



# The Efficacy of Internet-Based Interventions in Family-Centered Empowerment Among Children with Chronic Diseases: A Mixed-Methods Systematic Review

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**Background:** The incidence of chronic diseases in children is increasing worldwide, which can disrupt the quality of life. Family empowerment (FE) is one approach to strengthen family care among children with chronic diseases. In addition, internet has the potential in healthcare service interventions for families.

**Purpose:** This study aimed to determine the efficacy of internet-based family empowerment interventions among children with chronic diseases.

**Methods:** The study used a mixed-methods systematic review. A literature review was conducted following PRISMA guidelines using the PubMed, Scopus, ScienceDirect, and CINAHL databases. We used the PCC framework: chronic diseases (Population), family empowerment (Concept), and internet-based intervention (Context). Studies were eligible if published between 2013 and 2023, full-text, original study design, and focused on family empowerment in children with chronic diseases. Studies would be excluded if they were not in English or if the population was adults. The quality of the studies was assessed using the Mixed Methods Appraisal Tool (MMAT) version 2018. The study analysis used Sequential Explanatory Synthesis, which is a quantitative study (QUAN) synthesis followed by a qualitative study (QUAL) synthesis, then integrated using the QUAL data transformation technique.

**Results:** We highlight the quantitative study findings that an internet-based family empowerment intervention positively impacted family members' ability to care for children with chronic diseases with a mean Family Empowerment Scale (FES) total score of 4.13. We analyzed six study and identified four themes regarding efficacy of internet-based interventions in empowering families with children with chronic diseases: knowledge; availability of resources and time-saving; connectedness and communication; and family management and self-confidence.

**Conclusion:** Our study highlights that online-based interventions in family empowerment positively impact enhancing all domains of empowerment. This findings suggest that internet-based family interventions need to be adopted to fulfill the care needs of children with chronic diseases sustainably.

**Keywords:** children, efficacy, family empowerment, internet, online, chronic disease

## Introduction

The incidence of chronic diseases is increasing in several developed and developing countries, while the prevalence of chronic diseases in children remains sporadic. Data from the United Nations Children's Fund (UNICEF) in 2020

indicates that approximately 1.2 million adolescents and children under 20 die yearly due to chronic diseases, contributing to 13% of the total deaths from chronic diseases globally.<sup>1</sup> In the child population in the United States, it is estimated that 1% to 3% experience hypertension, and one in five children suffers from obesity. The incidence of type 2 diabetes in those under 20 has quadrupled, from 22,820 cases in 2010 to 84,131 cases in 2050.<sup>2</sup> The World Health Organization (WHO) through the International Agency for Research on Cancer (IARC) estimates that 8677 Indonesian children aged 0–14 years had cancer in 2020, making it the highest number compared to other countries in Southeast Asia.<sup>3</sup> An estimated 400,000 children aged 0–19 years develop cancer each year, including leukemia, brain cancer, lymphoma and solid tumors.<sup>4</sup>

Children with chronic diseases are at a higher risk of experiencing a diminished quality of life.<sup>5</sup> Consistent with Megari's research (2013), individuals living with chronic diseases can have a negative impact on their quality of life, leading to deteriorating health, delayed development, prolonged illness duration, the need for intensive medical care, and limitations in capabilities, functionality, and productivity.<sup>6</sup>

The role of the family is crucial in helping to address the issues that arise in children with chronic diseases.<sup>7</sup> Implementing a family-centered approach in the care of children with chronic diseases enhances family involvement and full participation in caregiving, decision-making, and improving the child's quality of life.<sup>8</sup> Additionally, nurses play a vital role in assisting parents in addressing the challenges that arise in children with chronic diseases.<sup>9,10</sup>

The Family-Centered Empowerment Model (FCEM) is one of approaches to strengthen family health.<sup>8,11</sup> FCEM provides opportunities for families to engage in comprehensive child care.<sup>12</sup> The Family-Centered Empowerment Model can help improve patients' quality of life of methamphetamine users and their families.<sup>13</sup> Consistent with the findings of Minooei et al (2016), it shows that Family-Centered Empowerment (FCE) interventions can assist parents in identifying needs, enhancing engagement, self-confidence, and the quality of life of children with chronic kidney failure.<sup>14</sup>

Internet has the potential in healthcare service interventions. A Systematic Review and Meta-analysis study show statistically significant improvements in the quality of life after Nurse-led Telehealth Intervention among adults with chronic diseases.<sup>15</sup> Another study indicates that telehealth technologies have proven effective in improving self-care skills, self-monitoring, and enhancing clinical outcomes among older adults with chronic diseases.<sup>16</sup> However, based on the author's research, a similar study has yet to identify telehealth use in Family Empowerment (FE) within the pediatric population with chronic diseases.

Previous study findings show that internet use has several benefits in child care, including increased knowledge, convenience, self-management, quality of life, scheduled visits, care coordination, privacy, cost efficiency, comfort, independence, and reduced hospitalizations and health visits.<sup>17–20</sup> In contrast, other studies state that it is easier for families to communicate with medical service providers during face-to-face meetings compared to telehealth in relationships with health professionals. Challenges in the use of telehealth include a lack of face-to-face interaction, concerns about compromised confidentiality, and the potential for misdiagnosis. In line with other studies, there is no significant difference in the knowledge scores of families who use the internet in the health care of children with special care needs, undergoing chemotherapy, and care during the COVID-19 pandemic.<sup>20–23</sup> Based on the results of a 1945 study of parents who use the internet, only half reported being able to distinguish the quality of online resources or feeling confident using online information to make health decisions.<sup>23</sup>

There is a research gap in that previous studies have only focused on quantitative or qualitative analysis related to understanding the impact of internet-based interventions on family empowerment for children with chronic diseases. Conclusive information regarding the benefits and impact of using telehealth in FE for children with chronic disease is essential. Therefore, it is important to conduct a review study of previous studies using a comprehensive approach involving a combined review of quantitative and qualitative studies to gain broad and deep insights into understanding the impact of internet-based FCE interventions on families facing multiple pediatric chronic conditions. This study aims to conduct a mixed-method systematic review to determine the efficacy of internet-based family empowerment interventions among children with chronic diseases.

## Materials and Methods

### Study Design

This study uses a mixed-methods systematic review that follows the framework by Pluye & Hong (2014) and Pace et al (2012).<sup>24,25</sup> This method is suitable for the subject of this study to explore comprehensive identification and integration of quantitative and qualitative research methodologies with complex data synthesis that allows for an in-depth understanding of a topic. The framework consists of seven stages: formulating review questions, establishing eligibility criteria, applying study search strategies, identifying studies, determining relevant studies, assessing study quality, and synthesizing studies.<sup>25</sup>

### Review Question and Eligibility Criteria

The review question developed in this study is “how efficacy of the internet-based intervention in family empowerment among children with chronic diseases?”. The inclusion criteria in this study were based on the PCC question framework. Population: children with chronic disease; Concept: family empowerment; and Context: internet-based intervention. A study was eligible for inclusion including articles published from 2013 to 2023, full-text, original study design, and topic of family empowerment focusing on children with chronic diseases. Studies were excluded if they were not in English and adult population. All researchers independently conducted studies included screening articles, appraising study quality, analyzing studies, and reporting results.

### Search Strategy

The search strategy for this study followed the PRISMA guideline.<sup>26–28</sup> A literature review was conducted using PubMed, Scopus, ScienceDirect, and CINAHL databases. The keyword adjusts the medical subject heading (MeSH) term using a boolean, including (“family empowerment” OR “parent empowerment” OR “family-centred empowerment” OR “family empowering” OR “parent empowering”) AND (“children” OR “adolescents” OR “child” OR “teenager” OR “kids” OR “pediatric”) AND (“chronic disease” OR “chronic illness” OR “long term conditions” OR “chronic conditions”) AND (“internet” OR “online” OR “web” OR “technology” OR “virtual” OR “digital” OR “telehealth” OR “telenursing”).

### Critical Appraisal

Study quality was assessed using the Mixed Methods Appraisal Tool (MMAT) version 2018 from Hong et al (2018).<sup>29</sup> We assessed articles independently conducted by two authors. The evaluation for study quality was consistent with five questions and four categories for response options across all study designs, including “yes”, “no”, and “cannot tell”. Scoring is done by providing a presentation for each question for each study design, with a range of 0–100%. Appraisal of studies based on MMAT criteria and tools for inclusion of study categories, namely quantitative non-randomized studies, quantitative randomized controlled trials, mixed methods studies, qualitative studies. After the assessment is carried out independently by each author, then the authors combine and recheck together to get the final results of the study appraisal. We did not exclude studies with low methodological quality to find a broad range of results and minimize study bias.

### Data Extraction

Data extraction in this study was conducted using the tabulation method in Microsoft Excel (Microsoft Corp., New York, USA). Data extraction summaries were done separately and divided into two groups: qualitative studies and quantitative studies, with each group presented in three subgroups of identification results, including study characteristic tables, intervention model and outcomes tables, and summary of findings tables. The items identified in the three subgroups of analysis included the study characteristic table comprising the study year, study design, location, setting, population, age, sample, parents’ education, parents’ occupation, model, and intervention; the intervention model and outcomes table including the study year, intervention model, length of study, follow-up, intervention duration, instrument of FE, process/

procedure of intervention, measurement, and outcome; and the summary of findings table comprising the study year, intervention model, aims of study, and results.

## Synthesis

Sequential Explanatory Synthesis consists of two phases: the synthesis of quantitative studies (QUAN) to provide initial information, followed by the synthesis of qualitative studies (QUAL) to confirm and support the findings of the QUAN synthesis. Firstly, the synthesis of QUAN study results and mixed methods collected in tables is conducted. Secondly, the findings of QUAL studies and mixed methods are integrated. Then, the interpretation of the results of both stages is carried out to reveal the findings. Convergent synthesis is used in this study, and the study's results are integrated using the data transformation technique of QUAL.<sup>25</sup>

## Results

### Description of Study Selection

The study's findings obtained 2280 articles from the four databases used, including PubMed, Scopus, ScienceDirect, and CINAHL. After removing duplicates from the collected articles and title screening, 61 articles remained. Then, selection based on title, full-text, topic, and language, there were 17 articles remaining. Therefore, after screening based on inclusion criteria, six articles were eligible for inclusion in this study (Figure 1). Then, the quality assessment of the included studies was analyzed using the Mixed Methods Appraisal Tool (MMAT) version 2018 (Table 1).

### Quantitative Study

#### Characteristics of Study

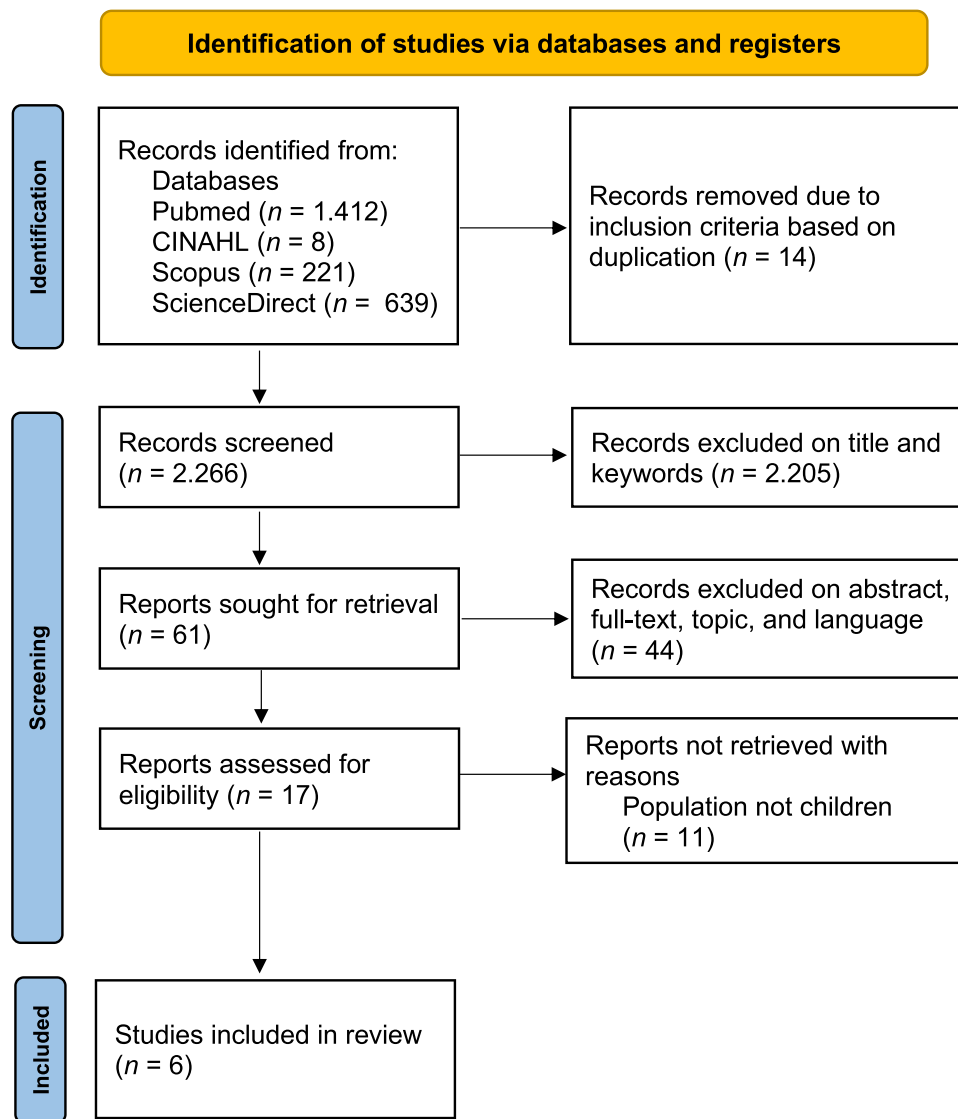
Four studies were analyzed, including study year, design, location, setting, population, age, sample, parents' education, occupation, and intervention model (Table 2 and 3). The included studies comprised quantitative studies and mixed-methods (4 studies), including quantitative non-randomized studies (n=2), quantitative randomized controlled trials (n=1), and mixed-methods (n=1). The studies were conducted in the United Kingdom (n=2), Japan (n=1), and Italy (n=1) and were conducted in hospitals (n=1) and homes (n=3).

The total sample of this study consisted of 199 children and 210 parents, with the population in this study including children aged 0–21 years with obesity (n=1), physical, intellectual, or developmental disabilities (n=1), chronic kidney disease (CKD) (n=1), and life-limiting illness (LLI) (such as cerebral palsy, intractable epilepsy, metabolic and genetic disorders) (n=1). Only one study provided information about the parents' age, occupation, and highest education level,<sup>30</sup> with the majority of parents aged 20–59 years, most having vocational and bachelor's degrees (47 individuals), 20 working part-time, and 16 being homemakers. Overall, the majority were non-randomized 65.24%, carried out in Europe 73.80%, interventions implemented at home 84.76%, and 100% online-based intervention models.

### Internet-Based Intervention of Family Empowerment Model

Four studies were analyzed, and we found that the intervention models used were telehealth counselling, Online Parenting Information and Support (OPIS), MyQuality, and a group-based online intervention program. After families received the intervention, follow-up was conducted using the FES with varying durations in each study, ranging from 3 weeks to 3 months (Table 4). The intervention procedures were primarily administered to families, especially parents, and allowed for the involvement of children with varying durations. Here are the four internet-based family empowerment models identified:

Model 1: Parents and children participated in video calls in three phases, each lasting 30 minutes. Phase 1 involved discussions with a nutritionist to improve compliance and create a nutrition plan. Phase 2 included discussions with a psychologist to provide motivational support and restore the children's and the family's self-efficacy. In Phase 3, discussions were held with a kinesiologist regarding the children's physical activities. Additionally, video tutorials were provided on exercise types tailored to the age and physical characteristics of the children.



**Figure 1** PRISMA Flow diagram. Adapted from Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. Creative Commons.

Model 2: This activity consists of 5 sessions. First, understanding the child's situation. Second, reflecting on the child and family's situation and desires. Third, setting goals for the family and child. Fourth, reflecting on the activities carried out to achieve the goals. Lastly, a small focus group discussion (FGD).

Model 3: The Intervention Group received support and access to the OPIS website.

Model 4: Parents were provided with hands-on demonstrations and training in using the application and invited to use it. Ongoing MyQuality support provided local nurses for the families.

## Outcomes

Four quantitative studies revealed that after online interventions were conducted to empower families with children with chronic diseases, there was a significant improvement in FES (Family Empowerment Scale) and clinical outcomes for the children.<sup>30-33</sup> First, after receiving telehealth counselling in FE, there was a significant increase in the child's BMI (Body Mass Index), Fat-Free Mass, and Waist Circumference ( $p < 0.000$ ). Second, a group-based online intervention program significantly impacted the total FES score, particularly showing a significant improvement in the Family Advocacy (FA) subdomain and the relationship with Social Support (SS). Families experienced lower caregiving burdens and higher self-

**Table 1** Quality Assessment of Included Studies Using the Mixed Methods Appraisal Tool (MMAT) Version 2018

<b>Quantitative non-randomized studies</b>	Are the participants representative of the target population?	Are measurements appropriate regarding both the outcome and exposure/intervention?	Are there complete outcome data?	Are the confounders accounted for in the design and analysis?	During the study period, is the intervention/exposure administered as intended?	Score (Percentage)
Wakimizu et al (2022) <sup>30</sup>	Y	Y	Y	N	Y	4/5 (80%)
Pecoraro et al (2021) <sup>31</sup>	Y	Y	Y	N	Y	4/5 (80%)
<b>Quantitative randomized controlled trials</b>	Is randomization appropriately performed?	Are the groups comparable at baseline?	Are there complete outcome data?	Are outcome assessors blinded to the intervention provided?	Did the participants adhere to the assigned intervention?	
Swallow et al (2014) <sup>32</sup>	Y	Y	Y	N	Y	4/5 (80%)
<b>Mixed methods studies</b>	Is there an adequate rationale for using a mixed methods design to address the research question?	Are the different components of the study effectively integrated to answer the research question?	Are the results adequately brought together into overall interpretations?	Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	
Harris et al (2015) <sup>33</sup>	CT	Y	Y	N	Y	3/5 (60%)
<b>Qualitative studies</b>	Is the qualitative approach appropriate to answer the research question?	Are the qualitative data collection methods adequate to address the research question?	Are the findings adequately derived from the data?	Is the interpretation of results sufficiently substantiated by data?	Is there coherence between qualitative data sources, collection, analysis and interpretation?	
Adriana et al (2014) <sup>34</sup>	Y	Y	Y	Y	Y	5/5 (100%)
Jones et al (2022) <sup>35</sup>	Y	Y	Y	Y	Y	5/5 (100%)

**Abbreviations:** Y, Yes; N, No; CT, Cannot tell.

**Table 2** Characteristics of Quantitative Studies and Mixed-Method Study (n = 4)

Study	Desain	Location	Setting	Population	Age		Sample		Education		Occupation		Intervention	Model
					Children	Family (Mth/Fth)	Children	Family (Mth/Fth)	Mth	Fth	Mth	Fth		
Wakimizu et al (2022) <sup>30</sup>	Non-randomize, waitlist-control trial	Japan	Home	Children with physical, intellectual, or developmental disabilities	2–20 years	20–59	55	55	Junior High School = 1, Senior High School = 7, Vocational School = 16, Bachelor's Degree = 31.	NA	Full-time employee = 9, Self-employed = 5, Part-time employee = 20, Homemaker (Housewife) = 16, Others = 5.	NA	Online	Group-based online intervention program
Pecoraro et al (2021) <sup>31</sup>	Retrospective study	Italy	Home	Children and adolescents with obesity	5–18 years	NA	82	82	NA	NA	NA	NA	Online	Telehealth counselling
Swallow et al (2014) <sup>32</sup>	RCT	United Kingdom	Home	Children with CKD	0–19 years	NA	30	41	NA	NA	NA	NA	Online	OPIS
Harris et al (2015) <sup>33</sup>	A longitudinal, mixed-method	United Kingdom	Hospital	Children with LLI (cerebral palsy, intractable epilepsy, metabolic and genetic disorder)	Three months to 21 years	NA	32	24 mother Four father Four both parents	NA	NA	NA	NA	Online	MyQuality

**Abbreviations:** LLI, life-limiting illness; CHD, congenital heart disease; Mth, mother; Fth, father; EMR, electronic medical record; RCT, randomized control trial; CKD, chronic kidney disease; OPIS, the online parent information and support.

**Table 3** Summary of Findings of Quantitative Studies and Mixed-Method Study (n = 4)

Domain	Number of Studies (N)	Sample Size (N)	Percentage (%)
<b>Overall studies</b>	<b>4</b>	<b>210</b>	<b>100</b>
<b>Desain</b>			
Quantitative RCT	1	41	19.52
Quantitative non-randomized	2	137	65.24
Mixed-Method	1	32	15.24
<b>Location</b>			
European	3	155	73.80
Asian	1	55	26.20
<b>Setting</b>			
Home	3	178	84.76
Hospital	1	32	15.24
<b>Intervention Model</b>			
Online	4	210	100

**Abbreviation:** randomized control trial, (RCT).

confidence. Third, the results of using the OPIS (Online Parenting Information and Support) system showed a significant FES score of 4.3 on average, and parents experienced an increase in their perception of competence and confidence in managing their child's condition, thus understanding and mitigating the impact of their child's condition. Fourth, MyQuality showed a positive effect on family empowerment. The average FES score increased from 3.45 to 3.85, indicating a significant improvement ( $p \leq 0.01$ ) overall (Table 4).

We highlight the quantitative study findings that an internet-based family empowerment intervention positively impacted family members' ability to care for children with chronic diseases with a mean Family Empowerment Scale (FES) total score of 4.13. This includes improvements in their skills and competencies, self-management, self-confidence, interactions with healthcare professionals, and the overall empowerment domain scores. Thus, it can aid in improving clinical outcomes for children with chronic diseases (Table 4 and 5).

## Qualitative Study

### Characteristics of Study

The three studies that have been analyzed encompass various items, including study years, research design, research locations, settings, populations, age ranges, samples, parental education levels, parental occupations, and the intervention models used (Table 6). The studies included in the analysis involved qualitative studies (n=2), including a phenomenological study (n=1) and an observational study (n=1), as well as mixed-methods studies (n=1). These studies were conducted in various locations, including the United Kingdom (n=1), Australia (n=1), and the United States (n=1), conducted in two settings, including hospitals (n=2) and one at home (n=1).

The total sample involved in this research comprised 72 children and 72 parents, with the age range of children spanning from 3 months to 21 years. These children had various conditions such as cerebral palsy, difficult-to-treat epilepsy, metabolic disorders, and genetic disorders (n=1), Alagille Syndrome (ALGS) (n=1), and Congenital Heart Disease (CHD) (n=1). Only one study provided information about the parents' highest level of education, with the majority having a high level of education, totalling 14 individuals.<sup>30</sup> In contrast, the other two had a low level of education. Overall, these three studies described FE interventions that adopted online-based models.



**Table 4** Intervention Model and Outcomes of Quantitative Studies and Mixed-Method Study (n = 4)

Studi	Model	Length of Study	Follow-Up	Duration of Intervention	Instrument of Family Empowerment	Procedure of Intervention	Measurement of Outcome	Outcome	
								Domain	Result
Pecoraro et al (2021) <sup>31</sup>	Telehealth counselling	Three months	Three weeks	30 minutes	NA	Parents and children participated in video calls in 3 phases, each lasting 30 minutes. Phase 1 involved discussing with a nutritionist to enhance compliance and create a nutrition plan. Phase 2 included discussing with a psychologist to provide motivational support and boost self-efficacy for children and the family. Phase 3 discussed the children's physical activities with a kinesiologist. Additionally, video tutorials were provided on exercise types tailored to the age and physical characteristics of the children.	Anthropometry	BMI	Increase significantly (+1.2 kg/m <sup>2</sup> )
							Bioelectrical impedance anal	Fat Free Mass	Increase significantly (+3.8 Kg)
							Measuring tape	WC	Waist Circumference does not change both groups
Wakimizu et al (2022) <sup>30</sup>	Group-based online intervention program	Five month	One month	Every Sunday	The Japanese version of FES	This activity consists of 5 sessions. Session 1 (Understanding the child's situation), Session 2 (Reflecting on the child's and family's situation and desires), Session 3 (Setting goals for the family and child), Session 4 (Reflecting on the activities undertaken to achieve the goals), Session 5 (small Focus Group Discussion - FGD).	FES Includes FA and SS	Total score	The FES total score was significant, with a medium effect size of 0.176, and average 7.9
							FES Includes FA and SS	FA	Scores for FA were significant, with a medium effect size of 0.128, and average 1.8
								SS	Scores for SS were significant, with a medium effect size of 0.183, and average 2.8
								SP	Scores for SS were significant, with a medium effect size of 0.175, and average 3.3

(Continued)

**Table 4** (Continued).

Studi	Model	Length of Study	Follow-Up	Duration of Intervention	Instrument of Family Empowerment	Procedure of Intervention	Measurement of Outcome	Outcome	
								Domain	Result
Swallow et al (2014) <sup>32</sup>	OPIS	20 weeks	On the week 20	NA	FES	The Intervention Group received support and access to the OPIS website.	REALM	Adult Literacy	Improvement in the perception of competence in managing the child's condition.
							FaMM	Family Management	The Condition Management Ability Scale scored 44.5 for the intervention group compared to 41.9 for the control group.
							FES	Family Empowerment	The average FES score for the control group was 4.3, while it was 4.1 for the intervention group.
							DAADS	Dads Active Support	In the control group, the Amount score was 84.4, and the Helpfulness score was 69.9, whereas in the intervention group, the Amount score was 73.9, and the Helpfulness score was 76.6.
Harris et al (2015) <sup>33</sup>	MyQuality	Ten month	Three month	NA	FES	Parents were provided with direct demonstrations and training in using the application and encouraged to use it. The continuous support from MyQuality included local nurses available for the families.	FES	Seizures, constipation, pain, and sleep problems	The average FES score increased from 3.45 to 3.85, indicating a significant improvement ( $p \leq 0.01$ ) overall. Out of 32 families, 23 chose to use the website. The most commonly reported issues were seizures (24/32), pain (6/32), sleep problems (6/32), and constipation (9/32).

**Abbreviations:** FES, family empowerment scale; FA, family (internal) relationships; SS, relationships with service systems; SP, involvement with the community; BMI, body mass index; IQR, inter-quartile range; WC, waist circumference; FFM, fat free mass; FM, fat mass; OPIS, the online parent information and support; DADS, the dad's active disease support scale; FaMM, the family management measure; REALM, rapid estimate for adult literacy in medicine; FDG, focus group discussion.

**Table 5** Summary of Findings of Quantitative Studies and Mixed-Method Study (n = 4)

FES Total Score	Mean Change	Mean Change Total
Pecoraro et al (2021) <sup>31</sup>	NA	4.13
Wakimizu et al (2022) <sup>30</sup>	7.9	
Swallow et al (2014) <sup>32</sup>	4.1	
Harris et al (2015) <sup>33</sup>	0.4	

**Abbreviation:** FES, Family empowerment scale.

### Internet-Based Intervention of Family Empowerment Model

The intervention models used in the qualitative studies included MyQuality, Facebook, YouTube, Google, and Electronic Medical Records (EMR). Follow-up assessments were conducted to measure FE scores using the Family Empowerment Scale (FES), the Family's Experience of Pediatric Surgical Mortality (PSM) Questionnaire, and the Chronic Sorrow Questionnaire–Caregiver Version, with a follow-up period ranging from 3 to 10 months (Table 7). The procedures for the FE models identified were as follows:

Model 1: Family education encompassed the following aspects: understanding the workings of warfarin, its indications, and factors affecting therapy stability; target therapy and dosage; dosing administration; determining when to test INR (International Normalized Ratio); utilizing healthcare services; managing INR levels at home; and discussing subtherapeutic INR levels.

Model 2: Parents were provided with hands-on demonstrations and training in using applications or websites and encouraged to use them. Additionally, in the case of MyQuality, local nurses were involved to facilitate the family's access to nearby healthcare services.

### Outcomes

The three qualitative studies that were analyzed revealed that after online interventions were conducted to empower families with children with chronic diseases using three online intervention models, parents expressed positive outcomes.<sup>33–35</sup> First, parents who used MyQuality reported that the website was easy and convenient. It helped manage care, increased their abilities and confidence to share information, facilitated easy access to information, improved their understanding of the disease, and contributed to managing their child's health. Second, parents who used Facebook, YouTube, and Google indicated that they used online communication for various purposes. This included enhancing their knowledge, accessing information, increasing their awareness and empowerment in managing their child's illness, helping their child, connecting with other parents with similar experiences, and communicating with service providers. However, the majority of parents used online communication during challenging times. Parents also reported that online communication could trigger unpleasant feelings about negative health information. Third, after using EMR, parents stated that they knew warfarin management, the ability to manage warfarin independently, saved time and felt supported by healthcare services (Table 7 and Table 8).

The findings from the analysis of qualitative studies support the findings from the analysis of quantitative studies. We emphasize that internet-based interventions in empowering families with children with chronic diseases have positive impacts, including enhancing knowledge, management skills, and confidence, facilitating easy access to information and time-saving, providing convenience, fostering connections with other parents with similar experiences, enabling communication with service providers, and feeling supported by healthcare services.

### Combined Evidence Thematic Synthesis of Quantitative and Qualitative Studies

Our combined findings from six studies reveal that online-based interventions in FE positively impact the total FES scores across all empowerment domains.<sup>30–35</sup> This study categorizes the findings according to the theme of the results,

**Table 6** Characteristics of Qualitative Studies and Mixed-Method Study (n = 3)

Study	Desain	Location	Setting	Population	Age		Sample		Education		Occupation		Model	Intervention
					Children	Family (Mth/Fth)	Children	Family (Mth/Fth)	Mother	Father	Mother	Father		
Harris et al (2015) <sup>33</sup>	A longitudinal, mixed-method	UK	Hospital	Children with LLI (cerebral palsy, intractable epilepsy, metabolic and genetic disorder)	Three months to 21 years	NA	32	24 mth Four fth Four both parents	NA	NA	NA	NA	Online	MyQuality
Adriana et al (2014) <sup>34</sup>	Phenomenological study	US	Home	Children with ALGS	Six months to 17 years	31 to 53	16	16	College educated (14) Non college educated (2)	NA	NA	NA	Online	Facebook, YouTube, Google
Jones et al (2022) <sup>35</sup>	Observational study	Australia	Hospital	Children with CHD	4–17 years	NA	24	24	NA	NA	NA	NA	Online	EMR

**Abbreviations:** ALGS, Alagille syndrome; LLI, life-limiting illness; CHD, congenital heart disease; Mth, mother; Fth, father; EMR, electronic medical record.

**Table 7** Interventions Model and Outcomes of Qualitative Studies and Mixed-Method Study (n = 3)

Study	Model	Length of study	Follow-up	Duration	Instrument	Process of Intervention	Outcomes	
							Theme	Statement of Family
Harris et al (2015) <sup>33</sup>	MyQuality	Ten month	Three month	NA	FES	Parents were provided with direct demonstrations and training in using the application and invited to use it. MyQuality's continued involvement included local nurses.	Acceptability	The application is easy and convenient, making care management more organized and helpful.
							Empowerment	Parents expressed experiencing an improvement in their abilities and confidence, enabling them to share information and communicate about the issues their child is facing due to the illness.
							Communication	Parents who have used the application feel that it has been helpful to them and provided access to information.
							Clinical value	The application helps improve understanding of the child's illness and contributes to clinical management.
Adriana et al (2014) <sup>34</sup>	Facebook, YouTube, Google	NA	NA	NA	The Chronic Sorrow Questionnaire–Caregiver Version	NA	Connectedness	Mothers indicated that they use online communication for various purposes. They often initiate searches using search engines like Google and eventually access information, enhance their knowledge and empowerment, help their child, and build relationships with others with similar experiences.
							Online triggers	Online communication can trigger chronic sadness and unpleasant feelings, as they often encounter negative information about ALGS.
							Empowerment	Mothers know the value of online information sources in enhancing their knowledge, information, and empowerment in managing their child's illness. This includes interacting with specialists, interpreting diagnoses, understanding medical instructions or recommendations, and communicating with service providers.
							Seasons of online communication	Mothers tend to use online communication more during challenging times. Additionally, mothers' choices and frequency of online communication are based on their previous experiences and knowledge of what is suitable for their situation.

(Continued)

Table 7 (Continued).

Study	Model	Length of study	Follow-up	Duration	Instrument	Process of Intervention	Outcomes	
							Theme	Statement of Family
Jones et al (2022) <sup>35</sup>	EMR	Ten month	Ten month	One hour	Kuesioner family's experience with PSM	Education includes: - How warfarin works, its indications, and factors affecting stable therapy. - Individual target therapy and dosing. - Administration of warfarin doses. - Determining when to undergo INR testing. - When to contact healthcare services. - Managing high INR at home (>5.0). - Discussion of low weight for subtherapeutic INR.	Gaining of knowledge	Parents stated that they have a basic knowledge of warfarin management, which helps them make dosing decisions at home.
							Trust and responsibility	Families are grateful for the trust and responsibility given to them, which makes them confident in their ability to manage their child's warfarin independently.
							Saving time	The Warfarin PSM program helps them save time and reduces the time spent on decision-making.
							Availability of resources	Parents feel independent and empowered to make decisions for their children and feel supported if they need assistance or advice.

**Abbreviations:** ALGS, Alagille syndrome; FES, family empowerment scale; PSM, patient self-management; INR, international normalized ratio; EMR, electronic medical record.

**Table 8** Summary of Findings of Qualitative Studies and Mixed-Method Study (n = 3)

Study	Intervention	Aims	Results
Harris et al (2015) <sup>33</sup>	MyQuality	To improve the Quality of Life (QoL) of children with LLI	Acceptance and ease of use of the website, as well as the graphical record of changes over time, to support ongoing management and collaborative review of medical interventions, nursing care, or social interventions.
Adriana et al (2014) <sup>34</sup>	Facebook, YouTube, Google	To explore the experiences of mothers of children with ALGS in using online health communication to manage their chronic sorrow	Online communication significantly influences how mothers of children with ALGS manage their chronic sorrow or unpleasant feelings. Findings suggest that mothers need emotional support and assistance accessing appropriate online resources.
Jones et al (2022) <sup>35</sup>	EMR	To determine the suitability and acceptance of warfarin PSM in children using the Epic Patient Portal	The average INR time was increased during PSM. Furthermore, there were no adverse events reported.

**Abbreviations:** ALGS, Alagille syndrome; QOL, quality of life; LLI, life limiting illness; PSM, patient self-management; INR, international normalized ratio; EMR, electronic medical record.

which are knowledge, availability of resources and saving time, connectedness and communication, and family management and self-confidence.

### Theme 1: Knowledge Enhancement

We found four studies that revealed online-based interventions in FE can enhance parental literacy, which assists parents in independently caring for children with chronic diseases.<sup>32–35</sup> The use of applications helps improve understanding of the child's condition and aids in clinical management comprehension.<sup>33</sup> Additionally, parents expressed that information from online sources was crucial in increasing their knowledge, information, and empowerment in controlling their child's illness, including understanding medical instructions or recommendations.<sup>34</sup>

### Theme 2: Availability of Resources and Saving Time

We found three studies that reported that online methods can assist families in providing resource support and facilitating access to needed information.<sup>30,33,35</sup> Acceptance, comfort, and ease of website use to support ongoing management and collaborative review of medical interventions, nursing care, or social interventions.<sup>33</sup> Parents feel supported when they need assistance or advice. Furthermore, it helps families save time and reduce decision-making time.<sup>35</sup>

### Theme 3: Connectedness and Communication

The four studies analyzed explain that internet-based family empowerment provides significant opportunities for relationships and communication between families, healthcare services, and other families facing similar issues.<sup>30,33–35</sup> Parents use online communication for various purposes and establish connections with others experiencing similar experiences. Parents receive assistance or advice from healthcare services when needed.<sup>35</sup> However, many parents still use online communication primarily during challenging times.<sup>34</sup>

### Theme 4: Family Management and Self-Confidence

Five studies indicate that after internet-based family empowerment, there is an improvement in parents' ability to self-manage and an increase in self-confidence.<sup>30–33,35</sup> Parents reported increased caregiving skills and self-confidence, enabling them to share information and communicate about their child's illness.<sup>33</sup> Furthermore, the trust and responsibility provided by these interventions make them confident in managing their child's illness independently.<sup>35</sup>

## Discussion

### Principal Finding

The primary objective of this mixed-methods systematic review is to assess the efficacy of internet-based interventions in FE for children with chronic diseases. Our findings from quantitative studies indicate that internet-based family empowerment interventions positively impact family abilities in caring for children, such as enhancing skills and competence, promoting self-management, boosting self-confidence, improving interactions with healthcare professionals, and enhancing total empowerment domain scores. This, in turn, can contribute to improved clinical outcomes for children with chronic diseases.<sup>30–33</sup> These findings are supported by the results of the qualitative studies, which suggest that internet-based interventions can enhance knowledge, management skills, and self-confidence, as well as provide convenience, facilitate connections with parents facing similar issues, enable communication with service providers, and offer support from healthcare services.<sup>33–35</sup>

Based on the six studies, the implementation of internet-based family empowerment can be applied to families with children with chronic diseases such as obesity, physical, intellectual, and developmental disabilities, chronic kidney disease, cerebral palsy, difficult-to-treat epilepsy, metabolic disorders, and genetic disorders, Alagille Syndrome, and Congenital Heart Disease.<sup>30–35</sup>

Our findings in the current study are supported by previous research. The study conducted by Minooei et al (2016) demonstrated that FE interventions can positively enhance the quality of life of children suffering from chronic kidney disease, both in terms of physical and psychosocial aspects.<sup>14</sup> This improvement is reflected in the reports of the children themselves but also in the experiences of their parents.<sup>36</sup> These findings align with the study conducted by Shogi et al (2019), which explained that empowering parents of children with cancer can significantly reduce the caregiving burden.<sup>12</sup> Furthermore, a family-focused empowerment approach has also been shown to increase self-efficacy and self-esteem in children with asthma.<sup>37</sup>

The study by Dang et al (2017) explained that providing interventions using mobile phones can help improve self-care efficacy and the quality of life of patients with heart disease.<sup>38</sup> This is further supported by other research indicating better physical and mental health outcomes and an increase in self-efficacy among diabetes patients receiving telehealth training models.<sup>39</sup> Consistent with the findings of Knight et al (2014), through remote monitoring technology (mHealth), patients can achieve significant improvements in various aspects of their health.<sup>40</sup>

The intervention models used in FE through online or internet-based approaches included MyQuality, Facebook, YouTube, Google, EMR, telehealth counselling, OPIS, and Group-based online intervention programs.<sup>30–35</sup> The procedures used varied and encompassed empowerment components such as the education process, direct demonstration and training, goal setting, family self-management, reflection on activities, and discussions and communication. This aligns with previous research that developed stages of FE without an internet-based approach in chronic patient management, including exploring reality, beliefs, and expectations; considering and making decisions; developing abilities in managing care; strengthening confidence; and evaluating program outcomes.<sup>41,42</sup>

Based on the combined results of quantitative and qualitative studies, we identified several thematic outcomes following internet-based family empowerment interventions, including increased knowledge, availability of resources and time-saving, connectedness and communication, family management and self-confidence.<sup>30–35</sup> This aligns with the study by Sayani et al (2019), which showed significant time and cost savings for patients receiving care for chronic diseases or infections through telemedicine in remote areas.<sup>43</sup>

The use of the internet still has its limitations. Findings from this study regarding internet use include online triggers. Online communication can trigger sadness and unpleasant feelings in families because they often encounter negative information about their child's illness.<sup>34</sup> However, the development of online media or applications should pay attention to clear and comprehensive information aspects and maintain consultation services to reduce the ambiguity of information received by families. Consistent with previous studies, it was revealed that a weakness in internet-based FE models is the limited internet connectivity, especially in geographically unsupported areas.<sup>44</sup> Additionally, not everyone has resources like smartphones to engage in FE.<sup>30</sup>



Overall, the findings of this study reveal that the implementation of online-based interventions in FE has a positive impact on enhancing all empowerment domains.<sup>30–35</sup> However, the potential of internet technology plays a crucial role in determining intervention strategies in healthcare, especially in the context of children with chronic diseases. Technological advancements are driving the adoption of telehealth as an electronic information and communication service to improve health, which can be widely utilized.<sup>45,46</sup>

## Strength and Limitations

This study still has some limitations that could potentially bias the findings. In qualitative and quantitative studies, most did not thoroughly explain confounding factors that could influence the research outcomes, and some did not clarify the intervention procedures and duration. Furthermore, the assessment of study quality using MMAT involved only two individuals, potentially introducing bias into the quality assessment results, not being able to access some full-text articles, and limiting references to English only may have limited the study's results.

Despite its limitations, several benefits of this study should also be acknowledged. First, the study implemented a comprehensive search strategy, strict inclusion and exclusion criteria, and a systematic data extraction and quality assessment process. Second, there is a lack of research on implementing internet technology in FE for children with chronic diseases. Furthermore, this is the first mixed-method systematic review to identify the use of internet-based interventions in empowering families of children with chronic diseases. The study involved countries worldwide, including Europe, America, Australia, and Asia. While the existing evidence is still limited, the findings of this study provide some strong indications of the effects of implementing internet-based interventions in empowering families with children with chronic diseases. However, these study findings represent four continents and can serve as valuable information for healthcare providers and governments as a basis for policy and strategic interventions.

## Implications for Clinical Practice and Policy

The implications of our findings suggest that internet-based interventions in family empowerment may have benefits in reducing problems in children with chronic diseases. This review offers a broader health intervention strategy, which allows nurses or health care providers to engage in internet-based interventions. The findings of this study support that internet-based family empowerment interventions should be adopted to meet the health care needs of children with chronic diseases.

Integrating pediatric nursing practice into internet-based care programs can be a new strategy in clinical practice. The approach of internet-based intervention in family empowerment for children with chronic diseases can be considered as a clinical policy to improve promising services in pediatric care with the principles of family empowerment.

## Conclusion

We present a mixed-method systematic review that explores the implementation of internet-based interventions in empowering families with children with chronic diseases. Our study identified six quantitative and qualitative studies, revealing that online intervention models can be used to empower families dealing with children suffering from chronic conditions such as obesity, physical and intellectual disabilities, developmental disabilities, chronic kidney disease, cerebral palsy, epilepsy, metabolic disorders, genetic disorders, Alagille Syndrome, and Congenital Heart Disease. The efficacy of internet-based family empowerment interventions is reflected in improving knowledge, availability of resources and time-saving, enhanced connectedness and communication, family management and self-confidence.

This study highlights that online-based interventions in FE positively impact enhancing empowerment across various domains. This study can serve as a foundation for further research on similar topics. As a future research direction, conducting a meta-analysis on the four efficacy themes of internet-based interventions in empowering children with chronic diseases is warranted.

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## Disclosure

The authors declare no conflicts of interest in this work.

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