

# Mild cognitive impairment is associated with passive suicidal ideation in older adults: A population-based study

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## Abstract

**Objective:** To investigate the association between MCI and passive/active suicidal ideation in a population-based sample of older adults.

**Method:** The sample included 916 participants without dementia acquired from the two population-based studies Prospective Population Study of Women (PPSW) and the H70-study. Cognitive status was assessed using a comprehensive neuropsychiatric examination and classified according to the Winblad et al. criteria: 182 participants were classified as cognitively intact, 448 had cognitive impairment but did not fulfill MCI criteria and 286 were diagnosed with MCI. Passive/active suicidal ideation was assessed using the Paykel questions.

**Results:** Passive or active suicidal ideation (any level) was reported by 16.0% of those with MCI and 1.1% of those who were cognitively intact. MCI was associated with past year life-weariness (OR 18.32, 95% CI 2.44–137.75) and death wishes (OR 5.30, 95% CI 1.19–23.64) in regression models adjusted for covariates including major depression. Lifetime suicidal ideation was reported more frequently in MCI (35.7%) than in cognitively intact participants (14.8%). MCI was associated with lifetime life-weariness (OR 2.90, 95% CI 1.67–5.05).

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Among individuals with MCI, impairments in memory and visuospatial ability were associated with both past year and lifetime life-weariness.

**Conclusion:** Our findings suggest reports of past year as well as lifetime passive suicidal ideation to be more frequent among individuals with MCI compared to those cognitively intact, indicating that individuals with MCI may constitute a high-risk group for suicidal behavior.

#### KEYWORDS

death wishes, mild cognitive impairment, old age, suicidal ideation

## 1 | INTRODUCTION

In most countries of the world, high suicide rates are observed among older adults; a number expected to rise due to aging of the population.<sup>1</sup> Major depression is the psychiatric disorder most strongly associated with late-life suicide. However, many older adults with suicidal ideation do not fulfill criteria for this condition.<sup>2,3</sup> It has been increasingly recognized that impairments in cognitive functioning may predispose to suicidal behavior.<sup>4–6</sup> Clinical studies in older adults have suggested that impaired cognitive functioning might compromise the ability to adapt and solve life's problems in an appropriate manner.<sup>4,7</sup> Since cognition is an ability particularly prone to decline with age,<sup>8</sup> the association between impaired cognitive competence and suicidal behavior in older adults is of particular interest.

The construct of MCI, defined by the currently widely accepted Winblad et al. criteria,<sup>9</sup> is suggested to capture the prodromal stage of dementia. It refers to a condition in which cognitive impairments are present but the ability to carry out everyday activities is still intact.<sup>10</sup> A recent cohort study found older adults to be at elevated risk of attempting suicide adjacently to an MCI diagnosis.<sup>11</sup> These findings suggest that individuals with MCI may constitute a group at particular high risk for suicide as they still have the functional ability to plan and act on suicidal thoughts.

Previous clinical studies in older adults have investigated impairments in specific cognitive domains among depressed suicide attempters and have found impairments regarding problem solving and decision-making,<sup>12–14</sup> cognitive inhibition,<sup>7</sup> reduced ability of understanding proverbs<sup>15</sup> as well as impairments in short-term and working memory.<sup>4,16,17</sup> Lower scores on Mini-Mental State Examination (MMSE)<sup>18</sup> and poorer visuospatial ability were found in older suicide attempters compared to a population-based sample matched for level of depression.<sup>15</sup> The results from these previous clinical studies has been complicated to interpret since participants were suffering from ongoing

### Significant outcomes

- In a cross-sectional, population-based sample, MCI was associated with both past year and lifetime passive suicidal ideation.
- Associations remained in models adjusted for covariates including major depression.
- Impairments of memory and visuospatial ability were associated with passive suicidal ideation in persons with MCI.

### Limitations

- The sample consists of older women and men and cannot be extrapolated to other populations.
- The study was underpowered to identify potential associations between MCI and active suicidal ideation/attempts.
- The cross-sectional design limits conclusions about directionality.

depression, the most common condition associated with suicidal behavior that at the same time is known to involve cognitive impairments.<sup>19–23</sup>

A handful of population-based studies have aimed at investigating whether impairments in specific cognitive domains contribute to an increase of suicidal ideation and behavior in older adults, beyond the involvement of depressive disorders. Results are mixed. One recent prospective population-based study in older adults found executive functioning at baseline to be associated with a sevenfold increased risk of suicide during a mean follow-up period of 4.9 years.<sup>24</sup> Neither suicidal ideation nor behavior were associated with suicide in that study. Poor performance on time-orientation tasks was reported in another population-based sample of older adults with passive suicidal ideation.<sup>25</sup> However, one population-based study found no

association between global cognitive functioning (based on tests assessing short-term and working-memory as well as verbal fluency) and reports of passive/active suicidal ideation in participants aged 50–64 and 65+.<sup>26</sup>

In this study, we investigated the association between cognitive status according to the Winblad et al. criteria and passive/active suicidal ideation in a population-based sample of older individuals. We also examined associations between impairments in specific cognitive domains and passive/active suicidal ideation among participants with MCI. We hypothesized that individuals with MCI would report passive/active suicidal ideation to a larger extent than cognitively intact individuals, and that such ideation would be associated with executive impairments.

## 2 | AIMS OF THE STUDY

The aim of this study was to investigate the relationship between MCI and passive/active suicidal ideation in a population-based sample of older women and men. A second aim was to assess whether the association was related to impairments in specific cognitive domains.

## 3 | MATERIALS AND METHODS

### 3.1 | Subjects

The study sample was obtained from two population-based surveys carried out between 2000–2002 in Gothenburg, Sweden, the Prospective Population Study of Women (PPSW) and the H70-study. Based on birth date, participants were recruited among women and men living in private households and in residential care, as previously described.<sup>27</sup> The study included women from PPSW born on certain dates in 1908, 1914, 1918, 1922. The sample included also participants in the H70-study, women and men born on certain dates in 1930 living in Gothenburg, Sweden, on September 1, 2000. Among the 1504 individuals selected to take part in the psychiatric examination, 1018 participated (response rate 67.7%). Of these, 94 individuals were excluded from the current study due to dementia, a further three were excluded due to incomplete cognitive examinations and five due to missing data on suicidal ideation, leaving an effective sample size of 916 individuals (692 women and 224 men). Compared to non-participants, participants did not differ regarding sex (female; 75.5% vs 71.6%,  $P = 0.110$ ) and age (mean 74.0 vs 74.3,  $P = 0.245$ ) and had similar rates of hospital care

as registered in the Swedish Hospital Discharge register during the five-year period prior to the examination ( $P = 0.309$ ).

The study was approved by the Ethics Committee for Medical Research at the University of Gothenburg. Written informed consent was obtained from all participants.

### 3.2 | Procedures

Trained psychiatric research nurses and a psychologist performed the clinical examinations at the geriatric psychiatry outpatient department or in the participant's home. Examinations included comprehensive social, functional, physical, neuropsychiatric examinations. Key informants were interviewed by telephone (see Supplemental material Table S1). The Comprehensive Psychopathological Rating Scale (CPRS)<sup>28</sup> was employed to rate neuropsychiatric symptoms. The Montgomery-Åsberg Depression Rating Scale (MADRS)<sup>28</sup> was used to rate symptoms of depression. The MADRS score used in this study was based on 7 items (MADRS-7 items) after the exclusion of two cognitive items (concentration difficulties and lassitude based on the items "concentration" and "taking initiative" from the CPRS) as well as the suicide item (also collected from the CPRS) as they were used in the assessment of cognitive status and suicidal ideation, respectively. The remaining seven items are rated 0 (symptom not present) to 6 (severe symptom level). The Mini-Mental State Exam (MMSE) was used to screen global cognitive function.<sup>18</sup> The neuropsychiatric assessment included modified items from the Alzheimer's Disease Assessment Scale (ADAS-Cog).<sup>29</sup> As previously described,<sup>30</sup> self-care daily activities (ADL) were assessed by research nurses using binary questions (yes/no) as proposed by the Katz Index (independent or dependent of help in bathing, dressing, toileting, transfer and feeding).<sup>31</sup> Instrumental ADL (IADL) tasks were based on assessment of difficulties in household management (cleaning, shopping, transportation and cooking) using similar binary questions (yes/no). Key informant interviews were semi-structured and included the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE),<sup>32</sup> a questionnaire assessing cognitive decline during the last 10 years, independent of pre-morbid ability.

### 3.3 | Diagnoses

#### 3.3.1 | MCI and dementia

MCI was classified according to the Winblad et al. criteria<sup>9</sup> using an algorithm based on binary information (not impaired/impaired) from three different sources,

i.e., self-report, key informant interview and neuropsychiatric assessment<sup>33</sup> and items regarding objective assessment of ADL and IADL as presented above (see Supplemental material Table S1). Non-demented individuals who (1) reported subjective cognitive impairment (scores >2 in any cognitive item using self-report), whether or not confirmed by key informant (IQCODE score >3.12, and (2) showed objective cognitive impairment according to neuropsychiatric assessments (score >0 in any cognitive item), and (3) had intact ADL (fully independent) and minimally impaired IADL (partially dependent, but not in all IADL) were classified as MCI according to Winblad et al. criteria.<sup>9</sup> Those neither cognitively intact, nor MCI who had intact ADL and minimally impaired IADL were classified as cognitively impaired not fulfilling MCI criteria (i.e., either reported subjective cognitive impairment without cognitive impairment according to the neuropsychiatric assessment; or did not report subjective cognitive impairment but showed cognitive impairment according to the neuropsychiatric assessment). Research notes were examined when the algorithm detected discrepancies between cognition and everyday functioning level in order to rule out ADL and IADL impairments due to physical disability. The MCI classification in such cases was confirmed at consensus conferences with dementia specialists (SS, IS, SK). At the consensus conference it was also agreed that ADL/IADL impairment was not due to cognition in individuals with MMSE scores >26.

The distribution of impairments in specific cognitive domains was assessed among participants with MCI using neuropsychiatric assessments of memory, language, visuospatial ability and executive functioning (see Supplemental material Table S1). All cognitive items were dichotomized (not impaired/impaired) as presented above. Scores in the impaired range in any single item within a domain resulted in “impaired” classification for the entire domain. The diagnosis of dementia was made on the basis of the neuropsychiatric examination and the key informant interview, using DSM-III-R criteria.<sup>34</sup> In the current study, dementia was used as an exclusion criterion only.

### 3.4 | Passive/active suicidal ideation

During the neuropsychiatric examination, participants were asked in accordance with the Paykel questions<sup>35</sup> if they: (1) felt life was not worth living, (2) wished they were dead, (3) had thoughts of taking their own life (4) had seriously considered taking their own life and (5) had made a suicide attempt. Paykel called these phenomena “suicidal feelings”, but for the purpose of this study, we used the term passive/active suicidal ideation.

The presence or absence (yes/no) of such ideation was recorded for specified time periods (past week, past month, past year or more than a year ago). As originally described by Paykel et al., time frames were pooled and suicidal ideation was categorized as present or absent during the past year or during lifetime.

### 3.5 | Psychiatric risk factors

Consumption of alcohol above 100 g/week for women and 150 g/week for men was classified as a current risk consumption. Major depression was diagnosed according to DSM-IV criteria<sup>36</sup> but without the bereavement criterion, making the diagnosis compatible to DSM-5.<sup>37</sup>

### 3.6 | Statistical analysis

Age differences between groups (cognitively intact, MCI and those with cognitive impairment not fulfilling MCI criteria) were tested using Student's *t* test. Categorical variables (i.e. female sex, marital status (married or cohabiting vs not married or cohabiting), education beyond mandatory, history of stroke, current risk consumption of alcohol, current usage of antidepressants and current major depression) and passive/active suicidal ideation during past year and during lifetime according to Paykel questions were compared using Fisher's exact test. The group of cognitively intact individuals was the reference group for all comparisons. Associations between cognitive status (intact, cognitively impaired not fulfilling MCI criteria and MCI) and reports of suicidal ideation (outcome variable yes/no) were tested using stepwise backward logistic regression models with age, female sex, marital status, education beyond mandatory and major depression as covariates. The relationship between subjective (self-reported) and objective cognitive impairment using neuropsychiatric assessment and suicidal ideation were also tested in a fully adjusted stepwise backward regression model with age, female sex, marital status, education beyond mandatory and major depression as covariates.

Further, for the subgroup with MCI, we analyzed associations between impairments in specific cognitive domains and suicidal ideation using Fisher's exact test. Stepwise backward logistic regression models were used to examine these associations while adjusting for age, female sex, marital status, education beyond mandatory and major depression. In an ancillary analysis we replaced major depression with depressive symptom score (MADRS-7 items).

Missing data was handled by list-wise deletion; no imputations were made. Fully adjusted models are



presented. Statistical tests were carried out using SPSS for Windows (version 24, SPSS Chicago, IL). All tests used a two-tailed  $P < 0.05$  to indicate statistical significance.

## 4 | RESULTS

Basic characteristics of the participants by cognitive status are presented in Table 1. Compared to those cognitively intact, participants with MCI were significantly older, more likely to be women and less likely to have education beyond mandatory. Further, they were less often married or cohabiting, and they were to a larger extent diagnosed with major depression.

Individuals with MCI reported past year life-weariness significantly more often than cognitively intact individuals (Table 2). An association was also seen regarding reports of past year death wishes. In all, 16.0% of the participants with MCI reported some level of passive/active suicidal ideation during the past year. The corresponding figure was 1.1% in the cognitively intact group. Thus, MCI was associated with a 17-fold increase in odds for any level of passive/active suicidal ideation. While elevated odds were also seen for the group that was not cognitively intact, but did not fulfill criteria for MCI, risk estimates were numerically lower than in the MCI group. However, confidence intervals were wide and overlap was apparent. Table 2 shows further that one third of those with MCI reported life-weariness at some point in life, compared to about one tenth of those who were cognitively intact. Further, participants with MCI

reported lifetime death wishes twice as often as cognitively intact individuals. An association was found between MCI and lifetime reports of suicidal ideation (any severity level). The same was observed for the group that was not cognitively intact but did not fulfill criteria for MCI.

Associations between MCI and both past year-life weariness and death wishes remained in regression models adjusted for age, sex, marital status, education level and major depression (Table 3). MCI was associated with a near three-fold increase in the odds of having experienced life weariness at some point in life compared to the cognitively intact group.

Results of corresponding regression models for the group with cognitive impairment not fulfilling MCI criteria indicated an association regarding lifetime reports of life weariness when compared to cognitively intact participants (Supplemental material Table S2).

Additional regression models were also carried out on the association between MCI passive suicidal ideation using MADRS-7 items score as a covariate (Supplemental material Table S3). MCI was associated only with life weariness, regardless of time frame.

Self-reported and objective cognitive impairment and their association with passive suicidal ideation are reported in regression models adjusted for age, sex, marital status, education level and major depression (Table 4). Subjective cognitive impairment was related to life weariness as well as death wishes, regardless of timeframe. Objective cognitive impairment was only related to past year life weariness.

**TABLE 1** Basic characteristics by cognitive status in a population-based sample of older individuals without dementia

	Cognitively intact	Not fulfilling MCI criteria		MCI	
	( <i>n</i> = 182)	( <i>n</i> = 448)	<i>P</i> value	( <i>n</i> = 286)	<i>P</i> value
Age, y, mean (SD):	72.5 (4.7)	74.0 (4.7)	.001 <sup>a</sup>	74.8 (5.6)	< .001 <sup>a</sup>
Sex, female, <i>n</i> (%):	116 (63.7)	349 (77.9)	< 0.001	227 (79.4)	< 0.001
Married/cohabiting, <i>n</i> (%):	111 (61.0)	243 (54.2)	0.132	126 (44.1)	< 0.001
Education beyond mandatory, <i>n</i> (%):	87 (48.3)	162 (38.1)	0.024	88 (32.1)	0.001
History of stroke, <i>n</i> (%):	9 (4.9)	33 (7.4)	0.296	29 (10.2)	0.055
Current risk consumption of alcohol <sup>b</sup> , <i>n</i> (%):	15 (8.4)	33 (7.9)	0.870	20 (7.8)	0.859
Current use of antidepressants, <i>n</i> (%):	1 (0.5)	6 (1.3)	0.680	5 (1.7)	0.412
Major depression, <i>n</i> (%):	0 (0.0)	9 (2.0)	0.066	28 (9.8)	< 0.001
MADRS-7 items, mean (SD):	1.0 (2.5)	2.1 (3.8)	< 0.001	5.0 (6.0)	< 0.001
MMSE, mean (SD):	29.3 (5.1)	29.6 (9.0)	0.642	28.3 (6.2)	0.094

Note: MCI, mild cognitive impairment. MADRS-7 items, Montgomery-Åsberg Depression Rating Scale with the exclusion of two cognitive items (concentration difficulties and lassitude) and the suicide item.

MMSE, Mini-Mental State Examination. SD, standard deviation.

*P* values for comparisons with cognitively intact group are significant at  $P < 0.05$ .

<sup>a</sup>In accordance with Student's *t* test; all other analyses in accordance with Fisher's exact test.

<sup>b</sup>Current consumption above 100 g/week for women and 150 g/week for men.

TABLE 2 Associations between cognitive status and passive/active suicidal ideation in a population-based sample of older adults without dementia

Suicidal ideation	Cognitively intact ( <i>n</i> = 182)		Not fulfilling MCI criteria ( <i>n</i> = 448)		MCI ( <i>n</i> = 286)		<i>P</i> value	OR (95% CI)	<i>P</i> value
	No. (%)	No. (%)	No. (%)	OR (95% CI)	No. (%)	OR (95% CI)			
<b>Past year</b>									
<b>Life weariness</b>	1 (0.6)	22 (5.8)	9.92 (1.33–74.20)	0.004	39 (16.8)	32.33 (4.39–237.94)	< 0.001		< 0.001
<b>Death wishes</b>	2 (1.2)	13 (3.2)	2.68 (0.60–12.02)	0.252	26 (10.3)	9.34 (2.19–39.88)	< 0.001		< 0.001
<b>Thought of taking your life</b>	1 (0.6)	3 (0.7)	1.22 (0.13–11.84)	1.000	7 (2.6)	4.54 (0.55–37.24)	0.158		0.158
<b>Seriously considered taking your life</b>	0 (0.0)	1 (0.2)	-	-	3 (1.1)	-	-		-
<b>Attempted to take your life</b>	0 (0.0)	0 (0.0)	-	-	1 (0.4)	-	-		-
<b>Suicidal ideation, any severity level</b>	2 (1.1)	27 (6.1)	5.81 (1.37–24.69)	0.006	45 (16.0)	16.99 (4.07–70.98)	< 0.001		< 0.001
<b>Lifetime</b>									
<b>Life weariness</b>	22 (12.1)	91 (20.4)	1.86 (1.13–3.08)	0.016	92 (32.3)	3.47 (2.08–5.77)	< 0.001		< 0.001
<b>Death wishes</b>	19 (10.4)	52 (11.6)	1.13 (0.65–1.97)	0.781	59 (20.6)	2.23 (1.28–3.88)	0.005		0.005
<b>Thought of taking your life</b>	14 (7.7)	34 (7.6)	0.99 (0.52–1.89)	1.000	27 (9.4)	1.25 (0.64–2.46)	0.616		0.616
<b>Seriously considered taking your life</b>	9 (4.9)	18 (4.0)	0.81 (0.36–1.83)	0.655	17 (5.9)	1.22 (0.53–2.79)	0.685		0.685
<b>Attempted to take your life</b>	3 (1.6)	11 (2.5)	1.50 (0.41–5.45)	0.767	11 (3.9)	2.40 (0.66–8.71)	0.266		0.266
<b>Suicidal ideation, any severity level</b>	27 (14.8)	182 (1.15–2.90)	0.010		102 (35.7)	3.18 (1.98–5.12)	< 0.001		< 0.001

Note: MCI, Mild Cognitive Impairment. OR, Odds ratio. CI, Confidence interval.

Associations between cognitive status and suicidal ideation were assessed using Fisher's exact test and are significant at  $P < 0.05$ .

Missing information regarding past year suicidal feelings: Cognitively intact  $n = 3$ , Not fulfilling MCI criteria  $n = 11$  and MCI  $n = 11$ .

Missing information regarding lifetime suicidal feelings: Not fulfilling MCI criteria  $n = 11$ .

**TABLE 3** Results of adjusted regression models for associations with past year and lifetime passive suicidal ideation<sup>a</sup>

Variable	Past year suicidal ideation		Death wishes	
	OR (95% CI)	P value	OR (95% CI)	P value
<b>Age</b>	0.96 (0.89–1.04)	0.330	0.97 (0.89–1.05)	0.456
<b>Sex (female)</b>	2.66 (0.70–10.21)	0.150	7.24 (0.94–55.58)	0.057
<b>Married or cohabiting</b>	0.42 (0.19–0.97)	0.042	0.74 (0.30–1.82)	0.506
<b>Education beyond mandatory</b>	1.12 (0.48–2.62)	0.801	1.40 (0.57–3.42)	0.459
<b>Major depression</b>	14.97 (5.37–41.74)	< 0.001	8.49 (3.18–22.68)	< 0.001
<b>MCI</b>	18.32 (2.44–137.75)	0.005	5.30 (1.19–23.64)	0.029
Variable	Lifetime suicidal ideation		Death wishes	
	OR (95% CI)	P value	OR (95% CI)	P value
<b>Age</b>	0.97 (0.92–1.01)	0.140	0.98 (0.93–1.03)	0.468
<b>Sex (female)</b>	1.45 (0.77–2.74)	0.252	1.41 (0.69–2.87)	0.349
<b>Married or cohabiting</b>	0.46 (0.29–0.75)	0.002	0.47 (0.27–0.79)	0.005
<b>Education beyond mandatory</b>	1.66 (1.03–2.70)	0.040	1.43 (0.84–2.44)	0.187
<b>Major depression</b>	8.40 (3.35–20.99)	< 0.001	4.72 (2.07–10.76)	< 0.001
<b>MCI</b>	2.90 (1.67–5.05)	< 0.001	1.75 (0.97–3.18)	0.064

Note: MCI, Mild Cognitive Impairment. OR, Odds ratio. CI, Confidence interval.

Associations between MCI and suicidal ideation in logistic regression models (stepwise backward) are significant at  $P < 0.05$ .

<sup>a</sup>Logistic regression models adjusted for age, sex, major depression, marital status and education level.

**TABLE 4** Results of adjusted regression models for associations between subjective or objective cognitive impairment and passive suicidal ideation<sup>a</sup>

Variable	Past year ideation		Death wishes	
	OR (95% CI)	P value	OR (95% CI)	P value
<b>Subjective cognitive impairment</b>	3.28 (1.73–6.20)	< 0.001	3.22 (1.44–7.20)	0.004
<b>Objective cognitive impairment</b>	2.88 (1.17–7.07)	0.021	1.95 (0.73–5.17)	0.181
Variable	Lifetime ideation		Death wishes	
	OR (95% CI)	P value	OR (95% CI)	P value
<b>Subjective cognitive impairment</b>	2.23 (1.57–3.18)	< 0.001	1.92 (1.27–2.92)	0.002
<b>Objective cognitive impairment</b>	1.54 (1.02–2.32)	0.041	1.25 (0.78–2.00)	0.355

Note: OR, Odds ratio. CI, Confidence interval.

Subjective cognitive impairment  $n = 299$  and Objective cognitive impairment  $n = 671$ .

Associations between subjective and objective cognitive impairment and passive suicidal ideation in logistic regression models (stepwise backward) are significant at  $P < 0.05$ .

<sup>a</sup>Logistic regression models adjusted for age, sex, major depression, marital status and education level.

Associations between impairments in specific cognitive domains and passive suicidal ideation among individuals with MCI are presented in Table 5. Impaired memory and visuospatial ability were associated with past year life-weariness. These impairments were also related to lifetime reports of life-weariness.

## 5 | DISCUSSION

In a population-based sample of 916 older men and women, MCI was associated with both past year and lifetime life-weariness and death wishes, independent of covariates including major depression. Our findings

TABLE 5 Associations between specific cognitive impairments and passive suicidal ideation in the subgroup with MCI<sup>a</sup>

Variable	Past year ideation <sup>b</sup>			Death wishes		
	No. (%)	OR (95% CI)	P value	No. (%)	OR (95% CI)	P value
Memory	13 (18.8)	2.78 (1.13–6.86)	0.026	10 (13.3)	1.76 (0.63–4.89)	0.282
Language	9 (20.5)	0.76 (0.22–2.67)	0.670	9 (18.0)	2.42 (0.88–6.62)	0.086
Visuospatial ability	18 (20.5)	2.96 (1.28–6.84)	0.011	8 (8.5)	0.73 (0.27–1.97)	0.532
Executive functioning	35 (17.0)	2.38 (0.77–7.32)	0.131	24 (10.8)	3.05 (0.97–9.66)	0.058
Variable	Lifetime ideation <sup>b</sup>			Death wishes		
	No. (%)	OR (95% CI)	P value	No. (%)	OR (95% CI)	P value
Memory	30 (34.9)	1.81 (1.00–3.28)	0.049	21 (24.4)	1.75 (0.95–3.24)	0.073
Language	22 (38.6)	1.32 (0.62–2.81)	0.472	16 (28.1)	1.20 (0.54–2.67)	0.649
Visuospatial ability	38 (35.2)	1.79 (1.03–3.10)	0.040	22 (20.4)	1.34 (0.75–2.42)	0.327
Executive functioning	79 (31.6)	1.40 (0.81–2.42)	0.228	52 (20.7)	1.36 (0.76–2.45)	0.304

Note: MCI, Mild Cognitive Impairment. OR, Odds ratio. CI, Confidence interval, SD, Standard deviation.

<sup>a</sup>*n* = 286.

<sup>b</sup>Associations between specific cognitive impairments among individuals with MCI and suicidal ideation in logistic regression models (stepwise backward) are significant at *P* < 0.05.

regarding the timeframe of suicidal ideation are of particular interest as individuals' "worst point" severity of suicidal ideation is a strong predictor of eventual suicide.<sup>38,39</sup> Our results also indicate a particular vulnerability among individuals with self-perceived cognitive impairment to report passive suicidal ideation, regardless of timeframe of such ideation. In participants with MCI, impairments in memory and visuospatial ability were related to not only past year but also lifetime life-weariness.

We could find no other population-based study targeting this age group for comparison of the association between MCI and suicidal ideation. MCI diagnosed according to the National Institute of Neurological and Communicative Disorders and Stroke, and the AD and Related Disorders Association (NINCDS-ADRDA) was previously found not to be associated with increased risk of suicide in a prospective study in older adults who attended a memory clinic.<sup>40</sup> Negative findings were also presented in a case-control study in older suicide attempters where MCI was based on measurement instruments, including MMSE as well as diagnostic interviews.<sup>41</sup>

We found self-perceived cognitive impairment to be associated with both life weariness as well as death wishes, regardless of timeframe. Elevated risk of suicide attempt among patients with MCI<sup>11</sup> and death by suicide adjacent to a dementia diagnosis<sup>42,43</sup> has previously been observed. Preserved insight regarding ongoing cognitive deterioration, anticipated progression of decreased functional ability, impending future loss of autonomy as well

as becoming a burden to others<sup>11</sup> have been highlighted as possible explanations behind increased suicidal behavior in this group.

Our findings of impaired memory assessed as recent and remote memory, semantic memory and time orientation among individuals with MCI who reported past year and lifetime passive suicidal ideation expands on results from a population-based study that found impaired time orientation among participants who reported past month passive suicidal ideation.<sup>25</sup> Impaired short-term and working memory have also previously been found in clinical samples of older depressed suicide attempters.<sup>4,16,44,45</sup>

No association was seen between impaired language assessed as speech comprehension, speech production and dysnomia (difficulties finding words) in the current study. These are abilities that are involved in the phonological loop, a key component in working memory,<sup>45</sup> that have not been previously studied in the context of suicidal ideation.

We found visuospatial ability assessed by the ability to draw geometrical figures to be impaired among individuals with MCI who reported passive suicidal ideation (both past year and lifetime). This task, which requires visuospatial conceptualisation, visual attention, and spatial working memory, has not been previously investigated in relation to suicidal behavior in population-based samples. However, a previous clinical study found suicide attempters to perform more poorly on tests of pentagon drawing compared to controls matched for level of depression.<sup>15</sup>



Contrary to our hypothesis, executive impairment was not associated with suicidal ideation in participants with MCI in the current study. Our work differs methodologically from previous studies as we have assessed executive impairment in comprehensive neuropsychiatric assessments, making it difficult to directly compare results with previous studies that have used standardized neuropsychometric tests. Impairments in any of the standardized tests of Frontal Assessment Battery, Trail Making Test A, Digit span Test and Verbal Fluency Test at baseline were not associated with an increase in suicidal ideation or attempt in a recent population-based prospective cohort study involving older adults; a seven-fold increase was however seen regarding risk of completed suicide.<sup>24</sup> A relationship between suicidal behavior and impairments in executive functioning have previously been suggested by clinical studies,<sup>7,12-14,17,46</sup> however, participants in these studies were suffering from ongoing depression which complicates comparison.

## 6 | STRENGTHS AND LIMITATIONS

Strengths of the study include the population-based samples assessed with comprehensive neuropsychiatric examinations and the availability of multiple sources of information on cognitive impairments including self-reports and key informant interviews, as well as objective assessments of ADL and IADL.

Some limitations need to be addressed. This study was cross-sectional and it is thus not possible to conclude a causal relationship between passive/active suicidal ideation and MCI. Also, the data was collected during 2000–2002. Making assumptions based on older data might be complex, however, we note stable prevalence figures for passive and active suicidal ideation in older adults residing in the catchment area over the past two decades.<sup>47</sup> Another limitation is that we were not able to model appropriately the more severe suicidal ideation and attempts in relation to MCI due to small numbers reporting these phenomena in our population-based sample. Selection bias may also be at play since potential participants with more severe suicidal feelings might decline participation. Results from this study cannot be extrapolated to younger populations.

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### CONFLICT OF INTEREST STATEMENT

SK has been consultant for Geras Solutions and Biogen. HZ has served at scientific advisory boards and/or as a consultant for Abbvie, Alector, Annexon, Artery Therapeutics, AZTherapies, CogRx, Denali, Eisai, Nervgen, Pinteon Therapeutics, Red Abbey Labs, Passage Bio, Roche, Samumed, Siemens Healthineers, Triplet Therapeutics, and Wave, has given lectures in symposia sponsored by Cellectricon, Fujirebio, Alzecure, Biogen, and Roche, and is a co-founder of Brain Biomarker Solutions in Gothenburg AB (BBS), which is a part of the GU Ventures Incubator Program. The other authors declare no conflict of interest.

### PEER REVIEW

The peer review history for this article is available at <https://www.webofscience.com/api/gateway/wos/peer-review/10.1111/acps.13549>.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

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### SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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