Effect of Mobile Based Health- Education on Quality of Life among Children with Chronic Kidney Diseases during COVID-19 Pandemic

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Abstract

Background: Chronic kidney disease (CKD) is one of the major health problems affecting children morbidity and mortality. Quality of life (QOL) has become a field of extensive research involving children, so the use of mobile based education for those children is very important to improve their health and QOL. **This study aimed** to evaluate the effect of mobile based health - education on the quality of life among children with chronic kidney diseases during COVID-19 Pandemic. **Design:** A quasi-experimental design (pre/post-test) was utilized. **Sample**: A purposive sample of 50 children suffering from chronic kidney diseases was selected. **Setting:** The study was conducted in the Pediatric Nephrology and Dialysis Unit and Outpatient clinic of pediatric nephrology at Mansoura University Hospital. **Tools:** Tool (I) Interviewing questionnaire which included two parts (1) demographic characteristics of children with chronic kidney diseases (2) children' knowledge questionnaire regarding chronic kidney diseases, and Tool (II) The Arabic Pediatric Quality of Life Inventory (PedsQL) is used to assess the children's quality of life (PedsQL) 4.0 Generic Core Scales (GCS). **Results:** The present study revealed that the mean age of children is 10.9 ± 2.1 years, there was a highly statistically significant difference in improvement in children's knowledge after using mobile based health education intervention in all tested areas. There was a statistically significant difference in the children's quality of life domain, knowledge regarding chronic kidney diseases post-intervention compared to pre-intervention. There is a statistical significance relation concerning levels of quality of life, and the demographic data of children with CKD $p \leq 0.05$. **Conclusion:** Mobile based health education had a positive effect on improving the quality of life of children with CKD. **Recommendations**: Mobile based health education can be integrated to home care and follow up for children with CKD at the health care settings.

Keywords: Children with chronic kidney diseases, Mobile based health education, Quality of life

Introduction

Chronic Kidney Disease (CKD) is defined as the presence of kidney damage, either structural or functional, or a decrease in glomerular filtration rate (GFR) of less than 60 mL/min/1.73 m2 of body surface area for more than 3 months **(Kidney Disease: Improving Global Outcomes, 2018).** Also CKD refers to a state of irreversible kidney damage and/or reduction of kidney function that is associated with a progressive loss of kidney function over time and associated with decrease in GFR, persistent elevation of urinary protein excretion, or both **(Romagnani et al., 2017).**

Children with CKD are suffering from cardiovascular comorbidity as hypertension **(Ali, et al., 2019).** In addition, there were significantly shorter with urinary protein-creatinine ratio, hypoalbuminemia, elevated blood pressure, dyslipidemia and anemia among children with CKD **(Wardly et al., 2015).** CKD complications such as anemia, metabolic acidosis and secondary hyperparathyroidism affect cardiovascular health and quality of life which require diagnosis and treatment **(Romagnani et al., 2017).**

Because of the global spread of Coronavirus disease 2019 (COVID-19), children make up 1-5% of all patients (**Dong et al., 2020**). Children with CKD at a higher risk of severe clinical manifestations of COVID-19 (**Dong & Bouey, 2020**). They require

maintenance hemodialysis (HD) and are at risk of infection because they are malnourished and has low immunity. The analysis of confirmed COVID-19 cases reported to the Centers for Disease Control revealed that children with CKD were 11 to 14 times more likely to require hospitalization and intensive care than those without CKD (**Ministry of Health and Family Welfare, 2020**).

Children with CKD require complex medication schedules, dietary restrictions, and invasive procedures such as three times weekly hemodialysis or daily nocturnal peritoneal dialysis **(Baiomy, Mohamed, Arab & Abd-Elmonem, 2019)**. Support and information are required to help these children cope with the difficulties they face throughout all stages of CKD. Unfortunately, interventions to help these children cope with the day-to-day consequences are lacking. Online support programs described the need for continuously available, accessible, and dependable support for children with CKD (**Swallow et al., 2014**). Evaluating the outcomes of nursing care practices extends beyond clinical disease indicators to the children's perception of their health condition and treatment. That is why the concept of assessing the quality of life (QOL) and health-related quality of life (HRQOL) has been raised **(Bullinger & Quitmann, 2014).**

A mobile health nursing intervention is defined as "the use of electronic information and communication by technologies to support and promote long-distance clinical healthcare, between children, parents and professional health care team in the community and pediatric clinical setting (**International Telecommunication Union, 2015**). A mobile health nursing intervention may be effective and beneficial. The nursing intervention may promote a dependable, time-saving, and cost-effective approach to provide quality healthcare at the primary care level. This has been defined as the delivery, management, and coordination of care and services via information and telecommunications technologies. In addition this technology enables faster access to better services, lowers costs and facilitates easy access to the most appropriate specialized skills, and improves the quality of health-care delivery to children with CKD (**Swallow et al., 2014**).

The **World Health Organization (WHO), (2020**) defines QOL as an individual's perception of their place in life in relation to the culture and value systems, in which they live, as well as their goals, expectations, standards, and concerns. QOL is now recognized as a multidimensional construct encompassing both subjective and objective measures**.** Measuring HRQOL is regarded as an important outcome indicator in evaluating healthcare interventions and treatments, as well as in understanding disease burden; it is also useful in identifying health inequalities, allocating health resources, and in epidemiological studies and health surveys. In clinical practice, QOL instruments have been suggested to be useful in identifying and prioritizing health problems for children, as well as identifying unexpected health problems. Measurement of quality of life became more important in health care as medical treatment became capable of extending life at the expense of quality of life or improving quality of life without extending life (**Solans et al., 2018**).

Developing new strategies for children with CKD access via mobile to improve care quality is critical. Smartphones and mobile technologies have the potential to promote child care. However, mobile phone providers clearly provide preferential treatment, and the extent of evidence is unknown (**Rodig et al., 2018**). Mobile apps provide concise information, allow for personalization, remembering, privacy, broke down barriers during sessions, and provide discretion for activities (**Kenny et al., 2015**). These mobile apps are aimed at symptom assessment, education, and promoting engagement in care, as well as skill practice learned during therapy and symptom monitoring (**Anthes, 2016**). The benefits of mobile health education include constant accessibility, equity of health resources, immediate support, anonymity, tailored content, lower costs, and increasing service capacity and efficiency **(Bakker et al., 2016).**

Nurses must conduct a structured interview with children and their caregivers at each dialysis visit, inquiring about a history of fever, cough, respiratory difficulty, and exposure to a COVID-19. Children should be

advised to use seats in the waiting area that are at least one meter apart. Children should be accompanied by only one attendant, who should also wear a facemask, to avoid overcrowding. Dialysis beds should be separated by at least 2 meters during dialysis and disinfection. Before beginning dialysis, children should be instructed to wash their hands and fistula arm. Puncture sites should be cleaned and disinfected as needed. When handling infected children' laundry, use disposable gloves **(Ibrahim , Ouda & Ismail, 2019).**

To reduce the possibility of cross-contamination, dirty laundry should not be shaken through the air. Bed linen should be changed between shifts and used linen placed in dedicated containers. Disposable gowns must be discarded after use**.** Encourage the use of separate equipment, such as stethoscopes, thermometers, saturation probes, and blood pressure cuffs, and ensure that it is cleaned and disinfected between shifts. Alcohol-based solutions are used to disinfect stethoscopes. Unless absolutely necessary, dialysis personnel should not touch the patient or use stethoscopes **(Ministry of Health and Family Welfare Directorate General of Health Services, 2020).**

Community health nurse and Pediatric nurse play a key role in the care of children with CKD and are considered as the basis of maintaining and promoting their health. Aim of nursing care is to increase control on their health and leads to positive results. It seems that nurses have the most important performances in health promotion for CKD management which requires new considerations. The pediatric nurse plays an important role in management of child undergoing hemodialysis therapy (**Swallow et al., 2014**). Concerning primary level of prevention, nurse should emphasize on improving quality of life among school age children and adolescents. It's important to practice exercise every day, eat healthy diet, get appropriate night's sleep and keep environment healthy. Early detection and management is very important as early as possible through frequent health education regarding early signs and symptoms of CKD. Nurses should provide support to children and their families in different community settings for caregivers in family health centers, school age children in schools and encouraging regular checkups as a main activity in secondary prevention. **(Stanhope & Lancaster, 2018).**

Significance of the study:

Chronic kidney disease (CKD) is the major health problem worldwide. The prevalence of CKD ranging from 15 to 74.7 per million children, 60% of affected children were males with median age 12 years old **(Furth et al., 2018)**. The prevalence ranges between 6% and 18.7% (**Yousefichaijan et al., 2016**). Sixty-four percent had congenital anomalies of the kidney and urinary tract; 26.1% of children had uncontrolled hypertension and the prevalence increased from 24.4% in CKD early stage to 47.4% in CKD late stage **(Schaefer et al., 2017).** In a developing country like Egypt, with insufficient resources and low-quality primary health care, end-stage renal disease (ESRD) is possibly the tip of the iceberg, where children are diagnosed with the renal disease after they have reached renal failure. The exact incidence and prevalence of CKD in children in Egypt is unknown due to absence of a national registry. Hemodialysis is the most common method used to treat the advanced and permanent kidney failure **(Ibrahim, Ouda & Ismail, 2019).**

It is critical to provide health education about the care provided by health professionals in order to improve the lack of knowledge and understanding of the necessary skills to follow. Also, when used as a source of health information, the Internet can benefit health care and promote care. This can be useful for children with CKD as a way of obtaining health information **(Swallow et al., 2014).** According to estimates, 40% of the world's population uses the Internet. Rapid growth in smartphone use has fueled access, with 95% of the world's population living in areas covered by mobile phone networks **(International Telecommunication Union, 2015).** The main interest was for more specific information about diseases. In children, 58% of the population aged 10 years and over had access to the Internet and 41% sought health

information **(Brazilian Internet Steering Committee, 2016).**

Advances in technology, such as the use of mobile in medical care for children with CKD who have a high chance of survival improve QOL as it help children with chronic kidney disease better manage their disease and related conditions, and 85% to 90% of patients have access to mobile health technology. Mobile based education has a significant impact on both mortality and CKD children's quality of life. Children with CKD are more likely to experience delays in neurocognitive development and a lower quality of life. Health-related quality of life (HRQoL) has recently been recognized as a predictor of treatment success in children with chronic diseases, and it is recommended that HRQoL measurement be included in clinical trials. It is critical to assess CKD children' quality of life (**WHO, 2020**).

An Egyptian study by **El Shafei, Hegazy, Fadel and Nagy (2018)** in Abou Elrish pediatric hospital found that there is a statistically significant difference between end stage renal disease (ESRD) children and controls regarding all aspects of QOL; total QOL mean score was 58.4 ± 15.3 and 86.8 ± 10 among cases and controls, respectively. All individual QOL domains were significantly worse in ESRD cases. Nurses as health professionals actively participate in identifying needs and initiating action to develop programs which promote the health of children. Nurse plays a crucial role in assessing, planning, developing, organizing, and applying health education programs for preserving a high level of knowledge and supportive practices toward children with CKD **(WHO, 2017).**

The current study will help pediatric and community health nurses to improve their practices in outpatients' clinics and family health centers concerning safety measures and nursing management for those children with CKD through assessment of risks, factors, surrounding environment and demonstrate proper nursing care and providing health education sessions for children and their caregivers. In addition, the current study will add to the bulk of nursing research regarding CKD among children and quality of life. So, the point of view of the researchers from this study there is important aim to evaluate the effectiveness of using mobile health- education and the QoL of children with CKD.

Aim of the study

The study aimed to evaluate the effect of using mobile based health - education on the quality of life among children with chronic kidney diseases during COVID-19 Pandemic through:

1- Assessing children's knowledge level regarding chronic kidney diseases after mobile based health education.

2- Implementing and evaluating the effectiveness of mobile based health education on the quality of life of children regarding chronic kidney diseases.

Research Hypotheses:

H1- Children who are subjected to mobile based health education will have satisfactory knowledge regarding chronic kidney diseases post-intervention than pre-intervention.

H2- Children who will receive mobile based health education regarding chronic kidney diseases their quality of life will be improved post-intervention than pre-intervention.

Subject and Methods:

Research design:

A quasi-experimental research design (one group pre/post - test) was used to evaluate the effect of using mobile based health - education on the quality of life among children with chronic kidney diseases during the COVID-19 pandemic.

Setting:

The study was conducted in the Pediatric Nephrology and Dialysis Unit and the Outpatient clinic of pediatric nephrology at Mansoura University Hospital. These settings were selected because of the high prevalence of children with CKD in selected settings and also, serve the biggest region of the population from both rural and urban areas.

Subjects and Sampling:

A purposive sample of 50 children was recruited from the previously mentioned settings within 3 months from April 2020 to June 2020. The subjects were used as pre intervention and post intervention group (the same group used as a control and study group).

Inclusion criteria: The inclusion criteria in the studied children were as follows:

1. Children who were educated.
2. Aged from 10-<18 years old.
3. Had mobile smart and internet access.

Exclusion criteria: The exclusion criteria in the studied children were as follows:

1. Critically ill children with unstable physiological parameters.
2. Children who have cognitive or behavioral abnormalities that may interfere with children communication with the researchers.

Tools for data collection: Data were collected using the following tools (pre/post) as follows:

Tool (I):-Interviewing questionnaire for children with chronic kidney diseases developed by the researchers through reviewing related literature **(WHO, 2020; Bryan et al., 2018; Rodig et al., 2018; Solans et al., 2018)**, it was written in the Arabic language and included the following parts:

First part: Demographic characteristics of children such as age, sex, educational level, residence, diagnosis, duration, stage, and etiology of CKD, child's past medical history of other disease and family history of renal disease.

Second part: Children's knowledge questionnaire regarding CKD: (pre-post tool)**:** it was designed by the researchers to identify the level of children's knowledge regarding CKD, it contained 20 questions. Each question was answered by the children either true or false. It included: questions related to children knowledge about CKD; the meaning, causes, the common age of CKD occurrence, the manifestation and effect of CKD on the child, diagnosis, duration of treatment, needs of the child, nursing care to (diet, sleeping, hydration and activity) medical treatment approaches, side effects of drugs, that was introduced to children through the mobile based education.

The scoring system of Children's knowledge questionnaire regarding CKD was (0) if the answer is false and (1) if the answer is true with a total grade of 20. The level of knowledge was determined as good (≥70%), average (<70% - >50 %), and poor level (≤50%).

Tool (II): The Arabic PedsQL Inventory is used to assess the children's quality of life (PedsQL) 4.0 Generic Core Scales (GCS): Assessment of health-related quality of life (HRQoL) using the Arabic version of the PedsQL™ Pediatric qualifies of life inventory (PedsQL) 4.0 Generic Core Scales (GCS). It is a 23- item questionnaire that includes: Physical subscale (8 items), an Emotional subscale (5 items), a Social subscale (5 items), and a School subscale (5 items).

Scoring System for Assessing Quality of Life: point Likert scale from 0 (never) to 4 (almost always). The answer of the PedsQL asks the children to rate each item using a 5-point rating scale ranging from never' to almost always' as follows: 0 → never a problem, 1 → rarely a problem, 2 → sometimes a problem, 3 → often a problem, 4 → almost always a problem. The instructions ask how much of a problem each item has been during the past month after that, reverse scoring for each subscale from 0–100 scale was done as follows: 0=100, 1=75, 2=50, 3=25, 4=0, so that higher scores indicate a better HRQoL. The total QoL level was classified as the following Low QoL (score from 24-44), Average QoL (score from 45-69) and High QoL (70 to ≤92).

The PedsQL™ yields 3 summary scores: Psychosocial score = sum of the items over the number of items answered in the emotional, social, and school subscales. Physical score = physical subscale score. Total score: sum of all the items over the number of items answered on all the scales (**James et al., 2015).**

The PedsQL child self-reports for ages 8–18 years were used. The Arabic version of the PedsQL™ has proved to be understandable and feasible to use. It has demonstrated good reliability for both healthy and children with chronic illnesses. It also showed good construct

validity, making it suitable for research and clinical use in Egypt. Cronbach's α internal consistency values for the total and subscale scores exceeded 0.70. Test-retest reliability was high (reliability coefficient exceeded 0.9) **(El-Beh, et al., 2018).**

Validity of the tools:

The face and content validity of the tools for clarity, comprehensiveness, appropriateness, and relevance were tested by a board of five experts in pediatric nursing and community health nursing; the board ascertained the face and content validity of the tools.

Reliability of the tools:

Reliability was assessed through Cronbach's alpha reliability test α= 92% in the first tool and the second tool's reliability was 0.89.

Ethical considerations:

Approval was obtained from the Mansoura Faculty of Nursing Research Ethics Committee to conduct this study. Before beginning the questionnaire, the researchers informed the participants that their participation in the study was entirely voluntary and that they could withdraw at any time and their care is not affected. They were also assured that their information would be kept private and would only be used for research purposes. To gain the cooperation of children and their parents, written consent was obtained.

Administrative Design:

The manager of the Pediatric Nephrology and Dialysis Unit and Pediatric Nephrology Outpatient Clinic at Mansoura University Hospital obtained an official letter of approval from the Dean of the Faculty of Nursing to conduct this study. This letter explained the study's purpose and significance. The manager of the Pediatric Nephrology and Dialysis Unit and the Outpatient Clinic of Pediatric Nephrology at Mansoura University Hospital then gave his approval.

Pilot study:

A pilot study was including 10% (5 children with chronic kidney diseases) of the total sample size (n=50). The pilot was carried out to assess the feasibility of the study, as well as the clarity, objectivity and applicability of tools and the time needed to complete it, there were no needed modifications in the tools, and the pilot study sample were included in the study.

Operational Design:

This design included a description of the preparatory phase, pilot study, and implementation phase including fieldwork, methods, and procedures of the study, design, and implementation of the mobile health education and evaluation phase.

Preparatory phase:

The mobile based health – education was designed in the Arabic language after reviewing the related past, and current Arabic and English literature covering various aspects of the problem, using available books, articles, and magazines to get acquainted with the research problem for children with chronic kidney diseases and develop the content, the necessary modifications were carried out by the researchers and the final form of the health education was started after developing the study tools and content of the guiding hand out to implement the health education intervention through mobile phone Whats App. Mobile-based health education was designed according to the actual needs assessment of the CKD children. The researchers prepared mobile based health – education material (booklet) after reviewing related literature regarding CKD and gave it to all children in simple Arabic language. Also, the researchers prepared mobile conversations and messages after reviewing evidence-based research and comprehensive literature about CKD.

Designed mobile based health - education booklet about CKD in children:

The booklet was designed by the researchers and written in Arabic language, this booklet contained illustrative colored pictures and the main points of each training session **(WHO, 2020**; **Rodig et al., 2018; and Ministry of Health and Family Welfare, 2020).**

Aim of the booklet: The general goal is to equip children with knowledge regarding CKD.

Specific objectives:

- To improve the studied children's knowledge regarding CKD.
- To improve the studied children's quality of life.

The contents of the mobile health education:

Chronic kidney disease (CKD): (Introduction, definition, types, signs and symptoms, predisposing factors, measuring blood pressure and preventing complications, Diet management (recommended and un recommended diet), knowledge about dialysis, knowledge is related to therapy (importance, types, sites, routes, preparation, storage, and complications), problems that face those children, physical exercise (importance, precautions, types, and technique of suitable exercise), personal hygienic care (importance, oral care, and skincare), importance of control CKD and follow-up, Preventive measures during COVID-19 such as the right way of handwashing, how to wear and remove facemask correctly, and taking a temperature with an oral thermometer).

Fieldwork:

The study was carried out from the first of April 2020 to the end of June 2020 at Pediatric Nephrology and Dialysis Unit and Outpatient Clinic of Pediatric Nephrology at Mansoura University Hospital in Egypt. The researchers first introduced themselves and explain the objectives of mobile based health education to the children who agreed to be included in this study to gain their trust, cooperation, and confidence. All the studied children were subjected to routine care in the study setting and then the content of health education intervention through the mobile phone was prepared in the light of the actual need assessment of the children. Before applying the mobile based education the children involved in the study were interviewed two times per week from 9:00 am to 11:00 am to collect data using the study tools. The average time spent on children's completion of the questionnaires was approximately 30 minutes.

The second part in first tool and second tool were used twice. For the first time, these were used as a pretest for the assessment of children's knowledge about CKD and their quality of life. Then, these tools were used as a post- test immediately after finishing the educational implementation to evaluate the effect of mobile based education on quality of life among children with CKD during COVID-19.

The implementation phase:

Stated and implemented the general and specific objective of mobile health – education to meet the assessment needs of the study children. The researchers wore personal protective equipment; gloves and facemask and follow COVID-19 precautions when contacting with children before starting the mobile based education. All telephone numbers of participating children were collected and participated in the Whats App group on mobile for all studied children. All children received mobile-based health education using the mobile phone and using simple Arabic language different illustrated posters to facilitate concentration and understanding of studied children. Videos and mobile were used to demonstrate the management and health education for children with CKD. SMS were sent weekly to the children to refresh their knowledge about CKD control by mobile phone. Chatting with the children was every two days to answer any questions they need. Also, using mobile and audio sessions placed on mobile and telephone calls were applied to discuss any issue about CKD care. During mobile massages, researchers allowed children to ask any questions they want. Mobile based health education implementation was performed for 8 weeks.

All children with CKD will receive nine sessions of mobile based health education: ***The first session*** (30 minutes) concentrated on mobile based health education knowledge (definition, types, and importance to the control of CKD conditions). ***The second session*** (30 minutes) concentrated on CKD knowledge (predisposing factors, clinical manifestations, measure of blood pressure, complications, and management). ***The third session*** (45 minutes) concentrated on diet management knowledge for children with CKD (recommended and unrecommended diet and the relation between diet and CKD control). ***The fourth session*** (30

minutes) concentrated on dialysis knowledge (types, causes, procedures, management, and prevention of complications). ***The fifth session*** (30 minutes) concentrated on therapy-related knowledge (importance, types, sites, routes, preparation, storage, and complications). **The sixth session** (30 minutes) focused on issues that children with CKD face. ***The seventh*** (30-minute) session was all about physical activity (importance, precautions, types, and technique of suitable exercise). ***The eighth session*** (30 minutes) concentrated on personal hygiene (importance, oral care, and skin care). ***The ninth*** (30-minute) session focused on the significance of CKD control and follow-up.

The evaluation phase:

This phase is considered the second phase of assessment that was done immediately after finishing the mobile based health - education implementation to evaluate evaluated the effect of using mobile based health - education on the quality of life in children with chronic kidney diseases, each child was reassessed by using the same tools of pre intervention and comparison was done to determine the effect of the health - education implementation. The same group was used as a post test (study group).

Statistical Analysis:

The Statistical Program for Social Science (SPSS) version 20.0 was used to analyze the statistical design data. The mean and standard deviation of quantitative data were used (SD). The frequency and percentage of qualitative data were used. The following tests were carried out: To compare proportions between two qualitative parameters, the Chi-square ($\mathbf{X^2}$) test of significance was used. The confidence interval was set to 95%, and the acceptable margin of error was set to 5%. As a result, the p-value was deemed significant as follows: P-values of $\leq$0.05 were considered significant, P-values of $\leq$0.01 were considered highly significant, and P-values of >0.05 were considered insignificant.

Results:

Table (1) shows that the mean age of studied children was 10.9 ± 2.1years old, near two-thirds (63.2%) were males. Most of the studied children (84%) were from rural.

Figure (1) demonstrates that more than half (56%) of studied children were at the primary level, while ten percent (10%) of them were at the secondary level of education.

Table (2) highlights that most (79%) of the studied children had no past medical history of other disease and 21% had a past medical history, three quarter (76%) were had a negative family history of renal disorders. More than one thirds (35%) of them were the duration of illness was less than 1 year. Additionally, more than two-thirds (67%) of studied children was nephrotic syndrome the etiology of CKD, and only 4.0% of them had multisystem conditions were the etiology of CKD.

Figure (2): Illustrates that less than two-thirds (65%) of the studied children were at the first stage of the disease and 29% at the fifth stage (ESRD).

It was observed from t**able (3)** that 67% of children had a poor level of knowledge regarding CKD pre mobile health education implementation as compared to 4% post mobile health education implementation, While, 90% of them had a good level of knowledge post intervention as compared to 4% pre intervention and there was a statistical significant difference regarding to the total knowledge of studied children pre and post mobile health education ($P<0.05$).

Table (4) represents that the mean scores of all quality of life domains of children with CKD in physical, emotional, social, and school domains (64.7 ± 16, 75.9 ± 17.1, 84 ± 9.1, and 57 ± 14.7 respectively) were a high rate of quality of life post-implementation of the mobile health education, compared to pre-mobile health education (56.5 ± 18.5, 64.2 ± 24.5, 61.6 ± 29.4, 46.1 ± 24.3 respectively). Also, it showed that there was an improvement in the total QoL means scores post-implementation (76.8 ± 10.1), while was (57.4 ± 15.3) at pre-mobile health education. A highly statistically significant difference was found between total mean scores of all quality

of life domains pre-and post- mobile health education implementation with a p-value (≤0.01).

Figure (3) shows that half (50%) of children with CKD had average QOL post implementing the mobile health education, and 26% of them had low QOL post implementing the mobile health education compared to more than two-thirds (69%) pre-mobile health education.

Table (5) illustrates that there was an improvement in the total QoL means scores post-implementation (76.8 ± 10.1), while was (57.4 ± 15.3) at pre-mobile health education. Statistically, a highly significant difference was found between total mean scores of all quality of life domains pre-and post- mobile health education implementation of the p-value (≤0.01).

Table (6) portrays the relation between levels of quality of life of children with CKD, regarding their demographic characteristics. This result found that there was a statistically significant relationship between the quality of life level and sex with a p-value (≤0.05), and highly significance relations between levels of quality of life with age, residence and educational level, with a p-value (≤0.01).

Table (1): Distribution of children with CKD according to their demographic characteristics (n=50).

Items	CKD children	
	No.	%
Age (years)		
• 10- < 14	37	74.4
• 14- <18	13	25.6
Mean± SD	**10.9 ± 2.1years**	
Gender		
• Males	32	63.2
• Female	18	36.8
Residence		
• Rural	42	84.0
• Urban	8	16.0

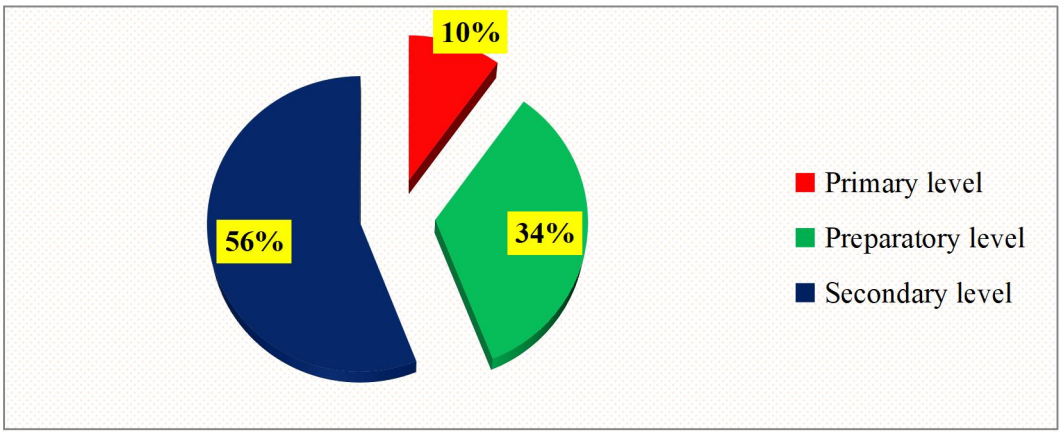

Figure (1): Distribution of children with CKD according to their educational level (n=50).

Table (2): Distribution of CKD children according to their medical history (n=50).

Items	CKD children	
	No.	%
Past medical history of other diseases		
• Yes	10	21.0
• No	40	79.0
Family history of CKD:		
• Negative	38	76.0
• Positive	12	24.0
Diagnosis		
• Minimal change in nephrotic syndrome	8	17.0
• Steroid dependent	16	33.0
• Steroid resistance nephrotic syndrome	8	15.0
• Chronic renal failure (CRF) (not on dialysis)	3	6.0
• End-Stage Renal Disease (ESRD) (on regular dialysis)	15	29
Duration of CKD disease		
• Less than 1 year	18	35.0
• 1 - < 2 years	7	14.0
• 2 - < 3 years	10	21.0
• 3 years and more	15	30.0
Etiology of CKD		
• Congenital abnormalities and hereditary conditions	10	20.0
• Nephrotic syndrome	33	67.0
• Multisystem conditions	2	4.0
• Unknown	5	9.0

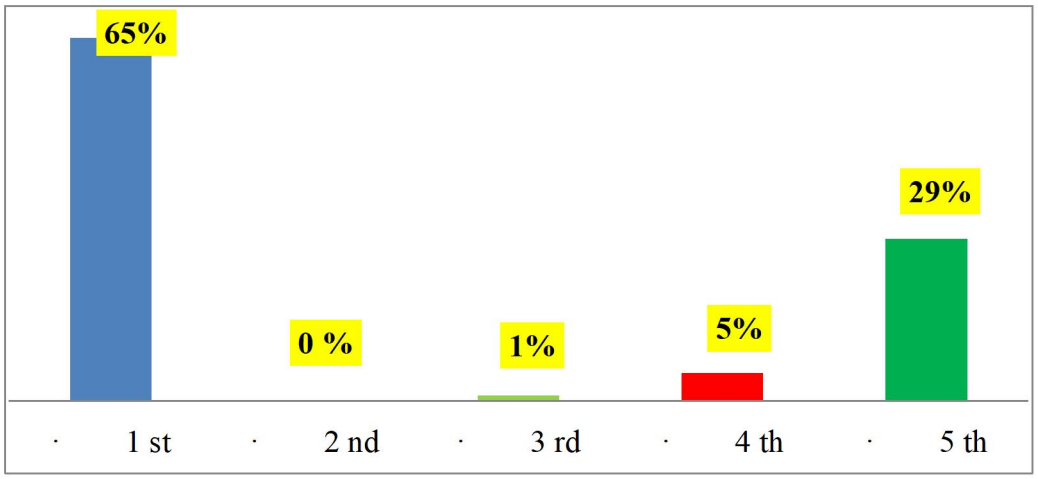

Figure (2): Distribution of children with CKD according to their stages of CKD disease (n=50).

Table (3): Effect of the mobile health education implementation on the total score of knowledge of studied children with CKD (no =50).

Total knowledge of children	Children's total scores of knowledge				X^2	p-value
	Pre-mobile health education		Post-mobile health education			
	No.	%	No.	%		
Poor level (≤ 50%)	33	67	2	4	90.35	<0.05*
Average (>50% - <70%)	15	29	3	6		
Good (≥ 70%)	2	4	45	90		
Mean ±SD	**11.9±6.7**		**31.6±8. 2**			

*Significance at ≤0.05 levels

Table (4): Child means scores of QoL domains pre and post-mobile health education implementation (n=50).

Domains of QoL	Pre-mobile health education implementation	Post-mobile health education implementation
-Physical QoL mean score	56.5 ± 18.5	64.7 ± 16.6
-Emotional QoL mean score	64.2 ± 24.5	75.9 ± 17.1
-Social QoL mean score	61.6 ± 29.4	84 ± 9.1
-School QoL mean score	46.1 ± 24.3	57 ± 14.7
-Total QoL mean score	57.4 ± 15.3	76.8 ± 10.1
Value	**<0.001****	

**Highly significance at ≤0.01 levels

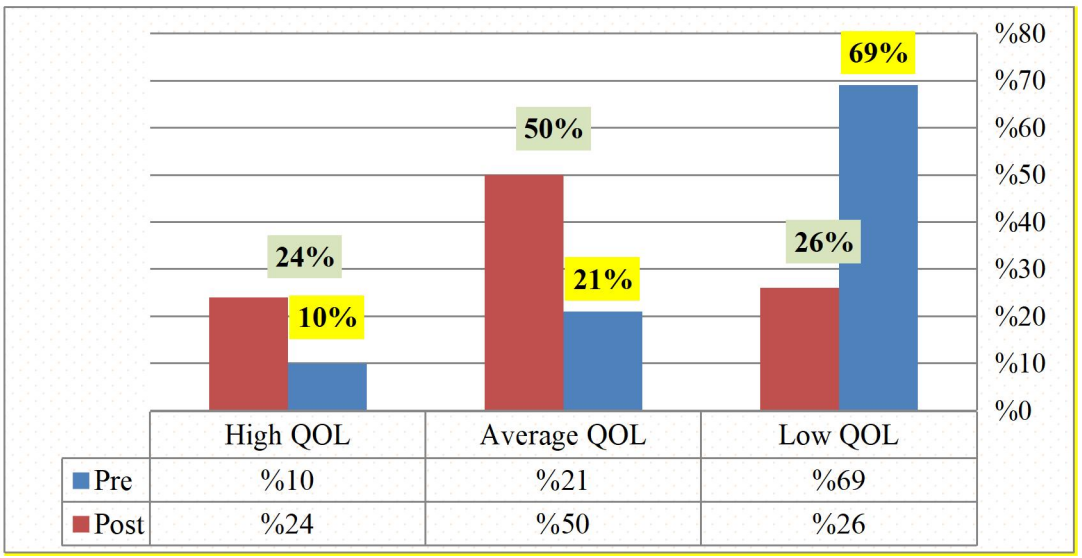

Figure (3): Distribution of children with CKD according to their level of quality of life (pre and post- mobile health education implementation) (n=50).

Table (5): Mean and standard of deviation of the total score of quality of life pre and post-mobile health education implementation) (n=50).

Studied variable	Pre-mobile health education (N=50)	Post mobile health education (N=50)	Paired t-test	P-value
	Mean ±SD	Mean ±SD		
Quality of life domains	57.4 ± 15.3	76.8 ± 10.1	**12.987**	**0.001****

A highly significance at ≤0.01levels

Table (6): Relation between total QoL levels among children with CKD and their demographic characteristics (n=50).

Demographic characteristics	levels of total quality of life							
	Low QoL (24-44) (n=13) (26%)		Average QoL (45-69) (n=33) (66%)		High QoL (70≤92) (n=4) (8%)		Chi-square test	
	No.	%	No.	%	No.	%	X^2	p-value
Age (years)								
• 6- < 10	3	23.0	8	24.0	1	25.0	18.085	0.004**
• 10- < 14	8	60.0	18	56.0	2	75.0		
• 14- 18	2	17.0	7	20.0	1	25.0		
Sex								
• Male	9	68.0	21	65.0	1	25.0	6.638	0.033*
• Female	4	32.0	12	35.0	3	75.0		
Educational level								
• Primary level	8	60.0	18	54.0	1	25.0	25.436	0.001**
• Preparatory level	3	23.0	11	33.0	2	50.0		
• Secondary level	2	17.0	4	13.0	1	25.0		
Residence								
• Urban	4	32.0	7	20.0	2	50.0	10.103	0.006**
• Rural	9	68.0	26	80.0	2	50.0		

*Significance at ≤0.05 levels
**highly significance at ≤0.01 levels

Discussion:

The Internet has become a more important source of CKD information in recent years. Physicians, nurses, and other health professionals must be aware of, understand, and apply their knowledge and experience to evaluate the underlying evidence. Sharing status information with physicians and nurses, as well as conducting Internet searches, is related to children's health (**Ericsson, 2016**). As a result, mobile health education provides a particularly powerful and pervasive platform for delivering health interventions to children. Mobile health education makes use of the functions of a mobile device, but it is most commonly supported by the download of mobile apps **(Ofcom, 2017).** So the study aimed to evaluate the effect of using mobile health education to improve the quality of life among children with chronic kidney diseases.

According to the current study, the average age of the children studied 10.9 ± 2.1years. These findings are consistent with **Hooper et al., (2011**), who studied the Neurocognitive functioning of children and adolescents with mild-to-moderate chronic kidney disease and found in their study that children were 10- 13 years old, and also with the results of the current study, which were done on 15 children with end-stage renal disease (ESRD) on regular hemodialysis and These findings contradict those of **Mohamed (2018**), who conducted a study on "Self-Care for School-Age Children with Nephrotic Syndrome in Assiut University Hospital" in which sociodemographic data showed that the highest percent of school-

age children with nephrotic syndrome were 8 years.

In the current study findings, nearly two-thirds of children with CKD were males. This finding is similar to those of **Ragab M and Ragab A, (2017)** in Mansoura Children University hospital who studied "Assessment of lipid profile in Egyptian children with chronic kidney diseases on conservative therapy and those under regular dialysis" and reported that about one-third of children were females and more than two-thirds of them were males. Also, **Mohamed, (2018)** found that more than half of the participants were males.

Also, the finding of the present study showed that regarding the residents of children with CKD it was observed that more than three-quarters of them were from rural. This observation may be explained by that rural family are often from low socioeconomic levels, which in turn seek medical advice in the local unequipped health units or may delay seeking medical advice. This result is in agreement with a study conducted by **Mohamed, (2018)**, and found that 5% were living in urban and 95% were living in rural areas.

The finding of the present study revealed that more than two-thirds of studied children were nephrotic syndrome the etiology of CKD and only one ten percent of them had multisystem conditions were the etiology of CKD. This result supported that **Kamal, (2018**) studied the effect of chronic kidney diseases negatively on the physical growth and intelligence quotient of children and adolescents and reported that congenital abnormalities and hereditary conditions represent that nephrotic syndrome was the cause of CKD among a high percentage of studied subjects. On the other hand, **Ahmad et al., (2019)** in their study in Iran stated that congenital malformations and hereditary conditions were the commonest cause of CKD.

The current study's findings revealed a statistical significant difference found in improvement in the knowledge of the studied children. From the researchers' point of view, this reflected the positive impact of mobile based education intervention. The findings are similar to those of a recent study conducted by **Rana et al., (2020**) titled "Assessment of knowledge regarding chronic kidney diseases among non-medical university students in Bangladesh: a cross-sectional study," which discovered that adequate children knowledge is associated with effective disease prevention, control, and promotion.

This finding is similar to that of **Dong et al., (2020**), who investigated the "Epidemiology of COVID-19 among children in China" and discovered an improvement in knowledge among children during COVID-19 after the intervention.

The current finding showed that the mean scores of all quality of life domains of children with CKD in physical, emotional, social, and school domains were significantly higher after mobile- based health education implementation than before. From the researchers' point of view, this confirmed the effectiveness of mobile based education intervention and explained by the significance of introducing a CKD educational program via mobile. According to the researchers, this association is explained by increased knowledge about CKD, which results in an improvement in children's quality of life. According to this association, when the studied children have sufficient knowledge, they can practice well, which can improve their quality of life, in addition, using mobile accessibility reduce the children effort to reach the information at the time they need.

The findings of the present study indicated that there was an improvement in the total QoL means scores post-implementation by using mobile compared to pre-health education. A statistically significant difference was found between total mean scores of all quality of life domains pre-and post- health education implementation by using mobile. From the researchers point of view, this may be explained that the achievement of the main goals of health education by using mobile to strengthen the quality of life by reducing the side effects complications of the disease, improving health education, helping children to accept their disease, facilitating a normal lifestyle, and providing link and communication with the physician/nurse that may be helpful to alleviate their problem. Lower scores of children with CKD at pre-health education implementation could be explained by the clinical fact that those children are subjected to numerous short-term and long-term complications that alter their lives, such as

frequent hospitalization, painful procedures, school absence, and restrictions on activities that have a negative emotional impact **(Rodig et al., 2018).**

The results of the current study indicated that half of the children with CKD had average QoL post implementing the health education, and just above one quarter of them had low QoL post implementing the health education by using mobile compared to more than two-thirds pre-health education. In the researchers' opinion, it means that mobile can be used to obtain clinical self-assessments of CKD symptoms and education about care compared to using paper and pencil assessments that may reduce time spent at hospitals and improve treatment outcomes. Regarding lower scores, pre-health education implements the physical functioning score. This finding could be attributed to chronic kidney disease-mineral and bone disorder, a complication of CKD (CKD-MBD). CKD-MBD is defined as a systemic disorder of mineral and bone metabolism caused by CKD, manifested by abnormalities in calcium, phosphorus, parathyroid hormone (PTH), or vitamin D metabolism, abnormalities in bone histology, linear growth, or strength, and vascular or other soft tissue calcification, all of which have a negative impact on their quality of life **(Goldstein et al., 2016).**

Regarding lower scores of emotional and social functioning of studied children, lower psychological values in children with CKD may reflect a lack of control, social isolation, low self-esteem, perceived inability to gain independence, uncertainties about their health and future, and lifestyle restrictions caused by time-consuming and ongoing dialysis (**Tjaden et al., 2016**). Additionally, children receiving immunosuppressive therapy may develop Cushingoid facies and growth retardation as a result of long-term daily corticosteroid administration, as well as hirsutism and gingival hypertrophy. **(Rodig et al., 2018).**

The improvement in the total QoL means scores post-implementation according to the researchers' point of view, this result confirms the successful primary goal of health education implementation for children with CKD. These results might reflect that; children were suffering from lacking some supporting factors of recovery that were introduced to studied children through the educational program using mobile. Also, this finding is supported by **McKenna et al. (2016)** study, which explained it using the "response shift" theory, which states that patients with chronic illness (such as dialysis recipients) develop internal defense mechanisms to cope with negative feelings as living with their illness becomes routine. Furthermore, the QoL of school functioning is lower in CKD children; this result is supported by a study conducted by **(Kiliś-Pstrusińska et al., 2013).**

The finding of the current study highlighted that a statistically significant relation detected between the residence of studied children and their total quality of life. This result is supported by **Abdel-Baki, et al., (2017),** entitled "Understanding children access and utilization of technology to inform the development of technology-enabled therapeutic interventions" who found that, a statistically significant relationship between residence and total quality of life for patients. From the researchers' point of view, these results reflect that residence may affect awareness, beliefs, and use the technology and the internet regarding disease improvement.

The finding of the current study illustrated that, regarding the relation between the educational level of studied children and their total quality of life, there was a statistically significant relation between educational level and their quality of life. This result may be explained by that educational level could be interfered with a poor understanding of communication which in turn may affect the psychological status for this children patients and effect on the quality of life for them.

The finding of the current study reported that mobile health education was effective in improving the quality of life, knowledge, and practice of preventive measures among children with CKD during COVID-19 after the implementation. These results were supported by the aim and hypotheses of the present study.

This finding is consistent with the findings of **Macias et al. (2017**), who investigated the use of mobile phone apps to promote mental and physical well-being and discovered that improving audio, video, media players, graphic displays, interactive features, bidirectional communication and texting, and Internet networking opens up new avenues for engaging

children patients with both automated resources and human supports. According to the researchers, the portability of mobile phones allows children with CKD to take them wherever they go, and users can read, hear, and view self-management skills, suggestions, and demonstrations that are relevant to the challenges they encounter as they go about their daily lives, and provide support that improves the disease burden and the quality of life of children with CKD.

Moreover, this result is in the same line with **the Board of Governors in Supersession of the Medical Council of India**, **(2020)** which reported that Teleconsultations and mobile education for patients and their families are encouraged to minimize hospital visits and infections. Physicians, nurses, and other health professionals could better utilize the Internet and mobile technology to provide health information to children, broadening their understanding of the disease and emphasizing the importance of their role in managing and sharing care with the medical staff in order to improve clinical outcomes.

Conclusion:

Based on the findings of the current study's aim and hypotheses, the current study concluded that mobile based health education was effective in improving knowledge among children with CKD after the implementation. Mobile based health education had a statistical significant difference on improving the quality of life of children with chronic kidney diseases. The majority of children with chronic kidney diseases pre-intervention have a low level of quality of life that improved after the implementation of a mobile based health- education program in all dimensions of the quality of life for the children with CKD: physical domain, emotional domain, social domain, and school domain immediately after implementation of health education intervention**.**

Recommendations:

The researchers recommended the following, considering the study findings:

- Mobile based health education can be integrated to home care and follow up for children with CKD at the health care settings.
- Future researches should include:

1- Replicating this research with larger sample sizes in a variety of at different health care settings.

2- Evaluating the impact of mobile health education on children's safety aspect.

3- Evaluating the economic value of using mobile health education as an integral component in the management of this patient population.

Conflict of Interest:

The authors declare that they have no conflict of interest.

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