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BRIEF REPORT

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Lack of energy is associated with malnutrition in nursing home residents: Results from the INCUR study

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Abstract

Background: Lack of energy is a symptom frequently complained by older people, leading to the inability to continue functioning at the expected level of activity. This study aimed to investigate whether nutritional status was associated with lack of energy in nursing home (NH) residents.

Methods: This was a cross-sectional study. A total of 570 NH residents (72.1% women) in 13 French NHs from the Incidence of pNeumonia and related ConseqUences in nursing home Residents study cohort were included in the study. Lack of energy was measured by the question "Did you feel full of energy during the past week?" from the geriatric depression scale. Nutritional status was evaluated according to Mini Nutritional Assessment Short-Form (MNA-SF). Unadjusted and adjusted logistic regression models were performed to test the association of nutritional status with lack of energy.

Results: The mean age of participants was 86.5 (SD 7.5) years. A total of 246 NH residents (43.2%) reported a lack of energy. Overall, 71 (12.5%) residents were malnourished and 323 (56.7%) residents were at risk of malnutrition. Malnutrition was significantly associated with lack of energy (OR = 3.42, 95% CI = 1.92–6.08, $P < 0.001$), even after adjustment for potential confounders (OR = 2.41, 95% CI = 1.29–4.52, $P = 0.006$). Among the single items of the MNA-SF, decrease in food intake, low mobility, and psychological stress or acute disease were individually associated with lack of energy, independently of potential confounders (OR = 1.85, 95% CI = 1.24–2.77, $P = 0.003$; OR = 1.43, 95% CI = 1.10–1.86, $P = 0.008$; OR = 1.48, 95% CI = 1.19–1.84, $P < 0.001$; for each point respectively).

Conclusions: Lack of energy and malnutrition were closely associated. The reporting of lack of energy should lead to a comprehensive assessment of the aging individual (as happening for malnutrition) in order to preventively/promptly act on potentially reversible causes.

KEYWORDS
aging, exhaustion, fatigue, frailty, malnutrition

INTRODUCTION

Fatigue or lack of energy is often experienced by older people with frailty. Although pervasive and associated with adverse health events, this symptom is often neglected by healthcare professionals. Indeed, fatigue is strongly associated with inability to continue functioning at a normal level[1] and is a powerful predictor of multiple negative outcomes (e.g., hospitalizations, increased use of healthcare services, mortality).[2–4] The pathophysiology of age-related fatigue is yet to be deciphered; however, malnutrition may represent one pathway to consider. Both nutritional deficiencies[5] and obesity[6] have been reported to influence fatigue levels. Older people have increased requirements of some nutrients, especially in the presence of highly catabolic conditions. When the intake of dietary protein and energy is inadequate to meet demands, body fat and muscle are catabolized to provide energy,[7,8] leading to overt symptoms like fatigue or tiredness.[9,10] Fatigue may therefore be envisioned as a disorder of energy balance,[11] mimicking the exhaustion of the metabolic reserves of the older individual.[7–10] An adequate intake especially in energy and protein may thus represent a strategy to counteract muscle decline and address the symptom of fatigue.

Undernutrition has been associated with poor physical performance with the consequent onset of fatigue.[10] Low-grade systemic inflammation, a hallmark of aging, is responsible for a reduction of food intake, altered metabolism, and increased muscle catabolism.[12] Nevertheless, the association between nutritional status and fatigue has been poorly investigated. In particular, little data are available for the most vulnerable populations, such as nursing home (NH) residents, in whom the prevalence of fatigue and malnutrition is especially high.

To address this gap, we investigated whether lack of energy was associated with nutritional status in a population of NH residents. In addition, we sought to determine whether specific aspects of malnutrition would increase the risk of experiencing fatigue.

Key Points

- Lack of energy is a symptom frequently complained by older people, leading to the inability to continue functioning at the expected level of activity.
- Lack of energy is highly prevalent in nursing home residents (43.2% in our sample).
- Lack of energy and malnutrition are closely associated.
- The presence of lack of energy and/or malnutrition should lead to the comprehensive assessment of the individual.

Why does this Paper Matter?

We found a high prevalence of lack of energy and a significant association between malnutrition and lack of energy. A simple question exploring the possible lack of energy may provide useful information about functional status of older individuals, thus providing the entry door to adapted clinical approach.

METHODS

Study design

We performed a cross-sectional analysis of the Incidence of pNeumonia and related ConseqUences in nursing home Residents (INCUR) study. The design of the INCUR study has been previously described.[13] In short, the INCUR was a longitudinal observational study for which 800 people aged 60 and older living in 13 randomly selected NHs in the Midi-Pyrenees region of France were recruited. The primary objective of the INCUR study was to monitor the incidence of pneumonia and its clinical and economic consequences. All data were collected from the medical charts of NH residents. Information about clinical status, nutrition, physical function, cognition, depression, quality of life, and healthcare costs was recorded. The project was approved by the Ethical Committee of the Toulouse University Hospital. Since the collected data were all part of the clinical routine, no written informed consent was required according to local regulations. However, all participants were informed about the study procedures and free to decline their participation. A total of 570 NH residents were included in the present analysis, after excluding 230 individuals with missing data for the main variables of interest (i.e., malnutrition and lack of energy).

Outcome measure

Lack of energy was measured at baseline as a binary variable in response to the question "Did you feel full of energy during the past week?", included in the 10-item geriatric depression scale (GDS).[14] Participants who answered "no" were categorized as fatigued.

Nutritional status

Nutritional status was evaluated using the Mini Nutritional Assessment Short-Form (MNA-SF).[15] The MNA-SF includes six items: reduced food intake, non-volitional weight loss in the past 3 months, mobility, psychological stress or acute disease during the past 3 months, neuropsychological problems, and low body mass index (BMI). In 135 participants, BMI was not available and was replaced with low calf circumference, as recommended in the MNA-SF guidance[15] being this parameter (1) a marker of poor nutrition, and (2) highly predictive of adverse outcomes in older persons. The total MNA-SF score ranges from 0 (most severe malnutrition) to 14 (no sign of malnutrition). Specifically, a score of 12–14 is indicative of a normal nutritional status, while a score of 8–11 and 0–7 identifies the risk of malnutrition and malnutrition, respectively.

Other measurements

Sociodemographic data and presence of comorbidities were collected. Depression was measured according to the 10-items GDS.[14] The item defining lack of energy (dependent variable of the present study) was excluded from the computation of the total score used in the analyses. Functional status was measured through the activities of daily living (ADL) scale (ranging from 0 [dependent] to 6 [independent])[16] and a modified instrumental ADL (IADL) scale (ranging from 0 [dependent] to 4 [independent]).[17] A 36-item Frailty Index (FI) was computed according to the model proposed by Rockwood and Mitnitski.[18]

Statistical analysis

Chi-square and *t*-tests were used to describe the population according to the study outcome. Logistic regression models were performed to test the association of lack of

TABLE 1 Baseline characteristics of the study sample ($N = 570$) according to the presence of lack of energy

Variable	Overall $N = 570$	Lack of energy		P^a
		No ($N = 324$)	Yes ($N = 246$)	
Age, years	86.5 (7.5)	85.8 (7.6)	87.3 (7.2)	0.02
Sex (women)	72.1%	55.2%	44.8%	0.21
BMI, Kg/m^2	25.8 (5.4)	25.9 (5.4)	25.7 (5.4)	0.74
Education, years	8.4 (3.3)	8.4 (3.1)	8.4 (3.5)	0.93
MNA score (0–14)	10.1 (2.3)	10.6 (2.1)	9.7 (2.4)	<0.001
ADL score (0–6)	2.8 (1.8)	3.0 (1.8)	2.4 (1.7)	<0.001
IADL score (0–4)	0.8 (0.7)	0.9 (0.7)	0.8 (0.7)	0.30
GDS[a] score (0–9)	2.5 (2.2)	1.8 (1.9)	3.4 (2.6)	<0.001
Frailty index (score)	0.37 (0.10)	0.36 (0.11)	0.39 (0.10)	<0.001
Diabetes	15.9%	15.0%	17.1%	0.51
Dementia	34.7%	35.2%	34.0%	0.77
COPD	7.5%	6.7%	8.5%	0.42
Hypertension	61.1%	60.9%	61.5%	0.87
Cancer	15.5%	14.7%	16.6%	0.53
Cerebrovascular disease	11.8%	12.5%	10.9%	0.56
Coronary artery disease	6.6%	8.0%	4.9%	0.14
Congestive heart failure	29.8%	27.5%	32.8%	0.17

Note: Values are presented as mean (SD) or percentage.

Abbreviations: ADL, activities of daily living; BMI, body mass index; COPD, chronic obstructive pulmonary disease; GDS, geriatric depression scale; IADL, instrumental activities of daily living; MNA, mini nutritional assessment.

[a]Computed excluding "lack of energy".

energy (dependent variable) with nutritional status (independent variable). Unadjusted and adjusted (for age, sex, and FI) models were performed. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were reported. Statistical significance was set at $P < 0.05$. All analyses were performed with IBM SPSS Statistics version 26 (IBM Corp, Armonk, NY).

RESULTS

The baseline characteristics of the study sample according to the presence of fatigue are presented in Table 1. The study sample consisted of a total of 570 NH residents (mean age 86.5, SD = 7.5 years; women $n = 411$, 72.1%). At baseline, the mean MNA-SF score was 10.1 (SD = 2.3) points, with 71 (12.5%) residents resulting malnourished, and 323 (56.7%) at risk of malnutrition. A total of 246 participants (43.2%) reported a lack of energy. Participants reporting lack of energy were older, more dependent in the ADLs, showed more depressive symptoms according to the GDS, and were frailer.

Results of the logistic regression analyses are reported in Table 2. In both unadjusted and adjusted models, the MNA-SF score was inversely associated with lack of energy. Being malnourished was independently related to lack of energy in the unadjusted model (OR = 3.42, 95% CI = 1.92–6.08, $P < 0.001$) as well as after adjustment for age, sex, and FI (OR = 2.41, 95% CI = 1.29–4.52, $P = 0.006$).

Secondary analyses were conducted to explore which items of the MNA-SF were contributed the most to the reported association. First, adjusted models individually testing each single MNA-SF item in the association with the lack of energy (Table 3, Model 1) were conducted. Item A (i.e., decrease in food intake), item C (i.e., reduced mobility), and item D (i.e., acute disease or psychological stress over the past 3 months) were positively associated with fatigue (OR = 2.19, 95% CI = 1.50–3.20, $P < 0.001$; OR = 1.47, 95% CI = 1.14–1.89, $P = 0.003$; OR = 1.55 95% CI = 1.26–1.91, $P < 0.001$; for each point, respectively). Then, a single exploratory model simultaneously including all MNA-SF items was performed (Model 2). Results were consistent, confirming the association of items A, C, and D with lack of energy.

It could be argued that adjusting for a multidimensional measure as the FI might bring in the models some instability/risk of collinearity. For this reason, additional analyses

TABLE 2 Relationship of the Mini Nutritional Assessment (MNA) Score with lack of energy in nursing home residents

	Unadjusted OR (95% CI)	*P*	Model 1 OR (95% CI)	*P*
MNA score continuous	0.84 (0.78–0.90)	<0.001	0.87 (0.80–0.95)	0.002
MNA score categories				
Normal nutritional status (12–14 points, $n = 180$)	Reference group		Reference group	
At risk of malnutrition (8–11 points, $n = 323$)	1.39 (0.95–2.02)	0.09	1.14 (0.77–1.71)	0.51
Malnourished (0–7 points, $n = 71$)	3.42 (1.92–6.08)	<0.001	2.41 (1.29–4.52)	0.006

Note: Model 1: Adjusted for age, sex, Frailty Index.
Abbreviations: CI, confidence interval; OR, odds ratio.

TABLE 3 Relationship of single items of the Mini Nutritional Assessment (MNA) score with lack of energy in nursing home residents

Single items of the MNA	Model 1 OR (95% CI)	*P*	Model 2 OR (95% CI)	*P*
A. Decrease in food intake	2.19 (1.50–3.20)	<0.001	1.85 (1.24–2.77)	0.003
B. Involuntary weight loss during the past 3 months	1.09 (0.75–1.58)	0.67	1.16 (0.78–1.73)	0.46
C. Mobility	1.47 (1.14–1.89)	0.003	1.43 (1.10–1.86)	0.008
D. Acute disease or psychological stress over the past 3 months	1.55 (1.26–1.91)	<0.001	1.48 (1.19–1.84)	<0.001
E. Neuropsychological problems	0.86 (0.69–1.09)	0.22	0.86 (0.67–1.09)	0.21
F. BMI or CC, cm	1.09 (0.93–1.29)	0.28	1.07 (0.90–1.27)	0.43

Abbreviations: BMI, body mass index; CC, calf circumference; CI, confidence interval; OR, odds ratio; Model 1, Adjusted for age, sex, Frailty Index. Model 2, Adjusted for age, sex, Frailty Index, lack of energy and all the MNA items; *N*, number of nursing home residents with the item; *n*, number of patients with the item and lack of energy.

were reperformed using a modified FI computed after the exclusion of items potentially capturing signs of malnutrition and depressive symptoms. However, results did not substantially change.

DISCUSSION

Our study showed a high prevalence (43.2%) of lack of energy in older adults living in NH. A poor nutritional status was significantly associated with lack of energy, independent of potential confounders. Decrease in food intake, reduced mobility, and psychological stress or acute disease in the past 3 months were identified as the MNA-SF items contributing the most to the association between malnutrition and fatigue. Surprisingly, unintentional weight loss in the past 3 months and BMI, both of which are often used to capture the wasting component of the frailty phenotype, were not significantly associated with lack of energy. This might suggest that lack of energy is only partially related to anthropometry, and provide a more multidimensional measure of the malnutrition status. On the other hand, it is also possible that the MNA represents an assessment instrument capturing something more than malnutrition per se, and more comprehensively capturing the more general complexity of the individual.

Malnutrition (i.e., undernutrition) is highly prevalent in older people, especially among those who live in NHs.[19–21] At the same time, fatigue, frequently manifested as a lack of energy, also represents a highly prevalent and burdening condition in frail older adults.[1] However, to our knowledge, only a few studies have explored the association between poor nutritional status and fatigue in older adults. In 2014, Singh et al.[10] found a negative correlation between self-reported mobility tiredness and BMI ($r = -0.364$, $P = 0.01$) in a population of NH residents with undernourishment. More recently, Kushkestani et al.[22] reported a positive association ($r = 0.410$, $P < 0.001$) between malnutrition, defined according to the MNA, and fatigue (assessed using the Functional Assessment of Chronic Illness Therapy Fatigue questionnaire) in NH residents. Another recent study[23] documented that severe weight loss was an independent predictor of moderate (OR = 1.17, 95% CI = 1.03–1.34, $P = 0.019$) to severe fatigue (OR = 1.21, 95% CI = 1.05–1.39, $P = 0.01$) in older patients at hospital discharge. Tsutsumimoto et al.[24] reported that anorexia of aging was independently associated with exhaustion (OR = 1.39, 95% CI = 1.11–1.74, $P = 0.004$). Recently, Davis et al.[25] explored how perceived fatigability explains the association between poor diet quality and low physical function. They found an inverse association between the Healthy Eating Index and the Pittsburgh Fatigability Scale Physical score.

Interestingly, malnutrition has often and increasingly been associated with the concept of physical frailty. It has even been suggested that the multidimensional nature of malnutrition may somehow mirror the heterogeneous condition of frailty. The MNA itself instrument has been indicated as a possible tool for measuring the frailty status in older persons.[26,27] Among the symptoms most characterizing the frail individual, exhaustion is one of the most representative.[28] Geriatric syndromes have been described as conditions characterized by symptoms that can result not only from diseases but also from the accumulation of deficits in multiple systems determining a decreased compensatory ability.[29] Indeed, given its frequency and etiology in older persons, it becomes clear as fatigue may be looked as a geriatric syndrome.

Interestingly, the univariate analyses testing the prevalence of single diseases according to the presence of lack of energy did not show significant differences. On the other hand, persons reporting lack of energy showed a higher FI compared with non-fatigued peers. This may be explained by the fact that the clinical complexity of the NH population is not defined by a single condition but by the interaction of multiple signs, symptoms, diseases, and disabilities. It can be assumed that the self-reported lack of energy may reflect the exhaustion of the homeostatic reserves of the individual and a sort of clinical alert launched by the organism challenged in its limited reserves by a disproportionate stressor.[11]

Some limitations of our study are important to consider. Our study was cross-sectional. Therefore, no causal relationship among lack of energy and nutritional status could be established. Furthermore, the definition of lack of energy was derived from the GDS. As such, our operationalization of fatigue may have captured the psychological dimension of the symptom and potentially underestimated the physical domain. The measure of lack energy is crude and the yes/no dichotomous outcome may lack sensitivity. More sensitive instrument could better capture the gradient of association between malnutrition (and its components) with increasing levels of anergia, potentially demonstrating a dose–effect relationship between the two.

In conclusion, the present study showed a high prevalence of lack of energy in a cohort of NH residents. Our study identified a positive association between malnutrition and lack of energy. The lack of energy might represent the clinical manifestation of a poor nutritional status and mimic the exhaustion of the metabolic reserves of the individual. More research is needed to clarify the biological and clinical features of lack of energy in frail older persons, especially given the relationship between the

symptom and several adverse outcomes (including functional impairment, hospitalizations, increased use of healthcare services, mortality). The identification of potential targets for tackling fatigue might potentially lead in the future to the development of specific pharmacological and non-pharmacological interventions.

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CONFLICT OF INTEREST

MC has received honoraria from Nestlé Health Science for presentations at scientific meetings and being part of expert advisory boards. The other authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Domenico Azzolino and Matteo Cesari contributed to conceptualizing and writing the manuscript. Emanuele Marzetti, Marco Proietti, Riccardo Calvani, Philipe de Souto Barreto, and Yves Rolland edited and revised manuscript. Domenico Azzolino, Matteo Cesari, Emanuele Marzetti, Marco Proietti, Riccardo Calvani, Philipe de Souto Barreto, and Yves Rolland approved the final version of manuscript.

SPONSOR'S ROLE

None.

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