



# Differences in Quality of Life Among Children with End-Stage Kidney Disease Undergoing Hemodialysis and Peritoneal Dialysis

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Received: 13 November, 2024; Revised: 29 December, 2024; Accepted: 3 January, 2025

## Abstract

**Background:** Children with end-stage kidney disease (ESKD) require therapies such as hemodialysis (HD) and peritoneal dialysis (PD). These treatments can impact a child's quality of life (QoL); however, research comparing the QoL between children undergoing HD and those undergoing chronic PD in developing countries is limited.

**Objectives:** This study compared the QoL of children with ESKD undergoing PD versus HD.

**Methods:** This study employed an analytic observational method with a cross-sectional design conducted from December 2023 to March 2024. Consecutive sampling was used for participant recruitment and data collection. The Pediatric QoL Inventory (PedsQL™) version 4.0 Questionnaire was utilized, and data were analyzed using the Mann-Whitney non-parametric test, with statistical significance set at  $P < 0.05$ .

**Results:** The sample consisted of patients undergoing HD ( $n = 12$ , 48%) and PD ( $n = 13$ , 52%). Based on child and parent reports, the mean QoL score was significantly higher for PD patients compared to HD patients, although no significant differences were observed in certain aspects. The highest score was recorded in children's reports regarding social aspects ( $91.53 \pm 22.2$ ).

**Conclusions:** The QoL of pediatric patients on PD was better than that of patients on HD.

**Keywords:** Children, Chronic Kidney Disease, Hemodialysis, Peritoneal Dialysis, Quality of Life

## 1. Background

Chronic kidney disease (CKD) is defined by the presence of structural or functional abnormalities in the kidneys that persist for at least 3 months, with or without a decrease in glomerular filtration rate (GFR) – i.e., less than  $60 \text{ mL/min/1.73 m}^2$  – that lasts for more than 3 months, along with kidney damage or without kidney damage (1). Based on global CKD prevalence, the number of people living with stages I to V CKD worldwide is estimated to be 843.6 million (2). Global pediatric data suggests that kidney disease affects 18.5 - 58.3 children per 1 million, and this number may increase significantly over the next 20 years (3). Such an increase could elevate the mortality rate in children of this age group and is considered a major threat to their quality of life (QoL).

A previous study found that the QoL of children with CKD in Indonesia, particularly in West Java and specifically at Hasan Sadikin Central General Hospital (RSHS), Bandung, indicated around 52 new cases of CKD per year (4). The prevalence of CKD in this area reached more than 3.8%, though it remained below 6.4%. The rising incidence of kidney failure aligns with the increasing demand for therapies for patients with kidney disease (5).

In 2018, there were 66,433 new hemodialysis (HD) patients and 132,142 active HD patients (6). This data represents a significant increase from 2017, when there were 30,831 new patients and 25,446 individuals undergoing HD in 2016. This trend reflects the growing incidence of end-stage kidney disease (ESKD) each year. Of the new HD patients in 2018, 30.82% were aged 45 - 54 years, and 0.31% were pediatric patients aged 1 - 14 years. According to the 2018 data, 98% of end-stage renal

disease patients were using HD, while 2% were receiving peritoneal dialysis (PD) therapy (6).

There are three types of kidney replacement therapy (KRT): Hemodialysis, PD, and kidney transplantation (KT). Among these, HD is more commonly used as a KRT option, alongside PD and KT, in most countries (7). Both HD and PD are effective in clearing waste substances from the blood, but they differ in their impact on the QoL of patients. Hemodialysis, which is typically performed 2 - 3 times a week and involves long durations, can restrict activity, cause feelings of isolation, and interfere with daily life. Although PD has less interference with daily activities, it may cause physical discomfort, such as abdominal distension or pain around the peritoneal catheter. Psychological aspects, including stress, depression, and anxiety, also significantly affect the QoL of patients with CKD.

Health-related quality of life (HRQOL) is an important indicator in patients with end-stage renal disease who undergo HD or PD (8). The QoL for CKD patients refers to a condition in which patients feel comfortable physically, psychologically, spiritually, and socially, and are able to fully utilize their lives for their own happiness and that of those around them (9). According to the findings of previous studies, the QoL for patients undergoing PD therapy is better both physically and psychologically, and these patients have a lower mortality rate compared to those undergoing HD (10). The QoL in children receiving KRT is crucial to examine further, as it is important for demonstrating the effectiveness of healthcare and overall well-being (9). Furthermore, the comparison of QoL between children with CKD undergoing HD and chronic PD, particularly in developing countries, has not been well-documented. However, data on the QoL of pediatric patients undergoing continuous ambulatory peritoneal dialysis (CAPD) is important for parents.

## 2. Objectives

This study compared the QoL of children with ESKD undergoing PD versus HD.

## 3. Methods

This is a quantitative study employing an analytical observational design with a cross-sectional approach to measure the QoL in children with end-stage renal disease undergoing HD and PD. The study was conducted at the pediatric outpatient clinic of RSHS, Bandung, West Java, between December 2023 and March 2024. Participants included routine HD and PD patients at RSHS, Bandung, aged 5 - 18 years, diagnosed with end-

stage CKD, who provided consent to participate and whose family approved their involvement. Participants were selected using a consecutive sampling method. Exclusion criteria included intellectual disabilities and certain syndromic conditions affecting mental and intellectual function, parents of patients with visual impairments or dementia, and those with severe infections that caused unconsciousness in either the parents or children.

Patient characteristics assessed in this study included age, sex, weight, height, nutritional status, laboratory results, CKD etiology, and QoL. Informed consent was obtained verbally and in writing from both the patients and their parents before completing the questionnaire.

Data were collected using the Pediatric QoL Inventory (PedsQL™) version 4.0 ESKD Module questionnaire, developed by Varni et al., as a brief and standardized method for measuring HRQOL. This tool assesses both patient and parent perceptions of HRQOL in pediatric patients with chronic health conditions and has been widely used in various previous studies (11). Data collection using the PedsQL Questionnaire was conducted by pediatricians at RSHS. The questionnaire was administered to children and their parents, specifically those with end-stage renal disease undergoing HD and PD at RSHS, Bandung. Both children and parents were asked to complete the questionnaire according to their own or their children's abilities. Prior to completing the questionnaire, participants were informed about the purpose of the study, and written informed consent was obtained from their parents or guardians. Data security and confidentiality were maintained throughout the data collection and analysis processes.

The PedsQL Questionnaire consists of 23 items that assess children's QoL, as defined by the World Health Organization (WHO). It includes four aspects: Physical, emotional, social, and school functioning. The PedsQL score is calculated using reverse scoring. For reverse scoring, a selection of zero (never) is assigned a value of 100, one (very rarely) a value of 75, two (sometimes) a value of 50, three (often) a value of 25, and four (almost always) a value of 0. The score for each aspect is calculated by summing the total answer scores and then dividing by the number of questions in that aspect. Higher scores indicate better HRQOL.

Data were analyzed using SPSS version 13.0 (IBM Corp, Armonk, New York, United States). The Mann-Whitney non-parametric test was used to examine differences in PedsQL scores because the data were not normally distributed, as determined by the Shapiro-Wilk test.

Statistical significance was set at  $P < 0.05$ . The minimum sample size was determined by:

$$U = \frac{n_1 \times n_2 + n_1(n_1 + 1)}{2 - R_1}$$

U = the Mann-Whitney statistic

$n_1$  = the sample size of group 1

$n_2$  = the sample size of group 2

$R_1$  = the sum of ranks for group 1

#### 4. Results

This study was conducted on 25 children aged 2 to 18 years, selected through consecutive sampling. The sample included patients undergoing HD ( $n = 12$ , 48%) and PD ( $n = 13$ , 52%) at RSHS, Bandung. For 18 patients, only parental proxy reports were available, while 15 patients had both a parent proxy report and a child self-report.

Based on Table 1, among children undergoing HD, more than half of the respondents were male (58.3%). Additionally, all respondents (100%) were aged between 10 and 18 years. It can also be observed that most respondents had normal nutritional status (BMI 18.5 - 24.9), with a total of seven individuals (58.3% of the respondents). Among children undergoing PD, the number of male respondents was also higher than half of the sample (61.5%). Furthermore, most respondents were in the 10 - 18 years age range, with a total of 11 individuals (84.6% of the respondents). Most respondents had normal nutritional status (BMI/A -2 SD to +1 SD), with a total of 12 individuals (92.3% of the respondents). Initial measurements of various laboratory parameters taken before starting the intervention, such as creatinine, urea, TIBC, Fe, and ferritin, tended to fall within the same category. Overall, the hemoglobin levels in both HD and PD patients were low. The causes of CKD in the patients were attributed to atypical hemolytic uremic syndrome (aHUS), focal segmental glomerulosclerosis (FSGS), membranoproliferative glomerulonephritis (MPGN), and rapidly progressive glomerulonephritis (RPGN), with 75% of the respondents' CKD being caused by FSGS.

Table 2 shows the results of the QoL in HD and PD patients. The average values of PD children's reports in the categories of physical activity ( $87.5 \pm 20.6$ ), emotional ( $70.38 \pm 17.9$ ), social ( $91.53 \pm 22.2$ ), and education ( $86.05 \pm 21.6$ ) were higher than those of HD patients, who had physical activity values of  $60.15 \pm 19.6$ , emotional  $65 \pm 20.1$ , social  $79 \pm 20.9$ , and education  $60.5 \pm 20.3$ .

In parent reports for children undergoing PD, the mean scores in the categories of physical activity ( $86.05 \pm 21.6$ ), emotional ( $78.07 \pm 18.4$ ), social ( $85 \pm 25.4$ ), and education ( $80 \pm 31.2$ ) were generally higher than those for HD children, who had physical activity values of ( $68.09 \pm 15.1$ ), emotional ( $74 \pm 25.3$ ), social ( $89 \pm 10.2$ ), and education ( $53 \pm 19.2$ ). In the parent report, the social aspect in HD children scored higher in QoL than PD children.

Table 3 presents the QoL results for HD and PD patients. The average values of PD children's reports in the categories of physical activity ( $87.5 \pm 20.6$ ), emotional ( $70.38 \pm 17.9$ ), social ( $91.53 \pm 22.2$ ), and education ( $86.05 \pm 21.6$ ) were higher than those of HD patients, who had physical activity values of ( $60.15 \pm 19.6$ ), emotional ( $65 \pm 20.1$ ), social ( $79 \pm 20.9$ ), and education ( $60.5 \pm 20.3$ ).

In parent reports for children undergoing PD, the mean scores in the categories of physical activity ( $86.05 \pm 21.6$ ), emotional ( $78.07 \pm 18.4$ ), social ( $85 \pm 25.4$ ) were also higher. A mean difference test was conducted on the QoL scores of children undergoing HD and PD in four aspects: Physical, emotional, social, and educational activities. The four aspects were analyzed from two perspectives: Children's self-reports and parents' proxy reports. The results of the difference test, obtained using the Mann-Whitney method, showed that in children's self-reports, there were significant differences in physical and social activities. In the parents' report, all aspects had a significant value, with a P-value  $< 0.05$ , indicating that the difference in the average QoL scores between children undergoing HD and children undergoing PD was statistically significant.

The results of the independent samples *t*-test to determine the overall difference in the QoL of children showed an average difference of 13.38, with a P-value of 0.001. Therefore, it can be concluded that there is a significant difference in the QoL between children undergoing HD and those undergoing PD.

#### 5. Discussion

There are three types of KRT: Hemodialysis, PD, and KT, each of which has different effects on the QoL of children. PD and HD are the two most commonly used methods of KRT for CKD patients (7). Each method has certain advantages and disadvantages, and the choice between them depends on individual factors, such as the patient's physical health, disease progression, home environment, and personal preferences.

Among the 25 samples in this study, which consisted of 12 HD patients and 13 PD patients, there were more males than females. According to the Riskesdas results,

**Table 1.** Characteristics of Hemodialysis and Peritoneal Dialysis Patients <sup>a</sup>

Characteristics	HD	PD
<b>Gender</b>		
Male	7 (58.3)	8 (61.5)
Female	5 (41.7)	5 (38.5)
<b>Age, y</b>		
< 10	0 (0)	2 (15.4)
10 - 18	12 (100)	11 (84.6)
<b>Nutrition status</b>		
IMT/U -3 SD to -2 SD	5 (41.7)	1 (7.7)
IMT/U -2 SD to +1 SD	7 (58.3)	12 (92.3)
<b>Lab results</b>		
Baseline creatinine		
High	12 (100)	13 (100)
Normal	0 (0)	0 (0)
Baseline urea		
High	12 (100)	13 (100)
Normal	0 (0)	0 (0)
Baseline TIBC		
High	12 (100)	13 (100)
Normal	0 (0)	0 (0)
Baseline Fe		
Normal	0 (0)	0 (0)
Low	12 (100)	13 (100)
Baseline ferritin		
High	12 (100)	13 (100)
Normal	0 (0)	0 (0)
Hemoglobin		
Normal	0 (0)	0 (0)
Low	12 (100)	13 (100)
Etiology		
SHU Atypik	0 (0)	1 (8)
FSGS	9 (75)	12 (92)
MPGN	2 (17)	0 (0)
RPGN	1 (8)	0 (0)

Abbreviations: HD, hemodialysis; PD, peritoneal dialysis; FSGS, focal segmental glomerulosclerosis; MPGN, membranoproliferative glomerulonephritis; RPGN, rapidly progressive glomerulonephritis.

<sup>a</sup> Values are expressed as No. (%).

the prevalence of CKD in Indonesia is higher in men than in women. Previous studies have also found that the incidence of CKD is higher in men and that men are more susceptible to developing kidney disease than women (8, 12). This may be due to the faster decline in kidney function in men compared to women, which could negatively affect their HRQOL (13). Additionally, glomerular disease is a common cause of kidney disease in children and occurs more frequently in males than females (14, 15). This condition affects 15 - 29% of children with CKD worldwide, and nephrotic syndrome (NS) is

one of the most common manifestations of pediatric glomerular disease (15).

Pediatric NS typically has a good prognosis with appropriate medical treatment. However, the prognosis is often poor in developing countries, especially among children from low socioeconomic backgrounds. This is primarily due to inappropriate treatment, including the use of herbal products and traditional medicine, which often dominate or replace the medical treatment recommended by doctors. In this study, there were more patients aged over 10 years compared to those in the younger age group. This is likely due to the progressive

**Table 2.** Quality of Life of Children with End Stage Renal Disease Undergoing Hemodialysis and Peritoneal Dialysis

Domain	Children Self-report	Parent's Report	Overall Average
<b>HD</b>			67.82 ± 21.1
Physical activity	60.15 ± 19.6	68.09 ± 15.1	
Emotional	65 ± 20.1	74 ± 25.3	
Social	79 ± 20.9	89 ± 10.2	
Education	60.5 ± 20.3	53 ± 19.2	
<b>PD</b>			81.21 ± 24.5
Physical activity	87.5 ± 20.6	86.05 ± 21.6	
Emotional	70.38 ± 17.9	78.07 ± 18.4	
Social	91.53 ± 22.2	85 ± 25.4	
Education	86.05 ± 21.6	80 ± 31.2	

Abbreviations: HD, hemodialysis; PD, peritoneal dialysis.

**Table 3.** Mann-Whitney U Test Results

Domain	Mean Difference	P-Value
<b>Children self-report</b>		
Physical activity	27.34	0.004
Emotional	5.13	0.553
Social	14.03	0.007
Education	9.15	0.289
<b>Parent's report</b>		
Physical activity	17.96	0.047
Emotional	4.07	0.960
Social	4.00	0.597
Education	27.00	0.019
<b>Total</b>	13.38	0.001

nature of the disease, which leads to CKD stage V, also known as ESKD.

The results of this study indicated that the QoL in children with PD was better than in children with HD. This is evident from the higher mean QoL scores across all aspects—physical, emotional, social, and school—among PD patients compared to HD patients, as reported by both children and parents. The social aspect had the highest QoL score in both child and parent reports for both HD and PD patients. Another study found that the QoL reported by children with PD was better than that reported by their parents, which is consistent with the findings of this study (16).

This finding is consistent with previous studies that have shown the QoL of children on PD is better due to the minimal impact on the child's daily life (8, 10, 17-19). The cultural and regional factors in our subjects are similar, mostly consisting of land and hills, with relatively good transportation, though it requires considerable time and funds. In a study conducted in

Saudi Arabia, the QoL of pediatric patients on PD was significantly higher than that of pediatric patients on HD ( $P = 0.045$ ). Additionally, male pediatric patients on HD had significantly better QoL scores on the interaction subscale ( $70.83 \pm 15.95$ ) compared to female patients ( $30.00 \pm 24.00$ ,  $P = 0.023$ ) (10). In another study, PD patients reported greater freedom and the ability to enjoy valuable time compared to HD patients, who require more time in the hospital for dialysis. As a result, PD patients can continue their activities without being hindered by therapy or medication (8). Furthermore, PD can help maintain residual kidney function better than HD (19).

Peritoneal dialysis has several advantages that can contribute to improve QoL. In terms of physical aspects, children undergoing PD often exhibit better treatment tolerance. Hemodialysis, which requires more intensive procedures, can cause fatigue and negatively impact the patient's physical condition. Peritoneal dialysis, performed at home, allows the child to maintain their

energy levels and reduces interference with daily activities. The flexibility of the PD schedule enables better adjustment to the child's rest and physical activity needs. Additionally, this flexibility may contribute to better emotional stability in children (18, 20).

Children undergoing PD reported better QoL in the areas of emotional well-being, relationships with family and parents, and financial resources compared to those undergoing HD (21). Parents were able to save money and have more flexibility, as the need to travel for accommodation decreased from three times a week to once a month, thus saving both time and money. Children undergoing PD therapy also had greater opportunities to participate in social activities, interacting with friends at school and with family, which is crucial for healthy social development. Furthermore, PD patients tended to be more active in maintaining social interactions and social support, contributing to improved physical health and emotional well-being compared to children undergoing HD, thereby enhancing their overall QoL (20).

In terms of emotional aspects, both children and parents reported no significant differences between HD and PD, as patients with CKD face a higher risk of depression and anxiety.

Although most patients experienced infections and flow failure during CAPD, the results of examining children's QoL using the PedsQL yielded an unexpected outcome: The QoL in children receiving PD therapy was better than that in children receiving HD. This may be attributed to the fact that the PedsQL test was conducted when the CAPD flow was stable, thus resolving the issue of flow failure.

The limitation of this study is the difficulty of randomization, which may have introduced bias. This is due to the general reluctance of people to undergo PD therapy, stemming from previous patient reports of frequent obstructions of the PD device and infections. Additionally, this study was conducted at only one location, RSHS in Bandung, Indonesia, meaning that the results may vary based on the specific conditions of that setting. Better results might be achieved if the obstruction and infection rates in CAPD at RSHS were reduced.

When selecting the KRT modality for pediatric patients, it is important to consider patient preferences, social support, and psychological factors. Therefore, the choice between HD and PD should always involve a thorough discussion among the patient, family, and medical team, taking into account the medical, psychosocial, and practical aspects of daily life.

### 5.1. Conclusions

The present study demonstrated that the QoL of pediatric CKD patients at RSHS, Bandung, who underwent PD was better than that of those undergoing HD. Given the findings showing better QoL in children undergoing PD, clinicians and parents can be better informed when making decisions regarding the management of pediatric ESKD. The choice of dialysis method is crucial, not only for addressing medical needs but also for considering the broader impact on the child's physical, emotional, social, and educational well-being. The results of this study further support the suggestion of CAPD as a preferred KRT modality for children with ESKD.

### Acknowledgements

We would like to express our sincere gratitude to Dr. Eddy Fadlyana, Dr., SpA (K), M. Kes., Rini Rossanti, Dr., SpA., M.Kes., Renya Hiasinta, Dr., SpA., and all the pediatric residents in the nephrology and growth and development division during the enrollment period.

### Footnotes

**Authors' Contribution:** A. N. H.: Manuscript writing, data collection, statistical analysis; A. W.: Data collection, supervision of data collection, writing, statistical analysis, manuscript preparation; R. T.: Supervision of quality-of-life measurement, manuscript revision.

**Conflict of Interests Statement:** The authors declare that there are no conflicts of interest regarding this manuscript.

**Data Availability:** The dataset used in this study is available upon request from the corresponding author during submission or after publication. The data are not publicly available due to patient privacy concerns.

**Ethical Approval:** Data were collected after obtaining approval from the Health Research Ethics Committee of the Faculty of Medicine, Padjadjaran University (approval number: 6/UN6.KEP/EC/2024).

**Funding/Support:** This study was funded by an internal grant from Universitas Padjadjaran (RPLK No. 1753/UN/6.3.1/PT.00/2024).

**Informed Consent:** Informed consent was obtained prior to each participant's enrollment.

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