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Determinants of Frailty Status in Elderly Patients with Permanent Pacemakers at Adam Malik Hospital, Medan

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ABSTRACT

Introduction: Frailty is highly prevalent among elderly patients following permanent pacemaker implantation, with rates exceeding 70%. The Comprehensive Geriatric Assessment (CGA) evaluates frailty through domains such as nutrition (Mini Nutritional Assessment, MNA), comorbidities (Charlson Comorbidity Index, CCI), functional status (Barthel Index), cognition (Mini Mental State Examination, MMSE), mood (Geriatric Depression Scale, GDS), quality of life, polypharmacy, and pacemaker implantation duration, alongside sociodemographic factors like age and sex. Identifying factors influencing frailty is essential for optimizing outcomes and quality of life in this population.

Methods: This cross-sectional study included patients aged ≥60 years with permanent pacemakers attending the Arrhythmia Clinic at Adam Malik Hospital, Medan, from October to December 2024. Frailty was assessed using the CGA. Bivariate analyses employed Fisher's exact test and chi-square tests to evaluate associations between frailty scores and variables including MNA, CCI, Barthel Index, MMSE, GDS, quality of life, polypharmacy, implantation duration, age, and sex. Multivariate logistic regression was used to identify significant predictors of frailty.

Results: Of 62 participants, 62.9% were aged 60–74 years. Bivariate analysis revealed that 58.1% of malnourished patients (per MNA) were frail ($p<0.008$), and 94.1% of those on polypharmacy regimens were frail ($p<0.001$). Multivariate analysis identified polypharmacy as the only significant predictor of frailty (OR 14.0; 95% CI 2.186–89.675).

Conclusion: Nutritional status and polypharmacy are associated with frailty in elderly pacemaker patients, with polypharmacy showing a significant independent effect. Targeted interventions addressing polypharmacy may improve frailty outcomes in this population.

Keywords

Frailty, Permanent Pacemaker, Polypharmacy, Nutritional Status, Elderly

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INTRODUCTION

The global elderly population, defined as individuals aged ≥60 years according to Indonesian Law No. 13/1998, is projected to reach 2 billion by 2050, amplifying concerns about frailty, a syndrome of heightened vulnerability to stressors that increases the risk of falls, disability, and health decline [1,2]. Frailty, characterized by sarcopenia, nutritional deficits, hormonal changes, and chronic inflammation, is often assessed using Fried's Phenotype Model, which identifies frailty through unintentional weight loss, exhaustion, reduced grip strength, slow walking speed, and low physical activity and classifies individuals as frail (≥3 criteria) or prefrail (1–2 criteria) [3,4]. The Frailty Index (FI) developed by Mitnitski et al.

Comprehensive Geriatric Assessment (CGA) offers a broader evaluation of deficits, including diseases, physical and cognitive impairments, and psychosocial factors, providing higher sensitivity for predicting adverse outcomes [5,6]. Frailty prevalence varies globally, from 4% in Taiwan to 27.3% in Spain, with Indonesian studies reporting 25.2% in geriatric hospitals linked to age ≥70 years, functional dependence, and malnutrition [4,7,8]. Permanent pacemaker implantation (PPI), a common therapy for non-coronary arrhythmias, is increasingly performed in older adults, with 70% of 1,342 Indonesian procedures performed in 2021 involving those aged >60 years [9]. PPI reduces fall risk and enhances quality of life, but is associated with limited 5-year survival (45%) in those aged ≥85 years, with dementia, cancer, and diabetes as key mortality predictors [10]. CGA, incorporating tools such as the Mini Nutritional Assessment and Charlson Comorbidity Index, is critical for identifying frailty risk factors post-PPI [11,12]. This study investigated the factors influencing frailty in elderly patients with PPI, addressing a critical gap in longitudinal outcome research [9].

METHODS

This analytical cross-sectional study was conducted to identify the factors influencing frailty status in elderly patients with permanent pacemakers at Adam Malik Hospital, Medan, from October to December 2024. The study population included all patients aged 60 years or older with a permanent pacemaker in situ who provided written informed consent and could communicate effectively in Bahasa Indonesia. Participants were required to have a Frailty Index (FI) score of at least 0.25, indicating frailty or pre-frailty. Exclusion criteria included documented cognitive impairment that prevented valid questionnaire responses, and inability to communicate adequately in Bahasa Indonesia. Ethical clearance was obtained from the Adam Malik Hospital Ethics Committee, ensuring compliance with ethical standards.

Eligible participants underwent structured interviews to complete the 40-item Frailty Index (FI-40), Mini Nutritional Assessment (MNA), Charlson Comorbidity Index (CCI), Barthel Index of Activities of Daily Living (ADL), and Geriatric Depression Scale (GDS). Relevant clinical data, including pacemaker implantation duration, polypharmacy status, and sociodemographic details (age and sex), were extracted from medical records. All assessments were performed by trained investigators to ensure consistency, and questionnaire scores were calculated by the research team. Data were summarized descriptively in narrative forms and tables, capturing patient characteristics and frailty-related variables. Bivariate analyses used Spearman's rank correlation for continuous and ordinal variables, an independent t-test to examine sex-based differences, and Pearson's correlation for cognitive status and frailty associations, with statistical significance set at $p<0.05$. Multivariate linear regression analysis was conducted to evaluate the combined impact of all assessed factors on the frailty scores.

RESULTS

This analytical cross-sectional study was conducted with 62 elderly patients (aged ≥60 years) who had permanent pacemakers at Adam Malik Hospital, Medan, from October to December 2024, with the objective of evaluating factors influencing frailty status. The majority of participants were aged 60–74 years (39; 62.9%), with a gender distribution of 54.8% male (34) and 45.2% female (28). Frailty was prevalent, with 74.2% (46) classified as frail and 25.8% (16) as pre-frail according to the Frailty Index (FI-40). Nutritional status assessment revealed that 58.1% (36) were at risk of malnutrition, 21.0% (13) were malnourished, and 21.0% (13) were normal. Most patients exhibited mild comorbidities (50; 80.6%), while 16.1% (n = 10) had moderate comorbidities, and 3.2% (n = 2) had severe comorbidities. Depression was common, with 69.4% (43) likely to be depressed and 30.6% (19) depressed. Functional status varied: 17.7% (11) were independent, 40.3% (25) had mild dependence, 33.9% (21) had moderate dependence, and 8.1% (5) had severe dependence. Cognitive status was normal in 64.5% (n = 40) of the patients, with 35.5% (n = 22) showing moderate impairment. Polypharmacy (≥5 medications) was reported in 54.8% of patients (34), and the duration of pacemaker implantation was ≥2 years in 41.9% (26), 1–2 years in 35.5% (22), and <1 year in 22.6% (14). Quality of life was moderate in 91.9% (n = 57) and low in 8.1% (n = 5) (Table 1).

Table 1. Basic Characteristics of Elderly Patients with Permanent Pacemakers at Adam Malik Hospital, Medan

Parameter	Count (n=62)	Percentage (%)
Age (years)		
60–74	39	62.9
75–89	22	35.5
≥90	1	1.6
Gender		
Male	34	54.8
Female	28	45.2
Nutritional Status		
Normal	13	21.0
At risk of malnutrition	36	58.1
Malnourished	13	21.0
Comorbidity		
Mild	50	80.6
Moderate	10	16.1
Severe	2	3.2
Depression		
Likely depressed	43	69.4
Depressed	19	30.6
Functional Status (ADL)		
Independent	11	17.7
Mild dependence	25	40.3
Moderate dependence	21	33.9
Severe dependence	5	8.1
Cognitive Status		
Normal	40	64.5
Moderate memory impairment	22	35.5
Severe memory impairment	0	0.0
Polypharmacy		
Yes	34	54.8
No	28	45.2
Duration of Pacemaker Implantation		
<1 year	14	22.6
1–2 years	22	35.5
≥2 years	26	41.9
Quality of Life		
Moderate	57	91.9
Low	5	8.1
Frailty		
Pre-frail	16	25.8
Frail	46	74.2

Data were collected from October to December 2024 at the Arrhythmia Clinic, Adam Malik Hospital, Medan.

Bivariate analyses revealed significant associations between frailty and nutritional status (p=0.008), with 100% of malnourished patients (13/13) and 72.2% of those at risk (26/36) being frail compared to 53.8% of those with normal nutrition (7/13). Polypharmacy was also significant (p<0.001), with 94.1% of polypharmacy patients (32/34) being frail compared to 50.0% without (14/28). Other factors, including age (p=0.830), sex (p=0.895), comorbidity burden (p=0.075), functional status (p=0.537), cognitive status (p=0.136), depression (p=0.347), implantation duration (p=0.747), and quality of life (p=0.315) were not significantly associated (Table 2). Multivariate logistic regression (Backward LR) identified polypharmacy as the only independent predictor of frailty (OR 14.0; 95% CI 2.186–89.675; p=0.005), indicating a 14-fold increased risk of frailty in patients on polypharmacy (Table 3).

Table 2. Factors Associated with Frailty Score in Elderly Patients with Permanent Pacemakers

Parameter	Pre-frail n (%)	Frail n (%)	Total n (%)	p-value
Age (years)				0.830b
60–74	10 (25.6)	29 (74.4)	39 (100.0)	
75–89	6 (27.3)	16 (72.7)	22 (100.0)	
≥90	0 (0.0)	1 (100.0)	1 (100.0)	
Gender				0.895a
Male	9 (26.5)	25 (73.5)	34 (100.0)	
Female	7 (25.0)	21 (75.0)	28 (100.0)	
Nutritional Status				0.008b*
Normal	6 (46.2)	7 (53.8)	13 (100.0)	
At risk of malnutrition	10 (27.8)	26 (72.2)	36 (100.0)	
Malnourished	0 (0.0)	13 (100.0)	13 (100.0)	
Comorbidity				0.075b
Mild	16 (32.0)	34 (68.0)	50 (100.0)	
Moderate	0 (0.0)	10 (100.0)	10 (100.0)	
Severe	0 (0.0)	2 (100.0)	2 (100.0)	
Functional Status (ADL)				0.537b
Independent	3 (27.3)	8 (72.7)	11 (100.0)	
Mild dependence	5 (20.0)	20 (80.0)	25 (100.0)	
Moderate dependence	6 (28.6)	15 (71.4)	21 (100.0)	
Severe dependence	2 (40.0)	3 (60.0)	5 (100.0)	
Cognitive Status				0.136b
Normal	13 (32.5)	27 (67.5)	40 (100.0)	
Moderate memory impairment	3 (13.6)	19 (86.4)	22 (100.0)	
Depression				0.347a
Likely depressed	13 (30.2)	30 (69.8)	43 (100.0)	
Depressed	3 (15.8)	16 (84.2)	19 (100.0)	
Polypharmacy				<0.001a*
Yes	2 (5.9)	32 (94.1)	34 (100.0)	
No	14 (50.0)	14 (50.0)	28 (100.0)	
Duration of Pacemaker Implantation				0.747a
<1 year	3 (21.4)	11 (78.6)	14 (100.0)	
1–2 years	5 (22.7)	17 (77.3)	22 (100.0)	
≥2 years	8 (30.8)	18 (69.2)	26 (100.0)	
Quality of Life				0.315a
Moderate	16 (28.1)	41 (71.9)	57 (100.0)	
Low	0 (0.0)	5 (100.0)	5 (100.0)	

Notes: a. Chi-Square test, b. Fisher's Exact Test, *significant p<0.05.

DISCUSSION

This study investigated factors influencing frailty in 62 elderly patients with permanent pacemakers (PPMs) at Adam Malik Hospital, Medan, revealing a high frailty prevalence (74.2%), consistent with global estimates of 30–73% in similar populations [13,14]. Nutritional status and polypharmacy emerged as significant predictors of frailty, consistent with prior research. Notably, 100% of malnourished patients and 72.2% of those at risk of malnutrition were frail (p=0.008), corroborating the findings of Luo et al. (2022), who linked malnutrition assessed via the Mini Nutritional Assessment to cognitive frailty and recommended dietary interventions such as the Mediterranean diet [15,16]. Similarly, Xu et al. (2022) and Li et al. (2021) identified low fruit and vegetable intake and high BMI as frailty risk factors, emphasizing the nutritional impact on physiological reserves [17,18]. Polypharmacy was strongly associated with frailty (p<0.001), with 94.1% of patients on ≥5 medications classified as frail, consistent with Kontatinos et al. (2024), who found that polypharmacy, particularly diuretics, exacerbated frailty in cardiac patients by causing electrolyte imbalances

and muscle loss [19]. Diuretics, common in our cohort along with antihypertensives and statins, likely compounded nutritional deficits and accelerated frailty.

Table 3. Multivariate Logistic Regression of Factors Affecting Frailty Score

Parameter	Coefficient (B)	OR	95% CI (Min–Max)	p-value
Model 1 (Initial)				
Malnutrition vs Normal	21.272	1730	0.000–∞	0.998
At risk of malnutrition vs Normal	1.165	3.206	0.518–19.850	0.210
Severe comorbidity vs Mild	18.579	1171	0.000–∞	0.998
Moderate comorbidity vs Mild	20.200	5925	0.000–∞	0.998
Cognitive impairment vs Normal	0.678	1.969	0.321–12.098	0.464
Polypharmacy (Yes vs No)	2.692	14.768	2.235–97.565	0.005*
Constant	-1.529			
Model 2				
Malnutrition vs Normal	21.342	1856	0.000–∞	0.998
At risk of malnutrition vs Normal	1.281	3.60	0.592–21.889	0.164
Severe comorbidity vs Mild	18.718	1346	0.000–∞	0.999
Moderate comorbidity vs Mild	20.202	5938	0.000–∞	0.999
Polypharmacy (Yes vs No)	2.639	14.00	2.186–89.675	0.005*
Constant	-1.435			

Notes: *Significant $p<0.05$. Logistic regression (Backward LR) was used to identify independent predictors of frailty.

In contrast, age, sex, comorbidity burden, functional status, cognitive status, depression, pacemaker implantation duration, and quality of life showed no significant associations with frailty ($p>0.05$), aligning with findings by Joseph et al. (2023), Yang et al. (2023), and Chang et al. (2022) for age, sex, and comorbidities in PPM patients [20,21]. However, the lack of an association with depression contrasts with Xu et al. (2022) and Li et al. (2021), who reported significant links, suggesting population-specific variations [17,18]. Similarly, the non-significant impact of QOL diverges from Hoth et al. (2008), indicating context-dependent effects [22,23]. Multivariate analysis identified polypharmacy as the sole independent predictor (OR, 14.0; $p=0.005$), highlighting its dominant role in frailty risk, a novel finding in patients with PPM.

The strengths of this study include its comprehensive assessment of frailty determinants and robust multivariate approach, isolating the impact of polypharmacy. Limitations include the absence of post-PPM cardiac function data, limited quality of life evaluation, and a modest sample size, which may restrict generalizability. These findings underscore the need for targeted interventions addressing polypharmacy and nutritional status to mitigate frailty in elderly patients with PPM. Future research is required to validate these results in larger, diverse cohorts [14,19].

CONCLUSION

A study of 62 elderly patients with permanent pacemakers at Adam Malik Hospital, Medan, identified nutritional status and polypharmacy as significant predictors of frailty, with polypharmacy increasing frailty risk 14-fold (OR, 14.0; 95% CI, 2.186–89.675; $p=0.005$) based on comprehensive questionnaire assessments, including the Frailty Index, Mini Nutritional Assessment, and other geriatric tools. While nutritional deficiencies were prevalent, particularly among the 58.1% at risk of malnutrition and 21.0% malnourished, polypharmacy emerged as the dominant independent factor in the multivariate analysis. These findings highlight the need for targeted interventions to optimize medication regimens and address nutritional deficits to mitigate frailty in this population. Further research in larger, more diverse cohorts is warranted to validate these results and to inform broader clinical strategies for improving outcomes in elderly pacemaker patients.

DECLARATIONS

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The Authors agree to be published in the Journal of Society Medicine.

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AUTHORS' CONTRIBUTIONS
All authors contributed to the work, including data analysis, drafting, and reviewing the article. All authors approved the final version of the manuscript and were accountable for all aspects.

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