

Review

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Review

The Impact of Exercises and Physical Activity Programs on Paediatric Patients Undergoing Haemodialysis in Africa: A Scoping Review

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Abstract

Introduction: Chronic kidney disease and kidney failure are associated with a decline in physical abilities resulting in severe health-related complications. Physical activities and exercise improve the quality of life of paediatric patients undergoing dialysis. This scoping review aims to evaluate existing literature on the impact of exercise programs on paediatric patients undergoing dialysis in Africa. **Methods:** A systematic search of electronic databases, including CINAHL, EBSCO, Medline, PubMed, and Scopus, was conducted to identify peer-reviewed articles focusing on the effects, impact and benefits of exercises and physical activity programs in paediatric patients undergoing dialysis. The selection process was done by two authors and included importing search results, removing duplicates, screening titles and abstracts based on a criterion, and analysed the reference lists of selected studies to ensure comprehensive coverage. Two peer-reviewed studies were eligible for final review. **Results:** Two exercise-based intervention studies focused on children receiving dialysis in Egypt, highlighting a narrow regional scope within Africa. The initial study demonstrated significant improvements in health-related quality of life after muscle stretching and isometric exercises. These improvements were particularly evident across multiple dimensions of the Pediatric Quality of Life Inventory. A subsequent study found reductions in psychological distress and positive biochemical changes after four and eight weeks. While there were no significant baseline differences in depression, anxiety, or stress, the exercise regimen showed emerging psychosocial benefits over time. A notable omission was the lack of detail regarding contraindications and precautionary measures. These are essential for informing clinical decision-making and ensuring exercises are both safe. **Discussion:** The findings underscore the importance of incorporating exercise into the standard care of paediatric patients undergoing dialysis to facilitate better health outcomes. Further research is needed to develop and implement effective exercise interventions tailored to other countries in Africa.

Keywords: dialysis; paediatric; physical activity; exercise; quality of life; scoping review; Africa

1. Introduction

Kidney Failure is a significant public health challenge in Africa, accounting for more than 50% in paediatric populations [1]. The incidence of KF in African countries is elevated, primarily attributed to the prognosis remaining unfavourable due to the unavailability of resources for acute and chronic renal replacement therapy (RRT) [2,3]. Chronic kidney disease (CKD) is characterised by the presence of kidney damage or an estimated glomerular filtration rate (eGFR) persisting for 3 months or more [4]. CKD involves a progressive loss of kidney function, often resulting in Kidney Failure (KF) requiring the need for RRT, such as dialysis or transplantation [5].

Dialysis provides essential support by maintaining physiological stability through the removal of metabolic waste products, regulating fluid and electrolyte balance, and maintaining acid-base

homeostasis [5]. Although the causes of KF vary by age and race, the most common causes are congenital anomalies in children under 12 years, contributing 34% to 43% prevalence of KF [6].

Globally, two types of dialysis are used in practice, namely peritoneal dialysis (PD) and haemodialysis (HD) [5,6,7]. PD accounts for 9% of all RRTs and 11% of all dialysis. PD is often preferred in younger children due to its technical simplicity, the lesser need for trained staff, and its convenience for home treatment [7,8,9]. However, HD is more commonly utilised in the adolescent group, usually in a hospital setting [9]. Although the use of PD is attractive in low-income countries, it is accompanied by high costs of the necessary peritoneal fluids, which affects its accessibility and optimal usage [9].

Children undergoing dialysis often report a lower health-related quality of life (QoL) compared to their peers in the earlier stages of chronic kidney disease or those who have received a kidney transplant [10,11,12]. This decline is particularly evident across multiple domains, including physical functioning, emotional well-being, social interactions, and academic performance [10,11,12]. HD is associated with more fatigue and disruption of physical condition compared to PD [13]. Emotional suffering is evident regardless of the type of RRT, with both children and caregivers reporting psychological challenges of anxiety, social isolation, poor self-esteem and lack of self-control [14]. Furthermore, school attendance and academic achievement are often negatively affected due to frequent absences for treatment and hospitalisations [11].

Physical activities and exercises are widely acknowledged as therapeutic interventions to improve physical functioning. Exercise is associated with several benefits, including improved physical function, muscle mass, and strength [15,16]. However, the exercise capacity of children diagnosed with KF undergoing dialysis is poorer than that of their healthy peers. Exercise intolerance is correlated with protein-energy wasting and chronic inflammation that exist [17,11].

While incorporating exercise during dialysis has been shown to enhance clinical outcomes, its implementation in paediatric and adolescent populations remains relatively underutilised [18]. Maintaining PA and exercises is essential for patients undergoing dialysis; however, clinical guidelines concerning the appropriate type, timing, intensity, and safety of exercise interventions are reported to be inconsistent globally [19]. The limited availability and variability of guideline recommendations often restrict clinicians' ability to promote PAs and exercises among paediatric nephrology patients [20]. Thus, this scoping review aims to map the available evidence on methods, types, benefits, outcomes, effects of PA and exercise programmes on the paediatric population undergoing haemodialysis.

Despite recent reviews in multiple countries [16,18,19,20,21] this review aims to synthesise and map the current literature on paediatric patients undergoing dialysis, addressing the significant challenges they face in terms of physical, emotional, and social well-being, specifically in African countries, which are not well represented in the above reviews. Given the vital role of exercise in improving the quality of life for both adults and children with kidney disease, there is a need to systematically examine the existing literature on exercise programs specifically designed for children undergoing dialysis. The review aims to map evidence regarding the types, benefits, and barriers of such interventions, providing clinicians and healthcare providers with insights to inform practice. By identifying gaps in the current literature and consolidating evidence, the review will help determine the gaps for targeted exercise programs that enhance health-related quality of life for paediatric patients undergoing renal replacement therapies, aligning clinical practice with the latest research findings. In addition, the review answers the question: What is the scope of the literature regarding the types, impact, outcomes, and barriers of exercise interventions for children on haemodialysis in Africa?

2. Methods

This scoping review, which consisted of peer-reviewed published articles, was conducted in line with the framework outlined by Arksey and O'Malley [22]. Two researchers initiated the review, assisted by the university librarian, and developed the inclusion and exclusion criteria. The literature was systematically searched and reported following the PRISMA extension for scoping reviews

(PRISMA-ScR) reporting tool [23]. The review question was formulated considering Population, Concept, and Context. This scoping review was limited to articles covering the effects of physical activities and exercise in paediatric patients undergoing HD in Africa. The review was limited to studies conducted only in Africa.

2.1. Search Strategy

The literature search was conducted between August 2024 and April 2025 after several pilot searches. The piloted searches allowed for refinement to suit the scoping review. The following databases were searched for peer-reviewed articles related to the subject: CINAHL, MedLine, EBSCO, PubMed, Scopus, and Science Direct for peer-reviewed articles related to the subject. The librarian contributed to identifying the appropriate databases, keywords, and search strings to ensure a comprehensive search. Constant communication was maintained with the librarian to ensure a smooth search process.

(Pediatric* OR Paediatric* OR Child* OR Adolescent* OR Youth OR "Young people" OR Teen* OR Juvenile*) AND (Dialysis OR Haemodialysis OR Haemodialysis OR "Peritoneal dialysis" OR "Renal replacement therapy" OR "End-stage renal disease" OR ESRD OR "Chronic kidney disease" OR CKD OR "Kidney failure") AND ("Physical exercise" OR "Exercise program*" OR "Physical activity" OR "Physical training" OR "Resistance training" OR "Aerobic exercise" OR "Strength training" OR "Therapeutic exercise" OR "Exercise intervention*" OR "Exercise therapy") AND ("Quality of life" OR QOL OR "Health-related quality of life" OR HRQOL OR "Exercise tolerance" OR "Muscle strength" OR "Physical function*" OR "Emotional well-being" OR "Psychological well-being" OR "Cognitive function*" OR Fatigue OR "Physical fitness" OR "Cardiorespiratory fitness" OR "Functional capacity")

2.2. Study Selection Criteria

This scoping review included original research articles published in peer-reviewed journals between 2015 and 2025 and written in the English language. Studies were required to involve paediatric and adolescent participants aged 0-18 years who were undergoing dialysis treatment. The research focus needed to examine physical exercise or physical activity interventions designed explicitly for dialysis patients within the paediatric population. Additionally, included studies were required to report outcomes related to quality of life, physical functioning, or other health-related measures in paediatric dialysis populations following physical activity interventions.

Studies were excluded from this review if they were review papers, meta-analyses, commentaries, dissertations, conference proceedings, abstracts, editorials, or book chapters, as only primary research data were considered appropriate for inclusion. Articles published in languages other than English were excluded due to resource limitations for translation and to maintain consistency in data extraction processes. Studies that did not focus specifically on paediatric or adolescent populations aged 0-18 years, or those that included mixed populations without separate analysis of paediatric data, were also excluded. Furthermore, studies examining aspects other than physical activities and exercises among paediatric dialysis patients did not meet the inclusion criteria. Finally, studies that failed to report on quality of life, physical functioning, or related physical health outcomes following exercise interventions were excluded from the analysis.

2.3. Screening and Selection Process

Two reviewers independently screened the titles and abstracts of the identified articles to ensure rigour and reduce potential bias. Each reviewer assessed the articles using the predefined inclusion and exclusion criteria to ensure consistency and minimise bias. Any disagreements during this process were resolved through discussion and consensus among the reviewers. To ensure the rigour and completeness of our search methodology, a librarian was consulted to form part of the final decision-making process and to verify the relevance, comprehensiveness, and accessibility of the

selected databases and search strategies. The screening and selection process was conducted, and duplicates were removed using EndNote software. Secondly, carefully screening all imported studies' titles and abstracts based on the inclusion criteria. Thirdly, the reference list of the identified articles was screened to ensure comprehensive coverage of the evidence. Full-text screening was conducted for all the identified articles (See Fig. 1 for the review screening process flow chart). The research team scrutinised this process.

2.4. Data Extraction, Analysis, and Report

A standardised data extraction sheet in Microsoft Excel was used to collate, chart, and summarise the data from studies and reports. The following basic information regarding the eligible studies was systematically extracted and tabulated to ensure consistency: authors and publication year, title of each study, country, study design, method of intervention, impact, benefits and barriers, data analysis, and key findings (See Table 1 for the basic information of the studies included in the final review).

The data extraction process was carried out systematically by two researchers who collaborated to ensure consistency and accuracy. Prior to the review, the reviewers jointly developed and finalised the data extraction table, agreeing on its contents to standardise the process (See Table 1 below for basic information on the eligible studies). Both reviewers critically assessed and validated the data extraction table. Authors extracted only the data items that align with the scoping review questions [24]. A narrative synthesis typically provides a broad overview of the existing literature, identifies vital concepts, and highlights research gaps; hence, it is best suited for this scoping review. The data analysis process was validated through multiple rounds of review by both researchers and the librarian to ensure consistency and alignment with the research objectives. Furthermore, a narrative synthesis was employed to categorise the findings [24]

3. Results

This scoping review included two original research articles, following the process of excluding articles that did not answer the research question and those that were duplicates (Figure 1). The distribution of retrieved articles' publication years, publication region, and adopted research design or methods is presented below in Table 1.

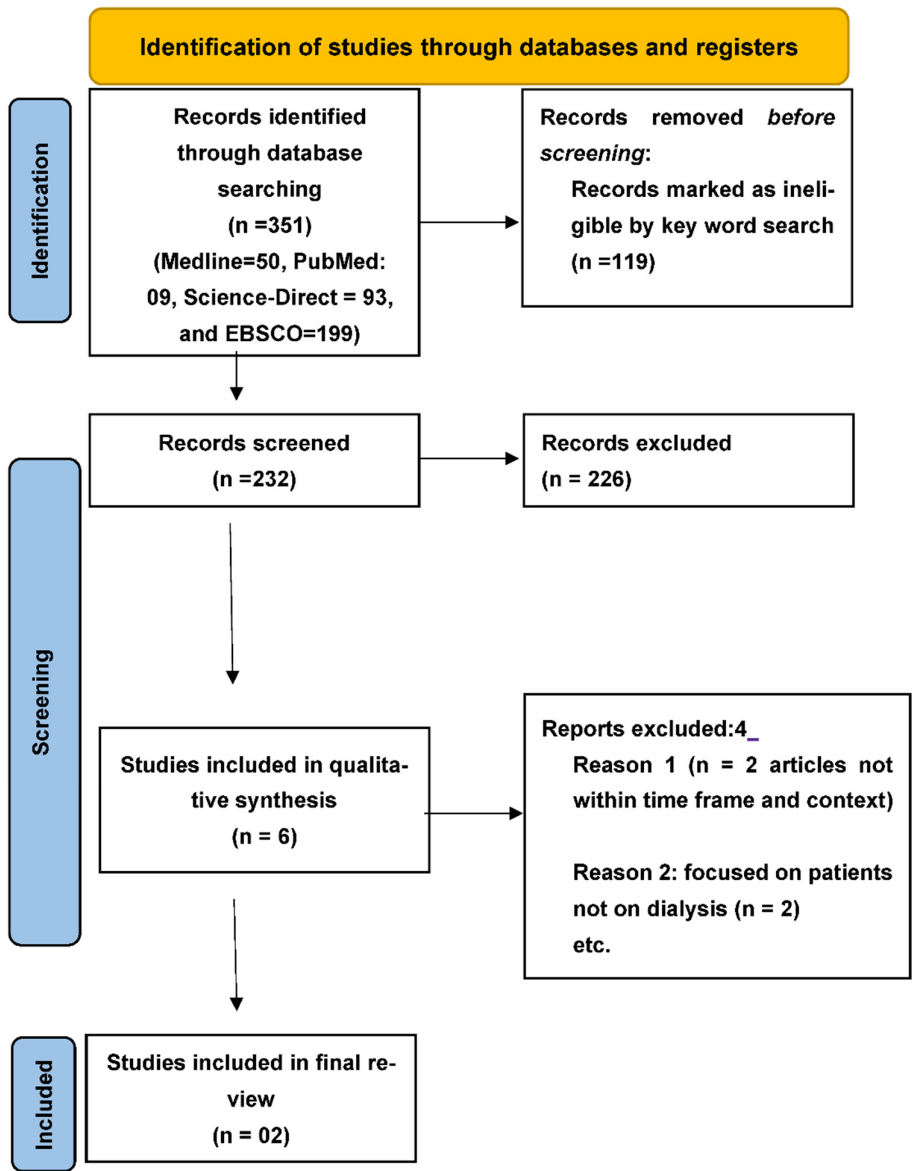


Figure 1. PRISMA ScR Flow Diagram.

3.1. Geographical Location of Studies and Duration of Intervention

In this review, both studies we examined were conducted in Egypt, highlighting a limited geographical context for our analysis. The duration of the intervention varied from three months, July to September 2022 [25] to six months, November 2020 to April 2021 [26]. One study employed a randomised control trial [25] and the other study used a quasi-experimental design [26].

3.2. Types of Interventions, Impact and Outcomes

The first study investigated the effects of muscle stretching and isometric exercises on the quality of life (QoL) of children undergoing HD [25]. The Paediatric Quality of Life scale version 4.0 (PedsQL™), translated into Arabic, was the outcome measure used to assess health-related QoL before and after the exercises. The PedsQL™ consists of 23 items divided into four domains: physical, emotional, social functioning, and school performance. Initially, there were no significant differences between the study and control groups across these domains. However, post-intervention results

showed that the study group experienced significant improvements in the total PedsQL™ score compared to the control group ($p = 0.001$), with an effect size of 0.531 indicating a moderate-to-large difference. Notable increases were observed in physical function (from 132.50 to 483.33), emotional functioning (from 141.67 to 356.67), social functioning (from 195.83 to 419.17), and school performance (from 165.0 to 389.17). After two months of intervention, 66.7% of participants reported improved QoL, compared to just 3.3% in the control group. No significant correlation was found between child age and total QoL ($p = 0.47$) [25].

The second study assessed the impact of intradialytic exercise on fatigue, psychological distress, and biochemical markers [26]. Fatigue symptoms were measured using the Paediatric Quality of Life Inventory Multidimensional Fatigue Scale (PedsQL-MFS), consisting of three subscales: sleep/rest fatigue, cognitive fatigue, and general fatigue. Psychological distress was evaluated with the Depression Anxiety and Stress Scale (DASS-21). Researchers also measured biochemical markers through blood samples for creatinine, blood urea nitrogen (BUN), sodium, calcium, potassium, and phosphorus, comparing the results monthly after dialysis.

Key findings included no significant differences in total mean scores of depression, anxiety, and stress between study and control groups before the exercise program ($p=0.856$) [26]. However, significant differences were observed after 4 and 8 weeks of intervention ($p=0.000$). The study group showed improvements in BUN, calcium, and phosphorus levels after 4 and 8 weeks, compared to the pre-intervention levels. There was a significant difference in total chemical values between groups after 4 and 8 weeks ($p=0.001$). Additionally, a positive correlation existed between fatigue scores and anxiety, depression, and stress in the study group, with a highly significant difference compared to the control group ($p < .001$) [26].

3.3. Barriers to Exercise Interventions

None of the reviewed articles indicated barriers associated with exercise interventions [25,26]. This could refer to contraindications and precautions towards exercises.

4. Discussion

This scoping review provided insight into the extent of evidence regarding the types, benefits, impact, and barriers of exercise interventions for children on haemodialysis in Africa. Two studies met the inclusion criteria and were conducted between 2022 and 2024 [25,26], demonstrating a scarcity of studies conducted among paediatric populations. This finding was unexpected considering the well-established value of physical activity and exercise. Exercise benefits patients receiving maintenance HD, improving their QoL and physical abilities [27]. A systematic review and meta-analysis demonstrated that home-based exercise interventions, lasting 3-6 months, significantly improved physical performance in patients undergoing maintenance dialysis [28].

Patients with kidney failure, whether adults or paediatric, are commonly known to be physically inactive. A study conducted in the United States of America revealed that children and young adults with CKD have very low levels of physical activity [29]. These patients were measured by a pedometer; a device tied around the waistline above each patient's hip every morning and worn throughout the day while doing usual activities [29]. An imperative benefit of pedometers is that they are user-friendly and easy to understand [30]. Furthermore, a recent narrative review emphasised the critical need for integrated and collaborative approaches to evaluating physical activity and exercise requirements in this population. The review highlighted the feasibility of incorporating physical activity monitoring into electronic patient records and stressed the importance of ongoing dialogue between healthcare providers and patients to ensure effective implementation. [30].

While no PA and exercise can be deemed more beneficial than others, it is crucial to monitor patients' physical activity daily [31]. A study conducted in Egypt among children with CKD, although not on dialysis, suggests that adopting and implementing progressive resistance exercises twice weekly and medical care regimens can significantly improve quality of life and functional capacity in paediatric patients with CKD [32]. The Global Physical Activity Questionnaire (GPAQ), an internationally

validated instrument for measuring PA, has been made available and translated into various languages worldwide. It has been validated among adults in more than 20 countries, mainly in Asia and Europe. The GPAQ verified significant reliability with time intervals of three days to two weeks [33].

Recent technological advances have emerged as methods for promoting intradialytic PA and exercise. These include using social networks for information sharing and social communication, the production of virtual reality gaming, intradialytic yoga, or electrical stimulation of muscles, and the recommendation to promote PA and exercise programs [34]. Virtual Reality gaming consists of a digital game that utilises a computer-based system. Players are engaged in a simulated portal with a 360-degree view using either a helmet-mounted display or a flat-screen televisions. They engage in real interactions within the environment while completing various crucial tasks. This format enables players to participate in physical activities while gaming [35]. Typically, virtual reality gaming is incorporated into intradialytic exercise and has been shown to be effective in enhancing physical performance and improving quality of life, thereby potentially playing a vital role in promoting adherence [36,37,38]. The use of technology may be beneficial even for paediatric patients on dialysis. A recent systematic review and meta-analysis demonstrated that home-based exercise interventions were associated with significant improvement compared to usual care intradialytic exercise interventions in patients undergoing maintenance dialysis [28].

Recommendations

To enhance the quality of life for paediatric patients undergoing HD, it is essential to develop standardised guidelines for physical exercise that cater specifically to their needs. Personalised exercise plans, created in collaboration with healthcare professionals, should be integrated into routine dialysis treatments. Educating healthcare providers and engaging families will foster a supportive environment, while the use of technology, such as mobile apps, can help monitor activity levels and motivate children to be more active. Additionally, addressing barriers to exercise, implementing multi-disciplinary approaches, and encouraging peer support groups will create a holistic framework that promotes physical activity. This comprehensive strategy aims to improve not only the physical well-being but also the emotional and social aspects of children on dialysis, particularly in underrepresented regions like Africa.

Future studies should incorporate clearly defined safety parameters, including patient selection criteria, monitoring guidelines, and response plans for exercise-related complications. Doing so will enhance clinical utility and support the development of standardised, evidence-based rehabilitation frameworks across diverse care settings.

Table 2. Articles for the final review.

Authors and Year of Publication	Title of the Study	Objective	Country	Population Sample and Size	Study Design	Exercise Intervention Method	Key Findings and Gaps Identified
1. Khalf-Allah et al. 2024	Effect of muscle stretching and isometric exercises on quality of life in children undergoing regular hemodialysis	The study aimed to investigate the effect of muscle stretching and isometric exercises on QoL of children undergoing hemodialysis.	Egypt	68 children from a total population of 87 children undergoing hemodialysis at the Pediatric Nephrology Unit in Assiut University Children's Hospital aged from 6 to 18 years old. The sample included 60 children with half split to either study group or control group by a web-based randomizer.	Randomised control trial.	A 40-minute program conducted 3 times weekly for 2 months during hemodialysis sessions. Stretching exercises (20 minutes, 2nd hour): targeted calf, hamstring, and quadriceps muscles with 10-15 repetitions to group. All domains improved significantly: physical functioning increased nearly four-fold, while emotional, chest, biceps, stomach, and hip muscles held for 3-5 seconds, 10-15 repetitions each. Safety protocols avoided body part connected to dialysis machines. Children received initial supervision from a trained researcher, progressing to independent performance under supervision with gradual repetition increases based on individual tolerance.	Children performed stretching and isometric exercises for 40 minutes, three times weekly during dialysis sessions over two months. Results showed 66.7% of exercising children achieved good quality of life compared to only 3.3% in the control group. All domains improved significantly: physical functioning increased nearly four-fold, while emotional, social, and school performance also enhanced substantially. The program benefited all age groups equally, demonstrating that structured exercise during dialysis can transform the overall well-being of pediatric patients with kidney disease. After 3 months of exercise, it was shown that most children in the study group (66.7%) had good QoL, in contrast to only 3.3% in the control group, with a highly statistically significant variation between the two examined groups pertaining to the health-related QoL scale (P value=0.001) after exercise.
2. Salama et al. 2022	Effect of Intradialytic Exercise on Fatigue, Psychological Distress, and Biochemical Findings among Hemodialysis Children	To evaluate the effectiveness of intradialytic exercise on fatigue, psychological distress, and biochemical findings among hemodialysis children.	Egypt	50 children aged 6-18 years with chronic renal disease on hemodialysis. Using a simple random sample, half were split into either control or study group.	Quasi-experimental design	A quasi-experimental design was used to conduct the study two groups (study and control group pre/ posttest) were used to achieve the study purpose. Study group: They practiced exercises for two months, three times a week, during the first two hours of haemodialysis sessions. Control group: They only received scheduled	Highly statistically significant differences were observed in children's fatigue before intervention, after four and eight weeks of intervention, compared with the control group. Highly significant difference in the total mean score of anxiety, depression, and stress after four and eight weeks of intervention between the study and control groups. Improvement in the mean score of blood urea nitrogen (BUN), calcium and phosphorus in the study group after 4 and 8 weeks of intervention compared to before intervention. The study concluded that intradialytic exercise had a positive effect on fatigue, psychological distress, and biochemical findings among hemodialysis children

5. Limitations

Despite the generally positive outcomes reported across studies, several limitations were apparent. First, the heterogeneity in intervention designs, outcome measures, and evaluation timeframes makes direct comparisons challenging. Second, both studies employed unique designs over different intervals, potentially limiting the strength of evidence. Third, the long-term sustainability of improvements was not measured, with most studies focusing on short-term outcomes. No mention was made of barriers linked to exercise interventions. This observation highlights a potential gap in addressing contraindications and precautions that should be considered when implementing these exercise programs. It's crucial to recognise that while exercise can offer numerous benefits, there may be specific circumstances or health conditions that warrant caution, emphasising the importance of individualised approaches to exercise. Lastly, both studies in this review were conducted in a single country (Egypt), for which the situation in other regions and or countries may differ.

6. Conclusions

The synthesis of findings provides a comparative analysis, revealing common trends across the studies, namely, the positive impact of various exercise interventions on reducing fatigue and psychological distress while enhancing functional capacity and QOL. In conclusion, the review summarises the key outcomes, asserting that exercise interventions can significantly benefit paediatric patients undergoing HD and those with CKD. The absence of adverse events or reported barriers could suggest that interventions were well tolerated; however, without formal documentation of screening criteria, individual risk stratification, or exclusion thresholds, it remains unclear how universally applicable these findings may be. This limits the translation of such protocols to other African contexts where comorbidities, resource constraints, and clinical supervision may differ.

7. Contribution of the Review

This scoping review contributes to physiotherapy and paediatric nephrology by examining the benefits of exercise and physical activities in HD, comprehensively analysing the existing literature on the outcomes of exercise and physical activities among paediatric patients in dialysis settings. It highlights the need for more studies on this phenomenon in various countries within the African region. Furthermore, the review paves the way for future studies that include the roles of physiotherapy, families or caregivers, and support of other multidisciplinary team members in promoting exercises and physical activities in paediatric patients undergoing HD.

Author Contributions: MMS, the first author, was responsible for the conceptualisation and design of this review. SAN and MMS searched and gathered the data together. SAN initiated the first draft, and MMS also gathered data for the study, conducted data analysis, and reviewed and provided constructive feedback. Both authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors have no conflicts of interest to declare for this paper.

Abbreviations

The following abbreviations are used in this manuscript:

CKD	Chronic Kidney Disease
KF	Kidney Failure
RRT	Renal Replacement Therapy
eGFR	Estimated Glomerular Filtration Rate
PD	Peritoneal Dialysis
HD	Haemodialysis
QoL	Quality of Life
PA	Physical Activity

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