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Original Article

Perception of Physical Activity and Quality of Life in Pediatric Patients with Pacemakers

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Abstract

Objectives: Despite improvements in pacemakers (PM), quality of life and expectations and barriers of physical activity (PA) of children remains understudied. This study aim to compare quality of life and expectations and barriers of PA with healthy controls and the relationship between these parameters in children with PM.

Methods: Pediatric patients with arrhythmia aged between 7 and 18 years, with stable clinical conditions and PM implantation for over 1 year, were included in the study. The study comprised 31 patients with pacemaker (16 females, 15 males; mean age: 13.25±3.63 years) and 31 healthy controls matched by age and gender (16 females, 15 males; mean age: 12.09±1.85 years). The pediatric quality of life ınventory questionnaire was used to assess quality of life. PA Outcome Expectancies, PA Barriers Scale, and PA Home Environment Scale were assessed for PA perception.

Results: The PM and control groups were similar in terms of age, sex, and body mass index ($p>0.05$). Children with PM had significantly lower positive expectations scores and significantly higher negative expectations scores regarding PA than their healthy peers ($p<0.05$). Environmental barriers identified by parents of children with PM were significantly lower than those in the healthy group ($p<0.05$). Physical health scores were significantly lower in the pacemaker group than in the control group, and also parents ($p<0.05$). A significant negative correlation was found between quality of life scores (total and physical health) and negative expectations from PA ($p<0.05$). Conversely, total quality of life and physical health scores showed a strong positive correlation with perceived family support for PA ($p<0.05$).

Conclusion: This study emphasizes the significant role of PA perceptions in the quality of life of pediatric pacemaker patients. Addressing negative expectations and enhancing family support are crucial strategies for promoting PA and improving quality of life in this population.

Keywords: Pacemaker, pediatric, physical activity.

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Pacemakers (PM) are essential devices used to manage heart rhythm disorders, particularly in pediatric patients with congenital or acquired arrhythmias. Each year, an estimated 1.35 million babies are born with congenital heart disease; 25% require surgery within the 1st year, and 1% need permanent pacemaker therapy.[1] In

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pediatric and adolescent populations, the most common arrhythmias requiring pacemaker implantation are post-surgical atrioventricular (AV) block and sinus bradycardia.[2] Advances in treating congenital heart defects have resulted in many pacemaker placements in children.[3] As a result, it is essential to address the physical and psychosocial impacts of living with an implanted device. While pacemaker implantation is a well-established and effective treatment that greatly enhances physical health and survival rates, it also creates challenges that can impact the patient's quality of life.[4]

Health-related quality of life (HRQoL) is a multidimensional concept. It reflects how individuals perceive the impact of their health, treatment, and related factors on their physical, emotional, and social well-being. For children with PM, this impact is profound, as their physical limitations, frequent medical interventions, and psychosocial challenges significantly shape their daily lives. Unlike their healthy peers, children with PM often struggle with reduced participation in physical activities, body image concerns due to visible scars, and anxiety about their health.[5–7] These factors may lower HRQoL. Studies show that children with PM report a lower quality of life than healthy children, especially in physical and social areas.[4,8–10]

Physical activity (PA) plays a crucial role in the quality of life for pediatric patients with PM.[9] Research shows children with PM are less active than their healthy peers.[5,11] This may lead to a considerable change in their physical and psychosocial well-being. Lower PA levels could result from negative views on the safety and benefits of PA. This could further reduce their participation. These children frequently face barriers such as parental overprotection, fear of device malfunction, and concerns about overexertion.[12–14]

Facilitators of PA, such as family support and health-care guidance, play a pivotal role in overcoming these barriers, enabling greater participation in physical activities.[15] The perception of PA, influenced by internal beliefs and external factors, may shape how these children engage in daily activities, potentially affecting their HRQoL outcomes.[13] Therefore, understanding the balance between barriers and facilitators is essential for improving PA engagement and, consequently, the overall quality of life of children with PM.

PA is crucial not only for maintaining physical fitness but also for promoting mental health and social integration. Yet, studies show that patients with congenital heart diseases often exhibit reduced exercise capacity, which may lead to diminished PA participation.[16,17] Parents' concerns about safety and the child's fear of overexertion or device malfunction often exacerbate this lack of involvement.[18] These factors contribute to lower PA levels in children with PM than their healthy peers, potentially leading to lower quality of life. Much like in adult congenital heart disease patients, where perceptions and family support influence barriers and facilitators to PA, children with PM also rely on family attitudes to shape their engagement in PA.[19] Parental overprotection, which aims to prevent harm, may unintentionally create barriers to PA and limit the child's ability to lead a physically active and socially engaging life.

Understanding these barriers and addressing the beliefs that limit PA in pediatric patients with pacemaker is crucial. These insights can improve their quality of life by promoting physical and psychological resilience and reducing health anxiety.

The primary aim of this study was to examine the relationship between quality of life and perceptions of PA in pediatric patients with PM. The secondary aim was to explore how personal and family-related barriers to PA affect their well-being compared to healthy peers.

Materials and Methods

This cross-sectional study was approved by the Bahcesehir University Ethical Committee (Approval No: 87839) in September 2024. All study procedures adhered to the principles outlined in the Declaration of Helsinki. Before the study commenced, written informed consent was obtained from both the participating children and their parents.

We conducted the study at Hacettepe University Pediatric Cardiology Department. Pediatric patients with arrhythmia aged between 7 and 18 years, with stable clinical conditions and pacemaker implantation for over 1 year, were included in the study. Patients were excluded if they had acute infections, severe neurological or orthopedic conditions, other systemic diseases, Down syndrome, or could not cooperate with measurements.

We selected healthy controls randomly from local schools, ensuring no systemic diseases or physical disabilities. We conducted evaluations during routine patient follow-up visits and scheduled appointments for control group participants.

Assessments

All participants underwent physical examinations, electrocardiography, and echocardiography performed by a pediatric cardiologist. B-type natriuretic peptide (BNP) levels were obtained from the most recent hospital records, along with a review of the patients' medical history and cardiac diagnoses. Information regarding pacemaker details, such as indication for implantation, electrode positioning, pacemaker mode, and rate settings, was collected. In addition, demographic and physical data, including age, weight, and height, were documented. We used specialized assessment questionnaires validated in Turkish for children and their families.[20–22] The questionnaires were administered to the children and their families through face-to-face interviews, each lasting approximately 30 min.

Quality of Life Assessment

The pediatric quality of life ınventory (PedsQL) questionnaire consists of 23 items that assess physical, emotional, social, and school functioning. Higher scores signify an improved health-related quality of life for children. This study utilized the PedsQL 4.0 Generic Core Scales, with forms tailored for child and parent assessments across the 5–7, 8–12, and 13–18 age groups.[10,23] Calculations were conducted for the total scale score, physical functioning score, and psychosocial health score, which includes emotional, social, and school functioning components.

PA Outcome Expectancies

Our study used a modified 17-item PA outcome expectancies questionnaire to assess children's perceptions of PA.[24] This measure aims to evaluate motivational factors influencing PA engagement. The outcome expectancy measure includes response options: (1) "true of me," (2) "sort of true of me," and (3) "not true of me." Positive expectancy items cover potential benefits of PA, such as increasing strength, maintaining weight, enhancing health and fitness knowledge, improving appearance, boosting energy, and providing enjoyment with friends. Conversely, negative expectancy items address potential barriers, including feelings of inadequacy in sports, teasing, fatigue, clumsiness, time constraints, risk of injury, hair issues, and excessive sweating.

PA Barriers

We applied a previously validated 13-item Likert scale to assess parents' perceptions of barriers to their children's PA.[25] This scale evaluates various personal and environmental factors that may limit activity levels. Parents rated each item on a scale from (1) "not a barrier" to (5) "very much a barrier," covering potential obstacles such as financial costs, weather, safety concerns, pollution, lack of access or sidewalks, age-related issues, disabilities or injuries, fatigue, time limitations, work and family obligations, and competing priorities. This assessment builds on earlier studies that identified two primary dimensions of PA barriers: Personal/individual and social/environmental factors.

Perceived Family Support For PA

We assessed the impact of the home environment on children's PA, focusing on their views of parental support. We used PA Home Environment Scale. A two-item scale measured how often parents allowed sedentary activities like TV and video games, while a five-item scale evaluated children's perceptions of parental support for PA.[26] Children-rated statements such as feeling safe playing outside, encouragement to be active when the weather is good, being motivated to engage in PA over watching TV, going for walks together, and family involvement in physical activities. This approach helped us understand how perceived parental support might promote an active home environment.

Statistical Analysis

Statistical analyses were conducted using Statistical Package for the Social Sciences 25.0 for Windows (IBM, Armonk, NY, USA). Descriptive statistics for the variables were presented as mean±standard deviation, median (range), and percentages, depending on the data type. The Shapiro–Wilk test was used to assess the normality of the data distribution. For normally distributed variables, comparisons were made using Student's t-test, while the Mann–Whitney U test was used for non-normally distributed variables. A $p<0.05$ was considered to indicate statistical significance. The Pearson's correlation coefficient was used for two-tailed analysis of the relationships between variables.

Power analysis was performed to calculate the sample size needed to detect a significant difference in PA expectancies, the primary outcome, between the two groups. An estimated 27 children per group ensured 80% power with a two-tailed α 0.05.

Results

The study comprised 31 pacemaker patients (16 females, 15 males; mean age: 13.25±3.63 years) and 31 healthy controls matched by age and gender (16 females, 15 males; mean age: 12.09±1.85 years).

Table 1 presents the demographic and medical characteristics of the participants. No significant differences were found between the pacemaker and control groups in terms of age, sex, height, weight, or body mass index ($p>0.05$). In 90% of the patients, the pacemaker indication was either congenital or post-operative complete AV block, while in the remaining 10%, the indication was sick sinus syndrome. Among those with post-operative AV block, the underlying causes were primarily associated with congenitally corrected transposition of the great arteries

Table 1. Demographic and medical characteristics of the participants

Parameter	**PM group (n=31)**	**Control group (n=31)**	**p**
Sex, female/male (%)	16/15 (51–49)	16/15 (51–49)	1
Age (year)	13.41±3.21	12.09±1.85	0.05^b
Height (cm)	151.74±16.96	157.77±13.81	0.13^b
Weight (kg)	46.12±16.45	51.51±14.48	0.17^b
Body mass index (kg/m^2)	19.36±3.48	20.34±3.23	0.25
Congenital heart defects, n (%)			
Congenital AV block	9 (29)		
Congenitally corrected transposition of the great arteries	9 (29)		
Venticular septal defect	6 (19.4)		
Sick sinus syndrome	3 (9.7)		
Fallot tetrology	2 (6.5)		
Atrial septal defect- Venticular septal defect	2 (6.5)		
Pacemaker ımplantation ındications, n (%)			
Postoperative or congenital complete AV block	28 (90)		
Sick sinus syndrome	3 (10)		

Yates' Chi-square test; ^{b}: Mann Whitney U test; PM: pacemaker, AV: Atrioventricular block.

and ventricular septal defect repair surgeries (Table 1). In 90% of the children, PM were located in the pectoral pocket, with leads positioned pericardially in 93% of cases. Single-chamber PM were used in 76.7% of the children, while dual-chamber PM accounted for 23.4%. The lower rate limit averaged 55±2.88 ppm, and the upper rate limit was 145±5 ppm. All patients had rate-responsive PM.

Echocardiographic evaluation, conducted by an experienced pediatric cardiologist, showed that all patients had normal systolic and diastolic function, with no AV valve insufficiency or residual shunt. Brain natriuretic peptide (BNP) levels were within normal limits (39.96±8.02 pg/mL), and all patients were classified as New York Heart Association class I. The mean ejection fraction was 68.31±11.75%.

The results of the applied questionnaires are presented in Table 2. Children with PM had significantly lower positive expectations scores and significantly higher negative expectations scores regarding PA than their healthy peers (p<0.05). Perceived family support for physical activities was similar among children in each group (p>0.05).

Environmental barriers identified by parents in the control group for their children were significantly higher than those in the pacemaker group (p<0.05). Scores for individual barriers reported by both groups of parents were similar (p>0.05).

Evaluation of the Pediatric Quality of Life Scale showed that the total score, psychosocial health, and emotional functioning were comparable between the pacemaker and control groups for patients and families (p>0.05). In contrast, physical health scores were significantly lower in the pacemaker group than in the control group, and also or parents (p<0.05, Table 2).

The relationship between quality of life and PA expectancies in the pacemaker group is presented in Table 3. A significant negative correlation was observed between the total quality of life score and negative expectations from PA (r=-0.397, p=0.037). Similarly, physical health scores showed a significant negative correlation with negative expectations from PA (r=-0.525, p=0.004). Conversely, significant positive correlations were found between the total quality of life score and the perceived family support for PA (r=0.588, p=0.001), as well as between physical health scores and the perceived family support for PA (r=0.613, p=0.001). No significant correlations were identified between psychosocial health scores and any of the PA expectancies (p>0.05).

Discussion

Despite advancements in PM, quality of life and expectations and barriers of PA of children remain understudied. This study aims to evaluate quality of life and perceptions of PA and the relationship between these parameters in children with these devices. This study demonstrates that children with PM have challenges in maintaining PA and overall quality of life. Children with PM had different positive and negative expectations from PA. Findings indicate that children with PM showed significantly lower physical health scores than their healthy peers despite similar psychosocial and emotional functioning.

Table 2. Comparison of physical activity and quality of life between groups

Variable	PM group (n=31)	Control group (n=31)	z/t-value	p
Physical activity outcome expectancies scores				
Positive expectancies				
Child	19.23±3.56	21.45±2.74	-2.655	0.010*
Negative expectancies				
Child	13.69±2.85	12.80±4.86	-2.118	0.034*
Physical activity home environment				
Child	9.69±2.42	10.74±2.51	-1.593	0.117
Physical activity barriers scale				
Environmental barriers				
Parent	8.9±2.9	9.8±3	-3.924	0.001**
Personal barriers				
Parent	8.5±2.5	11.38±3.3	-1.177	0.244
PedsQL				
Total score				
Child	73.45±10.71	74.96±14.38	-0.464	0.644
Parent	70.75±10.95	77.95±16.52	-1.975	0.053
Physical functioning score				
Child	71.34±13.56	79.92±18.08	-2.089	0.041*
Parent	69.04±15.04	80.15±20.44	-2.383	0.020*
Psychosocial health score				
Child	74.17±10.39	72.31±16.80	0.520	0.605
Parent	71.98±16.66	76.66±16.90	-1.078	0.285

Independent sample t-test, *: p<0.05, **: p<0.01. PM: Pacemaker, PedsQL: Pediatric quality of life inventory.

Table 3. Relationship between quality of life and physical activity expectancies of pacemaker patients

Variable	Positive expectations from physical activity	Negative expectations from physical activity	Perceived family support for physical activity
Quality of life total scale score			
r	0.028	-0.397	0.588
p	0.884	0.037*	0.001**
Quality of life physical health total score			
r	0.218	-0.525	0.613
p	0.257	0.004**	0.001**
Quality of life psychosocial health total score			
r	-0.186	-0.305	0.203
p	0.357	0.122	0.310

Pearson's correlation, *: p<0.05, **: p<0.01.

A notable outcome of this study is the presence of more negative expectations and less positive expectations toward PA among children with PM than in their healthy counterparts. This perception may arise from concerns about physical limitations, safety, or fears related to device malfunction. Such negative outlooks have been documented in children with other chronic conditions, where perceived risks are associated with decreased motivation and participation in PA.[14] In a survey of parents of children with congenital heart disease, 14% expressed uncertainty regarding the safety of exercise, 1% perceived it as unsafe, and 15% had unresolved questions about their child's PA level.[27] The negative expectations identified in our study may be driven by personal fears and parental concerns, which often act as barriers to PA. Overprotective behaviors exhibited by parents and other caregivers, such as teachers, have been associated with feelings of social exclusion, diminished self-esteem, and impaired development of self-efficacy.[12] Conversely, some children may voluntarily exclude themselves from physical activities due to perceived physical limitations and low self-efficacy.[28]

Parental perception also plays a critical role in shaping PA habits in children.[29,30] This study reveals a similar level of perceived family support for PA between the pacemaker and control groups, underscoring the importance of family involvement in promoting active lifestyles, regardless of medical conditions. Previous research has shown that children's PA engagement is strongly influenced by family support, with higher levels of perceived parental support linked to increased activity participation.[31] Creating positive expectations through supportive environments and motivated families and supporters can encourage participation and create a more inclusive experience for children. Highlighting the tangible benefits of PA while simultaneously addressing fears and misconceptions can increase participation and improve overall quality of life.

Participation in PA can be significantly hindered by numerous environmental and personal barriers. The results also highlight environmental barriers that influence activity levels differently across groups. Parents of pacemaker group identified less environmental barriers to PA than those in the control group. This result may suggest that families of patients with pacemaker perceive fewer external obstacles because they are more focused on individual health-related barriers. Such perceptions align with studies highlighting how health conditions can shift focus toward personal limitations over environmental factors. Addressing these environmental and personal barriers through structured guidance and parental support could reduce obstacles to PA, especially for patients with pacemaker.

It is known that the quality of life of children with PM is affected.[7] Despite the mild severity of the disease, physical function scores were lower on self- and parent-forms than controls in this study. Furthermore, both groups exhibited similar levels of psychosocial functioning. Despite these challenges, the similarity in psychosocial and emotional health scores between the pacemaker and control groups suggests a level of resilience in children with PM, possibly due to psychological adaptation to their condition. Previous research on children with implanted cardiac devices has observed minimal differences in psychological outcomes compared to healthy peers, particularly as children adapt to their health status and device management over time.[9,32] However, the physical health limitations noted in our study reflect the need for supportive interventions that address their care's physical and psychological aspects.

Our findings underscore the positive association between family support and quality of life, specifically physical health. This suggests that family involvement could mitigate some of the physical limitations reported by patients with pacemaker, potentially enhancing both physical and psychological outcomes. Encouraging families to actively participate in or support physical activities may create a more conducive environment for children with PM to exercise, as family encouragement has been previously shown to improve physical health outcomes in children with chronic health conditions.[33]

This study has a limitation in its cross-sectional design, which restricts the ability to infer causality. Objective PA measurements could have enriched the study's findings. Future research utilizing longitudinal designs could provide valuable insights into how perceptions and quality of life evolve in pediatric patients with pacemaker.

Conclusion

This study highlights the impact of PA perceptions on the quality of life in pediatric patients with PM. Addressing negative expectations and enhancing family support may be key strategies for promoting PA and improving the quality of life in this population. Future research should focus on developing targeted interventions that encourage positive attitudes toward PA and provide supportive environments for these children to thrive.

Disclosures

Ethics Committee Approval: The study was approved by the Bahcesehir University Ethics Committee (no: 87839, date: 10/09/2024).

Authorship Contributions: Concept – M.S.; Design – S.T.; Supervision – S.T., M.S.; Funding – N.V.Y.; Materials – İ.E., T.K.; Data collection and/or processing – S.T.; Data analysis and/or interpretation – M.S., S.T.; Literature search – S.T.; Writing – S.T., M.S., H.T., N.V.Y.; Critical review – M.S., İ.E., H.T.

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