ORIGINAL ARTICLE

Perception and Utilisation of Information and Communication Technology (ICT) in the Management of Diabetes in Children: Insights From Health Students in Indonesia

Alva Cherry Mustamu[1, 2]

Abstract

Background/Aim: The management of diabetes in children necessitates active involvement from diverse stakeholders, encompassing parents, lecturers, medical experts, nutritionists and technology-facilitated information and communication technology (ICT). In this context, medical students play a crucial role in the management of diabetes in children. Aim of this study was to delineate the perceptions and utilisation of ICT in the management of diabetes in children among students in Indonesia.

Methods: This study employed the cross-sectional method, enlisting participants from bachelor and diploma programs in midwifery, nursing and nutrition at the Health Polytechnic of the Ministry of Health, Indonesia. Data were gathered through the distribution of questionnaires *via* the *WhatsApp* platform. The questionnaire encompassed respondent demographics, knowledge about diabetes in children, perceptions and utilisation of ICT in the management of paediatric diabetes, factors influencing ICT perception and utilisation and the efficacy of ICT implementation in paediatric diabetes management. The collected data were subjected to univariate and multivariate analyses, employing structural equation modelling with partial least squares.

Results: The analytical findings revealed a noteworthy correlation between perception factors and the effectiveness of managing diabetes in children. Nevertheless, ICT utilisation and knowledge about paediatric diabetes did not exhibit significant individual influences on the effectiveness of diabetes management in children. These findings underscored the significance of a comprehensive understanding of diabetes, a favourable perception towards ICT utilisation and engagement in activities involving ICT to enhance the effectiveness of paediatric diabetes management.

Conclusion: The utilisation of ICT in the management of paediatric diabetes by health students holds significant potential for enhancing effectiveness in management. This necessitates a profound understanding of diabetes, a favourable perception regarding ICT utilisation and active engagement in ICT-related activities as integral components of paediatric diabetes management strategies.

Key words: Type 1 diabetes mellitus; Paediatric; Diabetes management; Technology information and communication; ICT; Perception; Effectiveness.

1. Department of Nursing, Ministry of Health Polytechnic Sorong, West Papua, Indonesia.
2. Quality Assurance and Education Development Centre, Health Polytechnic of the Ministry of Health of the Republic of Indonesia, Sorong City, West Papua Province, Indonesia.

Corresponding author:
ALVA CHERRY MUSTAMU
E: alvamustamu@poltekkessorong.ac.id

34

Mustamu. Scr Med. 2024 Jan-Feb;55(1):33-42.

Introduction

Type 1 diabetes mellitus is an autoimmune chronic condition characterised by impaired insulin production, leading to elevated blood glucose levels. Despite constituting only 2 % of global diabetes cases, type 1 diabetes exhibits a considerable prevalence, ranging from 5 % to 10 %, impacting an estimated 21–42 million individuals worldwide. In Indonesia, the prevalence of type 1 diabetes has witnessed a significant increase over the past decades, rising from 3.88 to 28.19 cases per 100 million people.[1-4]

The management of type 1 diabetes in children demands focused attention from various stakeholders, encompassing parents, healthcare professionals, nutritionists and technology. Parents play a crucial role by gaining a comprehensive understanding of paediatric diabetes and providing essential emotional support. Healthcare professionals, including doctors and nurses are instrumental in monitoring and controlling blood sugar levels, as well as administering treatment in the event of complications. Nutritionists contribute by designing dietary patterns tailored to children with diabetes and imparting information about essential nutrients and supplements. Concurrently, technology can be leveraged for the supervision and regulation of blood sugar levels, the coordination of dietary routines and the formulation of a customised exercise program suitable for the child's condition.[5, 6]

Several studies indicate that incorporating technology, such as digital blood sugar meters, calorie-counting apps and physical activity monitors, can be beneficial in aiding children with type 1 diabetes in managing their condition. Additionally, technology serves as a valuable tool for formulating exercise programs tailored to suit the specific needs of children with diabetes. Moreover, student education emerges as a pivotal agent of societal change, playing a vital role in disseminating knowledge and outreach initiatives related to the management of diabetes in children.[7, 8]

Results of a study conducted in the United States show that the utilisation of a mobile application for blood sugar monitoring demonstrated a positive impact on enhancing blood sugar control in children diagnosed with type 1 diabetes.[7] Another study conducted in Canada revealed that the utilisation of a calorie-counting app can contribute to enhancing children's comprehension of healthy eating patterns.[9] Similarly, research conducted in Italy demonstrated that engaging children with type 1 diabetes in interactive games can be effective in promoting increased physical activity.[10]

The management of diabetes in children necessitates collaborative efforts and coordination among parents, medical professionals, nutritionists and technology for information and communication. Technology, specifically information and communication technology (ICT), assumes a pivotal role in paediatric diabetes management when it provides essential information and tools. Establishing appropriate dietary patterns and promoting increased physical activity are crucial components for monitoring the health condition of children with diabetes. Moreover, the knowledge possessed by students becomes highly significant in the management of paediatric diabetes. As prospective healthcare professionals, they possess the requisite knowledge and skills essential for paediatric diabetes management. Furthermore, students have access to the latest information regarding diabetes management and the most recent technological advancements applicable to the management of diabetes in children.[11]

As catalysts for societal transformation, health students can offer education and outreach initiatives regarding the management of diabetes in children to various segments of society, encompassing parents, teachers and friends of children with diabetes. Through this approach, the knowledge held by students can play a pivotal role in heightening public awareness concerning the significance of diabetes management in children and fortifying social support networks for those children affected by diabetes.[12-14]

Nonetheless, health students may encounter several potential challenges related to the utilisation of ICT in the management of type 1 diabetes in children. These challenges encompass limitations in knowledge and skills about the latest technological advancements, as well as constraints in accessing timely updates and adequate health facilities.[8, 15]

A preceding study indicated that students generally possess commendable knowledge concerning type 1 diabetes in children; nevertheless, their awareness regarding the latest technological advancements applicable to diabetes management remains somewhat restricted. Additionally,

Mustamu. Scr Med. 2024 Jan-Feb;55(1):33-42.

35

research suggests that students may encounter challenges in effectively navigating blood sugar monitors and insulin pumps, potentially impeding the optimal management of type 1 diabetes in children.[7, 8, 15]

In the realm of paediatric diabetes management, student knowledge assumes a crucial role in leveraging ICT to enhance blood sugar control and mitigate the risk of complications. The augmentation of knowledge and skills among students in utilising ICT coupled with familial and environmental support, has the potential to significantly amplify the effectiveness of paediatric diabetes management.[16-19]

This research distinguishes itself from previous studies as it focused on exploring the perceptions and utilisation of ICT in managing diabetes in children among Indonesian health students. The researcher's goal was to delve into methodological perspectives and introduce innovative approaches, setting them apart from existing studies. The primary objective of the study was to elucidate the perceptions and utilisation of ICT in the management of diabetes in children among students in Indonesia. The anticipated outcomes aimed to provide additional information and enhance understanding regarding the application of ICT in paediatric diabetes management. Moreover, the research indicated potential benefits for parents, children, healthcare professionals (doctors and nurses) and experts, contributing to the improvement of diabetes management in children.

Methods

This study was a cross-sectional study. The study was carried out at the Health Polytechnic of the Ministry of Health. Data collection was carried out in March 2023 through distributed questionnaires *via WhatsApp*.

Participants

The Health Polytechnic under the Ministry of Health provided bachelor's and diploma programs tailored for health students with interests in nutrition, nursing and midwifery. The study subjects consisted of willing participants who fulfil specific criteria related to their knowledge about the treatment of diabetes in children. The selection of participants was conducted based on their availability and their ability to meet the qualifying requirements pertinent to the subject matter, ensuring a suitable cohort for the study.

Variables

The research outcomes encompassed the effectiveness of managing diabetes in children, with a primary focus on the utilisation of ICT in the management process. Predictors and potential challenges included demographic factors such as type, gender, marital status and semester level, along with knowledge about diabetes in children and perceptions and utilisation of ICT in the management of paediatric diabetes. Additionally, effect modification explored the interaction between these factors, shedding light on their interconnected influences in the context of paediatric diabetes management.

Source of data

Data for this study were gathered using a questionnaire designed through *Google Forms*. The questionnaire comprised several sections, including respondent identity, knowledge about diabetes in children, perceptions and utilisation of ICT in paediatric diabetes management, levels of ICT use in diabetes management for children, factors influencing perception and ICT use and the effectiveness of ICT utilisation in managing diabetes in children. All questions in the questionnaire utilised a Likert scale, with response options ranging from 1 to 5, indicating varying degrees of agreement or disagreement.

Bias

Attempts made to overcome internal bias in a potential study included giving the same opportunity to all student nurses, nutritionists and midwives to become respondents, testing the validity and reliability of the instrument before data collection, delivering an explanation of intent and purpose to the candidate respondent before filling out the questionnaire and using an inside Likert scale question. Method structural equation modelling—partial least squares (SEM-PLS) analysis was also used to control influence factors and troublemaker potential. Ten samples for each variable were used, following the minimum sample rule of regression analysis, or structural equation modelling with partial least squares. Quantitative variables in this study were managed through statistical analysis methods, encompassing both univariate and multivariate analyses. Univariate analysis examined individ-

36

Mustamu. Scr Med. 2024 Jan-Feb;55(1):33-42.

ual variables independently, providing insights into their individual characteristics and distributions. On the other hand, multivariate analysis considered the simultaneous relationships between multiple variables, allowing for a more comprehensive understanding of the interplay among them in the context of the study. This dual approach facilitated a nuanced and thorough examination of the quantitative variables within the research framework.

Statistical analyses

Univariate analysis was employed to assess the characteristics of the respondents using statistical software, specifically Jamovi. This analysis allowed for the measurement of individual variables independently, providing a detailed examination of respondent attributes. In contrast, multivariate analysis utilised structural equation modelling with the partial least squares method. The SEM-PLS method was applied to model the relationships between influencing factors, the utilisation of ICT in paediatric diabetes management and its effectiveness in disease management. Additionally, SEM-PLS was utilised to control for influencing factors and potential challenges in the study, offering a comprehensive understanding of the interconnected variables within the research framework.

Data collection were carried out through a *Google Forms* questionnaire, therefore no data were lost.

Results

Demographic characteristics of research participants

The study encompassed 103 respondents who participated in the survey; however, two respondents were unwilling and 32 respondents lacked any information about the management of diabetes in children. Consequently, 69 individuals responded to the survey. The majority of respondents were female (95.7 %), with an average age of 19.7 years. Additionally, the majority were unmarried (98.6 %). Respondents exhibited diverse educational backgrounds, with bachelor's programs in midwifery (34.8 %) and nursing diploma programs (26.1 %) being predominant. Regarding internet usage, respondents tended to use the internet moderately, with an average fre-

quency rating of 3.94 on a scale of 1 to 5. The majority of respondents (94.2 %) reported having partial internet access and facilities. However, a notable proportion (92.8 %) lacked experience in working or undergoing an apprenticeship related to the management of diabetes in children. The data is presented in Table 1.

Table 1: Demographic characteristic of the participants

Variable	Value	
Age	**Mean (SD), min-max**	
Years	19.7 (1.51), 17-24	
Gender	**N**	**%**
Man	3	4.3
Woman	66	95.7
Marital status	**N**	**%**
Single	68	98.6
Married	1	1.4
Study program	**N**	**%**
Nutrition diploma	5	7.2
Midwifery diploma	9	13.0
Nursing diploma	18	26.1
Bachelor midwifery	24	34.8
Bachelor nursing	13	18.8
Frequency of the Internet usage	**Mean (SD), min-max**	
Likert scale (1-5)	3.94 (1.14), 1-5	
Internet access and facilities	**N**	**%**
Available	65	94.2
Not available	4	5.8
Experience	**N**	**%**
No	64	92.8
Yes	5	7.2

Experience: Work or apprentice involved in management of diabetes in children;

Validity and reliability instrument

The research outcomes indicated that all the measured constructs in the study exhibited high reliability, as evidenced by Cronbach's alpha values surpassing 0.7. This observation underscored that the questions within the research instrument exhibited commendable internal consistency, rendering them dependable for measuring the intended constructs. Furthermore, the Pearson moment validity test results demonstrated significant correlations between all constructs and the measured questions. This finding affirmed the validity of the instrument in effectively capturing the desired constructs in the study. The data is presented in Table 2.

Outer loading

The results of the outer loading test were robust, revealing that all examined questions in this study exhibit outer loading values surpassing 0.7. This signified that each question makes a signifi-

■ Mustamu. Scr Med. 2024 Jan-Feb;55(1):33-42.

37

Table 2: *Validity and reliability tests*

Question	Pearsons (r)
Understanding about diabetes in children (Cronbach's α = 0.900)	
I have enough knowledge about diabetes symptoms in children.	0.746
I know the right method to prevent complications of diabetes in children.	0.866
I understand the possible complications that happen as a consequence of diabetes in children.	0.913
I understand how to manage diabetes in children, including arrangements for eating and drinking as well as recommended exercise.	0.861
I always look for the latest information about diabetes in children so that I can give optimal care.	0.839
Perceptions about the use of technology, information and communication (ICT) in the management of diabetes in children (Cronbach's α = 0.952)	
I feel ICT is very helpful in the management of diabetes in children.	0.839
I'm sure that ICT can help monitor blood sugar levels in children with diabetes.	0.950
I believe that ICT can help arrange diets in children with diabetes.	0.924
I feel that using ICT can help parents better understand the management of diabetes in children.	0.951
I argue that using ICT can help increase the quality of life in children with diabetes.	0.924
Utilisation rate of ICT in the management of diabetes in children (Cronbach's α = 0.897)	
I often use mobile applications to monitor the blood sugar levels of children with diabetes.	0.815
I feel comfortable using ICT in the management of diabetes in children.	0.884
I have been using social media to look for information related to the management of diabetes in children.	0.867
I feel helped by the existence of ICT in the eating patterns of children with diabetes.	0.781
I often look for the latest information about the management of diabetes in children through websites or applications.	0.869
Influencing factors: perception and utilisation of ICT in the management of diabetes in children (Cronbach's α = 0.938)	
I believe that using ICT is very helpful for managing diabetes in children.	0.916
I feel ICT is very helpful in monitoring blood sugar levels in diabetic children.	0.880
I feel I can easily access information about ICT for managing diabetes in children.	0.866
I feel I have sufficient skills in using ICT for the management of diabetes in children.	0.917
I feel ICT can help reduce the risk of complications in children with diabetes.	0.903
Effectiveness of using ICT in the management of diabetes in children (Cronbach's α = 0.958)	
I believe that using ICT can help control blood sugar in children with diabetes.	0.919
I believe that using ICT can help reduce the risk of complications in children with diabetes.	0.949
I feel comfortable using ICT in the management of diabetes in children.	0.948
I'm sure that using ICT can improve the quality of life for a child with diabetes.	0.896
I will recommend to the families of patients with diabetes that they use ICT during their care.	0.916

cant contribution to the intended construct. Outer loading values exceeding 0.7 suggested that the questions effectively represent the measured constructs and contributed substantially to the measurement of those constructs. Consequently, the outcomes of the outer loading test affirmed that the research instrument employed in this study possessed strong validity. The robust relationship between each question and its measured construct instilled confidence in the instrument's capability to reliably measure the desired constructs within the context of managing diabetes in children. The data is shown in Figure 1.

Criteria quality

The R-square quality indicates that the model utilised in this study exhibited a commendable ability to elucidate the variation in the dependent variable based on the independent variables employed. This suggested that the model was robust and reliable in analysing and predicting
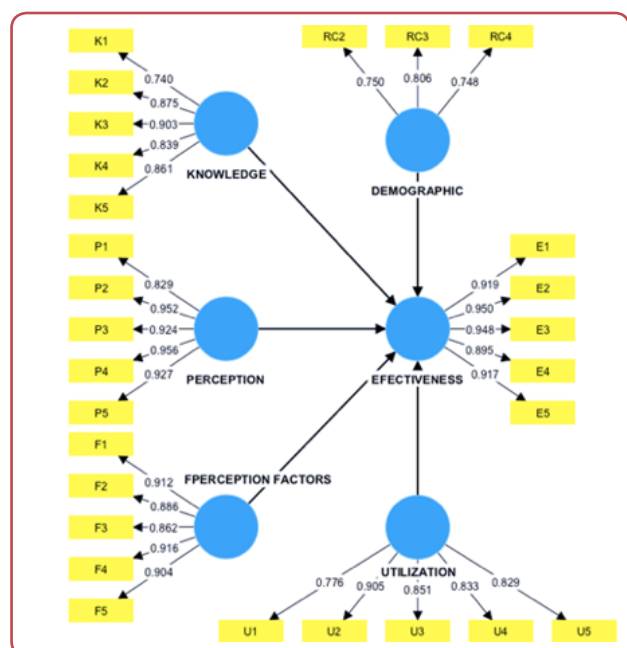

Figure 1: *Outer loading test: the research instrument employed possessed strong validity*

the connections between the variables involved in the management of diabetes in children. The high R-square value signified the proportion of variability in the dependent variable that was explained by the independent variables, underscoring the model's effectiveness in capturing and understanding the relationships within the context of paediatric diabetes management. The data is presented in Table 3.

Table 3: R-square quality criteria analysing the model ability to analyse and predict the connections between the variables involved in the management of diabetes in children

Variable	R-square	Adjusted R-square
Effectiveness	0.816	0.801

Validity and reliability construct

The results of the validity and reliability tests indicated that the research instrument utilised in this study demonstrated good reliability and validity. The reliability assessment, conducted using Cronbach's alpha method, revealed that all constructs exhibited values exceeding 0.7, indicating a commendable level of internal consistency. Demographic constructs, including gender, marital status and semester level, as well as utilisation, knowledge, perception factors, perception and effectiveness, exhibited high reliability with Cronbach's alpha values of 0.665, 0.898, 0.900, 0.939, 0.953 and 0.958, respectively.

These findings affirmed that the questions employed in the research instrument align consistently with the intended constructs. Additionally, the results of the construct validity, assessed through the Rho a and Rho c methods, also demonstrated high values across all constructs. The Rho a values range between 0.668 and 0.961, while the Rho c values range between 0.812 and 0.968. This underscored that each question within the construct maintained a significant relationship with the construct under measurement, highlighting coherence among the questions within each construct.

Furthermore, the average variance extracted values substantiated the construct validity, with average variance extracted (AVE) values ranging from 0.590 to 0.858. The elevated AVE values affirmed that the variables within each construct effectively explained the variation in the respective constructs. The data is presented in Table 4. Based on the presented table, it was deduced that the research instrument employed in this study

was a reliable and valid tool for measuring the intended constructs. This instilled confidence in the results of measurements and analyses conducted using such instruments, thereby providing a basis for trust in the interpretation and generalisation of research findings.

Table 4: Validity and reliability construct of the researched instrument

Variable	Cronbach's alpha	Rho a	Rho c	AVE
Demographics	0.665	0.668	0.812	0.590
Utilisation	0.898	0.934	0.923	0.706
Knowledge	0.900	0.926	0.926	0.715
Perception factors	0.939	0.942	0.953	0.803
Perception	0.953	0.961	0.964	0.844
Effectiveness	0.958	0.959	0.968	0.858

AVE: average variance extracted;

The results of the inner model test, as determined by the p-values, lead to the conclusion that there exists a significant association between the constructs of perception factors, perception and effectiveness within the given context. The p-value obtained for both perception factors and perception constructs was < 0.001, signifying a statistically significant connection with the effectiveness construct.
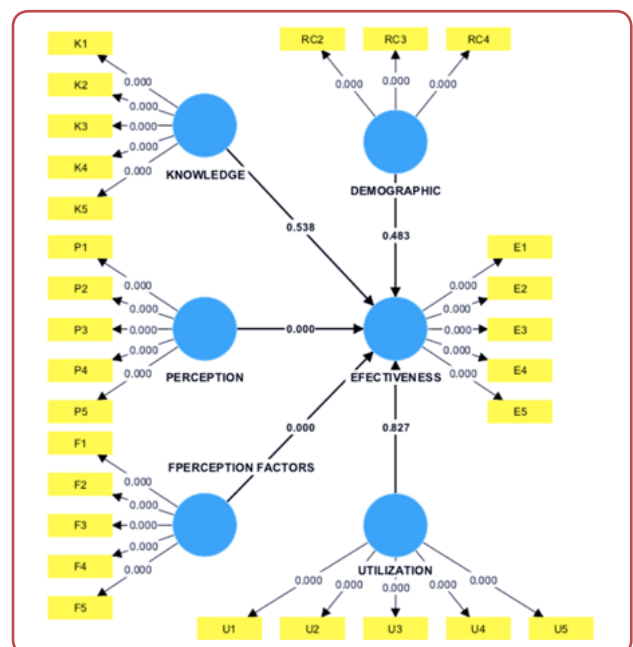

Figure 2: Inner model analysing the association between the constructs of perception factors, perception and effectiveness within the given context

Conversely, the p-value test results for demographic constructs (gender, marital status and semester level), utilisation and knowledge reveal higher values, namely 0.483, 0.827 and 0.538,

■ Mustamu. Scr Med. 2024 Jan-Feb;55(1):33-42.

39

respectively. These values suggested that demographic factors (gender, marital status and semester level), technology utilisation and knowledge about diabetes in children did not exert a significant influence on the effectiveness of the management of diabetes in children. The data are presented in Figure 2.

Based on these findings, it can be concluded that factors influencing perception, such as the utilisation of technology for information and communication, along with perceptions regarding technology utilisation, played a pivotal role in enhancing the effectiveness of diabetes management in children. However, demographic factors (gender, marital status and semester level), technology utilisation and knowledge about diabetes in children did not exert a significant influence on the study's effectiveness.

Discussion

The management of diabetes in children is a critical aspect that necessitates an effective strategy.[7, 8, 20, 21] This study endeavours to elucidate the perceptions and utilisation patterns of ICT in the management of paediatric diabetes among students in Indonesia. The research findings underscore that perceptions and adept utilisation of ICT have a substantial impact on the efficacy of diabetes management in children. Specifically, maintaining a positive perception and leveraging technology for information dissemination and communication emerged as pivotal factors contributing to enhanced management effectiveness. Conversely, demographic variables such as gender, marital status and semester level, alongside considerations of technology use and knowledge regarding paediatric diabetes were not found to exert a statistically significant influence on the effectiveness of management practices.

The study revealed several noteworthy findings. Firstly, it highlighted the crucial role of ICT in the management of diabetes in children. The effective utilisation of technology substantially enhances the efficacy of diabetes management, underscoring the necessity of integrating technology into strategies for diabetes care. Furthermore, the study emphasise that factors such as the perception and utilisation of technology wield greater influence than demographics and knowledge. This observation aligns with previous research

indicating that knowledge, perception and technology utilisation are pivotal elements in the effective management of diabetes in children.[22]

However, some studies, like that of Berndt et al, found no significant relationship between technology use and diabetes management effectiveness.[23] This discrepancy may be due to variations in research samples and methods. Similarly, research by Ng et al suggests that technology's impact on diabetes management may be limited due to social and psychological factors. Therefore, a holistic approach is needed in addition to technology use.[24]

The utilisation of SEM-PLS as a statistical method for multivariate analysis bestows a significant advantage in this study. This approach enables a comprehensive understanding of the intricate relationships among the variables under investigation. In the context of this study, SEM-PLS not only reveals the correlation between the utilisation of ICT in the management of diabetes in children and the effectiveness of disease management but also assists in identifying factors influencing ICT utilisation and potential challenges within this context. The strength of SEM-PLS is particularly evident in its ability to address complex, non-linear models, a common occurrence in research involving multiple independent and dependent variables.

Additionally, the meticulous handling of data through the use of *Google Forms* as a data server is a pivotal aspect of this study. This approach ensures the preservation of data integrity, preventing any loss or fragmentation of data during the processes of data collection and storage. This not only upholds the veracity of the data but also ensures that analyses are conducted with comprehensive and accurate datasets. Hence, the adoption of SEM-PLS in multivariate analysis and the judicious data management executed *via Google Forms* constitute two crucial facets that underpin the validity and excellence of this research.

This study has several limitations, notably the constrained sample size comprising student midwives, nutritionists and nurses. To enhance the generalisability of the findings, future research endeavours should encompass a more extensive and diverse participant pool. The utilisation of self-report questionnaires introduces potential response bias; hence, incorporating objective measures such as blood sugar levels is imperative for ensuring the reliability of results. To mitigate

40

Mustamu. Scr Med. 2024 Jan-Feb;55(1):33-42.

these limitations, forthcoming research should consider enlarging the sample size, adopting objective data collection methodologies and evaluating the direct influence of technology on diabetes management.

Presented study proposes the hypothesis that increased utilisation of ICT in diabetes management by midwifery students, nutritionists and nurses leads to better blood sugar control and reduced complications in children with diabetes. Future research should test this hypothesis with larger samples and objective measures, considering various influencing factors in diabetes management. The implications of this research are significant. It highlights the need to enhance the understanding and skills of midwifery, nutrition and nursing students in using ICT for diabetes management. Creating a supportive environment with adequate infrastructure and training is crucial. Moreover, the findings provide a foundation for targeted interventions and policies to improve diabetes management through ICT, benefiting children with diabetes.

Conclusion

This study indicates that the utilisation of information technology in managing diabetes in children by student midwives, nutritionists and nurses holds significant potential to enhance the effectiveness of managing this condition. The findings underscore the crucial relationship between knowledge, perception and the utilisation of information technology, emphasising their pivotal role in managing childhood diabetes. However, there are limitations in this study, such as the limited sample size and reliance on self-reported data by respondents. To enhance future research, it is recommended to involve a more diverse sample representation and employ more objective methods of data collection. Despite its limitations, this research makes a significant contribution to understanding the role of technology in managing childhood diabetes. Its findings can shape more effective clinical practices and policies, emphasising the importance of a holistic approach involving knowledge enhancement, fostering a positive attitude toward technology and actively utilising technology in managing diabetes in children.

Ethics

Acknowledgement

Conflicts of interest

The author declares that there is no conflict of interest.

Funding

■ Mustamu. Scr Med. 2024 Jan-Feb;55(1):33-42.

41

Data access

The data that support the findings of this study are available from the corresponding author upon reasonable individual request.

Author ORCID numbers

Alva Cherry Mustamu (ACM):
0000-0002-6682-514X

Author contributions

Contributed to the conceptualisation, methodology development, software, validation, formal analysis, investigation, resource management, data curation, original draft writing, revision and visualisation aspects in this research: ACM

References

1. Pulungan AB, Fadiana G, Annisa D. Type 1 diabetes mellitus in children: experience in Indonesia. Clin Pediatr Endocrinol. 2021;30(1):11-8. doi: 10.1297/cpe.30.11.

2. Rochmah N, Faizi M, Hisbiyah Y, Perwitasari RK, Nuzula TM, Endaryanto A, et al. Analysis of the ZNT8, GAD65, HLA-DQA1, HLA-DQB1, and C-peptides in Indonesian children with type 1 diabetes mellitus. Int J Health Sci. 2022;6(S9):1927–36. doi: 10.53730/ijhs.v6nS9.12857.

3. Agustini N, Nurhaeni N, Pujasari H, Abidin E, Lestari AW, Kurniawati A. Family support towards resilience in adolescents with type I diabetes: a preliminary study in Indonesia. Asian Pac Isl Nurs J. 2019;4(2):66-71. doi: 10.31372/20190402.1028.

4. Irawan J, Mulawardi M. An epidemiologic study on type 2 diabetic foot disorders in Indonesia -A perspective from an uncontrolled blood glucose level until amputation. JINASVS. 2020;2(1):41–5. doi: 10.36864/jinasvs.2020.2.010.

5. Zabeen B, Bhowmik B, Huda K, Naz F, Tayyeb S, Azad K. Use of telemedicine for the management of type 1 diabetes in children and adolescents in Bangladesh during the COVID-19 pandemic. J Diabetol. 2021;12(1):18-21. doi: 10.1016/j.diabres.2023.110809.

6. Ferrito L, Passanisi S, Bonfanti R, Cherubini V, Minuto N, Schiaffini R, et al. Efficacy of advanced hybrid closed loop systems for the management of type 1 diabetes in children. Minerva Pediatr (Torino). 2021 Dec;73(6):474–85. doi: 10.23736/S2724-5276.21.06531-9.

7. Monaghan M, Bryant BL, Inverso H, Moore HR, Streisand R. Young children with type 1 diabetes: recent advances in behavioral research. Curr Diab Rep. 2022;22(6):247–56. doi: 10.1007/s11892-022-01465-0.

8. Chiang JL, Maahs DM, Garvey KC, Hood KK, Laffel LM, Weinzimer SA, et al. Type 1 diabetes in children and adolescents: a position statement by the American Diabetes Association. Diabetes Care. 2018 Sep;41(9):2026–44. doi: 10.2337/dci18-0023.

9. Brown JM, Franco-Arellano B, Froome H, Siddiqi A, Mahmood A, Arcand J. The content, quality, and behavior change techniques in nutrition-themed mobile apps for children in Canada: app review and evaluation study. JMIR Mhealth Uhealth. 2022 Feb 16;10(2):e31537. doi: 10.2196/31537.

10. Brew-Sam N, Chhabra M, Parkinson A, Hannan K, Brown E, Pedley L, et al. Experiences of young people and their caregivers of using technology to manage type 1 diabetes mellitus: systematic literature review and narrative synthesis. JMIR Diabetes. 2021 Feb 2;6(1):e20973. doi: 10.2196/20973.

11. Hanberger L, Ludvigsson J, Nordfeldt S. Use of a web 2.0 portal to improve education and communication in young patients with families: randomized controlled trial. J Med Internet Res. 2013 Aug 23;15(8):e175. doi: 10.2196/jmir.2425.

12. Pansier B, Schulz PJ. School-based diabetes interventions and their outcomes: a systematic literature review. J Public Health Res. 2015 Apr 15;4(1):467. doi: 10.4081/jphr.2015.467.

13. Nannsen AØ, Kristensen K, Johansen LB, Iken MK, Madsen M, Pilgaard KA, et al. Management of diabetes during school hours: a cross-sectional questionnaire study in Denmark. Healthcare (Basel). 2023 Jan 13;11(2):251. doi: 10.3390/healthcare11020251.

14. Kang H, Ahn Y, Lee JE, Sohn M. School nurses' management for children and adolescents with diabetes. Child Health Nurs Res. 2015;21(2):176–82. doi: 10.4094/chnr.2015.21.2.176.

15. Hatun Ş, Yeşiltepe Mutlu G, Gökçe T, Avcı Ö, Yardım N, Aycan Z, et al. Care and support of children with type 1 diabetes at school: the Turkish experience. J Clin Res Pediatr Endocrinol. 2021 Dec;13(4):370–4. doi: 10.4274/jcrpe.galenos.2021.2021.0060.

16. David S. Knowledge discovery technique for web-based diabetes educational system. J Health Med Informat. 2010;1:102. doi:10.4172/2157-7420.1000102.

17. Fontecha J, González I, Barragán A, Lim T. Use and trends of diabetes self-management technologies: a correlation-based study. J Diabetes Res. 2022 Jun 7;2022:5962001. doi: 10.1155/2022/5962001.

18. Odom JM, Stancil M, Nelson B, Russ-Sellers R, Schwecke N, Dawson J, et al. Improving diabetes control through remote glucose monitoring in a diabetes self-management program for employees of a health system. Clin Diabetes. 2019 Jul;37(3):203-10. doi: 10.2337/cd18-0056.

19. Dewi SC, Kurniasari R. Pengrauh Edukasi Menggunakan Media Leaflet dan Website terhadap Pengtahuan Mahasiswa Mengenai Faktor Risiko Diabetes Mellitus. JUKMAS 2022 Oct;6(2):106–12. Indonesian.

20. Hart RI, Kimbell B, Rankin D, Allen JM, Boughton CK, Campbell F, et al. Parents' experiences of using remote monitoring technology to manage type 1 diabetes in very young children during a clinical trial: Qualitative study. Diabet Med. 2022 Jul;39(7):e14828. doi: 10.1111/dme.14828.

21. Peters AL, Ahmann AJ, Hirsch IB, Raymond JK. Advances in glucose monitoring and automated insulin delivery: supplement to endocrine society clinical practice guidelines. J Endocr Soc. 2018 Oct;2(11):1214–25. doi: 10.1210/js.2018-00262.

22. Chinnici D, Middlehurst A, Tandon N, Arora M, Belton A, Reis Franco D, et al. Improving the school experience of children with diabetes: Evaluation of the KiDS project. J Clin Transl Endocrinol. 2018 Dec;15:70–5. doi: 10.1016/j.jcte.2018.12.001.

23. Berndt RD, Takenga C, Preik P, Kuehn S, Berndt L, Mayer H, et al. Impact of information technology on the therapy of type-1 diabetes: a case study of children and adolescents in Germany. J Pers Med. 2014 Apr;4(2):200–17. doi: 10.3390/jpm4020200.

24. Ng SM, Finnigan L, Connellan L, Kiernan C, Coward S. Improving paediatric diabetes care with the use of an integrated paediatric electronic diabetes information management system and routine uploading of blood glucose meters and insulin pumps in outpatient clinics. Arch Dis Child. 2014 Nov;99(11):1059. doi: 10.1136/archdischild-2014-307021.