 4. Repetitive health complaints [drs_4]
 5. Repetitive anxious complaints/concerns (non-health-related) [drs_5]
 6. Sad, pained, worried facial expression [drs_6]
 7. Crying, tearfulness [drs_7]

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APPENDIX 11

APPENDIX 11: Decision of the Cantonal Human Research Ethics Committee (e-Delphi study)



Mme Carla Gomes da Rocha
SUPAA, Dpt de Psychiatrie, CHUV
Route de Cery 60
B60/00/036
1008 Prilly

Lausanne, 20/07/2023
Réf. PAM/ams/ac

Req-2023-00844 An e-Delphi study to build consensus on the relevant criteria to screen for depressive symptomatology among near-centenarians and centenarians

Dear Madam,

After an analysis of the documents transmitted, the CER-VD concludes that your project is out of the scope of the Swiss Human Research Act (HRA).

The decision of non-consideration implies that the CER doesn't take position with respect to the transmitted documents.

Best regards,


Prof. Pierre-André Michaud
Vice-président

Examined documents :

Brief_Project_Description_e-Delphi_V1_2023.07.04.docx, 04.07.2023
Invitation_Letter-Email_e-Delphi_V1_2023.07.04.docx, 04.07.2023
Questionnaire_e-Delphi_V1_2023.07.04.docx, 04.07.2023

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APPENDIX 12

APPENDIX 12: Graphical overview of the consensus rates (dimensions, criteria and types of assessment)

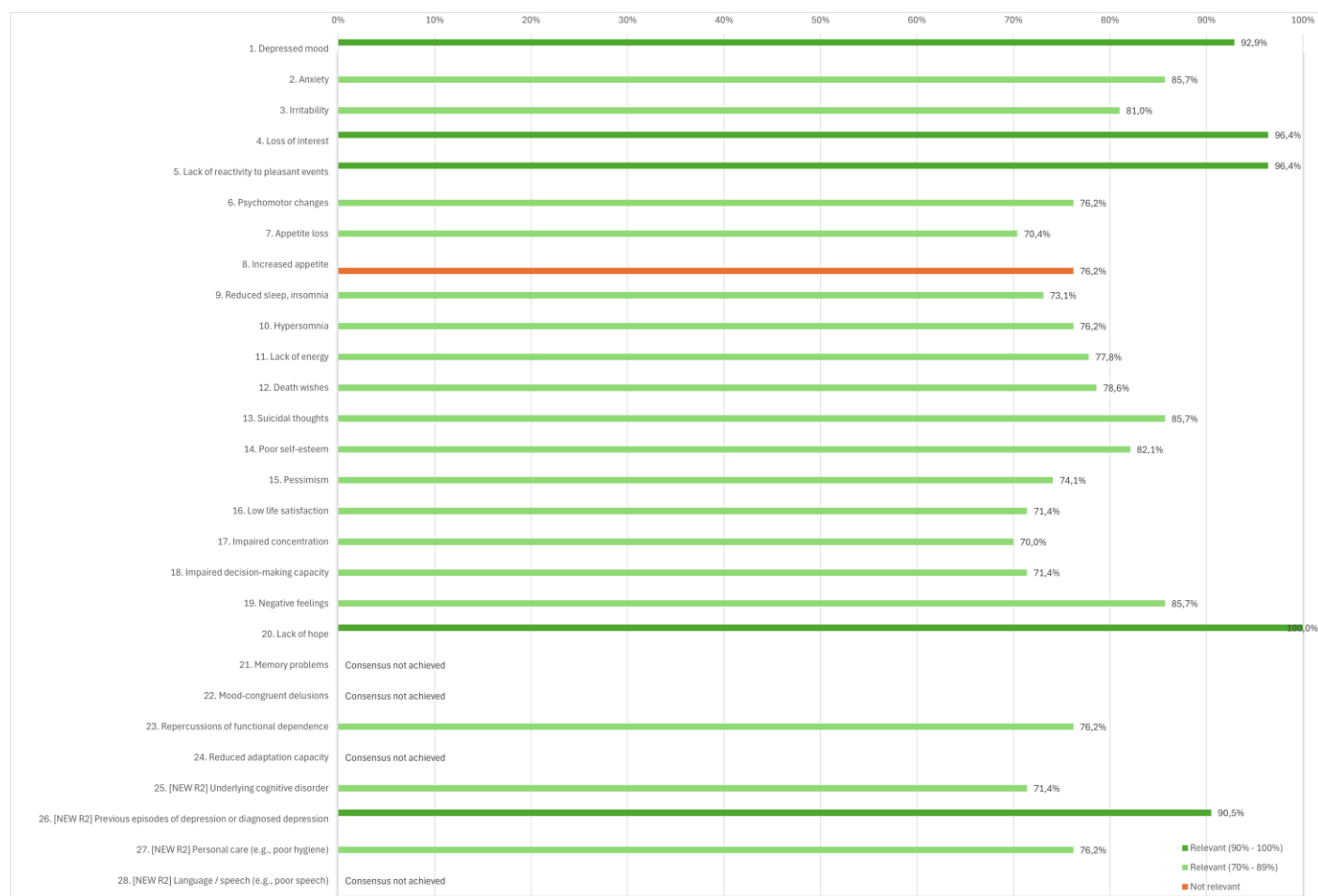


Figure 1: Graphical overview of the consensus rates for the potentially relevant dimensions for depression screening in near-centenarians and centenarians.

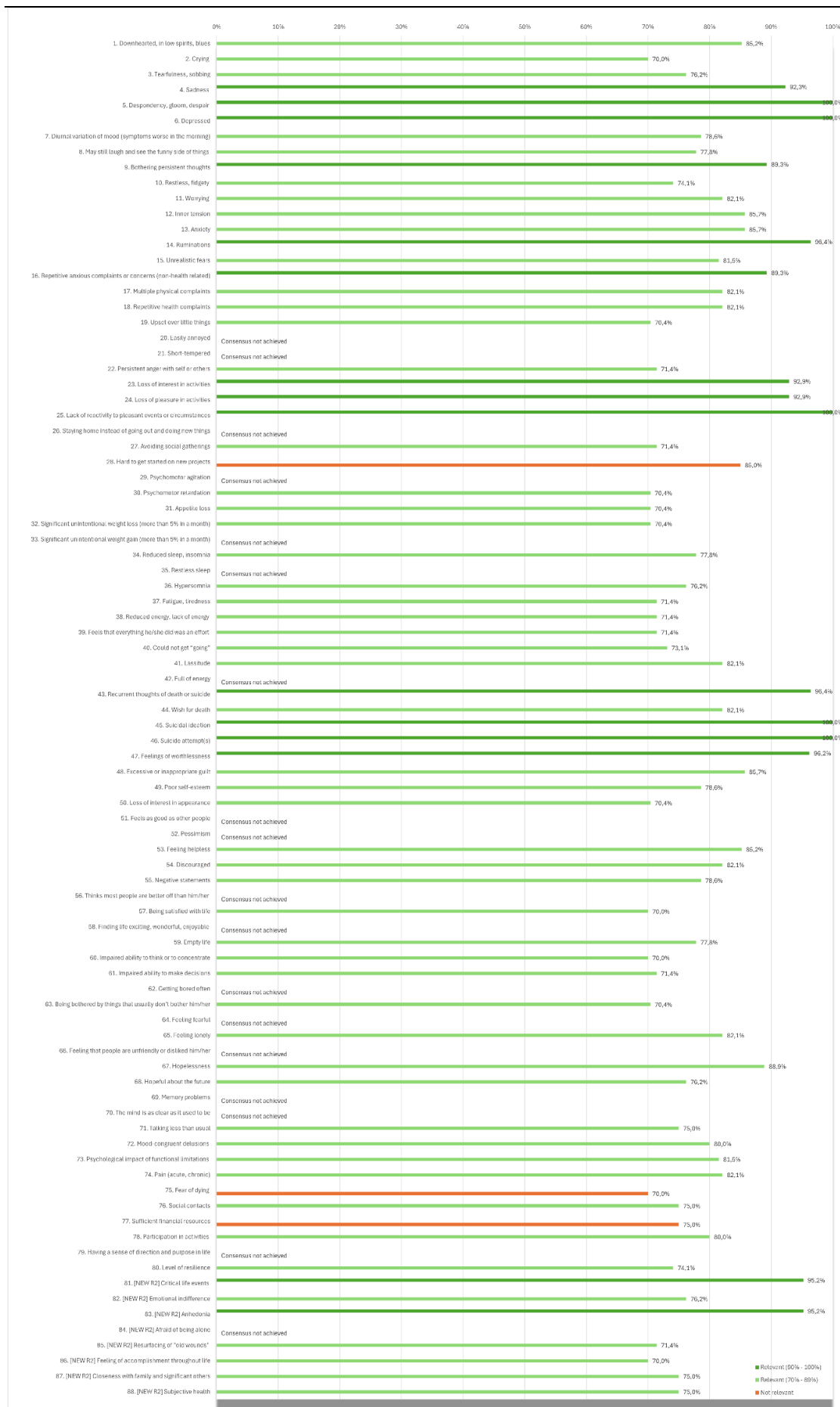


Figure 2: Graphical overview of the consensus rates for the potentially relevant criteria for depression screening in near-centenarians and

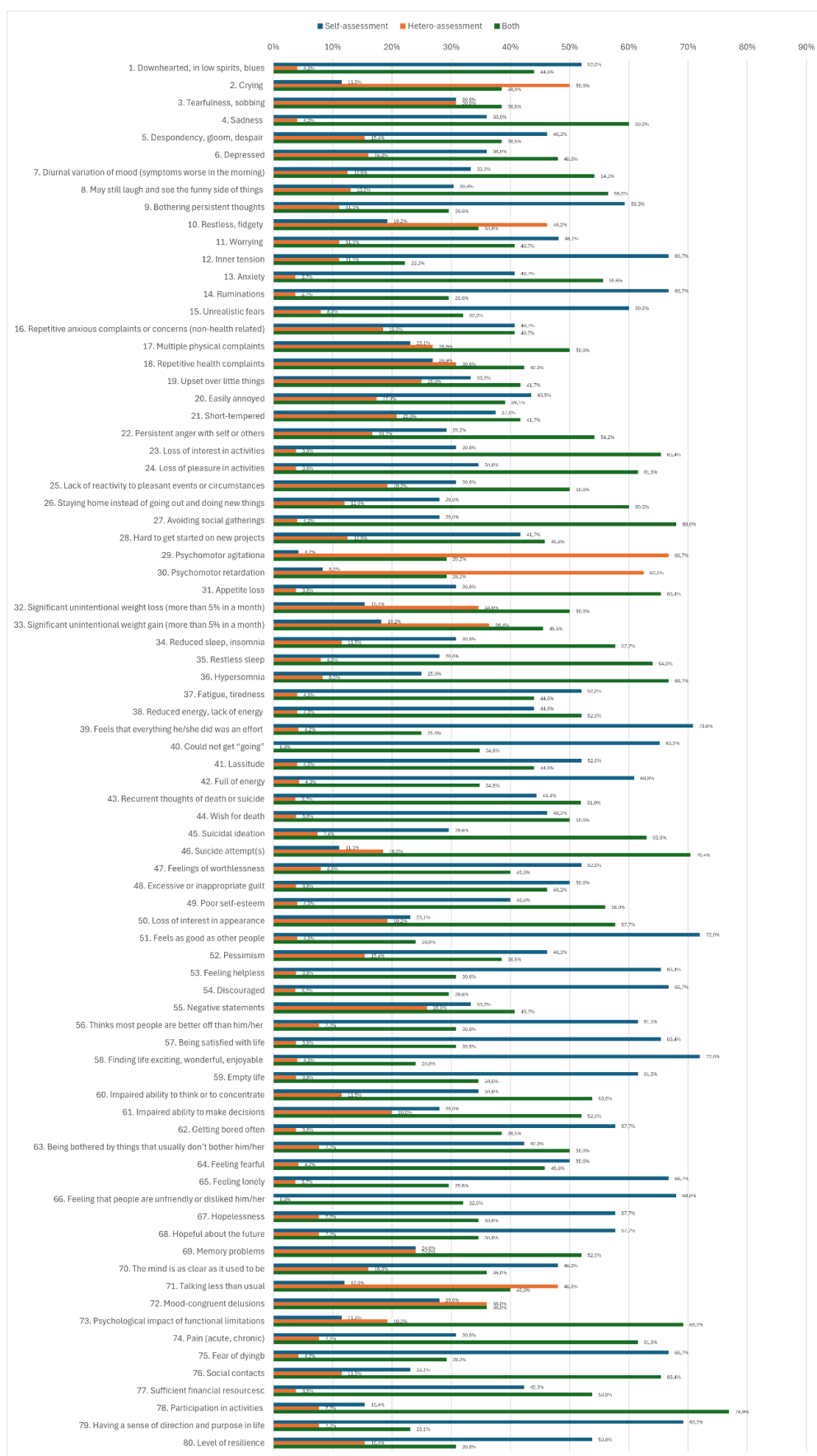


Figure 3: Graphical overview of the consensus rates for types of assessment methods for the potentially relevant criteria for depression screening in near-centenarians and centenarians.

APPENDIX 13

APPENDIX 13: Aspects of signs and symptoms of depression (duration, number, frequency, and severity)

A. Do you consider the duration of signs or symptoms to be important? (N = 28)

- Yes: 28 (100%)

A.1 [*If yes*] In your opinion, what is the minimum duration to consider the signs or symptoms as clinically significant?

R1 (N = 25)	
	n (%)
1 to 3 days	2 (8.0)
1 week	3 (12.0)
2 weeks	9 (36.0)
3 weeks	3 (12.0)
4 weeks	4 (16.0)
7 weeks	0 (0.0)
8 weeks	2 (8.0)
6 months	2 (8.0)

B. Do you believe that the minimum duration for signs/symptoms to be considered clinically significant differs between a recurrence in someone with chronic depression and a new onset of depression in this age group? (N = 21)

- Yes: 13 (61.9%)
- No: 8 (38.1%)

B.1 [*If yes*] For a recurrence in someone with chronic depression, what do you believe is the minimum duration for the signs/symptoms to be considered clinically significant? (In days, weeks or months)

R2 (N = 13)	
	n (%)
1 week	3 (23.1)
2 weeks	9 (69.2)
7 weeks	1 (7.7)

B.2 [*If yes*] For a new onset of depression, what do you believe is the minimum duration for the signs/symptoms to be considered clinically significant? (In days, weeks or months)

R2 (N = 13)	
	n (%)
3 days	1 (7.7)
1 week	2 (15.4)
2 weeks	2 (15.4)
3 weeks	2 (15.4)
4 weeks	5 (38.5)
9 weeks	1 (7.7)

C. Do you believe the number of signs/symptoms is important to consider when assessing potential depression in this age group? (N = 21)

- Yes: 13 (61.9%)
- No: 6 (28.6%)
- I don't know: 2 (9.5%)

C.1 [*If yes*] In your opinion, what is the minimum number of signs/symptoms that should warrant clinical concern for possible depression in this age group?

Min. number of signs/symptoms	R2 (N = 12)
	n (%)
1	1 (8.3)
2	4 (33.3)
3	4 (33.3)
4	1 (8.3)
5	2 (16.7)

D. Do you believe the frequency of signs/symptoms is an important factor to consider when assessing potential depression in this age group? (N = 20)

- Yes: 20 (100%)

D.1 [*If yes*] In your opinion, at what frequency should the presence of signs/symptoms raise clinical concern for potential depression (e.g., continuously, several times per day, several times per week ...)?

	R2 (N = 19)
	n (%)
Continuously	1 (5.3)
Several times per day	9 (47.4)
Near daily	3 (15.8)
Several times per week	6 (31.6)

E. Do you believe the severity of signs/symptoms is an important factor to consider when assessing potential depression in this age group? (N = 20)

- Yes: 18 (90.0%)
- No: 2 (10.0%)

E.1 [*If yes*] At what level of severity (on a scale of 1-10, with 10 being the most severe) would signs/symptoms warrant clinical concern for potential depression in this age group? (N = 18)

Mean (SD)	4.9 (1.4)
Median (Range)	5.0 (2-7)

Level of severity	n (%)
2	1 (5.6)
3	2 (11.1)
4	4 (22.2)
5	4 (22.2)
6	5 (27.8)
7	2 (11.1)

APPENDIX 14

APPENDIX 14: Steering committee's final determinations

Steering committee's decision on dimensions lacking consensus after three e-Delphi rounds

The committee's evaluations led to the following determinations:

- Dimension *Memory problems* (dim. 21) and dimension *Language / speech* (e.g., *poor speech*; dim. 28): these dimensions were classified as 'not relevant' for inclusion in the depression screening for individuals aged 95 and older. The committee felt that these dimensions may not capture the critical elements of depressive symptoms in this specific age group because they may overlap with cognitive deficits that are prevalent in older adults but not necessarily indicative of depression.
- Dimension *Mood-congruent delusions* (dim. 22) and dimension *Reduced adaptation capacity* (dim. 24): these dimensions were classified as 'relevant' for inclusion in the depression screening for individuals aged 95 and older. The committee concluded that mood-congruent delusions may be particularly indicative of depressive severity, while adaptation capacity is crucial for assessing an individual's capacity to manage daily stress and adapt to changes, factors that can significantly affect their overall mental health.

Steering committee's decision on criteria lacking consensus after three e-Delphi rounds

The committee's evaluations led to the following determinations:

- The following criteria were classified as 'not relevant' for inclusion in depression screening for individuals aged 95 and older: *Easily annoyed* (crit. 20), *Staying home instead of going out and doing new things* (crit. 26), *Psychomotor agitation* (crit. 29), *Significant unintentional weight gain* (more than 5% in a month) (crit. 33), *Full of energy* (crit. 42), *Feels as good as other people* (crit. 51), *Thinks most people are better off than him/her* (crit. 56), *Finding life exciting, wonderful, enjoyable* (crit. 58), *Getting bored often* (crit. 62), *Feeling that people are unfriendly or disliked him/her* (crit. 66), *Memory problems* (crit. 69), and *The mind is as clear as it used to be* (crit. 70).

Regarding criteria 20, 26, 33, 42, 51, 56, 58, 62, and 66, the committee concluded that they may not significantly reflect depressive symptoms in this age group, possibly because they could be more indicative of personality traits or lifestyle

choices rather than underlying depressive disorders. For criterion 29, the committee determined that it may often result from other medical conditions (e.g., Alzheimer's disease, delirium, anxiety disorders), making it less specific as an indicator of depression in the very old. Additionally, criteria 69 and 70 were excluded in line with the dimension *Memory problems* (dim. 21) being deemed 'not relevant', as previously presented. These memory-related issues may often reflect age-related cognitive decline or dementia rather than depressive disorders, thus being less specific indicators of depression in individuals aged 95 and older.

- The following criteria were classified as 'relevant' for inclusion in depression screening for individuals aged 95 and older: *Short-tempered* (crit. 21), *Restless sleep* (crit. 35), *Pessimism* (crit. 52), *Feeling fearful* (crit. 64), *Having a sense of direction and purpose in life* (crit. 79), and *Afraid of being alone* (crit. 84). The committee concluded that these criteria could be critical in identifying depressive conditions as they directly relate to emotional regulation, sleep disturbances, fear responses, negative outlooks, existential engagement, and social dependency, which can be seen as particularly important indicators of mental health challenges in older adults.

APPENDIX 15

APPENDIX 15: Table A. Findings on preferred assessment methods for depression screening criteria

		Round 1 N = 28	
	Self-assessment n/N (%)	Hetero- assessment n/N (%)	Both n/N (%)
1. Downhearted, in low spirits, blues	13/25 (52.0)	1/25 (4.0)	11/25 (44.0)
2. Crying	3/26 (11.5)	13/26 (50.0)	10/26 (38.5)
3. Tearfulness, sobbing	8/26 (30.8)	8/26 (30.8)	10/26 (38.5)
4. Sadness	9/25 (36.0)	1/25 (4.0)	15/25 (60.0)
5. Despondency, gloom, despair	12/26 (46.2)	4/26 (15.4)	10/26 (38.5)
6. Depressed	9/25 (36.0)	4/25 (16.0)	12/25 (48.0)
7. Diurnal variation of mood (symptoms worse in the morning)	8/24 (33.3)	3/24 (12.5)	13/24 (54.2)
8. May still laugh and see the funny side of things	7/23 (30.4)	3/23 (13.0)	13/23 (56.5)
9. Bothering persistent thoughts	16/27 (59.3)	3/27 (11.1)	8/27 (29.6)
10. Restless, fidgety	5/26 (19.2)	12/26 (46.2)	9/26 (34.6)
11. Worrying	13/27 (48.1)	3/27 (11.1)	11/27 (40.7)
12. Inner tension	18/27 (66.7)	3/27 (11.1)	6/27 (22.2)
13. Anxiety	11/27 (40.7)	1/27 (3.7)	15/27 (55.6)
14. Ruminations	18/27 (66.7)	1/27 (3.7)	8/27 (29.6)
15. Unrealistic fears	15/25 (60.0)	2/25 (8.0)	8/25 (32.0)
16. Repetitive anxious complaints or concerns (non-health related)	11/27 (40.7)	5/27 (18.5)	11/27 (40.7)
17. Multiple physical complaints	6/26 (23.1)	7/26 (26.9)	13/26 (50.0)
18. Repetitive health complaints	7/26 (26.9)	8/26 (30.8)	11/26 (42.3)
19. Upset over little things	8/24 (33.3)	6/24 (25.0)	10/24 (41.7)
20. Easily annoyed	10/23 (43.5)	4/23 (17.4)	9/23 (39.1)
21. Short-tempered	9/24 (37.5)	5/24 (20.8)	10/24 (41.7)
22. Persistent anger with self or others	7/24 (29.2)	4/24 (16.7)	13/24 (54.2)
23. Loss of interest in activities	8/26 (30.8)	1/26 (3.8)	17/26 (65.4)
24. Loss of pleasure in activities	9/26 (34.6)	1/26 (3.8)	16/26 (61.5)
25. Lack of reactivity to pleasant events or circumstances	8/26 (30.8)	5/26 (19.2)	13/26 (50.0)
26. Staying home instead of going out and doing new things	7/25 (28.0)	3/25 (12.0)	15/25 (60.0)
27. Avoiding social gatherings	7/25 (28.0)	1/25 (4.0)	17/25 (68.0)
28. Hard to get started on new projects	10/24 (41.7)	3/24 (12.5)	11/24 (45.8)
29. Psychomotor agitation ^a	1/24 (4.2)	16/24 (66.7)	7/24 (29.2)
30. Psychomotor retardation	2/24 (8.3)	15/24 (62.5)	7/24 (29.2)
31. Appetite loss	8/26 (30.8)	1/26 (3.8)	17/26 (65.4)
32. Significant unintentional weight loss (more than 5% in a month)	4/26 (15.4)	9/26 (34.6)	13/26 (50.0)
33. Significant unintentional weight gain (more than 5% in a month)	4/22 (18.2)	8/22 (36.4)	10/22 (45.5)
34. Reduced sleep, insomnia	8/26 (30.8)	3/26 (11.5)	15/26 (57.7)
35. Restless sleep	7/25 (28.0)	2/25 (8.0)	16/25 (64.0)
36. Hypersomnia	6/24 (25.0)	2/24 (8.3)	16/24 (66.7)
37. Fatigue, tiredness	13/25 (52.0)	1/25 (4.0)	11/25 (44.0)
38. Reduced energy, lack of energy	11/25 (44.0)	1/25 (4.0)	13/25 (52.0)
39. Feels that everything he/she did was an effort	17/24 (70.8)	1/24 (4.2)	6/24 (25.0)

40. Could not get “going”	15/23 (65.2)	0/23 (0.0)	8/23 (34.8)
41. Lassitude	13/25 (52.0)	1/25 (4.0)	11/25 (44.0)
42. Full of energy	14/23 (60.9)	1/23 (4.3)	8/23 (34.8)
43. Recurrent thoughts of death or suicide	12/27 (44.4)	1/27 (3.7)	14/27 (51.9)
44. Wish for death	12/26 (46.2)	1/26 (3.8)	13/26 (50.0)
45. Suicidal ideation	8/27 (29.6)	2/27 (7.4)	17/27 (63.0)
46. Suicide attempt(s)	3/27 (11.1)	5/27 (18.5)	19/27 (70.4)
47. Feelings of worthlessness	13/25 (52.0)	2/25 (8.0)	10/25 (40.0)
48. Excessive or inappropriate guilt	13/26 (50.0)	1/26 (3.8)	12/26 (46.2)
49. Poor self-esteem	10/25 (40.0)	1/25 (4.0)	14/25 (56.0)
50. Loss of interest in appearance	6/26 (23.1)	5/26 (19.2)	15/26 (57.7)
51. Feels as good as other people	18/25 (72.0)	1/25 (4.0)	6/25 (24.0)
52. Pessimism	12/26 (46.2)	4/26 (15.4)	10/26 (38.5)
53. Feeling helpless	17/26 (65.4)	1/26 (3.8)	8/26 (30.8)
54. Discouraged	18/27 (66.7)	1/27 (3.7)	8/27 (29.6)
55. Negative statements	9/27 (33.3)	7/27 (25.9)	11/27 (40.7)
56. Thinks most people are better off than him/her	16/26 (61.5)	2/26 (7.7)	8/26 (30.8)
57. Being satisfied with life	17/26 (65.4)	1/26 (3.8)	8/26 (30.8)
58. Finding life exciting, wonderful, enjoyable	18/25 (72.0)	1/25 (4.0)	6/25 (24.0)
59. Empty life	16/26 (61.5)	1/26 (3.8)	9/26 (34.6)
60. Impaired ability to think or to concentrate	9/26 (34.6)	3/26 (11.5)	14/26 (53.8)
61. Impaired ability to make decisions	7/25 (28.0)	5/25 (20.0)	13/25 (52.0)
62. Getting bored often	15/26 (57.7)	1/26 (3.8)	10/26 (38.5)
63. Being bothered by things that usually don't bother him/her	11/26 (42.3)	2/26 (7.7)	13/26 (50.0)
64. Feeling fearful	12/24 (50.0)	1/24 (4.2)	11/24 (45.8)
65. Feeling lonely	18/27 (66.7)	1/27 (3.7)	8/27 (29.6)
66. Feeling that people are unfriendly or disliked him/her	17/25 (68.0)	0/25 (0.0)	8/25 (32.0)
67. Hopelessness	15/26 (57.7)	2/26 (7.7)	9/26 (34.6)
68. Hopeful about the future	15/26 (57.7)	2/26 (7.7)	9/26 (34.6)
69. Memory problems	6/25 (24.0)	6/25 (24.0)	13/25 (52.0)
70. The mind is as clear as it used to be	12/25 (48.0)	4/25 (16.0)	9/25 (36.0)
71. Talking less than usual	3/25 (12.0)	12/25 (48.0)	10/25 (40.0)
72. Mood-congruent delusions (delusions of poverty, illness or loss)	7/25 (28.0)	9/25 (36.0)	9/25 (36.0)
73. Psychological impact of functional limitations (incapacity to perform activities of daily living independently)	3/26 (11.5)	5/26 (19.2)	18/26 (69.2)
74. Pain (acute, chronic)	8/26 (30.8)	2/26 (7.7)	16/26 (61.5)
75. Fear of dying ^a	16/24 (66.7)	1/24 (4.2)	7/24 (29.2)
76. Social contacts	6/26 (23.1)	3/26 (11.5)	17/26 (65.4)
77. Sufficient financial resources ^a	11/26 (42.3)	1/26 (3.8)	14/26 (53.8)
78. Participation in activities (reading, using the computer/smartphone, TV/radio, playing an instrument/games, physical activity, gardening, going to the cinema/theatre/café/restaurant, attending religious services, visiting people, associative activities, etc.)	4/26 (15.4)	2/26 (7.7)	20/26 (76.9)
79. Having a sense of direction and purpose in life	18/26 (69.2)	2/26 (7.7)	6/26 (23.1)
80. Level of resilience	14/26 (53.8)	4/26 (15.4)	8/26 (30.8)

^a Criteria considered 'not relevant' over the e-Delphi rounds.

Note 1: In the first round, experts proposed eight additional criteria (criteria 81 to 88), which were subsequently incorporated into the second-round questionnaire. However, these additional criteria were not reviewed regarding the type of assessment, as this process was exclusive to the initial round.

Note 2: Results highlighted in bold indicate the criteria for which at least 50% of the experts positioned themselves in favour of that specific type of assessment.

