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Keywords	Foster families; older adults; malnutrition; Caribbean.

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Malnutrition and its determinants among older adults living in foster families in Guadeloupe (French West Indies). A cross-sectional study.

Abstract

Background: Foster families may represent an alternative model for dependent older adults in many countries where nursing homes are insufficiently developed. This study aimed to assess the prevalence of malnutrition and its determinants in older adults living in foster families in Guadeloupe (French West Indies).

Methods: This cross-sectional study was gathered from the KASAF (Karukera Study of Ageing in Foster families) study (n=107, 41M/66F, Mdn 81.8 years). Nutritional status was assessed with the Mini Nutritional Assessment Short- Form (MNA- SF). Clinical characteristics and scores on geriatric scales (Mini-Mental State Examination (MMSE), Activities of Daily Living (ADL), Short Physical Performance Battery (SPPB), Center for Epidemiologic Studies- Depression (CESD) and Questionnaire Quality of Life Alzheimer’s Disease (QoL-AD)) were extracted. Bivariate analysis and logistic models adjusted for age and gender were performed to test the association of nutritional status with socio-demographic variables and geriatric scales.

Results: Thirty (28.0%) older adults were malnourished (MNA-SF score ≤ 7). In bivariate analysis, malnutrition was associated with an increased prevalence of cardiovascular diseases (46.7% versus 19.5%, $p=0.004$), the presence of hemiplegia (30.0% versus 6.5%, $p=0.003$), a poorer cognitive status (MMSE score 4.7 ± 7.1 versus 9.7 ± 10.7 ; $p=0.031$), higher risk of depression (CESD score 27.3 ± 23.0 versus 13.5 ± 14.4 ; $p=0.035$) and dependency (ADL score 1.9 ± 1.9 versus 2.3 ± 2.1 ; $p<0.001$). Malnutrition was also associated with lower caregivers’ rating of QoL (QoL-AD score 21.8 ± 6.4 versus 26.0 ± 5.7 ; $p=0.001$) but not by older adult’s rating (24.1 ± 11.2 versus 28.3 ± 7.7 ; $p=0.156$). Similar associations were observed in logistic models adjusted for age and gender.

Conclusion: Malnutrition was common among foster families for older adults. Special attention towards the prevention and treatment of malnutrition in older adults from cardiovascular diseases, cognitive impairment, dependency and depression is necessary in this model of dependency support.

Keywords: Foster families; older adults; malnutrition; Caribbean

36 **Introduction**

37 Although foster families exist in many countries, this model is not widespread (1).
38 Consequently, very few studies have described and assessed the effectiveness of this model
39 on potential adverse health outcomes (2). In Guadeloupe (French West Indies, Caribbean
40 Island), the number of foster families has increased over the past three decades, due to the
41 aging of the population and the limited availability of nursing home placements. Cultural
42 factors may also contribute to this phenomenon. For instance, the importance of the family in
43 Caribbean culture and the public's reticence towards nursing homes may contribute to this
44 phenomenon. Foster families assume responsibility for the care of one to three residents in
45 their home, while a nurse, who visits the older adults on a daily basis, assumes paramedical
46 care. Foster families are remunerated directly by the relevant public authorities. In a
47 prospective observational study (KArukera Study of Ageing in Foster Families, KASAF), we
48 observed that the profile of older adults in foster families was similar to that for older adults
49 living in nursing homes in terms of co-morbidities, dementia and dependence (3). Foster
50 caregivers are responsible for the daily activities, including shopping, food preparation and
51 the provision of meals. It is essential that these meals meet the nutritional needs of older
52 adults.

53 Indeed, ensuring nutritional needs is fundamental to the care of older adults, particularly those
54 who are dependent (4). Ageing is associated with a change in body composition, a decrease in
55 lean body mass and an increase in fat mass. Malnutrition predisposes older adults to an
56 increased risk of adverse health outcomes such as frailty, osteoporosis, muscle wastage,
57 mortality (4), a lack of energy (5), a decline in health and physical functions (6) or falls (7).
58 Malnutrition is frequently underestimated and neglected, as its manifestations are non-
59 specific, particularly in the early stages. The following factors have been identified as
60 increasing the risk of malnutrition:-age over 85, low nutrient intake due to a loss of the ability
61 to eat independently, difficulty swallowing, becoming bedridden, pressure ulcers, a history of
62 hip fracture, dementia, depressive symptoms, and suffering from two or more chronic
63 illnesses (8).

64 Malnutrition has been the subject of investigation in both nursing homes and the community.
65 However, it has never been the subject of study in the context of foster families for older
66 adults. The aim of this study was to estimate the prevalence of malnutrition among older

67 adults receiving caregiving in foster families and to investigate the factors associated with
68 malnutrition using the baseline data of the KASAF cohort.

69

70

71 **Methods**

72 Study design

73 KASAF cohort is a prospective observational study of older adults (≥ 60 years old) living in
74 foster families in Guadeloupe. The study protocol (9) and inclusion data has been published
75 (3). At inclusion, 6 months and 12 months, healthcare professionals (geriatricians or clinical
76 research nurses) interviewed the participants and their professional caregivers. For this study,
77 we performed a cross-sectional analysis of the baseline's characteristics of participants. The
78 KASAF study and was approved by the Sud Méditerranée III Ethics Committee on July 1,
79 2020 (number 2020.05.03 bis_ 20.04.01.59610).

80 Outcome measure

81 The nutritional status was evaluated using the Mini Nutritional Assessment Short- Form
82 (MNA- SF) (Rubenstein) (9). 15 The MNA- SF comprises six items: reduced food intake,
83 non- volitional weight loss in the past 3 months, mobility, psychological stress or acute
84 disease during the past 3 months, neuropsychological problems, and low body mass index
85 (BMI). For adults whose BMI was missing, it was replaced by low calf circumference, as
86 recommended in the MNA- SF guidance (9). The total MNA- SF score ranges from 0
87 (indicating the most severe form of malnutrition) to 14 (indicating no sign of malnutrition).In
88 particular, a score of 12–14 is indicative of a normal nutritional status, while a score of 0–7
89 and 8–11 identifies malnutrition or risk of malnutrition respectively.

90 Other measurements

91 The sociodemographic data and comorbidities were collected from the foster caregiver. The
92 cognitive status was assessed using the Mini-Mental State Examination (MMSE) (10). A
93 score below 18 indicated the presence of major cognitive impairment. Functional status was
94 evaluated using the Activities of Daily Living (ADL) scale (11) and the instrumental ADL
95 scale (IADL) (12). Physical function was assessed using the Short Physical Performance
96 Battery (SPPB) (13) and depression with the Center for Epidemiologic Studies Depression
97 (CESD) scale (14). Quality of life of the participant was assessed using the QoL-AD
98 (Questionnaire Quality of Life - Alzheimer's Disease) (15), which was administered to the

99 participant and the caregiver.-Pain was quantified using a visual analogue scale (VAS), with
100 scores ranging from 0 to 100.

101 Statistical analysis

102 Quantitative variables were expressed as mean \pm standard deviation, median and minimum
103 and –maximum values. The qualitative variables were expressed as percentages. Chi- square
104 or Fisher test and t- tests were used to describe the population according to their nutritional
105 status. A Pearson correlation test was used to assess the correlation between the QOL-AD
106 scores of patient and their respective caregiver. Logistic regression models, which were
107 adjusted for age and gender, were conducted to examine the association between nutritional
108 status (the independent variable) and each comorbidity and each geriatric scale. We reported
109 odds ratios (ORs) and 95% confidence intervals (95% CIs). No imputation method was
110 performed for missing data- Statistical significance was set at $P < 0.05$. All analyses were
111 performed with R. 4.2.1.

112

113 Results

114 1. Frequency of malnutrition

115 A total of 107 older adults were included in the study. The mean age was 82.2 ± 11.6 years,
116 and 38.3% of the participants were men. They had been living in foster care for 4.6 ± 4.8
117 years. The frequency of malnutrition ($MNA-SF \leq 7$) was 28.0% (95% confidence interval
118 (CI): 20.9-39.1) (n=30). Furthermore, 52 (48.6%, IC95%: 39.1-58.1) older adults were at risk
119 of malnutrition (MNA-SF between 8 and 11 points). The prevalence of older adults with
120 malnutrition or at risk of malnutrition was 76.6% (IC95%: 68.6-84.6).

121 2. Factors associated with sociodemographic status and comorbidities

122 In bivariate analysis, malnutrition (compared to normal nutritional status or at risk of
123 malnutrition) was associated with cardiovascular diseases (46.7% versus 19.5%, $p=0.004$) and
124 hemiplegia (30.0% versus 6.5%, $p=0.003$). Malnutrition was not associated with age, gender,
125 length of stay in foster families, hypertension, diabetes, dementia and Parkinson’s disease
126 listed by the caregiver (table 1). In a model adjusted for age and gender, the OR were 3.94
127 (CI95%: 1.52-10.62) for cardiovascular disease and 11.36 (CI95%: 3.00-53.29) for
128 hemiplegia.

		Bivariate analysis	Model adjusted on age and gender
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Characteristics	All (n=107)	Malnutrition yes (n=30)	Malnutrition no (n=77)	p	OR (CI95%)	p
Age	82.2 ± 11.6	84.7 ± 11.3	81.2 ± 11.2	0.156		
<80 years old	44 (41.1%)	8 (18.2%)	36 (81.8%)			
≥ 80 years	63 (58.9%)	22 (34.9%)	41 (65.1%)	0.057		
Gender (men)	41 (38.3%)	8 (26.7%)	33 (42.9%)	0.122		
Length of stay in foster families	4.6 ± 4.8	4.2 ± 3.7	4.8 ± 5.2	0.576	0.98 (0.88-1.07)	0.647
Hypertension	49 (45.8%)	14 (46.7%)	35 (45.4%)	0.910	1.02 (0.42-2.42)	0.959
Diabetes	26 (24.3%)	7 (23.3%)	19 (24.7%)	0.884	0.93 (0.32-2.51)	0.903
Hypercholesterolemia	11 (10.3%)	4 (13.3%)	7 (9.1%)	0.498	2.86 (0.59-13.63)	0.178
Cardiovascular diseases (cardiac failure, myocardial infarction, stroke)	29 (27.1%)	14 (46.7%)	15 (19.5%)	0.004	3.94 (1.52-10.62)	0.005 ⁱ
Dementia	53 (49.5%)	19 (63.3%)	34 (44.2%)	0.075	1.75 (0.70-4.52)	0.237
Parkinson's disease	13 (12.2%)	6 (20.0%)	7 (9.1%)	0.184	2.58 (0.75-8.80)	0.124
Hemiplegia	14 (13.1%)	9 (30.0%)	5 (6.5%)	0.003	11.36 (3.00-53.29)	<0.001 ⁱⁱ
Kidney disease	4 (3.7%)	3 (10.0%)	1 (1.3%)	0.066	6.84 (0.81-144.09)	0.107
Cancer	1 (0.9%)	0 (0.0%)	1 (1.3%)	-		

129 *Table 1: Sociodemographic factors and comorbidities associated with nutritional status in KASAF study*

130 ⁱ: McFadden's Pseudo R2: 0.090

131 ⁱⁱ: McFadden's Pseudo R2: 0.133

132

133 3. Association between MNA-SF score and geriatric scales

134 Malnutrition (compared to normal nutritional status or at risk of malnutrition) was associated
135 with poorer cognitive status assessed by the MMSE score (4.7 ± 7.1 versus 9.7 ± 10.7 ,
136 $p=0.031$), especially among older adults with major cognitive disorders (MMSE score < 18)
137 (92.3% versus 30.0% , $p=0.023$). Among the 28 older adults with a MMSE score <18 who
138 were not diagnosed with dementia by the caregiver, six were malnourished (21.4%).
139 Malnutrition was also associated with a lower ADL score (1.9 ± 1.9 versus 2.3 ± 2.1 ,
140 $p<0.001$). Malnutrition was highly associated with bedridden older adults (96.7% versus
141 67.5% , $p=0.001$) and older adults totally dependent at meals (80.0% versus 42.9% , $p<0.001$)
142 in terms of activities of daily living. Malnutrition was associated with the caregivers

143 'estimation of QoL score (QoL-AD score 21.8 ± 6.4 versus 26.0 ± 5.7 ; $p=0.001$) but not by
 144 the self-reported QoL score (24.1 ± 11.2 versus 28.3 ± 7.7 ; $p=0.156$). The correlation
 145 coefficient between the QoL-AD score for older adult and their respective caregivers was 0.60
 146 ($p<0.001$). Finally, the CESD score for depression was associated with malnutrition ($27.3 \pm$
 147 23.0 versus 13.5 ± 14.4 ; $p=0.035$) (Table 2). The SPPB score (0.4 ± 1.3 versus 1.2 ± 2.2 ;
 148 $p=0.07$) and VAS pain score (63.3 ± 2.6 versus 41.3 ± 36.4 , $p=0.169$) were not statistically
 149 associated with the MNA-SF score (table 2).

150 In model adjusted for age and gender, the OR for malnutrition was 4.92 (1.27-32.69) for a
 151 MMSE score of ≤ 18 , 0.51 (0.31-0.76) for the ADL score, 0.87 (0.79-0.95) for QoL-AD caregivers
 152 'estimation and 1.05 (1.00-1.11) for the CESD score.

153

Scale	All (n=107)	Bivariate analysis			Model adjusted on age and gender	
		Malnutrition yes (n=30)	Malnutrition no (n=77)	p	OR	p
MMSE (n=96)	8.3 ± 10.1	4.7 ± 7.1	9.7 ± 10.7	0.031	0.94 (0.89-0.99)	0.045 ¹
MMSE ≤ 18 (n=96)	73 (76.0%)	24 (92.3%)	21 (30.0%)	0.023	4.92 (1.27-32.69)	0.043
ADL (n=107)	1.5 ± 1.8	1.9 ± 1.9	2.3 ± 2.1	<0.001	0.51 (0.31-0.76)	0.004 ²
<i>Full assistance for bathing</i>	84 (78.5%)	28 (93.3%)	56 (72.7%)	0.020		
<i>Full assistance of dressing</i>	88 (82.2%)	29 (96.7%)	59 (76.6%)	0.015		
<i>Full assistance for toileting</i>	90 (84.1%)	29 (96.7%)	61 (79.2%)	0.015		
<i>Bedridden</i>	81 (75.7%)	29 (96.7%)	52 (67.5%)	0.001		
<i>Incontinence</i>	91 (85.0%)	29 (96.7%)	62 (80.5%)	0.035		
<i>Totally dependent at meals</i>	57 (53.3%)	24 (80.0%)	33 (42.9%)	<0.001		
QOL-AD (n=47) residents	27.2 ± 8.8	24.1 ± 11.2	28.3 ± 7.7	0.156	0.93 (0.83-1.01)	0.104
QOL-AD caregivers' estimation (n=47)	24.8 ± 6.2	21.8 ± 6.4	26.0 ± 5.7	0.001	0.87 (0.79-0.95)	0.003 ³
VAS pain (n=37)	44.9 ± 35.6	63.3 ± 2.6	41.3 ± 36.4	0.169	1.01 (0.99-1.04)	0.322
SPPB (n=105)	1.0 ± 2.0	0.4 ± 1.3	1.2 ± 2.2	0.07	0.78 (0.52-1.03)	0.147
CESD (n=39)	16.7 ± 17.4	27.3 ± 23.0	13.5 ± 14.4	0.035	1.05 (1.00-1.11)	0.031 ⁴

154 Table 2: Associations between MNA-SF score and geriatric scales

155 ¹: McFadden's Pseudo R2: 0.178

156 ²: McFadden's Pseudo R2: 0.133
157 ³: McFadden's Pseudo R2: 0.110
158 ⁴: McFadden's Pseudo R2: 0.724
159

160 **Discussion**

161 This is the first study to assess malnutrition in foster families for dependent older adults. The
162 results highlighted the high prevalence of malnutrition in this setting (28.0%). In community-
163 dwelling older adults, the prevalence of malnutrition is between 3 to 6%,—depending on the
164 setting and assessment method (4, 17, 21). In Guadeloupe, the prevalence of malnutrition or
165 at-risk of malnutrition in older adults is 21.7% at home (18), which is a significantly lower
166 than observed in our study (i.e. 76.6%). Foster families in Guadeloupe are considered an
167 alternative to nursing homes. In the literature, the frequency of malnutrition in nursing homes,
168 based on the MNA scale, is estimated at 13.8% (17). In France, a study carried out in nursing
169 homes found a frequency of 15.7% (19). We observed a frequency of malnutrition of 92.3%
170 in older adults with severe cognitive impairment, which appears to be higher than that
171 reported in the literature. The estimated range is 6.8% to 75.6% (20) or 28.7% in another
172 systematic review using only the MNA score (21). In the model adjusted for age and gender, a
173 MMSE score ≤ 18 was associated with malnutrition (OR: 4.92 (CI95%: 1.27-32.69)). The
174 finding of the study indicated that dementia, as reported by the foster caregiver, was not
175 associated with malnutrition. However, the MMSE score suggested that almost 20% of the
176 older adults suffered from undetected severe cognitive impairment. Dementia, as well as
177 undernutrition, seems to be underestimated by foster caregivers.

178 Malnutrition was particularly prevalent in older adults with a history of cardiovascular disease
179 and hemiplegia. It is well established that malnutrition increases the risk of mortality and
180 hospitalizations in patients with chronic heart failure (22). Our study is consistent with several
181 other studies conducted ~~carried out~~ in nursing homes that have investigated the potential
182 association between malnutrition and depression or poor physical function (23). Furthermore,
183 we observed a strong association between dependency and malnutrition, particularly for in
184 patients who are bedridden or have difficulty eating. With regard to quality of life, we noted
185 that malnutrition was associated with QoL score as perceived by caregivers, but not with that
186 rated by older adults themselves. In nursing homes, malnutrition impacts quality of life
187 (24,25). This result may be due to the low number of older adults who were able to answer to
188 the QoL-AD scale, excluding older adults with severe dementia. Impaired cognition has been
189 associated with reduced quality of life when the caregiver is the assessor (26). Moreover,

190 quality of life perceived by the older adult is generally rated higher than that perceived by the
191 proxies' rating (27,28). Higher prevalence of malnutrition have been observed in adults aged
192 > 80 years and women (29). Although the association was not statistically significant, the
193 frequency of malnutrition was higher in adults aged > 80 years (34.9% versus 18.2%,
194 $p=0.057$) in our study.

195 Our study therefore provides important elements for the assessment of the foster family model
196 for dependent older adults. One strength of our study is that it presents data from a population
197 of Caribbean population, with a specific diet (especially in terms of fruit and vegetables) and
198 probably specific dietary intake (30). Foster families for older adults could provide a solution
199 to the challenge of dependency in many countries, particularly in the Caribbean and Africa.
200 Improving nutritional care represents an essential lever for developing this model. In terms of
201 nutrition, the foster family is presents both a strength and a weakness. It is easier to respect
202 the food tastes and preferences of the older adult in a domestic setting than in a collective
203 kitchen such as those found in nursing homes. Furthermore, the residents of nursing homes
204 have less flexibility in their meal schedules. Nevertheless, the quantity and quality of home-
205 cooked meals may not be optimal for malnourished older adults. Additional training and
206 specialized dietetic care, including advice, food enrichment, anthropometric monitoring,
207 consultations with nutritionists and dieticians and a food diary (4)), could be provided if
208 malnutrition is detected. An alternative solution could be the implementation of meal delivery
209 services. Currently, in Guadeloupe, the authorization to work as a foster caregiver requires 54
210 hours of training, with only a few hours devoted to hygiene and nutrition. It is also
211 noteworthy that weight was only available for 22 participants, despite the simplicity of the
212 tool for detecting recent malnutrition. Paramedical staff could also provide training and
213 screening for malnutrition, given that all foster care residents benefit from a daily visit from a
214 nurse.

215 Our study has a number of limitations. Firstly, there were no data concerning the
216 precariousness of family caregivers and the budget allocated to buying meals for the older
217 people. This socio-economic data could have been interesting to explore. Secondly, due to the
218 low sample size and the limit number of outcomes events for CESD scale or QOL-AD scale,
219 no multivariate model taking into account all the covariates associated with malnutrition was
220 performed. This is a cross-sectional study suggesting associations. The one-year longitudinal
221 follow-up of our study will enable us to identify risk factors for nutritional deterioration,
222 including hospitalizations and ADL.

223 **Conclusion:**

224 Malnutrition was common among older adults living in foster families. The prevalence of
225 malnutrition was higher in older adults with dependency, depression, cardiovascular diseases,
226 hemiplegia and cognitive impairment. The findings of this study indicate that there is a need
227 for greater focus on the nutritional requirements of older adults and the training of foster
228 caregivers in this area.

229 **Conflicts of Interest:** None declared.

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234 **Author's contribution:** Study Concept and Design: Denis Boucaud-Maitre, Hélène Amieva,
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236 Acquisition of data: Christine Rambohjan, Denis Boucaud-Maitre, Roxane Villeneuve, Leila
237 Rinaldo, Nadine Simo-Tabué, Maturin Tabué-Teguo. Drafting the manuscript: Denis
238 Boucaud-Maitre. Critical revision: Jean-François Dartigues, Ludwig Mounsamy , Laurys
239 Letchimy , Hélène Amiéva, Moustapha Dramé, Leila Rinaldo, Nadine Simo-Tabué. All
240 authors approved the final manuscript.

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347 SUPPLEMENTARY MATERIAL

348 S1 : dataset