

TITLE

The Mini Nutritional Assessment-Short Form and mortality in nursing home residents — Results from the INCUR study

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1 **The Mini Nutritional Assessment-Short Form and mortality in nursing home residents -**
2 **Results from the INCUR study**

3

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13 **Abstract**

14 **OBJECTIVES:** To examine whether the Mini Nutritional Assessment-Short Form (MNA-
15 SF) score and its individual items are predictors of mortality in a nursing home population.

16 **DESIGN:** Prospective, secondary analysis from the Incidence of pNeumonia and related
17 ConseqUences in nursing home Residents (INCUR) study with 1-year follow-up.

18 **PARTICIPANTS:** A total of 773 older persons (women 74.4%) living in 13 French nursing
19 homes.

20 **MEASUREMENTS:** At baseline, nutritional status was assessed with the MNA-SF. Overall
21 mortality rate was measured over a 12-month follow-up period after the baseline assessment
22 visit. Cox proportional hazard models were performed to test the predictive capacity of the
23 MNA-SF score and its single components for mortality.

24 **RESULTS:** Mean age of participants was 86.2 (standard deviation, SD 7.5) years. Mean
25 MNA-SF score was 9.8 (SD 2.4). Among participants, 198 (25.6%) presented a normal
26 nutritional status (12-14 points), 454 (58.7%) were at risk of malnutrition (8-11 points), and
27 121 (15.7%) were malnourished. After one year of follow-up, 135 (17.5%) participants had
28 died. Age, female gender, baseline weight, BMI and MNA-SF were significant predictors of
29 mortality whereas no specific chronic disease was. The total MNA-SF score was a significant
30 predictor of mortality (Hazard Ratio=0.81; 95% CI 0.74-0.90; p<0.001), even after adjustment
31 for potential confounders. Four individual items: weight loss, mobility, recent stress and BMI
32 were independent predictors of mortality.

33 **CONCLUSIONS:** The MNA-SF appears to be an accurate predictor of one-year mortality in
34 nursing home residents. Thus, this tool may be regarded not only as a nutritional screening
35 tool, but also as an instrument for identifying the most-at-risk individuals in this population.

36

37 **Key words:** Older age; Mini Nutritional Assessment; Nursing Homes.

38 **Introduction**

39 Malnutrition is associated with adverse health outcomes in older subjects. It predicts
40 hospitalization, infectious diseases (1) and death (2,3). Poor nutritional status is also related to
41 increased health care expenditures (2). On the other hand, nutritional interventions have
42 proven beneficial effects on weight gain and malnutrition-related outcomes such as morbidity
43 and mortality (4). Therefore, there has been a growing interest in assessing the nutritional
44 status of elders in order to facilitate the early detection of malnutrition and structure a proper
45 management.

46 Although many instruments have been developed and validated for nutritional
47 assessment (e.g. involuntary weight loss, Body Mass Index [BMI], albumin concentration,
48 Mini-Nutritional Assessment [MNA] (5)), these tools have rarely been explored in nursing
49 home (NH) residents (6). This population represents a highly vulnerable part of the
50 heterogeneous geriatric patients, characterized by a high prevalence of chronic diseases,
51 impaired cognitive and physical functions and limitations of activities of daily living (7).
52 Many risk factors may also increase the risk for malnutrition in these subjects, such as
53 polypharmacy (8) and multiple comorbidities (9). Unsurprisingly, the prevalence of
54 malnutrition in NH population has shown to reach 30% (3).

55 The MNA test is a very commonly used assessment tool of nutritional status (5). It has
56 shown great sensitivity, specificity and predictive positive value for malnutrition in elderly
57 subjects (96%, 98% and 97% respectively), but needs 15 minutes to be completed. The MNA
58 short form (MNA-SF) consists of 6 items and takes less than 5 minutes to complete. It was
59 originally elaborated as a first step in the screening of malnutrition. A score of 11/14 or lower
60 indicates a risk for malnutrition and triggers the administration of the full MNA questionnaire.
61 Nevertheless, the MNA-SF has also been validated as an independent tool for nutritional
62 screening in older adults (10). Interestingly, the items composing the MNA-SF are related to

63 functional or cognitive performance, and thus potentially provide information on multiple
64 health domains over and above the mere nutritional status.

65 However, there are still uncertainties regarding the ability of the MNA-SF to predict
66 mortality in older adults. In a systematic review the MNA-SF (as well as the full MNA) was
67 associated with higher mortality (Dent E, Visvanathan R, Piantadosi C, Chapman I
68 Nutritional screening tools as predictors of mortality, functional decline, and move to higher
69 level care in older people: a systematic review. *J Nutr Gerontol Geriatr.* 2012;31(2):97-145.)
70 In a recent population-based study involving elders from Taiwan with a 4-year follow-up, the
71 MNA-SF also appeared as an effective predictor of mortality. (Wang JY, Tsai AC. The short
72 form Mini Nutritional Assessment is as effective as the full-Mini Nutritional Assessment in
73 predicting follow-up 4-year mortality in elderly Taiwanese. *J Nutr Health Aging* 2013;17:
74 594–598.) On the other hand , another study found that the MNA-SF is not suitable to provide
75 prognostic information in older adults with multiple comorbidities (Vischer UM, Frangos E,
76 Graf C et al. The prognostic significance of malnutrition as assessed by the Mini Nutritional
77 Assessment (MNA) in older hospitalized patients with a heavy disease burden. *Clin Nutr*
78 2012;31:113–117.) In the present study, we conducted longitudinal analyses aimed at
79 examining the relationship between the MNA-SF and mortality in a sample of NH residents,
80 over one year of follow-up. We also studied which items of the MNA-SF may independently
81 explain this association.

82 **Methods**

83 *Study design and participants*

84 Data were from participants recruited as part of the Incidence of pNeumonia and
85 related ConseqUences in nursing home Residents (INCUR) study, a prospective observational
86 cohort study of 800 NH residents. The INCUR rationale, study design, and methodology have
87 been previously described (11). The primary aim of INCUR was to estimate the incidence of
88 pneumonia and the associated health-related expenditures in this population. The 6-month
89 recruitment period started in February 2012. The INCUR project ended on June 2013 after all
90 participants had been followed-up over 12 months.

91 Main eligibility criteria of INCUR included: age of 60 years and older; a functional
92 status ranging from 2 to 5 at the Autonomie Gérontologie - Groupes Iso-Ressources (AGGIR)
93 scale (i.e. the nationally recognized functional scale on which the allocation of social support
94 is decided by public health authorities in France; a score between 2 and 5 excluded totally
95 disabled patients as well as subjects with no impairment in basic activities of daily living)
96 (12) residents living in the NH for more than 30 days. The design of the INCUR project was
97 consistent with the Declaration of Helsinki and the study protocol was approved by the local
98 Ethics Committee.

99 Two follow-up visits were scheduled after 6 and 12 months from the baseline visit. At
100 these visits, besides of repeating the same multidimensional evaluation conducted at the
101 baseline, the possible onset of major health-related events occurred during the past 6 months
102 was ascertained. The present analyses were conducted in 773 subjects, after exclusion of 27
103 subjects with missing key data.

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105 *Variables of interest*

106 At baseline, socio-demographic information, medical history, and comorbidities were
107 recorded. Chronic diseases of interest were: atrial fibrillation, heart failure, coronary heart
108 disease, respiratory conditions, history of stroke and stroke-related impairment, cancer,
109 diabetes, Parkinson's disease and dementia. Weight and height were measured and BMI was
110 calculated. Current smoking and oxygen therapy were also recorded. Cognitive function was
111 assessed with the Abbreviated Mental Test scale (13). Depression was assessed with the 10-
112 item Geriatric Depression Scale (14).

113

114 *MNA-SF assessment*

115 The MNA-SF consists of the first six items, also known as the "screening part" of the
116 full MNA. Briefly these items are: A) food intake; B) involuntary weight loss; C) mobility; D)
117 recent psychological stress or acute disease; E) neuropsychological problem (i.e. dementia or
118 depression); and F) BMI. In case of missing value for [this item](#) (as frequently occurring in
119 bed-ridden residents), the BMI item [can be](#) replaced by the calf circumference (measured with
120 a tape). The MNA-SF score can range between 0 and 14 points with higher values indicating
121 better nutritional status. The MNA-SF score is also usually categorized into three groups
122 defining "normal" (12-14 points), "at risk" (8-11 points), and "malnutrition" (0-7 points)
123 statuses.

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127 *Statistical analyses*

128 Chi-squared tests and t-tests were used to describe the categorical and continuous
129 characteristics of the study sample according to the outcome of interest, respectively. Cox
130 proportional hazard models were used to evaluate the relationships of the MNA-SF score (as
131 both continuous and categorical variable) and its composing items with mortality. Results are
132 presented as hazard ratios (HR) and 95% confidence intervals (95% CI). Secondary analyses
133 were also conducted using the single items composing the MNA-SF as independent variables
134 of interest in the prediction of mortality. Although weight and height were significantly
135 different between deceased subjects and survivors, these two variables were not included in
136 the adjusted model because strongly correlated with the independent variables of interest. All
137 statistical analyses were performed using SPSS statistical software version 18.0.0 (IBM Corp,
138 New York). Statistical significance was defined as $P < 0.05$. For all the single items
139 significantly associated with mortality, sensitivity, specificity, positive and negative
140 predictive values and positive and negative likelihood ratios were calculated.

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146 **Results**

147 Descriptive characteristics of the study sample (n=773) according to the study
148 outcome are presented in Table 1. One hundred and thirty five (17.4%) residents died during
149 the 12 months of follow-up. Mean age of the study population was 86.1 (SD 7.5) years, with a
150 higher prevalence (74.6%) of women. The mean MNA-SF score was 9.8 (SD 2.4). In the
151 study sample, 198 persons (25.6%) had a normal nutritional status (MNA-SF 12-14 points),
152 454 (58.7%) were at risk of malnutrition (8-11 points), and 121 (15.7%) were malnourished.

153 Among the deceased residents, mean age was 88.5 (SD 6.9) vs. 85.7 (SD 7.5) in
154 survivors (p<0.001). Women represented 76.7% of survivors vs. 63.1% of deceased
155 (p=0.001). None of the chronic diseases was significantly associated with mortality. However,
156 indicators of nutritional status were predictors of 1-year mortality: baseline weight and BMI
157 were lower in NH residents who died (61.3 kg [SD 13.4] vs. 64.4 kg [SD 14.6], p=0.03; and
158 24.2 [SD 4.3] kg/m² vs. 25.4 [SD 5.3] kg/m², p=0.04 respectively) as well as the MNA-SF
159 score (9.3 vs. 9.9, p=0.02; Table 1).

160 In Table 2, results from Cox-proportional hazard models examining the MNA-SF and
161 one-year mortality were presented. The MNA-SF (continuous variable) was associated with a
162 significantly lower risk of dying during the follow-up, even after adjustment for age and
163 gender. When the MNA-SF score was categorized, malnourished subjects (0-7 points)
164 showed a significantly higher risk of mortality (HR=4.64, 95%CI 1.79-12.0; p=0.002)
165 compared to the reference group. A trend for association between being at risk of malnutrition
166 and higher risk of mortality (HR=2.40; 95%CI 0.99-5.79; p=0.052) was also observed.

167 Similar results were found in secondary analyses exploring the individual components
168 of the MNA-SF components and mortality (Table 3). Weight loss (p=0.02), BMI<21 kg/m²
169 (or calf circumference<31 cm) (p=0.004), recent disease or psychological stress (p=0.01) and

170 lack of mobility ($p=0.048$) were all significant predictors of the studied outcome. Their
171 sensitivity, specificity, positive and negative predictive values and likelihood ratios are
172 respectively displayed in Table 4. When considered individually, the four latter items showed
173 poor sensitivity for mortality. In contrast, the MNA-SF with a threshold of 12/14 had a correct
174 sensitivity (88.5%) for mortality. Moreover, only a borderline significance was reported for
175 the decrease in food intake item ($p=0.053$). The neuropsychological problem item was not
176 associated with mortality ($p=0.83$).

177 **Discussion**

178 In the present prospective study, a low MNA-SF score was a strong predictor of death
179 after one year of follow-up. A low BMI (or calf circumference) or recent weight loss were
180 individual and significant predictors of mortality in our sample. Two other items: “functional
181 impairment” and “recent acute stress”, which are likely to reflect a more general status of
182 frailty rather than malnutrition *sensu stricto*, were also significant predictors of mortality. On
183 the other hand, education or clinical conditions, including depression and dementia were not.

184 Malnutrition dramatically affects the vulnerable older persons, in particular those
185 living in institutions. Consistently to prior studies, only one quarter of our sample (25.6%)
186 had a normal (i.e ≥ 12) MNA-SF score whereas the other three quarters were either at risk of
187 malnutrition (58.7%) or malnourished (15.7%) (15,16). A recent systematic review has
188 examined the predictive validity of the available screening tools for malnutrition in NH
189 populations (17). Authors concluded that none of them emerged as the gold-standard. Another
190 study specifically assessed the usefulness of the MNA-SF for malnutrition screening in a NH
191 population (18). This study considered a smaller sample (n=151) of institutionalized subjects
192 compared to our work, and only 64.4% of undernourished patients were found to be correctly
193 classified using this tool. Nevertheless, the MNA score demonstrated to be feasible and
194 showed the best predictive capacity for survival (compared with Nutritional Risk Screening
195 and the Malnutrition Universal Screening Tool) among well-nourished NH residents (15).

196 The use of the MNA-SF offers several advantages: this tool is standardized,
197 reproducible, non-invasive, and takes only 5 minutes to be completed. Moreover, it is strongly
198 correlated with the full MNA (19,20). Interestingly, the 6 items of the MNA-SF comprise
199 three nutritional criteria (BMI, food intake and weight loss) as well as three criteria related to
200 “geriatric conditions” (mobility, recent acute stress and neuropsychological disorder). Thus,

201 this tool may be specifically tailored for frail older persons and is likely to provide insights
202 into the global health apart from the mere nutritional status.

203 In our study, the MNA-SF appeared as a predictor of mortality. Not only the total
204 score, but also the score categories (i.e. people at risk of malnutrition and malnourished
205 subjects) as well as most of the subitems when individually considered. Our results are
206 supported by the study of Tangvik and colleagues who recently investigated the association
207 between nutritional status and clinical outcomes (21). Authors have found that the
208 combination of four criteria from the ESPEN guidelines for nutrition screening 2002 (22)
209 (BMI <20.5 kg/m² / Weight loss within the last weeks / Reduced dietary intake during the last
210 weeks / Severe illness) was accurate to predict mortality, morbidity and hospitalizations in
211 Norway hospital in-patients. Interestingly, such criteria are very similar to 4 MNA-SF items
212 we found in our analyses. Thus, we may draw two main conclusions. First, our results are
213 consistent with the established relationship between nutritional status and survival in
214 institutionalized elderly (23,24). Second, the MNA-SF, may be regarded as a
215 multidimensional instrument for identifying the most vulnerable individuals of an elderly
216 population.

217 On the other hand, the absence of chronic conditions related with enhanced
218 mortality might be surprising. This result may be explained by the high prevalence of
219 coexisting chronic diseases in our population. Further, we did not take into consideration the
220 severity of the diseases. Obviously, severe heart failure or dementia are a heavier burden than
221 mild stages of these conditions and increase the risk of poor outcomes. Yet, the simple MNA-
222 SF showed an additional value to identify NH residents at higher risk of death whereas
223 specific pathological conditions did not. Two NH residents with the same multiple (but often
224 stable) clinical conditions may be at different risk of dying given their nutritional status
225 assessed with the MNA-SF. But the death event can be the consequence of an impaired

226 response to an acute stressor (e.g. infection) in polypathological individuals (25). Thus, the
227 MNA-SF may be considered as multidimensional assessment tool, resembling the frailty ones
228 (26,27), thus overcoming the single nosological entities commonly used in the clinical setting.
229 Consistently, the “mobility” and the “acute stress” items of the MNA-SF both reflect
230 functional performances and were predictors of mortality in our study. As such, our results
231 highlight the relationship between risk of death and functional status rather than
232 comorbidities.

233 The main strengths of our study were the large sample size and the prospective design.
234 The representativeness of our sample was good, with few missing data (23 subjects i.e. less
235 than four percent) despite one year of follow-up. On the other hand, some limitations have to
236 be acknowledged. [This study did not analyze biological markers of protein malnutrition \(e.g.
237 albumin concentration\) that are independent risk factor for mortality in NH residents.](#) We did
238 not consider either the causes of death or some other potential confounding factors to explain
239 the death. Yet, comorbidities, depression and dementia were not significantly associated with
240 death in our analyses. Moreover, the individual items of the MNA-SF have been
241 dichotomized instead of examining each category for each question of the form. Nevertheless,
242 we aimed at preserving the clinical meaningfulness when combining different categories of a
243 single item.

244 **Conclusion**

245 The MNA-SF and most of its subitems, but not clinical conditions, were significant
246 predictors of overall mortality in NH residents, independently of potential confounders. Our
247 findings support the use of this simple test in this population, not only for malnutrition
248 screening but also for obtaining an overview of the general risk profile of these complex older
249 adults. Therefore, the MNA-SF may pave the way not only for nutritional assessment but also

250 for comprehensive geriatric assessment and management of these vulnerable elders.

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355 **Table 1.** Baseline characteristics of our population

Variable, M±SD	Death event		
	No (n=638)	Yes (n=135)	P
Age (years)	85.7±7.5	88.5±6.9	<0.001
Gender (women)	76.7	63.1	0.001
Current smoking	2.5	3.1	0.66
Education (years)	8.5±3.3	8.1±3.1	0.28
Height (cm)	159.2±8.6	159.1±7.9	0.89
Weight (kg)	64.4±14.6	61.3±13.4	0.03
Body mass index (kg/m ²)	25.4±5.3	24.2±4.3	0.04
Clinical conditions			
Atrial fibrillation	12.3	17.0	0.25
Heart failure	26.9	33.3	0.26
Coronary heart disease	5.4	8.2	0.34
Respiratory disease	9.6	14.2	0.11
Stroke	7.7	11.9	0.38
Cancer	12.6	9.0	0.13
Diabetes	15.0	14.0	0.79
Parkinson's disease	5.9	5.9	0.98
Dementia	35.3	33.3	0.32
O ₂ therapy	1.8	2.2	0.70
Abbreviated Mental Test score (/10)	5.7±3.6	5.0±3.4	0.06
10-item Geriatric Depression Scale	2.9±2.4	2.9±2.5	0.84
MNA-SF score (/14)	9.9±2.4	9.3±2.4	0.02

356 Results are presented as means ± SDs, or percentages

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359 **Table 2.** Relationships of the Mini Nutritional Assessment-Short Form (MNA-SF) score with mortality over one year of follow-up in nursing
 360 home residents.

	Unadjusted HR (95% CI)	P	Adjusted* HR (95% CI)	P
MNA-SF score (continuous), n/N=52/773	0.83 (0.75, 0.91)	<0.001	0.81 (0.74, 0.90)	<0.001
MNA-SF score categories				
Normal nutritional status (12-14 points), n/N=6/198	1 (Reference group)		1 (Reference group)	
At risk of malnutrition (8-11 points), n/N=31/454	2.30 (0.96, 5.51)	0.06	2.40 (0.99, 5.79)	0.052
Malnourished (0-7points), n/N=15/121	4.31 (1.67, 11.10)	0.003	4.64 (1.79, 12.00)	0.002

361 CI: confidence interval; HR: Hazard Ratio; MNA-SF: Mini Nutritional Assessment-Short Form; n: number of deceased subjects/N: total number
 362 of subjects; *Adjusted for age and gender

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368 **Table 3.** Relationships of individual items composing the MNA-SF score with mortality in nursing home residents.

	Unadjusted HR for mortality (95% CI)	P	Adjusted* HR for mortality (95% CI)	P
Decrease in food intake over the past 3 months				
No decrease in food intake, n/N=36/627	1 (Reference group)		1 (Reference group)	
Moderate and severe decrease in food intake, n/N=16/146	1.97 (1.09, 3.55)	0.02	1.82 (0.99, 3.34)	0.053
Weight loss over the past 3 months				
No weight loss, n/N=26/513	1 (Reference group)		1 (Reference group)	
Weight loss between 1 and 3 kg, and greater than 3 kg n/N=25/248	2.04 (1.18, 3.54)	0.01	1.93 (1.10, 3.39)	0.02
Mobility				
Goes out, n/N=25/468	1 (Reference group)		1 (Reference group)	
Able to get out of bed/chair but does not go out, and bed or chair bound, n/N=27/305	1.68 (0.97, 2.89)	0.06	1.75 (1.00, 3.06)	0.048
Acute disease or psychological stress over the past 3 months				
No, n/N=31/593	1 (Reference group)		1 (Reference group)	
Yes, n/N=21/180	2.30 (1.32, 4.00)	0.003	2.12 (1.20, 3.74)	0.01
Neuropsychological problems				
No psychological problems, n/N=17/226	1 (Reference group)		1 (Reference group)	
Mild and severe dementia or depression, n/N=35/547	0.85 (0.47, 1.51)	0.58	0.94 (0.52, 1.70)	0.83
Body mass index (BMI, kg/m²) or calf circumference (CC, cm)**				
BMI ≥ 21 or CC ≥ 31, n/N=33/603	1 (Reference group)		1 (Reference group)	
BMI < 21 or CC < 31, n/N=19/170	2.08 (1.18, 3.66)	0.01	2.34 (1.31, 4.17)	0.004

369 BMI: Body Mass Index; CC: Calf circumference; HR: Hazard Ratio; CI: confidence interval n: number of deceased subjects/N: total number of
 370 subjects; *Adjusted for age and gender ; ** if BMI was not available, the CC was used at its place to define the item

372 **Table 4.** Sensitivity, Specificity, Predictive values and Likelihood ratios for mortality of the MNA-SF and its significant items

	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)	Positive Likelihood Ratio	Negative Likelihood Ratio
MNA-SF items						
● BMI < 21 or CC <31	36.5	79.1	11.2	94.5	1.74	0.80
● Acute disease / stress	40.4	78.0	11.7	94.8	1.83	0.76
● Weight loss \geq 1 kg	49.0	68.6	10.1	94.9	1.56	0.74
● Impaired mobility	51.9	61.4	8.9	94.7	1.35	0.78
MNA-SF <12	88.5	26.6	8.0	97.0	1.21	0.43
MNA-SF <8	28.9	85.2	12.3	94.3	1.95	0.84

373 BMI: Body Mass Index; CC: Calf circumference; MNA-SF: Mini Nutritional Assessment-Short Form

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