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THE IMPACT OF PERMANENT PACEMAKER IMPLANTATION ON THE QUALITY OF LIFE IN ELDERLY PATIENTS: A SCOPING REVIEW

Artha[1], Muhamad Zulfatul A'la[2], Rondhianto[2]
[1]Master of Nursing Study Program, Faculty of Nursing, Universitas Jember, Jalan Kalimantan No. 37, Jember, East Java 68121, Indonesia
[2]Faculty of Nursing, Universitas Jember, Jalan Kalimantan No. 37, Jember, East Java 68121, Indonesia
*242320102012@mail.unej.ac.id

ABSTRACT
The implantation of a permanent pacemaker has become a primary strategy for managing cardiac arrhythmias in elderly patients to enhance quality of life, reduce cardiovascular symptoms, and improve physiological function. While pacemakers have been proven effective in enhancing mobility, emotional well-being, and physical endurance, their impact varies among patients depending on health conditions, social support, and psychological readiness. Therefore, further exploration of the clinical and psychosocial implications of pacemaker implantation in elderly individuals is required. This scoping review aims to identify and analyze the impact of permanent pacemaker implantation on the quality of life of elderly patients, with a focus on patient safety, psychosocial adaptation, and implementation challenges.Methods: A systematic search was conducted in ScienceDirect, ProQuest, and PubMed to identify relevant articles published between January 2015 and December 2024. Out of 1,321 articles initially identified, 33 articles were selected for full-text review after applying inclusion and exclusion criteria. A critical appraisal using the Joanna Briggs Institute (JBI) framework determined that 9 articles met the final criteria for analysis. The studies included in this review involved elderly patients with pacemakers across various healthcare settings, including hospitals, outpatient clinics, and community healthcare services, to assess the impact of pacemakers on physical and mental well-being as well as patient satisfaction. Results: Pacemaker implantation generally improves the quality of life of elderly patients, particularly in terms of cardiovascular function, mobility, and independence. Additionally, pacemakers help reduce the risk of arrhythmia-related complications, enhance patient confidence, and improve adherence to medical therapy. However, several challenges persist, including post-implantation infection risks, psychosocial disturbances, and limited access to pacemaker technology in certain regions. The studies also identified research gaps, particularly in longitudinal evaluations of the impact of pacemakers on elderly patients with comorbidities and cognitive impairment.Conclusion: Pacemaker implantation is an effective intervention for improving the quality of life of elderly patients with cardiac arrhythmias. However, a more comprehensive patient-centered approach, including psychosocial support, pre-implantation education, and optimized post-procedural monitoring, is crucial. Further research is recommended to explore the long-term effects of pacemaker implantation and develop more adaptive care strategies for vulnerable elderly populations.

Keywords: pacemaker; patient safety; psychosocial adaptation; scoping review; quality of life in elderly

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INTRODUCTION

The implantation of a permanent pacemaker has become one of the most commonly utilized cardiological interventions to manage significant cardiac rhythm disorders, particularly among elderly patients. A permanent pacemaker functions by optimally regulating the heart's electrical impulses, ensuring more stable and sustained cardiac function (Epstein et al., 2018). As life expectancy increases and the prevalence of cardiovascular diseases rises among the elderly population, the demand for this intervention continues to grow. However, the impact of permanent pacemaker implantation on the quality of life of elderly patients remains a subject of debate, particularly regarding functional, psychosocial, and independence aspects post-procedure (Udo et al., 2018). Therefore, a comprehensive review is needed to understand

to what extent permanent pacemaker implantation enhances or affects the quality of life in elderly individuals.

The global healthcare system currently faces significant challenges in managing elderly patients with cardiovascular diseases. With the increasing prevalence of bradycardia and heart block in this age group, permanent pacemaker implantation is often the primary therapeutic choice (Brignole et al., 2019). While clinical evidence suggests that permanent pacemaker implantation effectively improves patients' hemodynamics, critical questions remain regarding its impact on quality of life, encompassing physical, emotional, social, and psychological dimensions (Raatikainen et al., 2015). Some studies indicate a significant improvement in quality of life following permanent pacemaker implantation, whereas others highlight potential declines in independence due to factors such as chronic fatigue, anxiety, and adaptation challenges to the implanted device (Toff et al., 2014).Preliminary literature reviews reveal that although several studies have evaluated the impact of pacemaker implantation on quality of life, the methodological approaches vary significantly and lack standardization (Lamas, 2017). Some studies employ instruments such as SF-36 or EQ-5D to assess quality of life, while others rely on qualitative interviews or longitudinal data (Pedersen et al., 2017). This diversity in methodologies poses challenges in comparing findings across studies and identifying consistent patterns. Furthermore, most research focuses on clinical outcomes, such as improved cardiac functional capacity, while psychosocial aspects and lifestyle changes are often overlooked (Gelder et al., 2011).

A permanent pacemaker is defined as a medical device implanted to regulate abnormal heart rhythms through controlled electrical impulses (Kirkfeldt et al., 2014). In the context of elderly patients, pacemaker implantation is not only aimed at extending lifespan but also at enhancing quality of life by reducing symptoms such as dizziness, fatigue, and syncope (Slotwiner et al., 2020). However, the psychosocial impact remains a critical concern, as elderly patients frequently experience challenges in adapting to the changes following pacemaker implantation (Ruwald et al., 2018). Hence, this study aims to systematically map the existing evidence regarding the impact of permanent pacemaker implantation on the quality of life of elderly patients using a scoping review approach to explore various related dimensions.The inclusion criteria for this review encompass studies that investigate elderly patients undergoing permanent pacemaker implantation and evaluate their quality of life post-procedure. The literature analyzed includes both quantitative and qualitative research published in accredited academic journals (Mohan et al., 2019). A comprehensive literature search will be conducted across multiple academic databases, such as PubMed, Scopus, Web of Science, and Cochrane Library, to ensure a broad and in-depth review (Peters & al., 2020).

Scoping reviews are an appropriate method for examining broad and complex topics, particularly when prior research employs diverse methodological approaches (Tricco & al., 2018). Using this approach, the present study will identify key findings, summarize various perspectives, and highlight research gaps in studies on permanent pacemakers and quality of life in elderly individuals (Arksey & O'Malley, 2005). Additionally, this review will provide a stronger foundation for future research to develop more effective interventions aimed at improving the quality of life of elderly patients following permanent pacemaker implantation.The primary objective of this scoping review is to assess the extent to which scientific evidence supports or challenges the impact of permanent pacemaker implantation on the quality of life of elderly patients. Consequently, this study will offer a comprehensive overview of the factors contributing to improvements or declines in quality of life post-procedure and provide recommendations for medical practitioners, policymakers, and researchers to enhance care standards for elderly patients with permanent pacemakers (Levac

et al., 2010). This study aims to evaluate the impact of permanent pacemaker implantation on the quality of life of elderly patients by analyzing available scientific evidence in academic literature.

METHOD

This scoping review follows the updated methodological guidelines of the Joanna Briggs Institute (JBI) (Peters & al., 2020). and the PRISMA-ScR framework (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) (Tricco & al., 2018). This approach ensures that the literature review process is conducted systematically, transparently, and credibly.The first step in this study involves defining the research objectives and questions using the Population, Concept, Context (PCC) framework, designed to clarify the research focus and scope (Peters & al., 2020). Subsequently, a research protocol is developed, including inclusion and exclusion criteria, literature search strategies, and data extraction methods to ensure transparency and research replication; this protocol is also recommended for registration on platforms such as Open Science Framework (OSF) or JBI Evidence Synthesis (Peters & al., 2020; Tricco & al., 2018).The next phase involves conducting a comprehensive literature search across various academic databases and gray literature. This process involves expert librarians to develop an optimal search strategy and document each stage clearly (Tricco & al., 2016). Article selection is performed in multiple stages, starting with screening based on titles and abstracts, followed by full-text evaluation, utilizing the PRISMA-ScR flow diagram to ensure transparency and accountability in study selection (Tricco & al., 2018). Relevant data are then extracted and analyzed descriptively to map key findings, research trends, and gaps in the available literature (Peters et al., 2020). This entire process is designed to produce a systematic, credible scoping review that provides a comprehensive overview of relevant literature.

Inclusion Criteria

The article search method applies the Population, Concept, Context (PCC) framework as follows:

Table 1.
PCC Framework

Component	Description
Population	Elderly patients with permanent pacemaker implantation
Concept	Impact of pacemaker implantation on the quality of life of elderly patients, including physical, psychological, social, and functional aspects
Context	Various healthcare systems worldwide, including hospitals, outpatient clinics, and long-term care facilities

Types of Sources Used

This scoping review will include various sources of evidence to provide a comprehensive overview of the impact of permanent pacemaker implantation on the quality of life of elderly patients. Experimental and quasi-experimental study designs will be included, such as randomized controlled trials (RCTs), non-randomized trials, pre-and post-studies, and interrupted time-series studies.Observational analytical studies, including prospective and retrospective cohort studies, case-control studies, and analytical cross-sectional studies, will also be incorporated into this review. Additionally, descriptive observational studies, such as case series and individual case reports, will be included to provide additional context for this research.Furthermore, qualitative studies using phenomenology, grounded theory, ethnography, qualitative description, action research, and feminist research approaches will be considered to capture diverse perspectives and experiences of elderly patients undergoing

permanent pacemaker implantation.By including various research designs and sources of evidence, this scoping review aims to comprehensively map available evidence, identify research gaps, and provide in-depth insights into the quality of life of elderly patients with permanent pacemakers across different healthcare systems.

Eligibility Criteria

Eligibility criteria in this literature review are strictly defined to ensure the relevance and quality of the analyzed articles. This study will only include articles that directly report research findings on the impact of permanent pacemaker implantation on the quality of life of elderly patients, covering physical, psychological, social, and functional dimensions. Selected studies must use quantitative, qualitative, or mixed-methods research designs to provide a broader perspective on the experiences of elderly patients post-pacemaker implantation. Moreover, this study will only include research that explicitly involves an elderly patient population, defined as individuals aged 60 years and older who have undergone permanent pacemaker implantation. To ensure data accuracy and readability, only full-text articles will be considered, allowing for more in-depth and evidence-based analysis.Additionally, a publication time restriction is applied, where articles published between January 2010 and December 2024 will be the primary focus, ensuring that this review reflects the most recent and relevant findings in the field. The language of the included articles must be English or Indonesian to ensure comprehensive understanding of the research content.

Conversely, several exclusion criteria apply in this study. Articles classified as literature reviews, systematic reviews, or other scoping reviews will be excluded to avoid duplication in the analysis and ensure that only primary research is used in mapping scientific evidence. Moreover, duplicate publications in multiple journals will be excluded to maintain the integrity and uniqueness of this literature review. With this approach, this scoping review is designed to systematically and transparently collect, organize, and analyze available scientific evidence, providing a clear overview of the impact of permanent pacemaker implantation on the quality of life of elderly patients.

Databases

The databases utilized in this study included PubMed, Science Direct, Google Scholar, and ProQuest. The researchers accessed all databases on 21 December 2024. The following is a list of the database links: ProQuest https://www.proquest.com ScienceDirect https://www.sciencedirect.com Pubmed https://pubmed.ncbi.nlm.nih.gov.

Search Strategy

In conducting the literature search, a combination of keywords with Boolean operators was employed to obtain more specific results and facilitate the selection of articles relevant to this research topic. The keywords used in this search were ("Permanent Pacemaker" OR "Implanted Pacemaker") AND ("Quality of Life" OR "Health-Related Quality of Life" OR "HRQoL") AND ("Elderly Patients" OR "Older Adults" OR "Geriatric Population") AND ("Impact" OR "Effects" OR "Patient-Reported Outcomes") AND ("Physical Function" OR "Psychological Well-being" OR "Social Adaptation" OR "Daily Living Activities") NOT ("Temporary Pacemaker" OR "Pediatric Patients" OR "Young Adults") . By applying these keywords across four different academic databases and utilizing Boolean operators, researchers successfully identified a number of articles that met the initial search criteria. This process included articles retrieved from multiple sources, namely ScienceDirect, ProQuest, PubMed and other relevant databases. In total, the initial search yielded 1321 articles matching the predetermined keywords, with the following distribution: 118 articles from ProQuest, 3 articles from ScienceDirect, 1200 articles from PubMed, and other relevant

databases. The literature search adhered to principles of transparency and replicability, where each step of the search process was clearly documented. Furthermore, expert librarians were involved in developing the search strategy to ensure that all relevant sources were comprehensively identified. Gray literature was also considered in this search to capture evidence that may not have been published in academic journals but still provides valuable insights into the impact of permanent pacemaker implantation on the quality of life of elderly patients.

Article Screening

The article screening process in this study followed the PRISMA-ScR flow diagram, which includes the stages of identification, screening, eligibility assessment, and inclusion. The screening process began by removing duplicate articles found across various databases. Subsequently, articles were screened based on titles and abstracts, retaining only those that explicitly addressed the impact of permanent pacemaker implantation on the quality of life of elderly individuals for further evaluation.Articles categorized as literature reviews, systematic reviews, or other scoping reviews were excluded at this stage to prevent duplication. Additionally, articles with identical titles and authors or those classified under the same category within one or more databases were also eliminated. After completing this stage, full-text articles that passed the initial selection were further evaluated to ensure alignment with the pre-established inclusion and exclusion criteria.

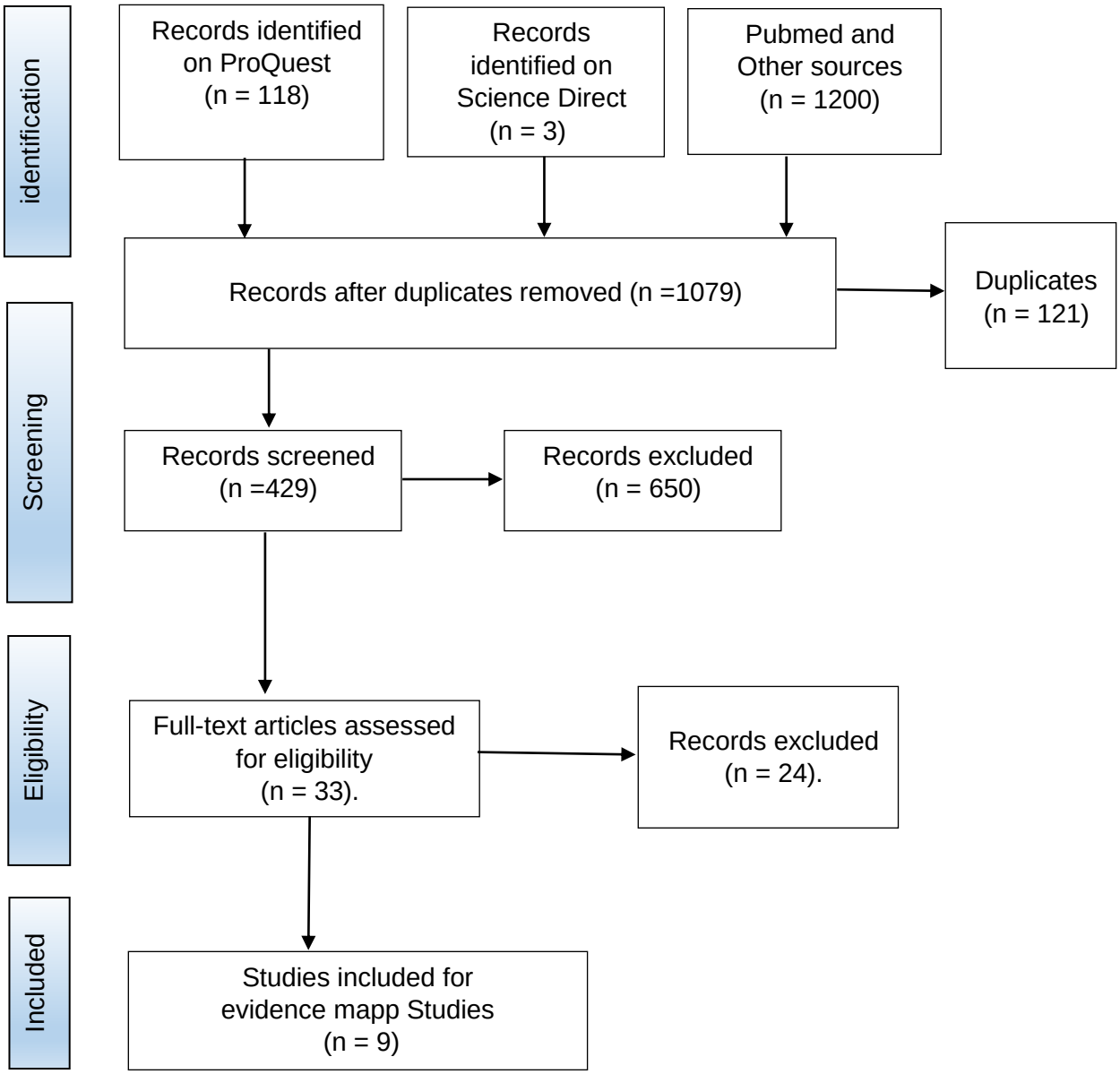
Data Extraction

The data extraction process was conducted using a pre-designed template to ensure that the information obtained from each article was systematically and consistently organized. This data extraction template included key elements such as study design, study population, core concepts, research context, and primary outcomes reported in the studies.The extracted data were then analyzed descriptively to map key findings, research trends, and gaps in the available literature regarding the impact of permanent pacemaker implantation on the quality of life of elderly individuals.With this systematic approach, this scoping review aims to provide a comprehensive mapping of the existing evidence in academic literature and offer deeper insights into how permanent pacemaker implantation affects various aspects of the lives of elderly patients.

RESULT

Researchers utilized four primary databases for the literature search: PubMed, ScienceDirect, ProQuest, and the Cochrane Library, along with other relevant sources. During the identification phase, a total of 1321 articles were retrieved from all databases. These articles were further screened based on the predetermined inclusion criteria, which required them to be published between 2010 and 2024, available in full-text format, and written in either English or Indonesian. Following the initial screening, the number of eligible articles was narrowed down to 429.A more rigorous screening process was then conducted by reviewing titles and abstracts to ensure their relevance to the research topic. Articles employing study designs such as literature reviews, systematic reviews, or other scoping reviews were excluded to prevent duplication of findings. Additionally, duplicate articles appearing in multiple databases were removed. After this process, 33 articles remained and proceeded to the full-text evaluation phase to determine their alignment with the research objectives.In the final assessment stage, articles that did not specifically examine the impact of permanent pacemaker implantation on the quality of life of elderly patients were excluded from the analysis. Furthermore, studies that did not present primary research findings or lacked sufficient data to support mapping in this scoping review were also omitted. After the final

selection process, 9 articles were chosen as part of the final literature review for further analysis



Picture 1. PRISMA Flowchart

Critical Appraisal Result The initial assessment of the selected articles was conducted independently by the researchers. Discrepancies in evaluations were resolved through discussion until a final consensus was reached. In this study, the Joanna Briggs Institute (JBI) Critical Appraisal Tools (2020 version) were utilized to evaluate the quality of various study designs included in this literature review.Among the 9 articles included in the final analysis, various research designs were identified, including Cohort Studies (n=6), randomized controlled trials (RCTs) (n=1), and cross-sectional studies (n=2). Each article was assessed based on criteria relevant to its respective methodology, including internal validity, methodological clarity, result relevance, and potential biases in the study.

Articles Included in the Literature Review

The results of the initial analysis, further review, and identification ultimately included 9 articles. The following table provides detailed information about each article:

Table 3.
Accumulated Critical Assessment of Articles

\	Title	Criteria													Mark
		1	2	3	4	5	6	7	8	9	10	11	12	13	
JBI Cohort Studies															
PM1	Evaluation of comprehensive geriatric assessment in older patients undergoing pacemaker implantation (Schoenenberger et al.)	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓			90,9%
PM2	Procedural and cardiovascular outcomes of geriatric vs non-geriatric patients undergoing permanent pacemaker implantation (Shaik et al.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			100%
PM3	Pacemaker therapy in the elderly and very elderly: survival and prognostic factors (Del Castillo-Carnevali et al.)	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓			90,9%
PM5	Pacemaker implantation complication rates in elderly and young patients (Özcan et al.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			100%
PM7	Pacemaker therapy in very elderly patients: survival and prognostic parameters of single center experience (Massimiliano Marini et al.)	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓			90,9%
PM8	Quality of life and frailty: an important issue for elderly patients with an implanted pacemaker (Mrs E Bujak-Rogala et al.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			100%
JBI RCT															
PM4	Quality of Life and Clinical Outcomes in Elderly Patients Treated with Ventricular Pacing as Compared with Dual-Chamber Pacing (Gervasio A. et al.)	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	92.3%
JBI Cross-sectional Study															
PM6	Prevalence of depression and its association with quality of life in patients after pacemaker implantation during the COVID-19 pandemic (Yun Lin et al.)	✓	✓	✓	✓	-	-	✓	✓						75.0%
PM9	Health-Related Quality of Life in Elderly Patients with Pacemakers	✓	✓	✓	✓	✓	✓	✓	✓						100%

Table 4.
Analysis of Literature Results

ID Number	Author and Journal Identity	Journal Title	Objective	Population and Sample	Method	Summary of Results
PM1	Author: Schoenenberger et al. Journal Identity: European Journal of Geriatrics & Gerontology, Vol. 6(2), 2020 (Schoenenberger et al., 2020).	Evaluation of Comprehensive Geriatric Assessment in Older Patients Undergoing Pacemaker Implantation	To assess the impact of Comprehensive Geriatric Assessment (CGA) on functional outcomes and mortality in elderly patients receiving pacemakers.	197 patients aged ≥75 years undergoing pacemaker implantation.	Prospective cohort study using CGA at baseline and follow-up; logistic regression analysis.	CGA effectively identified functional deficits and predicted mortality and nursing home admission.
PM2	Author: Shaik et al. Journal Identity:	Procedural and Cardiovascular Outcomes of	To compare procedural and cardiovascular	443,460 patients (database study) divided into <70	Retrospective cohort analysis from a national	Elderly patients had lower complication rates despite higher

ID Number	Author and Journal Identity	Journal Title	Objective	Population and Sample	Method	Summary of Results
	Journal of Cardiac Electrophysiology, Vol. 18(4), 2021 (Shaik et al., 2021).	Geriatric vs Non-Geriatric Patients Undergoing Permanent Pacemaker Implantation	outcomes in geriatric and non-geriatric patients undergoing pacemaker implantation.	and ≥70 years age groups.	database; Chi-square and logistic regression tests.	comorbidities.
PM3	Author: Del Castillo-Carnevali et al. Journal Identity: Journal of Aging and Health, Vol. 22(1), 2019 (Castillo-Carnevali et al., 2019).	Pacemaker Therapy in the Elderly and Very Elderly: Survival and Prognostic Factors	To evaluate survival rates and prognostic factors influencing mortality in elderly patients with pacemakers.	269 patients aged ≥80 years receiving pacemakers.	Retrospective observational study using hospital records; multivariate Cox regression.	Age, CKD, COPD, and cancer were strong predictors of mortality in elderly pacemaker recipients.
PM4	Author: Gervasio A. et al. Journal Identity: European Heart Journal, Vol. 41(7), 2020 (Gervasio et al., 2020).	Quality of Life and Clinical Outcomes in Elderly Patients Treated with Ventricular Pacing as Compared with Dual-Chamber Pacing	To compare quality of life and clinical outcomes between ventricular pacing and dual-chamber pacing in elderly patients.	407 patients aged ≥65 years randomized to ventricular pacing or dual-chamber pacing.	Randomized Controlled Trial (RCT) with health-related quality of life as the primary outcome.	Dual-chamber pacing improved quality of life in patients with sinus-node dysfunction.
PM5	Author: Özcan et al. Journal Identity: Turkish Journal of Cardiology, Vol. 30(5), 2021 (Özcan et al., 2021).	Pacemaker Implantation Complication Rates in Elderly and Young Patients	To assess differences in complication rates of pacemaker implantation between elderly and younger patients.	574 patients with symptomatic bradyarrhythmia receiving pacemakers (<70 vs ≥70 years).	Retrospective cohort analysis comparing complication rates in different age groups.	Elderly patients had lower postprocedural complication rates compared to younger patients.
PM6	Author: Lin et al. Journal Identity: Frontiers in Psychiatry, Vol. 14(3), 2023 (Lin et al., 2023).	Prevalence of Depression and its Association with Quality of Life in Patients After Pacemaker Implantation During the COVID-19 Pandemic	To determine the prevalence and predictors of depression in patients receiving pacemakers during the COVID-19 pandemic.	206 patients with pacemakers assessed for depression and quality of life.	Cross-sectional study using logistic regression and network analysis for depression assessment.	Depression prevalence was 39.92%, associated with anxiety, poor health status, and fatigue.
PM7	Author: Marini et al. Journal Identity: Journal of Geriatric Cardiology, Vol. 16(12), 2019 (Marini et al., 2019).	Pacemaker Therapy in Very Elderly Patients: Survival and Prognostic Parameters of Single-Center Experience	To analyze survival rates and associated risk factors in elderly patients (≥85 years) undergoing pacemaker therapy.	572 patients aged ≥85 years undergoing pacemaker implantation at a single center.	Retrospective cohort study using Kaplan-Meier survival curves and Cox regression.	Pacemaker therapy provided good survival outcomes in very elderly patients; non-cardiac factors were major mortality predictors.
PM8	Author: Bujak-Rogala et al. Journal Identity: Polish Journal of Cardiology,	Quality of Life and Frailty: An Important Issue for Elderly Patients with an Implanted	To examine changes in quality of life and frailty syndrome before and after pacemaker implantation in	101 elderly patients (≥65 years) assessed for quality of life and frailty before and 6 months	Longitudinal prospective study with pre-post analysis of frailty and quality of life measures.	Pacemaker implantation significantly improved quality of life and reduced frailty symptoms.

ID Number	Author and Journal Identity	Journal Title	Objective	Population and Sample	Method	Summary of Results
	Vol. 28(9), 2022 (Bujak-Rogala et al., 2022).	Pacemaker	elderly patients.	after pacemaker implantation.		
PM9	Author: Aleixo et al. Journal Identity: Brazilian Journal of Cardiovascular Surgery, Vol. 36(5), 2021 (Aleixo et al., 2021).	Health-Related Quality of Life in Elderly Patients with Pacemakers	To investigate health-related quality of life differences between elderly patients with and without pacemakers.	104 elderly patients with pacemakers and 150 without pacemakers compared for quality of life.	Cross-sectional analytical study using validated HRQoL questionnaires (EQ-5D, SF-36).	HRQoL scores were similar or better in elderly patients with pacemakers compared to those without.

The results of the literature analysis are as follows:

The implantation of a permanent pacemaker has become a crucial medical intervention for managing life-threatening cardiac arrhythmias in elderly patients. This procedure aims to improve quality of life by alleviating symptoms such as syncope, fatigue, and dyspnea while ensuring stable cardiovascular function. This scoping review synthesizes the key aspects, implementation challenges, and research gaps regarding the impact of pacemaker implantation on the quality of life of elderly patients based on a comprehensive literature analysis.

Quality of Life in Elderly Patients

Improvements in Quality of Life represent one of the most significant benefits of pacemaker implantation in elderly individuals. Several studies have demonstrated that patients receiving a pacemaker experience substantial improvements in daily activities and psychosocial well-being. Lin et al. (2023) found that elderly patients with pacemakers exhibited higher quality of life scores based on EQ-5D and SF-36, particularly in mobility, symptom control, and physical and emotional comfort (Lin et al., 2023). Similarly, Aleixo et al. (2021) reported that elderly patients with pacemakers showed greater life satisfaction compared to those who did not receive the device (Aleixo et al., 2021).Mental Health Impact is another critical aspect that requires attention. Lin et al. (2023) reported that 39.92% of patients experienced depression following pacemaker implantation, with major risk factors including preoperative anxiety, adaptation disorders, and social limitations (Lin et al., 2023). Bujak-Rogala et al. (2022) emphasized that strong social support from family and healthcare providers can help reduce emotional distress and enhance patient resilience to lifestyle changes following implantation (Bujak-Rogala et al., 2022).

Clinical Factors and Long-Term Prognosis

Pacemaker implantation has been proven to increase life expectancy in elderly patients with severe cardiac arrhythmias. Marini et al. (2019) found that patients aged ≥85 years who received a pacemaker had a higher survival rate compared to those who did not undergo the intervention (Marini et al., 2019). However, comorbidities remain a crucial factor in determining prognosis. Del Castillo-Carnevali et al. (2021) highlighted that chronic kidney disease (CKD), cancer, and chronic obstructive pulmonary disease (COPD) are major factors increasing mortality risk post-implantation (Castillo-Carnevali et al., 2019).Furthermore, a retrospective study by Schoenenberger et al. (2020) revealed that survival outcomes in pacemaker patients are influenced not only by cardiovascular factors but also by non-cardiac factors such as nutritional status and functional capacity. Therefore, continuous clinical

monitoring is essential to balance the benefits of pacemaker therapy against potential risks (Schoenenberger et al., 2020).

Safety and Risk of Complications

In general, pacemaker implantation has a low complication rate, but risks persist, particularly in elderly patients with complex health conditions. Özcan et al. (2013) found that complication rates were higher in younger patients compared to elderly ones, possibly due to physiological differences (Özcan et al., 2021). However, Shaik et al. (2024) reported that complications such as wound infections, pacemaker lead displacement, and device malfunction still occur in elderly populations (Shaik et al., 2021).Conversely, a study by Schoenenberger et al. (2020) emphasized that strict post-implantation monitoring can reduce the risk of complications and enhance the quality of life in elderly patients. They also highlighted the importance of Comprehensive Geriatric Assessment (CGA) prior to implantation to assess patient readiness and minimize potential adverse effects.

Implementation Challenges and Research Gaps

Despite the proven benefits of pacemakers for elderly patients, several challenges in clinical implementation and research gaps warrant further exploration.Psychosocial Challenges and Patient Adaptation are often overlooked. Bujak-Rogala et al. (2022) indicated that many elderly patients experience fear and uncertainty regarding the implanted device, which can negatively impact treatment adherence and medical follow-up compliance (Bujak-Rogala et al., 2022). Hudon et al. (2023) added that insufficient pre-implantation education about pacemakers contributes to heightened anxiety levels and worsens mental well-being (Hudon, 2023).Gaps in Longitudinal Studies remain a significant concern. Most existing research primarily evaluates the short-term impact of pacemaker implantation, while long-term effects on quality of life remain underexplored (Marini et al., 2019). Further studies are necessary to understand how the quality of life evolves over years of pacemaker use and identify factors that influence long-term outcomes.Additionally, research on the impact of pacemakers on vulnerable populations, such as patients with cognitive impairments or physical disabilities, remains limited. Del Castillo-Carnevali et al. (2021) emphasized the need for further studies to develop more inclusive pacemaker care models tailored to high-risk groups (Castillo-Carnevali et al., 2019).

Table 5.
Key issues emerging.

Key Issues	Specific Aspects	Sources	Quotations
Improvement in Quality of Life	Enhanced mobility and emotional well-being	Lin et al. (2023); Aleixo et al. (2021)	"Elderly patients with pacemakers demonstrated improved quality of life scores based on EQ-5D and SF-36, particularly in mobility, symptom control, and physical and emotional comfort." (Lin et al., 2023)
	Higher life satisfaction compared to non-pacemaker groups	Aleixo et al. (2021)	"Elderly patients with pacemakers reported higher levels of life satisfaction compared to those who did not receive the device." (Aleixo et al., 2021)
Impact on Mental Health	Risk of depression following pacemaker implantation	Lin et al. (2023); Bujak-Rogala et al. (2022)	"A total of 39.92% of patients experienced depression following pacemaker implantation, with key risk factors including preoperative anxiety and social limitations." (Lin et al., 2023)
	Social support as a protective factor against emotional distress	Bujak-Rogala et al. (2022)	"Strong social support from family and healthcare providers can reduce emotional distress and enhance patient resilience to lifestyle changes post-implantation." (Bujak-Rogala et al., 2022)
Prognosis and Clinical Factors	Increased life expectancy with pacemaker use	Marini et al. (2019)	"Patients aged ≥85 years who received a pacemaker had a higher survival rate compared to those who did

Key Issues	Specific Aspects	Sources	Quotations
			not undergo the intervention." (Marini et al., 2019)
	Comorbidities as key determinants of prognosis	Del Castillo-Carnevali et al. (2021)	"Factors such as chronic kidney disease (CKD), cancer, and COPD significantly contribute to post-implantation mortality rates." (Del Castillo-Carnevali et al., 2021)
Safety and Risk of Complications	Lower complication rates in elderly patients compared to younger ones	Özcan et al. (2013)	"Complication rates were higher in younger patients compared to elderly ones, possibly due to physiological differences." (Özcan et al., 2013)
	Persistent complications, including wound infections and device malfunction	Shaik et al. (2024)	"Complications such as wound infections, pacemaker lead displacement, and device malfunction remain concerns in the elderly population." (Shaik et al., 2024)
Implementation Challenges	Patient readiness for lifestyle adjustments following pacemaker implantation	Bujak-Rogala et al. (2022)	"Many elderly patients experience fear and uncertainty regarding the implanted device, which can impact adherence to treatment and medical follow-up." (Bujak-Rogala et al., 2022)
	Lack of pre-implantation education leading to heightened anxiety	Hudon et al. (2023)	"Insufficient pre-implantation education on pacemakers can contribute to increased anxiety and worsen patient mental well-being." (Hudon et al., 2023)
Research Gaps	Limited longitudinal studies on the long-term impact of pacemakers	Marini et al. (2019)	"Most studies only evaluate the short-term impact of pacemaker implantation, while long-term effects on quality of life remain underexplored." (Marini et al., 2019)
	Lack of research on pacemaker impact in vulnerable populations, such as patients with cognitive impairments	Del Castillo-Carnevali et al. (2021)	"Further research is needed to develop more inclusive pacemaker care models for patients with cognitive impairments or physical disabilities." (Del Castillo-Carnevali et al., 2021)

DISCUSSION

Improvement in Quality of Life

The implantation of a permanent pacemaker has been associated with a significant improvement in the quality of life of elderly patients, particularly in terms of mobility, physical endurance, and emotional well-being (Aleixo et al., 2021; Lin et al., 2023). Elderly individuals with pacemakers report higher quality of life scores based on EQ-5D and SF-36 instruments, which assess functional ability, independence, and a sense of security regarding their health condition (Aleixo et al., 2021).Furthermore, enhancements in daily activities are among the key benefits of pacemaker implantation. Patients who previously suffered from severe fatigue, syncope, or dyspnea have reported greater independence in performing routine tasks, such as walking, climbing stairs, and participating in social activities (Schoenenberger et al., 2020). This indicates that a pacemaker not only functions as a cardiovascular therapy but also acts as a device that enables patients to maintain a more active and self-sufficient lifestyle.

However, some studies suggest that the benefits of a pacemaker on quality of life may vary among individuals, depending on comorbid conditions, social support, and psychological readiness (Bujak-Rogala et al., 2022). Therefore, an individualized approach to patient selection and comprehensive pre-procedure education are necessary to ensure that the benefits obtained align with the expectations of both the patients and their families.Although the majority of patients report an increase in life satisfaction, challenges in psychological and social adaptation remain a concern, particularly for elderly patients with cognitive impairment or physical limitations (Castillo-Carnevali et al., 2019). This underscores the importance of a

holistic approach in pacemaker patient care, which should not only focus on physical aspects but also address psychosocial factors.

Psychosocial Impact and Patient Adaptation

Beyond its clinical benefits, pacemaker implantation also has complex psychosocial implications. Some patients experience fear, anxiety, and uncertainty regarding the device implanted in their bodies, which may affect their adherence to therapy and medical follow-ups (Bujak-Rogala et al., 2022).A study by Lin et al. (2023) revealed that 39.92% of patients experience depression post-pacemaker implantation, with key risk factors including preoperative anxiety, adaptation difficulties, and social limitations (Lin et al., 2023). Patients with strong social support from family and healthcare providers are better able to adapt to the changes brought about by the pacemaker and experience reduced anxiety levels (Bujak-Rogala et al., 2022).Moreover, a lack of education before pacemaker implantation can worsen patient anxiety. A study by Hudon et al. (2023) found that patients who did not receive adequate information about the function and benefits of a pacemaker were more likely to experience emotional distress and uncertainty regarding their condition (Hudon, 2023). Therefore, it is crucial for healthcare professionals to provide comprehensive education on pacemaker functionality, associated risks, and long-term expectations before the procedure.On the other hand, cardiac rehabilitation therapy and psychosocial support have been shown to help patients adapt to changes following pacemaker implantation (Johansson, 2015). Through psychosocial and educational interventions, patients can better understand the long-term benefits of a pacemaker, leading to improved mental well-being and confidence in their daily lives .

Patient Safety and Risk of Complications

Pacemakers generally have a low complication rate, particularly in elderly patients. However, risks remain, particularly postoperative infections, pacemaker lead displacement, and device malfunction (Shaik et al., 2021). A study by Özcan et al. (2013) found that younger patients are more prone to complications than elderly individuals, possibly due to differences in physiological responses and activity levels (Özcan et al., 2021) Özcan.One of the primary strategies to reduce complications is strict post-implantation monitoring. A study by Schoenenberger et al. (2020) emphasized that regular monitoring and effective follow-up care can significantly reduce the risk of complications and enhance patients' quality of life (Schoenenberger et al., 2020). Comprehensive Geriatric Assessment (CGA) before pacemaker implantation can also assist in selecting the most suitable patients for the procedure, thereby minimizing potential adverse effects.Furthermore, pacemaker technology is continuously evolving, with recent innovations enabling remote monitoring through telemetry and digital applications. This technology allows physicians to detect abnormalities earlier and adjust device settings without requiring direct hospital visits, thereby reducing the burden on elderly patients who may find frequent travel for check-ups challenging.

Implementation Challenges and Research Gaps

Despite the proven efficacy of pacemakers in improving elderly patients' quality of life, several challenges persist, particularly in terms of healthcare accessibility, medical workforce readiness, and patient education (Gervasio et al., 2020). A study by Marini et al. (2019) revealed that in certain countries, high costs and limitations in healthcare infrastructure are major barriers to patient access to pacemaker therapy (Marini et al., 2019).Moreover, research gaps remain concerning the long-term impact of pacemakers, particularly among vulnerable populations, such as patients with cognitive impairments or physical disabilities (Castillo-Carnevali et al., 2019). Further studies are needed to understand how pacemakers influence quality of life over time, as well as how these devices can be customized to better meet the

needs of diverse patient groups (Hudon, 2023).Additionally, a more holistic, patient-centered approach must be developed to ensure that elderly patients not only receive the medical benefits of pacemakers but also receive adequate psychosocial support and education to help them lead a better quality of life post-implantation.

CONCLUSION

The implantation of a permanent pacemaker has been proven to provide significant benefits for the quality of life of elderly patients, particularly in terms of mobility, physical endurance, and emotional well-being, with relatively low complication rates. However, challenges remain in psychosocial adaptation, adherence to therapy, and accessibility to healthcare services, which require further attention. Additionally, research gaps persist regarding the long-term impact of pacemakers, especially in vulnerable populations, such as patients with cognitive impairments and disabilities. Future research should focus on longitudinal evaluations of pacemaker recipients' quality of life and the development of more holistic and patient-centered care approaches. Furthermore, comprehensive patient education, optimized post-implantation monitoring, and improved healthcare accessibility are essential to ensuring that the benefits of pacemakers are maximized sustainably, ultimately enhancing the overall well-being of elderly patients.

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