Introduction

Frail elderly people in the community, in nursing homes or in hospital are at increased risk of malnutrition. In many instances, this malnutrition, affecting health, well-being and ability to overcome disease or injury, goes unrecognised by physicians, often due to their meagre training in nutritional assessment.

Many studies have been devoted to the evaluation of malnutrition in the elderly. The proportion of malnourished patients in acute care ranges from 26% to 61% (1-12) and among the patients in long-term care from 23% to 46% (7,13-16). However, it should be noted that the patient population varies according to the type of structure. Since different definitions of malnutrition and different types of scale were used in the various studies, it is difficult to clearly compare their results (17).

The Mini-Nutritional Assessment® (MNA®), was developed through a collaboration between the Toulouse University Hospital (France), the Medical School of New Mexico (USA) and Nestlé Research Centre (Switzerland) and was validated in three studies including more than 600 patients. The MNA® is a rapid and simple assessment tool designed to help health professionals involved in monitoring patients in hospitals and nursing homes (18-21). The MNA® scale comprises 18 items corresponding to 4 domains: anthropometric measurements, dietary behaviour, global (risks factor for malnutrition) and subjective assessment of self-perceived quality of health and nutrition. Assessment by the MNA® scale takes 10 to 15 minutes to complete. According to the MNA® scale score (rating from 0 to 30) elderly people can be classified as "well-nourished" (24 - 30), "at risk of malnutrition" (17 - 23.5), or "malnourished" (< 17).

Cross-validation indicated that the assessment is sufficiently sensitive that 70 to 75% of patients can be classified as well-nourished or malnourished without further biochemical tests or clinical evaluation (18). The MNA® scale is a reference tool integrated in the everyday geriatric assessment of the elderly at home as well as in acute, sub-acute or long-term care (19,22-24). MNA® is an efficient tool to assess the evolution of nutritional status in subjects at risk of malnutrition who underwent a nutrition intervention programme (25).

In order to compare the nutritional status of patients according to the type of care structure, a survey of elderly patients hospitalised in different departments of a same hospital was undertaken using the MNA®. Analysis of the nature of the pathology provides an explanation of the differences between the various types of institution.
Methods

All the elderly patients institutionalised in acute care (AC), sub-acute care (SAC) or long-term care (LTC) in the Hôpital Serre-Cavalier in Nimes, France, were tested by the MNA®. The survey covered the period from December 1995 to October 1996. In the French health-care system, acute and sub-acute care categories concern patients needing hospitalisation for periods of less than 15 days and 2 months, respectively. Long-term care generally concerns patients permanently hospitalized.

Baseline demographic variables (age, gender, size and weight) were recorded by nurses according to hospital practice. The Body Mass Index (BMI) = weight (kg) / size2 (m2) was calculated from the data and the patients were classified in 3 groups (well-nourished, at risk of malnutrition and malnourished) as described above. The MNA® sub-scores corresponding to the 4 domains of items were also calculated and used as variables.

For patients hospitalised in acute or sub-acute care, MNA® and BMI were evaluated twice: within the first 48 h after admission and at the end of hospitalisation. For patients institutionalised in long-term care, the target population was all the patients in care for more than 2 months.

Data analysis

JMP 3.0 (SAS Institute) and Statview 4 (Abacus Concept) were used for statistical analysis.

The frequency distributions of all relevant ordinal variables were calculated, whereas continuous variables were initially evaluated by standard descriptive parameters (mean, SD, median, etc.) as required.

Univariate analysis

Comparisons between the three groups, defined on the basis of the type of institution (AC, SAC or LTC), were computed using the c2 test or Fisher's exact test for ordinal variables. A one-way analysis of variance (ANOVA) or Student's t test was performed for continuous variables. Non-parametric tests (Wilcoxon, Kruskal Wallis, Median test) were also used for variables with a non-Gaussian distribution.

Multivariate analysis

In order to quantify the relative importance of each variable and to avoid structural artefacts, multivariate analyses were performed. The variables used for the multivariate analyses were those found to be linked to nutritional status in the univariate analyses. The analyses were performed as a bi-directional, step-by-step, logistic regression.

Results

Demographic and anthropometric baseline variables

Overall, 918 patients entered the study, 299 in AC, 196 in SAC and 423 in LTC. Demographic baseline variables were very similar in the three groups (Table 1). Two-thirds of the patients were female. The mean age of the population was 83 ± 8.3 years. The mean weight was 56.3 ± 12.5 kg and the mean body mass index 24.3 ± 4.7 kg/m2.

| Table 1 |
|---|---|---|---|---|
| | AC (n = 299) | SAC (n = 196) | LTC (n = 423) | Overall (n = 918) |
| Age (years) | mean ± SD [range] | 82.9 ± 7.0 [62 - 100] | 83.4 ± 6.8 [55 - 103] | 82.9 ± 9.7 [57 - 98] | 83.0 ± 8.3 [55 - 103] |
| Sex | % female | 67 % | 62 % | 69 % | 67 % |
| Weight (kg) | mean ± SD | 55.3 ± 9.1 | 57.3 ± 12.7 | 56.5 ± 14.3 | 56.3 ± 12.5 |
| BMI (kg/m2) | mean ± SD | 24.1 ± 3.4 | 24.0 ± 4.7 | 24.6 ± 5.4 | 24.3 ± 4.7 |

Underlying diseases

Overall, the most frequent pathologies were dementia/confusion (21%), trauma (13.6%), stroke (11.6%), and psychiatric diseases (10.2%).

Due to the different nature of the institutions implicated in AC, SAC and LTC, the frequency of distribution differed in the 3 groups (Table 2). Stroke and infectious diseases were more frequent in AC patients (respectively 14.1% and 7.7%), trauma in SAC patients (54.6%) and dementia/confusion or other psychiatric diseases in LTC (respectively 36% and 14.1%).

| Table 2 |
|---|---|---|---|---|
| Pathological type | AC (n = 299) | SAC (n = 196) | LTC (n = 423) | Overall (n = 918) |
| Stroke | 42 (14.0 %) | 18 (9.2 %) | 40 (9.5 %) | 100 (10.9 %) |
| Cancer | 14 (4.7 %) | 12 (6.1 %) | 17 (4.0 %) | 43 (4.7 %) |
| Cardiopathy | 21 (7.0 %) | 8 (4.1 %) | 28 (6.6 %) | 57 (6.2 %) |
| Dementia / Confusion | 42 (14.0 %) | 6 (3.1 %) | 133 (31.4 %) | 181 (19.7 %) |
| GI disease (except cancer) | 20 (6.7 %) | 5 (2.6 %) | 15 (3.5 %) | 40 (4.4 %) |
| Miscellaneous | 33 (11.0 %) | 14 (7.1 %) | 27 (6.4 %) | 74 (8.1 %) |
| Infectious diseases | 23 (7.7 %) | 5 (2.6 %) | 1 (0.2 %) | 29 (3.2 %) |
| Renal insufficiency | 7 (2.3 %) | - | 3 (0.7 %) | 10 (1.1 %) |
| Respiratory insufficiency | 17 (5.7 %) | 4 (2.1 %) | 8 (1.9 %) | 29 (3.2 %) |
| Metabolic diseases | 23 (7.7 %) | 1 (0.5 %) | 27 (6.4 %) | 51 (5.6 %) |
| Parkinson's disease / EPS | 19 (6.4 %) | 8 (4.1 %) | 16 (3.8 %) | 43 (4.7 %) |
| Psychiatric diseases | 28 (9.4 %) | 8 (4.1 %) | 52 (12.3 %) | 88 (9.6 %) |
| Trauma | 8 (2.7 %) | 107 (54.6 %) | 2 (0.5 %) | 117 (12.7 %) |
| No precise disease | 2 (0.7 %) | - | 54 (12.8 %) | 56 (6.1 %) |
MNA® scoring and thresholds

The mean (±SD) global MNA® score for the population was 19.8 ± 5.1 (range: 1.5 ; 30), with a slight difference between the 3 groups: 20.1 ± 5.9 (range: 1.5 ; 30) for AC, 18.8 ± 4.3 (range: 5.0 ; 30) for SAC, and 20.1 ± 4.7 (range: 5.0 ; 30) for LTC. The anthropometric and global subscores were the main factors accounting for the difference in total score between SAC patients and the two other groups (Figure 1).

Overall, according to the thresholds previously determined, one quarter (26.3%) of the patients were malnourished, half (49.6%) were at risk of malnutrition, and the remaining quarter (24.1%) were well-nourished. In the SAC group, the proportion of patients malnourished (32%) or at risk of malnutrition (55%) was higher than in the other groups (p<0.001) (Figure 2).

Factors correlated with nutritional status: univariate analysis

In order to identify the factors correlated with nutritional status, univariate analyses were performed between the MNA® score and each of the recorded variables.

Two factors were found to be correlated with nutritional status:
- The type of care: The nutritional status was less good in SAC and better in LTC (p = 0.005).
- The nature of the pathology: The worst nutritional MNA® scores were observed in conjunction with infectious disease (16.7 ± 6.6), stroke (18.6 ± 5.7), dementia (18.7 ± 5.1) and trauma (19.0 ± 4.4). These values were significantly different from those observed in patients suffering from heart disease (21.0 ± 4.6), metabolic diseases (21.7 ± 4.7) and gastrointestinal diseases (21.0 ± 5.4) (global difference: p < 0.0001; Kruskall Wallis test).

Factors correlated with nutritional status: multivariate analysis

Since univariate analyses show a correlation between the MNA® score, on the one hand, and the type of care and the pathology of the patient, on the other hand, a multivariate analysis was performed to determine whether the uneven distribution of pathologies among the different types of care accounted for the difference in MNA® score. The multivariate analysis carried out on the whole population indeed found a weaker correlation between the MNA® score and type of care, probably as a result of the differences in patient population in the three types of institution.

Since, even within the same pathological group, the underlying pathologies were probably not of the same kind or intensity in the different care groups, multivariate analyses were independently performed on the three groups.

Among patients in acute care, pathologies of infectious origin were correlated with a worse nutritional status than pathologies due to other causes (p < 0.0001, r2 = 4%). Nutritional status was also worse in older patients (p < 0.0007, r2 = 4%).

Among patients in sub-acute care, patients suffering from respiratory insufficiency, cardiopathy, or cancer had a lower MNA® score than patients with other pathologies (p < 0.0005, r2 = 5.6%). Female patients had a better MNA® score than men (p < 0.01, r2 = 2%).

Among patients in long-term care, patients suffering from stroke, dementia and traumatic injuries had a lower MNA® score than patients with other pathologies (p < 0.0001, r2 = 13.9%). Nutritional status was also worse in the older patients (p < 0.0001, r2 = 5%).

Evolution of MNA® score

In AC and SAC, MNA® was carried out on admission and at the end of hospitalisation, allowing study of the evolution of MNA® score during hospitalisation.

On the basis of the data recorded, patients were hospitalised for a mean duration (± SD) of 12.0 ± 6.3 days in AC (data from 257 out of 299 included patients), and 41.3 ± 23.3 days in SAC (data from 94 out of 196 included patients).

Seventeen (5.7%) deaths were recorded among the 299 patients hospitalised in AC and eleven (5.6%) deaths among the 196 patients hospitalised in SAC. There was a highly
significant difference between the mean MNA® score on admission of the 28 patients who died during the study (mean ± SD: 11.8 ± 0.9) and that of the surviving patients (20.1 ± 0.1), in AC and SAC. MNA® class was also predictive of the mortality risk, with 22 (16.1%) deaths among the 137 patients rated as "malnourished" (MNA® score ≤ 17), as compared to 6 (2.5%) deaths among the 243 patients "at risk of malnutrition" (MNA® score from 17 to 23.5) and no death among the 113 "well-nourished" patients (MNA® score ≥ 24).

During hospitalisation, the mean MNA® score of the surviving patients increased by 1.5 points in the AC group (N = 283) and by 3.0 points in the SAC group (N = 182), corresponding to a mean percentage increase of +11.3% and +18.6% respectively. Globally, out of the 137 patients of AC and SAC rated as "malnourished" at admission, 16% died, 35% remained "malnourished" and 49% improved their nutritional status.

In multivariate analysis, the improvement in MNA® score was mainly linked to the duration of hospitalisation (AC, p = 0.0006, r² = 4.7%; SAC, p = 0.04, r² = 5%). In SAC, the mean duration of hospitalisation was 29 days (median 20 days) for the patients showing an improvement in MNA® score ≥ 15%, compared with 16 days (median 12 days) for the remaining patients (table 3).

**Table 3**

<table>
<thead>
<tr>
<th>Pathological type</th>
<th>Mean MNA® ± SD</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infectious diseases</td>
<td>16.7 ± 6.6</td>
<td>(29)</td>
</tr>
<tr>
<td>Stroke</td>
<td>18.6 ± 5.7</td>
<td>(100)</td>
</tr>
<tr>
<td>Dementia / Confusion</td>
<td>18.7 ± 5.1</td>
<td>(181)</td>
</tr>
<tr>
<td>Respiratory insufficiency</td>
<td>18.7 ± 5.9</td>
<td>(29)</td>
</tr>
<tr>
<td>Trauma</td>
<td>19.0 ± 4.4</td>
<td>(117)</td>
</tr>
<tr>
<td>Cancer</td>
<td>19.4 ± 4.6</td>
<td>(43)</td>
</tr>
<tr>
<td>Parkinson's disease / EPS</td>
<td>19.8 ± 5.3</td>
<td>(43)</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>20.1 ± 5.2</td>
<td>(10)</td>
</tr>
<tr>
<td>Cardiopathy</td>
<td>21.0 ± 4.6</td>
<td>(57)</td>
</tr>
<tr>
<td>GI disease (except cancer)</td>
<td>21.0 ± 4.5</td>
<td>(40)</td>
</tr>
<tr>
<td>Psychiatric diseases</td>
<td>21.1 ± 4.4</td>
<td>(88)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>21.1 ± 4.6</td>
<td>(74)</td>
</tr>
<tr>
<td>Metabolic diseases</td>
<td>21.7 ± 4.7</td>
<td>(51)</td>
</tr>
</tbody>
</table>

GI : Gastro-intestinal
EPS : Extra-pyramidal symptoms

**Discussion**

In this study, we found that 24.7% of elderly patients admitted into acute care institutions were malnourished, as evaluated by the MNA® scale. This is lower than previously published results ranging from 26% to 61% (Potter 26% (1), Nightingale 35% (3), Gamble Coats 46% (4), Aoun 53% (5), Weinsler 48% (6), Drouard 50% (7), Rietsch 52% (8), Rapin 59%, (9) Manciet 60% (10), and Bienar 61%, as compared to 28% in younger people (<65 yrs) (12)). In addition, we found that 45.5% of patients were at risk of malnutrition. Overall, 70% of patients were not classified as well nourished, a proportion comparable to the higher estimations cited above. At the same time and in the same geographic area, 33% of 405 ambulatory elderly patients attending a preoperative anaesthesia visit were not classified as well nourished using the MNA® (26).

In our study, 32.5% of elderly patients hospitalised in sub-acute care were malnourished and 52.2% were at risk of malnutrition. The proportion of malnourished patients was close to that found by Brocker (36%) (27). Moreover, the proportion of malnourished patients (24.5%) admitted into long-term care, determined in our study, was close to that observed by Grosshans (24%) (14) and Lebreton (23%) (15) although smaller than that observed by Keller (45.5%) (13).

All the above authors concluded the presence of a high proportion of malnourished elderly patients in acute, sub-acute and long-term care. However, the concept of malnutrition and the tools used in these different studies varied and there is not a clear consensus on the definition of malnutrition and its management (3, 28-34).

It is thus difficult to compare recent and older studies, but it does not appear that much progress has been made in the diagnosis and the management of malnutrition in hospital from 1970 to 1990 (4, 32).

**Evolution of nutritional status**

Many authors reported that the duration of hospitalisation was an aggravating factor for nutritional status (1, 4, 6, 23, 35-38). In our study, the nutritional status of the patients hospitalised in acute care tended to improve with the duration of hospitalisation. This conclusion has also been reported recently by Joosten in a study including 155 patients (39). This finding could have two interpretations:

Either it reflects a change in the management of malnutrition, as postulated by Gamble-Coats, who reported that whereas in 1976 the prolongation of hospitalisation aggravated malnutrition, in 1988, nutrition status was, on the contrary, improved with hospitalisation (4).

Or, the sensitivity (1) and the specificity of the evaluating tools are not sufficient to assess modification of nutritional status over a period shorter than 3 weeks (7, 36). In fact, biological and anthropometric modifications linked to nutritional status require a minimal time to appear (e.g. the half-life of albumin is 21 days). When the duration of hospitalisation is short, as in our AC group (12 ± 6.3 days), the items of the "anthropometric" and "global" evaluations (accounting for a maximum of 17 points) are unlikely to vary. In contrast, the scores of the "dietetic" and "subjective" evaluations are prone to a rapid variation, all the more so if the nutritional problem is managed. Accordingly, in SAC, the patients were hospitalised for a longer period (41.3 ± 23.3 days) and we observed a clear correlation between the improvement in MNA® score and the duration of hospitalisation. The patients with an improvement greater than 15% stayed in hospital for a mean period of 29 days, as compared to 16 days.
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for those with a lesser improvement. The improvement can be explained by the importance (9 points) of the "global" items (autonomy, treatments, acute disease, etc.) in the MNA® score, since these items tend to improve with the time. Conversely, a bias is probably introduced by patients kept in hospital longer because their nutritional status failed to improve.

Mortality

The correlation between nutritional status, assessed by the use of MNA®, and death during hospitalisation in the AC or SAC groups is highly significant (p < 0.0001). No death was observed among patients rated as well-nourished (MNA® score≥24).

The relationship between nutritional status and mortality has been described by many authors according to various criteria (Table 4). Three other studies have demonstrated that MNA® score is correlated with mortality and can be considered as a prognostic factor (19,40,41). Analysis of the two-year survival of patients hospitalised in LTC is in progress.

Table 4

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of patients</th>
<th>Population</th>
<th>Nutritional status criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antonelli (23)</td>
<td>302</td>
<td>Medicine</td>
<td>Albumin, anthropometric</td>
</tr>
<tr>
<td>Sullivan (48)</td>
<td>322</td>
<td>Rehabilitation</td>
<td>Albumin, weight</td>
</tr>
<tr>
<td>Cornoni (49)</td>
<td>14407</td>
<td>Home</td>
<td>BMI</td>
</tr>
<tr>
<td>Lebreton (15)</td>
<td>74</td>
<td>LTC</td>
<td>Albumin, PINI, MNA</td>
</tr>
<tr>
<td>Gamble Coats (4)</td>
<td>228</td>
<td>Medicine</td>
<td>LOM</td>
</tr>
<tr>
<td>McMurtry (50)</td>
<td>83</td>
<td>Rehabilitation</td>
<td>Albumin, NSS</td>
</tr>
<tr>
<td>Klopf (51)</td>
<td>2342</td>
<td>Home</td>
<td>Albumin</td>
</tr>
<tr>
<td>Guiazzi (19)</td>
<td>175</td>
<td>Medicine</td>
<td>MNA®, biology</td>
</tr>
</tbody>
</table>

LOM: Likelihood of Malnutrition
PINI: Pronostic Inflammatory and Nutrition Index
NSS: Nutritional Status Score

Factors linked to malnutrition

The relationship between poor nutritional status and certain pathologies such as infectious disease and dementia, has been widely described in the literature (1,8,11,33,42-43,49). Malnutrition increases the risk of disease (44) and early rehospitalisation (45).

Increasing age is correlated with malnutrition (8,33). We confirmed this finding in patients in all three types of care.

In our study, we confirm the relationship between infectious diseases and a low MNA® score in patients in AC. However, in SAC, the correlation is greater with cardiac, respiratory and cancerous diseases, and in LTC with dementia, stroke and traumatic injuries. This difference probably reflects the specific population hospitalised in each type of care, particularly in SAC or LTC in which the admission is influenced by the medical and social status of the patients, including the ability to perform usual tasks influencing the nutritional status (e.g., patients unable to prepare their meals).

Conclusion

The "Audit National Belge" (Belgium national survey) carried out in 1997 (46), investigating the prevalence of bedsores in a population of 32,070 patients, highlighted the fact that nutritional status is taken into account in only 34% of patients. In 61% of patients, no nutritional adaptation is undertaken.

A report of the French Health Minister (47), dating from January 1997, severely judged the alimentary policy in hospital: the malnutrition rate was stated to be high, ranging from 12% to 69% according to department; diagnosis was rarely accomplished due to the lack of adequate diagnostic tools (especially standardised scales). The report cites "many flaws or inadequacies ... leading not only to a questionable "alimentary comfort", but also aggravating latent malnutrition or failing to cure objective malnutrition".

Malnutrition is frequent in elderly hospitalised people, in all types of care (acute, sub-acute and long-term). This situation is usually greatly underestimated, or ignored, although malnutrition is strongly associated with an increased risk of prolonged hospitalisation and mortality. It is consequently imperative to diagnose and manage malnutrition in the older patients.

This study has demonstrated the feasibility of assessing malnutrition by means of MNA® in different types of geriatric care. MNA® is a practical tool suitable for detecting and monitoring malnutrition, allowing rapid onset of its management. We advocate the systematic use of MNA® as part of the examination of elderly people on admission to hospital, for whatever reason.

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References


