Clinical Journal for Medicine, Health and Pharmacy, Vol. 3, No, 1, March 2025
ISSN: 3049-1282

Frailty, Nutrition, and Cognitive Decline: A Cross-Sectional Study in Geriatric Populations

Dr. Isabella Clarke[1], and Dr. Lars Hoffman[2]

[1,2]*Mayo Clinic, Rochester, USA.*

Received: 13/December/2024; Revised: 09/January/2025; Accepted: 21/February/2025; Published: 31/March/2025

Abstract

The human population is now aging at an accelerated rate. This results in increased dependence rates and necessitates the adaptation of health and social services to accommodate the aging population. This population has acquired frailty (FR) as one of its modifications. It is characterized as a clinically identifiable condition associated with the aging of many bodily functions, resulting in vulnerability. The genesis of FR seems multifaceted, with its pathophysiology shaped by the interplay of several variables. The research identifies four primary pathways that induce FR: atherosclerosis, sarcopenia, Cognitive Decline (CD), and malnutrition, together with their associated metabolic changes. Malnutrition correlates with cognitive impairment and functional decline; yet, it is recognized that insufficient food intake contributes to CD. Nutritional variables that affect vascular risk factors might impact the decline of dementia in people with cognitive FR. This study seeks to elucidate the dietary aspects investigated so far that contribute to the onset of FR, particularly CD.

Keywords: Frailty, Nutrition, Cognitive Decline, Geriatric Populations.

1 INTRODUCTION

Life expectancy is rising in most nations worldwide Heuveline (2022). Now, 8% of the global population is aged over 60, a statistic projected to rise to 15% by 2050. Population aging is associated with heightened comorbidity, working deterioration, and a greater incidence of elderly services syndromes—complex illnesses that do not conform to specific morbidity illnesses but present as phenomena such as frailty (FR) Sciacchitano et al. (2024), falls, inactivity, incontinence, and delirium.

FR is defined by reduced physiological reserves, with its prevalence exacerbated by aging. Studies advocate for a multimodal description of the condition, including its mental, physical, and social components and comorbidities Berk et al. (2023). The model characterizes FR as having signs of a minimum of three physical indications: weakening (diminished grip power), sluggishness (decreased walking speed), weight loss, poor physical activity, and fatigue. Individuals exhibiting one or two signs are categorized as prefrail. The incidence of FR in communities is thought to be between 3.8% and 50.2%, whereas the rate of preFR varies from 12.1% to 70.5%, depending on geographical area and screening methodologies used.

In medical care, individuals over 82 years of age with significant comorbidity or impairment are often misclassified as FR Mishkin et al. (2023). While they intersect, comorbidity, loss of functioning,

and FR are distinct phenomena. They all exert detrimental impacts on health and are correlated with impairment, hospital stay, and mortality. Functionality is characterized as a collection of mental and bodily competencies essential for sustaining independence in executing fundamental tasks of daily life, including social and Cognitive Decline (CD). PreFR and FR are risk indicators for declining function, particularly among those over 75.

2 BACKGROUND

Research methodology

This research used a cross-sectional methodology; hence, the research provides the findings according to the STROBE criteria for cross-sectional study design in medicine Ziemann et al. (2022).

Context

This research was performed in neighborhoods. Participants were either participants in senior community centers, offering entertainment for the aged, or residents of senior hostels, providing housing for fully self-sufficient older adults. The subject recruited and gathered information from 2019 to 2022.

Parameters

The factor that influenced the outcome was CD. The factors that were independent included malnutrition and melancholy. The socioeconomic, medical, and genetic factors included age, sex, relationship status, living situation, educational attainment, knowledge about health, tobacco use, alcohol consumption, and the e-allele genotypes of the apolipoprotein E (APOE) genes Adler et al. (2024).

Assessment Results

The dependent factors in this research include CD, physical weakness, and Mild Cognitive Impairment (MCI) Marselli, Favieri, & Casagrande (2023). The presence of either pre-physical FR or FR characterized physical FR. Physical FR was assessed using the FR scale. FR consists of five binary items with potential scores ranging from 0 to 5. An elevated score indicates an increased degree of physical FR. FR classifies FR into three severity stages: robust=0, pre-FR=1- 2, and FR=4- 5. Subjects with a FR score of 1 or above were classified as exhibiting physical weakness.

MCI is characterized by subjective memory complaints, objective CD, and mostly preserved functioning abilities Bermejo-Pareja et al. (2021). The CD was employed to evaluate MCI, and those with a CDR of 0.5 were classified as having MCI. This research utilizes Ruan's concept of CD, characterized by 1) physical weakness or pre-physical FR, 2) MCI, and 3) the absence of concomitant dementia. Eight subjects exhibiting both physical FR or pre-physical insufficiency and MCI were classified as experiencing CD. Individuals with CDR=0 and FR=0 were classified as robust, indicating CD without any signs of FR.

Elements

This research included two independent factors: 1) Depression and 2) Nourish. Sadness was assessed using the Geriatric Depression Score (GDS-15), consisting of 15 items, where a higher score signifies a greater degree of depression. Nutrition was evaluated using the Mini-Nutrition Assessment-Short Form (MNA-SF), composed of six questions with potential values ranging from 0 to 14. A superior score signifies an enhanced nutritional condition.

Confounding variables

Age, gender, and schooling were regarded as possible confounders according to prior research indicating their association with physical FR and MCI. Given that the APOE ε4 allele is a recognized genetic marker for Alzheimer's disease, a significant form of dementia, and MCI in older persons, the research encompassed APOE ε4 carrier status as a possible confounder in the investigation.

Sample size

This research examines the hypothesis about the relationships between CD state and two variables (depressive disorders and malnutrition), while controlling for four confounding factors (age, gender, level of education, and APOE ε4 carrier state) across the three results (cognitive weakness, physical weakness, and MCI). Prior research indicated that the impact sizes of diet (OR=3.2) and melancholy (OR=2.5) on FR were minimal to medium. The research prudently estimated the impact sizes of diet and melancholy on CD to be minimal to slight (i.e., f2=0.02-0.14). Utilizing Power for multivariate linear regression and adhering to certain constraints (i.e., number of indicators=3, strength=0.8, significance level=0.06, f2=0.07), a sample size of 160 participants was required for data analysis.

Statistical methodologies

Most demographic data, clinical elements, results, and covariates were characterized using average with variance or frequency with percentages. The factors were evaluated across four outcome categories: cognitive weakness, physical weakness, MCI, and robust. The pupil t-test, Mann-Whitney U examination, and Chi-Square testing were employed to compare the factors among subgroups. The statistical threshold was established at 0.05.

Multinomial logistic regression equations were used to evaluate the two possibilities based on the results. The variable of interest was nominal mental FR position, categorized as follows: 1) robust, 2) physical weakness, 3) MCI, and 4) CD. The robust subgroup was designated as the standard for calculating odds comparisons. Nutrition and melancholy were defined as the independent factors. Two designs, one uncorrected and one corrected for covariates (i.e., age, gender, level of education, and APOE ε4 carrier state), were estimated independently to ascertain the independence of the components from the confounders. The statistically significant threshold was established at 0.05. Insufficient information will be substituted with the average when the absence rate of factors is negligible (i.e., 5%

or less); multiple imputations will be used for factors with an absence rate above 5%, based on the missing trends.

3 RESULTS AND DISCUSSIONS

Of 732 individuals initially assessed for qualification, 21.8% were eliminated: 94.7% opted out of participation, and 4.6% failed to satisfy the selection criterion. The total research sample consisted of 565 individuals, or 78.2%. Based on the Fried FR Phenotype standards, the prevalence of weakness was 11.8%, while preFR incidence was 73.6%. 84.7% of those surveyed were categorized as preFR/FR (1 to 5 FR standards), and 15.2% were classified as robust (no FR standards). The preFR/FR category had a greater number of women. Most of those surveyed cohabited with their spouse; however, many older individuals in the preFR/FR category lived alone at home. The vigorous group engaged in a greater volume of weekly activity. No changes were seen in the frequency of comorbidities (Table 1).

Table 1: Characteristics Analysis

Category		Robust Set	FR Set
Gender	Female	31	325
	Male	60	148
Cohabitation	With partner	70	288
	Single	15	141
	With family	6	44
Physical activity	<3 hr/week	0	228
	3—6 hr/week	41	141
	>6 hr/week	50	104
Comorbidity	Hypertensions	60	310
	Diabetics	20	142
	Hyperlipidemia	36	207
	Metabolical syndrome	14	89

The age was greater in the preFR/FR cohort ($p < 0.001$). The functional examination revealed no variations in the Barthel and Lawton indexes for fundamental and instrumental responsibilities of daily living; accordingly, there were no discrepancies in walking (evaluated by Tinetti) or mental abilities. Conversely, the preFR/FR cohort had a markedly greater incidence of falls in the preceding 12 months and a considerably elevated fear of falling, as measured by the FES-I ($p < 0.001$). The quality of life was similarly favorable in the two categories (Table 2). In the objective nutritional evaluation, both categories exhibited a mean score above 11, indicating adequate health; yet, the preFR/FR cohort had a much lower rating than the robust cohort ($p = 0.019$). Among the biochemical indicators, only hemoglobin exhibited a significant difference across groups, with the preFR/FR cohort demonstrating reduced levels ($p < 0.001$). The preFR/FR subgroup had a markedly elevated BMI, body mass proportion, and considerably diminished handgrip strength.

Table 2: Quality of Life Analysis

Parameter	Robust	FR
Age	75.23	75.32
Daily prescribed medicine	4.32	4.85
Barthel	93.42	92.43
Lawton	8.24	8.32
Tinetti	27.43	26.39
MMSE	29.32	29.32
Falls over in 1 year	0.54	0.95
FES	11.32	21.34
EQ-5D indicator	0.94	0.85
EQ-5D VAS	71.34	75.23

In comparing hazards among groups, the preFR/FR subjects exhibited increased odds of displaying, in descending order: fear of tumbling, current falls, hemophilia (hemoglobin < 13.5 g/dL in boy and < 11.4 g/dL in girl), age exceeding 75, living by itself, polypharmacy, and girl sex (Table 3). A conditional logistic regression analysis was conducted to find determinants of FR. The model included the following factors: age category, sex, living alone, having diabetes, multiple medications, Barthel index < 95, history of decreases, FES-I > 25, anaemia (hemoglobin < 14.3 g/dL in males and < 13.2 g/dL in female), central weight gain, weight gain, and regular exercise. Handgrip was excluded since it is a criterion of the FR syndrome. The predictive model demonstrated statistical significance, accurately categorizing 82.4% of instances, with a precision of 93.1% and a sensitivity of 38.4%. The last simulation encompassed the factors of female sex, age beyond 75 years, a history of hemorrhage, a history of falls, and fear of tripping. The most significant predictor of FR was the fear of collapsing. Physical exercise was a crucial element in preventing FR.

Table 3: Performance comparison analysis

Parameter	Count	Robust	FR
MNA-SF	92	14.32	13.52
Haemoglobin	80	15.43	17.42
Total lymphocyte	80	2.54	2.54
Total cholesterol	79	189.43	194.23
Total proteins	65	8.43	8.42
Albumin	35	6.23	5.23
Creatinine	83	2.32	0.86
BMI	92	28.43	31.42
Waist circumference	92	105.32	105.23
Brachial circumference	92	32.43	32.43
Thigh circumference	92	46.23	49.52
Handgrip strength	92	31.25	19.43
Body fat	92	34.75	41.32

4 CONCLUSION

Oxidative damage is a critical element in the progression of CD. Therefore, augmenting dietary antioxidants (AO) is a therapeutic approach to treating these individuals. Many research investigations demonstrate the efficacy of AOs in modulating oxidative damage via their role as AOs that eliminate

free radicals or enhance the AO impact. Conversely, incorrect application of AOs has adverse consequences and toxicity at elevated dosages. More investigations and clinical trials are necessary to improve the clinical data.

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