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Original Research Article

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 analysed 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 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.

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 [51,62,63]. In Europe, the centenarian population is expected to increase from 176,000 in 2024 to 694,000 by 2050 [63]. In Switzerland, this demographic trend is reflected by an approximate doubling of

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centenarians every decade from 1950 to 2010, reaching 2086 by 2023 [43]. This remarkable growth is attributed to increased life expectancy due to better living conditions, healthcare, lifestyle and individual robustness [41,67]. 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 [42]. A key challenge is the increasing duration of morbidity, as healthy life expectancy is not keeping pace with overall life expectancy [55].

In other words, unfortunately, longevity is often accompanied by the onset or exacerbation of multiple health issues [27]. 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 [9,28] 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 [68], 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 [19,68]. 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 [22,46,9]. 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 [38]. 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 [4]. 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 [17,54].

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 [28,58]. Furthermore, functional dependence and depressive symptoms may act as mutual predictive factors [11,28,48,58,59], underscoring their bidirectional relationship. Nevertheless, other studies did not find significant associations [10,37]. 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 [36] revealed that depressive symptoms were the most prevalent neuropsychiatric symptoms (e.g., apathy, anxiety, irritability, sleep disorders), as measured by the Neuropsychiatric Inventory [30]. 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 [28], 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 %) [40]. 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 [18,26]. 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 [26]. 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 = 1114) 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) [16,24]. 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 [32], 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 [15]. 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) [16], which includes items less likely to be affected by sensory impairments commonly observed in centenarians [24], and has been employed in previous studies involving centenarians [1,28,47]. 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) [56]. 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 [21], suggesting possible clinical depression.

Symptoms of anxiety were assessed using the 5-item Geriatric Anxiety Inventory - Short Form (GAI-SF) [7]. 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, and 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 examine whether specific variables explained unique variance in depressive symptomatology, we conducted a stepwise regression analysis. Predictors were entered into the model in sequential steps to assess their incremental contribution to explaining variance in depressive symptoms (GDS-15 score). To avoid overparameterizing the model while ensuring potentially relevant predictors were retained, 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 [6]. For all analyses, statistical significance was set at $p < .05$. All statistical analyses were performed using IBM SPSS Statistics software, version 29.0 [25].

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 [23]. A bootstrap sampling method (5000 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, widowed, and community-dwelling. Regarding educational level, the 'high school/vocational high school' category was the most often represented, with few participants holding a university degree (Table 1).

Subjective and Physical health

Most participants rated their subjective health positively, despite experiencing a high burden of multimorbidity, with two-thirds reporting six or more health conditions. This suggests a notable level of resilience. While a substantial proportion never experienced physical pain or discomfort, nearly one in five reported frequent pain (Table 1).

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

	n (%)	*M* (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[a]		3.17 (0.88)	1 – 5
Poor / Fair	19 (18.6)		
Good /Very good / Excellent	83 (81.4)		
Number of health conditions[b]		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[c]		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[d] (shortened MMSE)		16.82 (3.09)	9 – 21
Mental health			
Anxiety symptoms (GAI-SF)		1.19 (1.29)	0 – 5
Depressive symptoms (GDS−15)[e]		3.89 (2.64)	0 – 11
Are you basically satisfied with your life?[f]	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?[f]	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?[f]	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?[f]	73 (71.6)		
Do you feel pretty worthless the way you are now?	36 (35.3)		
Do you feel full of energy?[f]	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).

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

[b] Health conditions were assessed using a list of 26 conditions.

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

[d] Cognitive status: shortened Mini-Mental State Examination (max. 21 points; [24]). 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.

[e] For each GDS-15 item, the reported values correspond to the '*yes*' responses.

[f] Items reversed for the calculation of the total GDS-15 score.

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

Participants showed mild cognitive impairment on average, based on the shortened MMSE. Anxiety symptoms were relatively low, while depressive symptoms were higher. The most commonly reported depressive indicators included dropping activities and interests, preference for staying at home, and feelings of low energy and worthlessness. Despite these concerns, most participants reported being satisfied with their life, in good spirits, and happy most of the time (Table 1). Using a GDS-15 cut-off score of > 5 points to indicate a positive screening [21,70], 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.

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 the variables which we considered relevant based on the described theoretical considerations. However, to avoid overparameterizing the regression model, we included only variables as predictors which correlated at least at p < .20 with depressive symptoms (i.e., living situation, widowed, subjective health, health conditions, anxiety, and functional capacity; it is of note that most correlations were significant at p < .05 level; the smallest link existed for subjective health with r = −.14 and p = .169, which we maintained given its importance found in prior depression studies). 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. Given that we were interested in the role of the specific predictors in relation to each other, we conducted a stepwise regression analysis, summarized in Table 3. The findings indicated that while living situation initially emerged as a significant predictor of depressive symptoms (GDS-15 score) (step 1; p < .05), it became non-significant when additional variables were included (steps 2, 3, and 4; p > .05). In the complete model, depicted at final step 4, number of health conditions, symptoms of anxiety, and overall functional capacity emerged as significant predictors (ps < .05). Thus, the complete 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 %).

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) (Fig. 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 when functional capacity is included in the model, the direct relationship between living situation and depressive symptoms is weak and not significantly detectable in our sample. Considering the ratio of the indirect effect to the total effect as suggested by Wen and Fan [66], results indicate that the indirect effect represented an important proportion of the total effect (i.e., P(m) = ab/c = .84/1.1 = .76). Thus, the proportion of the indirect effect relative to the total effect indicated that overall functional capacity explained 76 % of the effect of living situation on depressive symptoms. Additionally, considering the ratio of the indirect effect relative to the direct effect as another indicator of effect size, the indirect effect was three times larger in magnitude than the direct effect (i.e., ab/c′ =.84/.26 = 3.23).

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

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
Stepwise linear regression model predicting depressive symptoms (n = 102).

	Depressive symptoms (GDS-15)				
	B	*Beta*	*p*	R^2 *change*	R^2 *adjusted*
Step 1				0.038*	0.029*
Living situation (0 = priv, 1 = inst)	1.10	0.20	0.048*		
Step 2				0.036	0.056
Living situation (0 = priv, 1 = inst)	1.02	0.18	0.065		
Widowhood (0 = no, 1 = yes)	1.27	0.19	0.051		
Step 3				0.140**	0.174**
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*		
Step 4				0.032*	0.199*
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*		
R^2 TOTAL					0.247**

Note: Model at step 4 represents the complete model, including all predictors; it explains the most variance in depressive symptoms. Values of the *F*-tests are as follows: Model including step 1: $F(1, 100) = 3.99$, $p < .05$; Model including step 1 and 2: $F(2, 99) = 3.99$, $p < .05$; Model including step 1, 2, and 3: $F(5, 96) = 5.25$, $p < .001$; Model including all steps [complete model]: $F(6, 95) = 5.18$, $p < .001$).
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

with recent studies conducted in China, where the pathological threshold of the GDS-15 was exceeded in centenarians [69,71]. 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 [60].

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 % [40]. 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 [9]. These differences may be attributed to cultural factors and methodological variations in study design (e.g., different measurement tools, sub-population sampling).

Despite this prevalence, interpreting depressive symptoms in centenarians remains complex, as some screening items may overlap with underlying health conditions, such as sensory impairments, frailty or loss of autonomy. Distinguishing depressive features from adaptations to age-related constraints remains challenging (e.g., *having dropped many of their activities and interests* or *preferring to stay at home rather than going out and doing new things*), likely contributing to the under-identification of depressive symptoms in older and very old adults [33,52].

In addition, depressive symptomatology can show overlaps with dementia symptomatology, as both conditions can involve memory impairment, reduced motivation and psychomotor retardation, adding another layer of complexity [14]. Apart from dementia, other medical conditions (e.g., thyroid dysfunction, Parkinson's disease, stroke, medication side effects) may resemble or exacerbate depressive symptoms due to the presence of fatigue, apathy, functional dependence, memory impairment, and disturbances in mood and sleep [34,35,44,65,8].

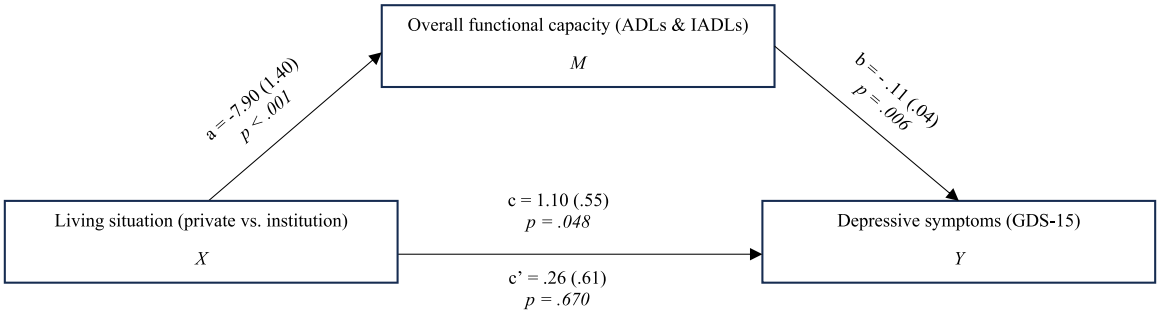

Fig. 1. Simple mediation diagram. Path coefficients a, b, c and c′ represent unstandardized regression weights, with standard errors shown in parentheses. The c coefficient reflects the total effect of living situation on depressive symptoms (statistically significant), while the c′ coefficient indicates the direct effect of living situation on depressive symptoms after accounting for the mediator–overall functional capacity (not statistically significant).

Given the diagnostic complexity of depressive states in very advanced age, these overlapping symptoms underscore the need for a comprehensive assessment, requiring greater clinical vigilance to distinguish depressive features from other conditions or age-related adaptations in order to ensure an accurate differential diagnosis.

To lay the groundwork for addressing these complexities, recent research has sought to identify the most relevant depressive signs and symptoms in individuals aged 95 and older [20]. The findings highlight the necessity of a multidimensional approach to depression screening in the oldest-old, emphasizing the importance of developing more tailored screening strategies. Additionally, symptom duration, frequency, and severity should be carefully considered in depression assessment for this age group. As an initial step toward improving depression evaluation in centenarians, the potential need for a dedicated screening tool to optimize mental health care has also been suggested to address current shortcomings. Given these diagnostic challenges, it is also important to consider broader health factors that may contribute to depressive symptoms. In our sample, the number of health conditions, anxiety symptoms, and overall functional capacity predicted depressive symptoms. The study participants presented poor objective health, averaging seven health conditions per individual—higher than reported in previous studies [1,10,28,45]. 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 [13], and its prevalence in our sample appeared higher than previously reported [27]. 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 [50]. 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 [49]. 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 [1,5,60]. 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 [29,37]. 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 [3]. However, although previous research has linked institutionalisation to poorer mental health outcomes, including depressive symptoms [12], 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 per se. Although our mediation model suggests that functional capacity plays a key role in the relationship between living situation and depressive symptoms, functional decline is commonly a major factor leading to institutionalisation. This raises the possibility that institutionalisation itself could contribute to depressive symptoms beyond functional dependence. Prior research has suggested that institutional care settings may introduce psychosocial stressors, such as reduced independence and social engagement, potentially exacerbating depressive symptoms [31,53]. For instance, institutionalised older adults may experience a reduced sense of control over daily routines and fewer opportunities for social participation, both of which have been linked to increased psychological distress and loneliness [57,64]. However, our results align with previous findings, which reported that when controlling for other factors, including functional capacity, living in an institution was not a significant predictor of depressive symptoms [61]. While institutionalisation may have an independent psychological impact, our findings suggest that the higher burden of functional dependence observed among institutionalised individuals accounts for most of the observed differences in depressive symptoms. 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 [39], and these proportions could be even higher among centenarians [12,28]. 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 behaviours while placing less emphasis on promoting independent ones [2]. Interventions designed to shift these scripts—by fostering 'independence-supporting' behaviours—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, our regression analysis was guided by theoretical considerations as well as statistical selection criteria. Still, we acknowledge that selecting specific predictors based on bivariate correlations with $p < .20$ may introduce a risk of Type I error due to multiple testing. While this approach was chosen to retain potentially meaningful predictors in an understudied context, some associations may have emerged by chance. Fourth, 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 analysing 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 insitutionalised, to re-develop and maintain a certain level of functional independence is essential. While optimising institutional care environments to better support independence remains crucial, efforts to maintain functional capacity before institutionalisation, through appropriate support in community settings, may also play an important role in reducing the risk of depressive symptoms. 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.

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CRediT authorship contribution statement

Gomes da Rocha Carla: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Conceptualization. **Jopp Daniela S.:** Writing – review & editing, Validation, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Hoffman Adar:** Writing – review & editing, Formal analysis, Data curation. **Falciola Justine:** Writing – review & editing, Formal analysis, Data curation. **Cavalli Stefano:** Writing – review & editing, Resources, Project administration, Funding acquisition, Conceptualization. **Herrmann François R.:** Writing – review & editing, Resources, Project administration, Funding acquisition, Conceptualization. **Röcke Christina:** Writing – review & editing, Resources, Project administration. **Verloo Henk:** Writing – review & editing, Visualization, Validation, Methodology, Conceptualization. **Ribeiro Olga:** Writing – review & editing, Visualization, Validation, Conceptualization. **von Gunten Armin:** Writing – review & editing, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Generative AI and AI-assisted technologies in the writing process

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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Supplementary material

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References

[1] Araujo L, Ribeiro O, Teixeira L, Paul C. Predicting successful aging at one hundred years of age. Res Aging 2016;38:689–709. https://doi.org/10.1177/0164027515603771.
[2] Baltes MM, Neumann EM, Zank S. Maintenance and rehabilitation of independence in old age: an intervention program for staff. Psychol Aging 1994;9:179–88. https://doi.org/10.1037//0882-7974.9.2.179.
[3] Baltes MM, Wahl HW. The dependency-support script in institutions: generalization to community settings. Psychol Aging 1992;7:409–18. https://doi.org/10.1037//0882-7974.7.3.409.
[4] Baltes PB, Baltes MM. Successful aging: perspectives from the behavioral sciences. Cambridge, UK: Cambridge University Press; 1990. https://doi.org/10.1017/CBO9780511665684.
[5] Boerner K, Kim K, Kim Y, Rott C, Jopp DS. Centenarians' end-of-life thoughts and plans: is their social network on the same page? J Am Geriatr Soc 2018;66:1311–7. https://doi.org/10.1111/jgs.15398.
[6] Bursac Z, Gauss CH, Williams DK, Hosmer DW. Purposeful selection of variables in logistic regression. Source Code Biol Med 2008;3:17. https://doi.org/10.1186/1751-0473-3-17.
[7] Byrne GJ, Pachana NA. Development and validation of a short form of the Geriatric Anxiety Inventory–the GAI-SF. Int Psychogeriatr 2011;23:125–31. https://doi.org/10.1017/S1041610210001237.
[8] Charoenngam N, Rittiphairoj T, Ponvilawan B, Prasongdee K. Thyroid dysfunction and risk of Parkinson's disease: a systematic review and meta-analysis. Front Endocrinol (Lausanne) 2022;13:863281. https://doi.org/10.3389/fendo.2022.863281.
[9] Cheng A, Leung Y, Harrison F, Brodaty H. The prevalence and predictors of anxiety and depression in near-centenarians and centenarians: a systematic review. Int Psychogeriatr 2019;31:1539–58. https://doi.org/10.1017/S1041610219000802.
[10] Cheung KS, Lau BH. Successful aging among Chinese near-centenarians and centenarians in Hong Kong: a multidimensional and interdisciplinary approach. Aging Ment Health 2016;20:1314–26. https://doi.org/10.1080/13607863.2015.1078281.
[11] Cimarolli VR, Jopp DS, Boerner K, Minahan J. Depressive symptoms in the oldest-old: the role of sensory impairments. Arch Gerontol Geriatr 2018;78:249–54. https://doi.org/10.1016/j.archger.2018.07.009.
[12] Cohen-Mansfield J, et al. The old, old-old, and the oldest old: continuation or distinct categories? An examination of the relationship between age and changes in health, function, and wellbeing. Int J Aging Hum Dev 2013;77:37–57. https://doi.org/10.2190/AG.77.1.c.
[13] Denkinger MD, Lukas A, Nikolaus T, Peter R, Franke S, Acti FE s g. Multisite pain, pain frequency and pain severity are associated with depression in older adults: results from the ActiFE Ulm study. Age Ageing 2014;43:510–4. https://doi.org/10.1093/ageing/afu013.
[14] Devita M, et al. Recognizing depression in the elderly: practical guidance and challenges for clinical management. Neuropsychiatr Dis Treat 2022;18:2867–80. https://doi.org/10.2147/NDT.S347356.
[15] Fillenbaum GG. Multidimensional Functional Assessment of Older Adults: The Duke Older Americans Resources and Services Procedures. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.; 1988. https://doi.org/10.4324/9780203771563.
[16] Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–98. https://doi.org/10.1016/0022-3956(75)90026-6.
[17] Freund AM, Baltes PB. Life-management strategies of selection, optimization and compensation: measurement by self-report and construct validity. J Personal Soc Psychol 2002;82:642–62. https://doi.org/10.1037/0022-3514.82.4.642.
[18] Gomes da Rocha C, Jopp DS, Cavalli S, Herrmann F, von Gunten A. Les Centenaires: Pourquoi s'y Intéresser ? Aperçu de l'Étude SWISS100. La Gaz médicale 2024;13:14–6.
[19] Gomes da Rocha C, von Gunten A, Jopp D, Ribeiro O, Verloo H. Why centenarians' depressive symptoms must become a priority for nurses. J Am Med Dir Assoc 2021;22:1118–9. https://doi.org/10.1016/j.jamda.2021.02.002.

[20] Gomes da Rocha C, von Gunten A, Vandel P, Jopp DS, Ribeiro O, Verloo H. Building consensus on the relevant criteria to screen for depressive symptoms among near-centenarians and centenarians: modified e-delphi study. JMIR Aging 2025;8:e64352. https://doi.org/10.2196/64352.
[21] Greenberg SA. The Geriatric Depression Scale (GDS): Short Form. New York: Hartford Institute for Geriatric Nursing, Rory Meyers College of Nursing; 2023.
[22] Hajek A, et al. Depressive symptoms and frailty among the oldest old: evidence from a multicenter prospective study. J Am Med Dir Assoc 2021;22:577–582 e572. https://doi.org/10.1016/j.jamda.2020.10.008.
[23] Hayes AF. Introduction to mediation, moderation, and conditional process analysis: a regression-based approach. New York: Guilford Press,; 2022.
[24] Holtsberg PA, Poon LW, Noble CA, Martin P. Mini-Mental State Exam status of community-dwelling cognitively intact centenarians. Int Psychogeriatr 1995;7:417–27. https://doi.org/10.1017/s104161029500216x.
[25] IBM Corp. IBM SPSS Statistics for Windows, Version 29.0. Armonk, NY: IBM Corp; 2022.
[26] Jopp D, von Gunten A, Herrmann F, Cavalli S. Swiss Centenarian Study (SWISS100): Vulnerability and Resilience at Age 100. Switzerland: SNSF - Swiss National Science Foundation; 2019. p. 1–40.
[27] Jopp DS, Boerner K, Rott C. Health and disease at age 100: findings from the second heidelberg centenarian study. Dtsch Ärzteblatt Int 2016;113:203–21. https://doi.org/10.3238/arztebl.2016.0203.
[28] Jopp DS, Park MK, Lehrfeld J, Paggi ME. Physical, cognitive, social and mental health in near-centenarians and centenarians living in New York City: findings from the Fordham Centenarian Study. BMC Geriatr 2016;16(1). https://doi.org/10.1186/s12877-015-0167-0.
[29] Kato K, Zweig R, Schechter CB, Barzilai N, Atzmon G. Positive attitude toward life, emotional expression, self-rated health, and depressive symptoms among centenarians and near-centenarians. Aging Ment Health 2016;20:930–9. https://doi.org/10.1080/13607863.2015.1056770.
[30] Kaufer DI, et al. Validation of the NPI-Q, a brief clinical form of the neuropsychiatric inventory. J Neuropsychiatry Clin Neurosci 2000;12:233–9. https://doi.org/10.1176/jnp.12.2.233.
[31] Khan M, Mahmood Z. Social engagement and psychological distress in institutionalized older adults: a mediating role of loneliness. J Postgrad Med Inst 2024;38:111–6. https://doi.org/10.54079/jpmi.38.2.3303.
[32] Knäuper B, Carriere K, Chamandy M, Xu Z, Schwarz N, Rosen NO. How aging affects self-reports. Eur J Ageing 2016;13:185–93. https://doi.org/10.1007/s10433-016-0369-0.
[33] Krishnamoorthy Y, Rajaa S, Rehman T. Diagnostic accuracy of various forms of geriatric depression scale for screening of depression among older adults: Systematic review and meta-analysis. Arch Gerontol Geriatr 2020;87:104002. https://doi.org/10.1016/j.archger.2019.104002.
[34] Lee PH, Yeh TT, Yen HY, Hsu WL, Chiu VJ, Lee SC. Impacts of stroke and cognitive impairment on activities of daily living in the Taiwan longitudinal study on aging. Sci Rep 2021;11:12199. https://doi.org/10.1038/s41598-021-91838-4.
[35] Liu M, et al. Associations between symptoms of pain, insomnia and depression, and frailty in older adults: a cross-sectional analysis of a cohort study. Int J Nurs Stud 2021;117:103873. https://doi.org/10.1016/j.ijnurstu.2021.
[36] Mall JF, Chouiter L, Antonietti JP, Ebbing K, von Gunten A. Cognition and psychopathology in nonagenarians and centenarians living in geriatric nursing homes in Switzerland: a focus on anosognosia. Psychogeriatrics 2014;14:55–62. https://doi.org/10.1111/psyg.12041.
[37] Margrett J, et al. Depression among centenarians and the oldest old: contributions of cognition and personality. Gerontology 2010;56:93–9. https://doi.org/10.1159/000272018.
[38] Meleis AI. Transitions Theory: Middle-Range and Situation-Specific Theories in Nursing Research and Practice. New York: Springer Publishing Company; 2010.
[39] Merçay C. La santé des 65 ans et plus en Suisse latine: Analyses intercantonales des données de l'Enquête suisse sur la santé 2017. Obs Suisse De la St (Obsan) 2020.
[40] Obsan. Indicateurs de la santé de la population âgée en Suisse. Neuchâtel: Observatoire suisse de la santé (Obsan); 2019.
[41] OECD. Health at a Glance 2023. Paris: OECD Indicators; 2023.
[42] OFS. Espérance de vie. Federal Statistical Office; 2024.
[43] OFS. Vivre 100 ans et au-delà. Federal Statistical Office; 2024.
[44] Pazan F, Wehling M. Polypharmacy in older adults: a narrative review of definitions, epidemiology and consequences. Eur Geriatr Med 2021;12:443–52. https://doi.org/10.1007/s41999-021-00479-3.
[45] Pedro VC, Arturo RH, Alejandro PM, Oscar RC. Sociodemographic and clinical characteristics of centenarians in Mexico City. Biomed Res Int 2017;2017:7195801. https://doi.org/10.1155/2017/7195801.
[46] Reppermund S, Heintze T, Srasuebkul P, Trollor JN. Health profiles, health services use, and transition to dementia in inpatients with late-life depression and other mental illnesses. J Am Med Dir Assoc 2021;22:1465–70. https://doi.org/10.1016/j.jamda.2020.10.018.
[47] Ribeiro O, et al. Health status, living arrangements, and service use at 100: findings from the oporto centenarian study. J Aging Soc Policy 2016;28:148–64. https://doi.org/10.1080/08959420.2016.1165582.
[48] Ribeiro O, Duarte N, Teixeira L, Paul C. Frailty and depression in centenarians. Int Psychogeriatr 2018;30:115–24. https://doi.org/10.1017/S1041610217001910.
[49] Ribeiro O, Teixeira L, Araujo L, Afonso RM, Pachana N. Predictors of anxiety in centenarians: health, economic factors, and loneliness. Int Psychogeriatr 2015;27:1167–76. https://doi.org/10.1017/S1041610214001628.
[50] Richmond RL, Law J, Kay-Lambkin F. Physical, mental, and cognitive function in a convenience sample of centenarians in Australia. J Am Geriatr Soc 2011;59:1080–6. https://doi.org/10.1111/j.1532-5415.2011.03404.x.
[51] Robine JM, Cubaynes S. Worldwide demography of centenarians. Mech Ageing Dev 2017;165:59–67. https://doi.org/10.1016/j.mad.2017.03.004.
[52] Royal College of Psychiatrists and British Geriatrics Society (2018). Collaborative approaches to treatment: Depression among older people living in care homes. London.
[53] Runcan PL. Elderly institutionalization and depression. Procedia - Soc Behav Sci 2012;33:109–13. https://doi.org/10.1016/j.sbspro.2012.01.093.
[54] Schumacher KL, Jones PS, Meleis AI. Helping elderly persons in transition: a framework for research and practice. In: Meleis AI, editor. Transitions Theory: Middle-Range and Situation-Specific Theories in Nursing Research and Practice. New York: Springer Publishing Company; 2010. p. 129–44.
[55] Scott AJ. The longevity society. Lancet Healthy Longev 2021;2:e820–7. https://doi.org/10.1016/S2666-7568(21)00247-6.
[56] Sheikh JI, Yesavage JA. Geriatric Depression Scale (GDS): Recent evidence and development of a shorter version. Clin Gerontol 1986;5:165–73.
[57] Silva e Farias IP, et al. Physical and psychological states interfere with health-related quality of life of institutionalized elderly: a cross-sectional study. BMC Geriatr 2020;20:386. https://doi.org/10.1186/s12877-020-01791-6.
[58] Song Y, et al. [Association between nutritional status and depression among centenarians in Hainan Province]. Zhonghua Yi Xue Za Zhi 2022;102:114–8. https://doi.org/10.3760/cma.j.cn112137-20210520-01171.
[59] Sun Z, et al. Associations between cardiac structure and function and depressive disorder: a centenarian study in China. Heliyon 2023;9:e13233. https://doi.org/10.1016/j.heliyon.2023.e13233.
[60] Teixeira L, Araujo L, Duarte N, Ribeiro O. Falls and fear of falling in a sample of centenarians: the role of multimorbidity, pain and anxiety. Psychogeriatrics 2019;19:457–64. https://doi.org/10.1111/psyg.12423.
[61] Uittenhove K, Lampraki C, da Rocha CG, Rott C, von Gunten A, Jopp DS. Profiles of centenarians' functioning: linking functional and cognitive capacity with depressive symptoms. BMC Geriatr 2024;24:451. https://doi.org/10.1186/s12877-024-05036-8.
[62] UN (2015). World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. New York.
[63] UN. Probabilistic Population Projections based on the World Population Prospects 2024. United Nations, Department of Economic and Social Affairs, Population Division; 2024.
[64] Valtorta N, Hanratty B. Loneliness, isolation and the health of older adults: do we need a new research agenda? J R Soc Med 2012;105:518–22. https://doi.org/10.1258/jrsm.2012.120128.
[65] Wang EY, Meyer C, Graham GD, Whooley MA. Evaluating screening tests for depression in post-stroke older adults. J Geriatr Psychiatry Neurol 2018;31:129–35. https://doi.org/10.1177/0891988718778791.
[66] Wen Z, Fan X. Monotonicity of effect sizes: Questioning kappa-squared as mediation effect size measure. Psychol Methods 2015;20:193–203. https://doi.org/10.1037/met0000029.
[67] WHO (2022). World Health Statistics 2022: Monitoring Health for the SDGs: Sustainable Development Goals. Geneva.
[68] WHO. Mental health of older adults. World Health Organization; 2023.
[69] Yao Y, et al. The prevalence of depressive symptoms in Chinese longevous persons and its correlation with vitamin D status. BMC Geriatr 2018;18:198. https://doi.org/10.1186/s12877-018-0886-0.
[70] Yesavage JA, et al. Development and validation of a geriatric depression screening scale: a preliminary report. J Psychiatr Res 1983;17:37–49. https://doi.org/10.1016/0022-3956(82)90033-4.
[71] Zhang C, et al. Psychometric properties and modification of the 15-item geriatric depression scale among Chinese oldest-old and centenarians: a mixed-methods study. BMC Geriatr 2022;22:144. https://doi.org/10.1186/s12877-022-02833-x.