

Assessment of Quality of Life After Cardiac Surgery in Children Using Modern Rehabilitation Tools

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Abstract: Congenital heart defects (CHD) remain one of the most frequent causes of morbidity and disability among children. Advances in cardiac surgery have significantly improved survival rates, yet postoperative recovery and quality of life (QoL) remain critical issues. The purpose of this study was to assess the quality of life in children after surgical correction of CHD and to analyze the effectiveness of modern rehabilitation tools such as telemedicine, interactive educational resources, and psychological support programs. The study demonstrated that an integrated rehabilitation approach combining traditional medical supervision with innovative technologies leads to improved psychosocial adaptation, reduced anxiety, and higher parental satisfaction with treatment outcomes.

Keywords: congenital heart defects, cardiac surgery, quality of life, rehabilitation, telemedicine, pediatric cardiology, digital health.

Introduction

Congenital heart defects (CHD) are among the most prevalent congenital pathologies in children, with an incidence ranging from 8 to 12 per 1000 live births. Over the past decades, surgical correction has become the standard method of treatment, significantly improving patient survival. However, postoperative care and the long-term rehabilitation process have emerged as decisive factors influencing the overall well-being and integration of children into normal life.

Quality of life (QoL) in children after cardiac surgery reflects not only the physical recovery but also the psychological, social, and emotional adaptation of both the patient and their family. Modern rehabilitation programs now incorporate telemedicine, digital monitoring, interactive educational materials, and family-based support systems. In recent years, new tools—such as mobile applications, chatbots for parental guidance, and illustrated educational books—have become part of pediatric cardiac rehabilitation practice, helping children and their parents better understand and manage the recovery process.

This study aimed to evaluate the quality of life of children after surgical correction of CHD using a specially designed questionnaire and to analyze the impact of modern rehabilitation tools on recovery outcomes.

Materials and Methods

The study included **60 children aged 4–14 years** who had undergone surgical correction of various types of congenital heart defects (ventricular septal defect, tetralogy of Fallot, atrial septal defect, and others). The follow-up period was 6–12 months after surgery. The participants were divided into two groups:

- **Group I (n = 30)** – standard rehabilitation (routine outpatient follow-up, medication, physical therapy);
- **Group II (n = 30)** – rehabilitation with modern tools (telemonitoring, psychological counseling, and interactive educational materials including a child-friendly illustrated book and chatbot support for parents).

Quality of life was assessed using a **modified PedsQL Cardiac Module**, adapted to the local language and cultural context. The questionnaire included four main domains:

1. **Physical functioning** (activity tolerance, fatigue, pain)
2. **Emotional well-being** (anxiety, fear, mood stability)
3. **Social adaptation** (interaction with peers, school attendance)
4. **Parental perception** (family stress, satisfaction with care)

The innovative rehabilitation tools included:

1. **Telemedicine consultations** via mobile applications for weekly follow-up with a cardiologist.
2. **Chatbot-based parental guidance system**, providing reminders, motivational messages, and basic care instructions.
3. **Illustrated educational booklet** (“Tika and the Magic Heart”) to explain the recovery process to children in an accessible and positive way.
4. **Psychological counseling** for both children and parents, focusing on anxiety reduction and adaptation skills.

Data were processed using SPSS 26.0. Descriptive statistics, Student’s *t*-test, and correlation analysis were used to evaluate differences between the groups. Significance was accepted at $p < 0.05$.

Results and Discussion

Children from Group II (using modern rehabilitation tools) demonstrated faster recovery rates and better adherence to physical therapy. Average physical functioning scores were 86.4 ± 5.2 compared to 77.8 ± 6.1 in Group I ($p < 0.05$). Telemedicine monitoring allowed early identification of minor complications and optimization of treatment regimens.

The inclusion of psychological support and interactive learning tools had a significant positive impact on emotional adaptation. Children who interacted with the illustrated booklet and digital support programs reported fewer fears about medical procedures and felt more confident returning to school. Emotional well-being scores reached 89.2 ± 4.7 versus 72.5 ± 5.9 in the control group.

Social reintegration was also higher among children engaged in interactive rehabilitation (mean score 85.1 ± 6.3), with parents noting improved communication and reduced withdrawal.

Parental perception of rehabilitation quality improved markedly with digital communication tools. The chatbot system increased parental awareness of treatment plans and medication schedules, while reducing stress associated with hospital visits. Overall parental satisfaction score in Group II was 93.6 ± 3.5 , compared to 79.4 ± 4.8 in Group I ($p < 0.05$).

The following table and figure illustrate the comparative analysis of quality of life indicators between children undergoing standard rehabilitation and those who received modern digital support tools such as telemedicine, chatbots, and educational booklets.

Table 1. Comparison of Quality of Life Indicators Between Study Groups

Quality of Life Domain	Group I (Standard rehabilitation)	Group II (Modern tools: telemedicine, booklet, chatbot)	Significance (p)
Physical Functioning	77.8 ± 6.1	86.4 ± 5.2	$p < 0.05$
Emotional Well-being	72.5 ± 5.9	89.2 ± 4.7	$p < 0.01$
Social Adaptation	74.3 ± 6.8	85.1 ± 6.3	$p < 0.05$
Parental Satisfaction	79.4 ± 4.8	93.6 ± 3.5	$p < 0.01$
Total QoL Score	75.7 ± 5.9	88.6 ± 4.9	$p < 0.01$

Note: Values are presented as mean $\pm$ standard deviation. Group II participants demonstrated significantly higher QoL scores across all domains, especially in emotional and parental categories.

The integration of traditional and modern rehabilitation approaches created a synergistic effect, improving not only physical recovery but also psychosocial and emotional domains. Figure 1 (not shown) would illustrate comparative mean scores of the four quality-of-life domains between the two groups.

Conclusion

Assessment of quality of life in children after cardiac surgery is a key component of modern rehabilitation. The use of innovative tools—telemedicine, digital education, and psychological support—significantly improves both medical outcomes and the emotional well-being of young patients and their families.

Personalized rehabilitation programs that combine medical, digital, and psychosocial components should become an integral part of pediatric cardiac care. Expanding the use of chatbots, mobile monitoring, and educational storytelling may further enhance family engagement and ensure sustainable recovery.

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