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Editorial

Announcing the launch of *Journal of International Nursing Research*

Naohiro Hohashi, PhD, RN, PHN, FAAN[1, 2]

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Those of us in the nursing professions are on the verge of a new beginning. In 2021, the Japan Society of Nursing Research (JSNR), a nursing study group with a long and distinguished history, will launch *Journal of International Nursing Research* (*JINR*) as an international English-language publication.

As the founding editor-in-chief of *JINR*, it is my great honor to be associated with this important undertaking. In connection with the inaugural edition of *JINR*, I would like to express my thanks for the support of the directors and auditors of JSNR, as well as to all of you who contributed your time. In particular, I am indebted to JSNR President Kiyoko Fukai for her understanding that brought about the creation of this journal. In addition, I greatly look forward to collaborating with the *JINR* Editorial Committee and international reviewers.

Since 1978, JSNR has been publishing its Japanese-language periodical, the *Journal of Japan Society of Nursing Research* (*JJSNR*). The *JJSNR* can be considered representative of academic journals in Japan, with a long history and splendid traditions. From 2014 to 2018, and from 2020 to the present, I served as an editor-in-chief. In the past *JJSNR* has published a number of English-language papers, and in 2015 was declared a multilingual publication in Japanese or English. From that point in time, guidelines were put in motion for the future publication of an English-language journal. From past and present perspectives, publication of academic papers on nursing in English has become the common practice, and this has also figured in our decision to launch *JINR*. Concurrent to this, *JJSNR* will no longer be soliciting English-language papers for publication.

As an international English-language journal, *JINR* will function as an open-access journal, with the papers that have been accepted promptly made public. Its scope will cover wide fields of nursing research, operating as a comprehensive journal not limited to any particular fields of specialization. Some years in the future we are hoping to register with PMC (PubMed Central), with the content of our papers also appearing in PubMed.

JINR is open to submissions from around the world. It welcomes original contributions on nursing studies in a variety of formats such as Review Article, Original Research, Practice Guidelines, Technical Report and Brief Report. Instructions for contributors can be viewed on the *JINR* web site (https://www.jinr.jsnr.or.jp/).

JINR sees its role as contributing to development of nursing studies on a worldwide scale. In this regard, we are determined that our enthusiasm toward nursing studies will continue to burn brightly.

We extend the warmest of welcomes to aspiring contributors, as well as to our colleagues and associates around the world, and look forward to hearing from you soon.

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Editorial

Celebrating the launch of *Journal of International Nursing Research*

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It's my honor to be invited by Professor Naohiro Hohashi to serve as the Deputy Editor for the *Journal of International Nursing Research (JINR)*. *JINR* is a brand new page transformed from the *Journal of Japan Society of Nursing Research (JJSNR)* which has a long lasting history in publishing nursing journals in Japanese. It's indeed my great honor to be a part of *JINR*, and have a share of it at this historic moment.

Changes are never easy. Taking a lead to make a change is even harder. I appreciate the courage from the Japan Society of Nursing Research to make a change, and am willing to witness such a change not just from an observer's perspective, but from a participant's point of view.

While such a change is just a beginning of the journey, I appeal to all you to join our journey, no matter which nursing specialty you are in. Setting as a new platform to us, *JINR* welcomes a wide range of submissions, including original research, practice guidelines, technical report, brief report or letter to the Editor.

With the concerted effort from the Editorial Committee, I hope together we could create a greater and higher impact in the region and towards the globe.

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Editorial

Preface to the first issue of *Journal of International Nursing Research*

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The Japan Society of Nursing Research (JSNR) was founded in 1970 with its predecessors, the Four National University Research Councils. In 1981, the name was changed to its current academic society name (JSNR), and it was established as Japan's first comprehensive academic organization for nursing science. This society aims to organize people who are widely involved in nursing science, to conduct nursing-related educational and research activities, to contribute to the progress and development of nursing science, and to contribute to the world. Our specialty, Research in Nursing, deals with various phenomena related to "human beings, health, environment, and nursing (care)." In particular, the purpose of Research in Nursing is to explore and propose hints and clues (theories) for people to live healthier and more prosperous. In other words, nursing science is a human and practical science that is close to people, which cannot be achieved without actually living people.

The most important project of this society, "*Journal of Japan Society of Nursing Research* (*JJSNR*)," was first published in 1978 as a journal written in Japanese centered on original papers, and a total of 44 volumes have already been published to date. *JJSNR* has published many valuable academic papers and has made a great contribution to the development of nursing science in Japan. The only challenge was that the valuable evidence could only be read in Japanese.

Therefore, in May 2021, the international journal, which was longed for by not only members of our society but also nurse scientists all over Japan, will finally be established. Nursing is a science that contributes to practice (applied science); therefore, papers written in Japanese are useful for busy practitioners. However, if details of high-quality nursing research that contributes to practice can only be read in Japanese, it cannot be utilized as a new finding shared by the entire world of the nursing academia because there are no borders in philosophy. Thus, the *Journal of International Nursing Research* (*JINR*) is established as a new step in the history of JSNR.

Lastly, we would like to express our deep gratitude to Dr. Naohiro Hohashi, Editor-in-Chief, for his great efforts in issuing *JINR*. This journal would not have been possible without the efforts of Dr. Hohashi. We would also like to thank the staff of Kyorinsha for their devoted cooperation. We are looking forward to the first issue of *JINR*, which will be published in May 2021. We do welcome postings from nurses (practitioners, educators, or researchers) not only in Japan but all from other countries worldwide, as well as scientists engaged in nursing research. We hope that the papers published in *JINR* will be actively utilized by many scientists and practitioners worldwide.

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Review Article

Nursing students' understanding of children with disabilities in Japanese nursing education: A literature review

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Abstract

In recent years, some Japanese nursing education facilities have started choosing facilities for children with disabilities as training sites. This provides students with a good opportunity to deepen their understanding of children with disabilities. However, there are cases in which learning nursing care for children with disabilities is difficult. In this study, we examined the literature on understanding children with disabilities in nursing education to practice effective practical training. We used CiNii, Google Scholar, PubMed, and Ichushi-Web (Ver. 5.0). For the analysis, we chose those original primary documents that described the nursing students' understanding of children with disabilities. We classified and named the summaries based on similarity. Seventeen documents on nursing students' understanding of children with disabilities were mostly analyzed through practical training in facilities for children with disabilities, and before the practical training, some students were anxious and confused. However, during the training, the students learned about the characteristics of the children's disabilities, consideration for the environment where children with disabilities live, communication methods, and so much more. The students were able to deepen their view of nursing through these experiences. It is important to reduce the anxiety of students through prior learning; teach the nursing view, in which the children's abilities are recognized and emotional interactions are valued; help students develop their independence and nursing view comfortably; show the importance of proactive nursing; and help them link their experiences to learning.

Keywords

understanding, children with disabilities, nursing education, literature review

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Introduction

In recent years, due to a shortened hospital stay and low number of pediatric wards caused by the declining birth rate, children are often admitted to general wards, making it difficult for nursing students to learn the nursing process. Consequently, some educational institutions started choosing facilities for children with disabilities as a practice site for pediatric nursing practice (Miyatani et al., 2013). Nursing care in facilities for children with severe motor and intellectual disabilities (SMID) requires qualities such as the ability to identify problems through observation, the skill to provide safe and necessary care with minimal distress, the skill to improve and enrich the quality of life, and a heart that is attentive to the feelings of children with disabilities and their families. It can be said that these characteristics are the basics of nursing (Manabe, 2011). Pediatric nursing practice at facilities for children with disabilities is a good opportu-

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nity for students to deepen their understanding of children with disabilities and learn important lessons of the basics of nursing. However, children grow and develop slowly, and there are large individual differences in their growth. There are many obstacles in pediatric nursing practice, such as difficulty in verbal communication, in understanding the child completely, and in understanding reactions due to disabilities that vary from disease to disease (Manabe, 2011). In addition, due to the changes in social conditions, such as the shift to nuclear families, students who have no experience with children with disabilities face difficulty in learning nursing for children with disabilities. In the current situation, it is meaningful to clarify the challenges nursing students face in understanding children with disabilities and learning to care for them and obtain suggestions for effective practical training. Therefore, this study aims to summarize the findings of domestic literature on nursing students' understanding of children with disabilities in nursing education.

Definition of Terms

We have defined "understanding of children with disabilities" as perceiving without prejudice the whole aspect of the persons under the age of 18 years who have considerable and continuous restrictions on their everyday and social lives (Ministry of Health, Labour and Welfare, 2008) in terms of their mind and bodily functions, body structure, activities, participation, environmental factors, and individual factors (World Health Organization, 2013).

Methods

Selecting the Target Literature

We used CiNii, Google Scholar, PubMed, and the search system "Ichushi-Web" (Ver.5.0) built by the Japan Medical Abstract Society (JAMAS) and searched the words [Kango kyōiku (nursing education)/TH or Kango kyōiku (nursing education)/AL], [Shōgai-ji (children with disabilities)/TH or Shōgai-ji (children with disabilities)/AL], and [Rikai (understanding)/TH or Rikai (understanding)/AL] in "Ichushi-Web." In CiNii and PubMed, 642 searches for nursing education, children with disabilities, and understanding were obtained, and in Google Scholar, "pediatric nursing practice" was added. We limited our search to literature published in the past 10 years to collect recent information. Of the 1,256 cases extracted, conference records and commentaries, special features, literature examinations, and literature that are not in the nursing field were excluded. Finally, the title, abstract, and text from 17 literatures on the understanding of children with disabilities by nursing students were analyzed.

We constructed a study selection flowchart adapted from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (Moher et al., 2009). The literature-selection process is shown in Figure 1. We carefully read each document using the review-matrix method of Garrard (2011) (Abe, 2012). In the analysis, we summarized the knowledge collected from each literature regarding how nursing students' understanding and guidance of children with disabilities and occur in nursing education. In addition, we focused on the changes that occurred before, during, and after the training. We also analyzed the environment where the children with disabilities reside to reveal where and how nursing students develop their understanding of children with disabilities. We analyzed and summarized the literatures using the content analysis technique of Krippendorff (1980) (Mikami et al., 2003). We classified and named the summaries based on similarity. In the selection and categorization of the literatures, bias risks were discussed and decided by two researchers until a consensus was reached (Figure 1).

Ethical Considerations

To avoid copyright infringement, we have ensured that citations and references are specified.

Results

Figure 2 provides the published years of the 17 targeted literatures. The year 2011 has the most number of cases ($n = 4$), whereas the remaining years vary, not showing any significant difference (Figure 2). Of our 17 targeted literatures, the research subjects comprised of 2 nurses and 15 nursing students.

The literature analysis revealed that there was only one study in which a parent of an individual with SMID provided lectures to the students. The others were all learning in practical training at facilities for children with disabilities and clinical training.

We examined the students' understanding of children with disabilities, with a focus on the changes that occurred before, during, and after training. We classified and named the contents summarizing the knowledge we collected from the 17 studies on the understanding of children with disabilities by nursing students in the nursing education field. Subsequently, the following three categories were extracted: anxiety and confusion before training, learning about children with disabilities at training, and what training leaders must keep in mind. Table 1 lists the 17 literatures and the descriptions of the categories mentioned.

1. Anxiety and Confusion before Training

First, we analyzed the learning process of the practical pediatric nursing training of two students. One student showed a slightly negative reaction on hearing that he will be training with children with motor and intellectual disabilities, although he had mentioned his affinity toward children and

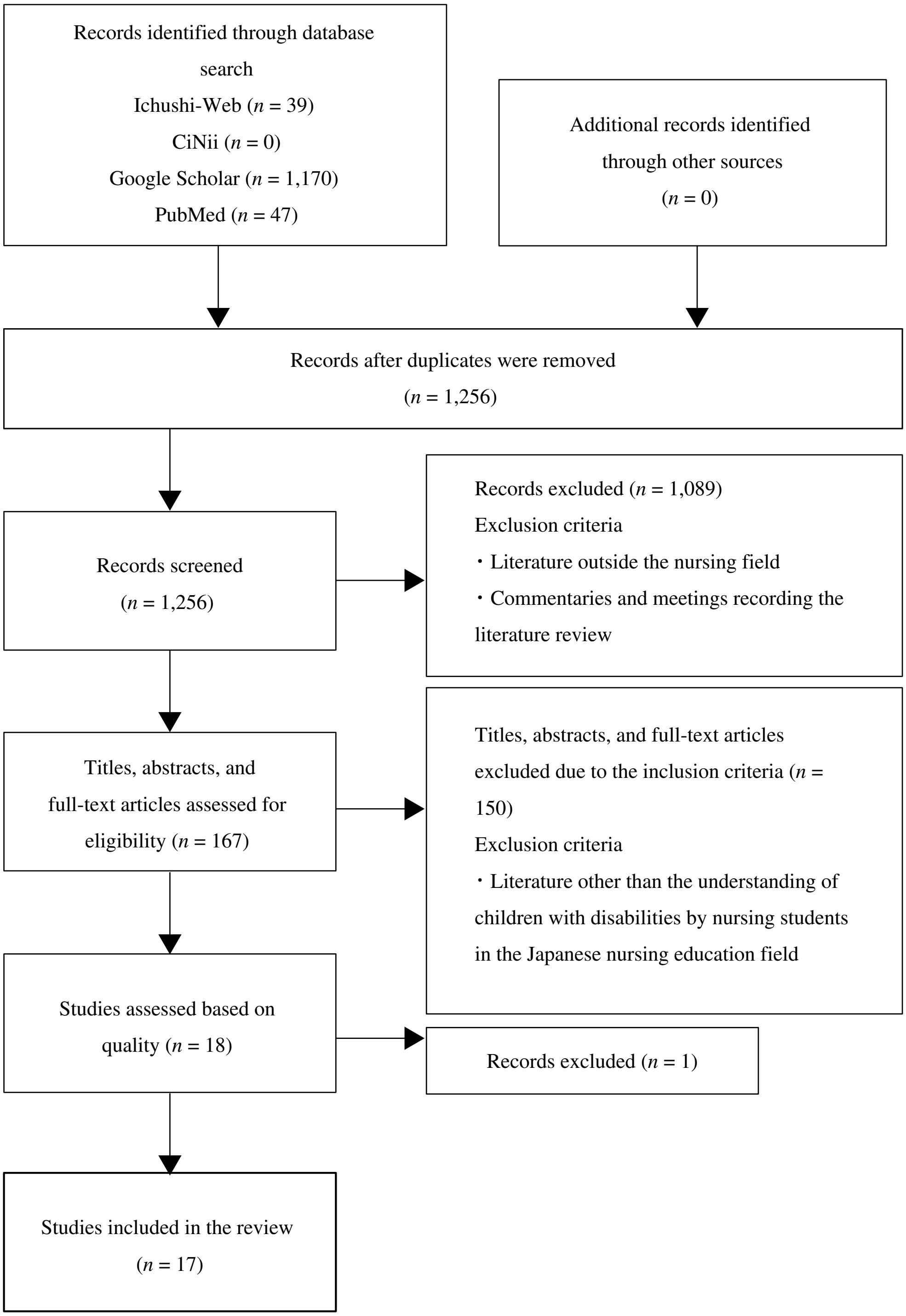

Figure 1. Study selection flowchart adapted from preferred reporting items for systematic reviews and meta-analyses (prisma).

desire to become a nursery teacher beforehand. The student was surprised, hesitant, and anxious when he met the children and noticed their deformities, knowing that they have communication difficulties and minimum facial expressions. The other student who had previously interacted with individuals with motor and intellectual disabilities did not display any signs of anxiety or negative reactions when meeting the children; however, it was reported that this student also faced difficulty in understanding the children (Harada & Tsuji, 2013). In the student questionnaire, "anxiety before training" was significantly higher in the wards for children with SMID, with an average of 4.5 ± 1.0, than in the general ward, with an average of 3.1 ± 1.1. However, the averages of "anxiety after the first day of training" were 2.9 ±

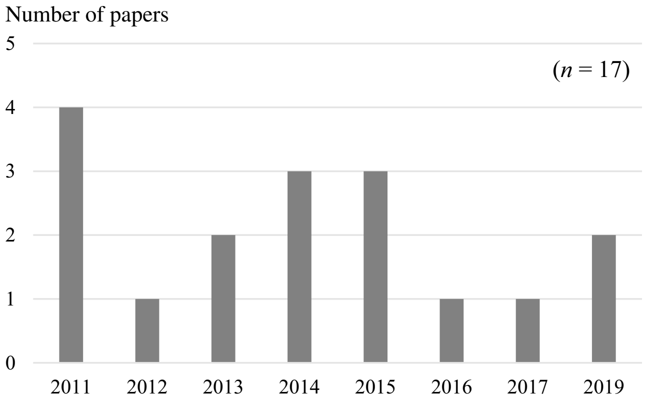

Figure 2. Publication years.

1.1 and 2.8 ± 1.2, showing no significant difference (Shinozawa et al., 2015). There were also reports on students being confused when trying to picture children with SMID before practical training (Sugimoto et al., 2015), and it became clear that the students felt anxious and confused before practical training.

2. Learning about Children with Disabilities at Training

In the study in which a parent of an individual with SMID provided lectures to students, a student said that he/she was taught about the feelings of parents naturally present regardless of the child's disabilities, making the student feel resentful toward the social environment and lack of public support for people with disabilities. The student stated that, as an aspiring nurse, he/she want to do his/her best to become an understanding person (Sadakane & Haisa, 2011).

During the practical training at the facility for children with disabilities, the students learned to understand the characteristics of children with disabilities (Nakata, 2019; Fujiwara et al., 2015; Matsushita & Kinjo, 2014; Okada et al., 2014; Hara et al., 2012; Nagashima et al., 2010; Sugimoto et al., 2015; Nakata, 2019); the importance of providing a safe, secure, and comfortable living environment (Nakata, 2019; Fujiwara et al., 2015; Hara et al., 2012; Hosoya & Nobusato, 2011; Shinozawa et al., 2015; Ogata & Aihara, 2016; Nagashima et al., 2010; Sugimoto et al., 2015); the importance of trusting relationships (Matsushita & Kinjo, 2014); how to interact with children with disabilities to overcome communication difficulties (Ogata & Aihara, 2016; Sugimoto et al., 2015; Hosoya & Nobusato, 2011); and the necessary nursing assistance based on their growth and development (Nakata, 2019; Shinozawa et al., 2015; Fujiwara et al., 2015; Okada et al., 2014; Hara et al., 2012; Hosoya & Nobusato, 2011; Nagashima et al., 2010), which included playing (Matsushita & Kinjo, 2014) and learning in training situations (Ogata & Aihara, 2016). The students also learned about the importance of understanding and supporting families with children with SMID (Nakata, 2019; Ogata & Aihara, 2016; Sadakane & Haisa, 2011; Fujiwara et al., 2015; Matsushita & Kinjo, 2014; Takahashi & Watanabe, 2011), the need for social support (Takahashi & Watanabe, 2011), and the importance of multidisciplinary cooperation (Nakata, 2019; Ogata & Aihara, 2016; Okada et al., 2014; Sugimoto et al., 2015; Hosoya & Nobusato, 2011). They were also able to recognize the role of nurses (Shinozawa et al., 2015; Okada et al., 2014; Sugimoto et al., 2015; Matsushita & Kinjo, 2014) and deepen their view of nursing (Sugimoto et al., 2015; Fujiwara et al., 2015; Wakase & Yamamoto, 2012; Hosoya & Nobusato, 2011; Sadakane & Haisa, 2011) while realizing their own challenges (Hara et al., 2012; Nagashima et al., 2010).

3. What Training Leaders Kept in Mind

As noted by the practical training instructors, it was suggested that having students understand children with SMID through enhanced prior learning and orientation using videos before starting the practical training is necessary (Sugimoto et al., 2015). In clinical practice, the supervising nurse showed the best ways of interaction to help students understand the importance of being in their usual physical state, worked with them on interactions that would be difficult for the students to do alone, and encouraged them to touch the children to help them approach without fear. The practical training instructors also suggested that the nursing students hug the child to bring them closer together mentally and encouraged the students to understand and relate to the background of the children with SMID (Todo, 2019). Furthermore, they conveyed the importance of accepting each child as they are (Nakata, 2019), the importance of seeing disabilities as the child's individuality, and the nursing view that recognizes the child's abilities while valuing any emotional interaction with the child (Wakase & Katada, 2017). The instructors praised and developed the students' positive aspects, implemented teaching methods that enabled the students to express their thoughts (Wakase et al., 2014), accepted the students, and were conscious of creating a comfortable atmosphere (Wakase & Katada, 2017). Furthermore, it was suggested that there is a need for educational involvement by teachers and instructors to aid students in adding explanations to what they see and consciously consider and learn from it (Fujiwara et al., 2015), as well as the need to give meaning to the importance of proactive nursing for preventing things getting worse (Todo, 2019).

Discussion

Children with disabilities are stigmatized by mainstream health professionals (Pelleboer-Gunnink et al., 2017), and the lack of nursing education has been pointed out in countries other than Japan (Lynn et al., 2018). Nursing education is important for nursing students to understand children with disabilities to overcome stigma and provide high-quality care for children with disabilities. In recent years, due to the status of pediatric nursing training, practical training in facilities for children with disabilities is becoming more common, and interest in the domestic literature on nursing students' understanding of children with disabilities in nursing education continues. To understand children with disabilities, in nursing education, most of the learning was from practical training, except for one analysis of learning from a lecture by a parent of a child with SMID. This shows that most of the facilities for children with disabilities are places for learning and are the main focus of understanding for children with disabilities. We regarded and focused on the changes that had occurred in the students' understanding of children with disabilities before, during, and after training. Subsequently, it was observed that the nursing students were unable to picture children with disabilities before the training and were anxious and confused.

Many universities are providing prepractice measures to increase the effectiveness of practical training (Miyatani et al., 2013). To effectively derive learning effects from practical training at facilities for children with disabilities, which is the core of nursing students' understanding of children with disabilities, aimed toward students who are greatly nervous and anxious (Matsumoto & Tomioka, 2018), there are also enhanced prestudy and orientation sessions that use video to counter the negative images. We believe that this is also an important preparation for understanding children with disabilities. We analyzed what the nursing students were learning during the training.

During their practical training at facilities for children with SMID, the students learned about the characteristics of the children's disabilities, consideration for the environment in which they live, communication methods and how to interact with them, care based on growth and development, family support, and a multidisciplinary approach. Nursing care at facilities for children with SMID is a multifaceted nursing practice, which can be considered the basics of nursing (Manabe, 2011). Through a great deal of learning, they were able to recognize the role of nurses and deepen their views on nursing. This indicates that practical training in facilities for children with SMID is an important training for nursing students, not only for understanding nursing care for children with disabilities but also for developing nursing views.

Clinical supervisors and teachers need to understand and accept students' feelings of nervousness, anxiety, and confusion and must try to interact with them in a way that will help them learn effectively and deeply (Matsumoto & Tomioka, 2018). Emotional interaction, such as encouraging the students to approach and touch and hold the child without fear, is also important (Todo, 2019) (Wakase & Katada, 2017). It was important to convey a nursing perspective that recognizes the child's abilities while valuing emotional interaction, allowing students to develop their independence and nursing perspective without anxiety, conveying the importance of proactive nursing, and connecting the experience to learning.

Conclusions

The nursing students' understanding of children with disabilities in nursing education has mostly been conducted through practical training in facilities for children with disabilities, and there was some anxiety and confusion before the training. However, the students learned about the characteristics of the children's disabilities, consideration for the environment in which children with disabilities reside, communication methods and how to interact with them, care based on growth and development, family support, and multidisciplinary approaches. They could recognize the role of nurses and deepen their view of nursing through these experiences. Reducing students' anxiety through prior learning, teaching the nursing view in which the child's abilities are recognized and where emotional interaction is valued, helping students develop their independence and nursing view comfortably, showing the importance of proactive nursing, and helping students link their experiences to learning are important. To support nursing students' understanding of children with disabilities and improve the effectiveness of practical training in facilities for children with disabilities, the continued evaluation of practical training instruction and examination of results are essential.

Limits to the Research and Future Topics of Discussion

This study was a literature review of nursing students' understanding of children with disabilities using a limited number of keywords; therefore, it is undeniable that a bias exists. Practical evaluation on training instruction to encourage nursing students' understanding of children with disabilities and the construction of educational programs on nursing for children with disabilities must be considered in the future.

This report is a revised edition of a report that will be presented at the 2021 24th East Asian Forum of Nursing Scholars.

Author Contributions

AN performed the entire process of manuscript preparation. YT provided advice and financial support for writing papers. Both have reviewed and accepted the final manuscript.

Declaration of Conflicting Interests

The authors declare that there are no conflicts of interest.

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Review Article

Components of hospital-to-home care interventions for patients with heart failure in Japan: An integrative review

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Abstract

Hospital-to-home care is important for improving the quality of life (QOL) of patients with heart failure (HF). However, there is little evidence of outcomes regarding hospital-to-home care interventions in Japan. Thus, this integrative review aimed to identify the components and outcomes of hospital-to-home care interventions for patients with HF in Japan. Electronic databases, such as MEDLINE, CINAHL, and Ichushi-Web, were systematically searched, and all forms of hospital-to-home care interventions in Japan were examined. Studies regarding transitional care, discharge planning, home care, and disease management were included. The characteristics and results of the intervention studies were summarized. Furthermore, we analyzed the components of hospital-to-home care interventions and considered the effective interventions for patients with HF, based on statistically significant results. Ten articles including nine interventions were reviewed. The average age of intervention participants ranged from 64 to 77.5 years old, and the sample sizes in the intervention groups ranged from 11 to 192 participants. The intervention components were categorized as follows: "hospital-based components," "home- and outpatient-based components," and "both hospital- and home-based components." The main intervention components comprised structured education, lifetime counseling, and follow-ups via telephone and video calls. The clinical outcomes included readmission, mortality, and QOL, measured up to 24 months after the interventions. There was limited evidence of interventions being continued from the hospital to home, follow-up immediately after discharge, and nurse home visits in Japan. Further studies are necessary to evaluate the outcomes of patients' experiences immediately after discharge and the quality of care transition.

Keywords
heart failure, patient discharge, quality of health care, transitional care

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Introduction

Heart failure (HF) is a life-threatening cardiac condition that is becoming increasingly prevalent. It is caused by defects in the cardiac structure, function, or both, which can ultimately lead to impaired peripheral circulation and organ oxygenation (Rosa et al., 2019). The number of individuals with HF in Japan is estimated to increase to 1.3 million by 2030 (Okura et al., 2008) and at least 26 million people worldwide (Savarese & Lund, 2017). The incidence of HF-related hospitalization is the highest in the first 30 days after patients' discharge, and the majority of HF-related rehospitalization cases in Japan occur within 90 days of discharge (Ishihara et al., 2020); the rate of readmission for HF is 40% within 1 year after discharge (Tsutsui et al., 2006). Rehospitalization burdens patients and affects their quality of

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life (QOL). Hence, proper care transitions for patients, who are discharged from the hospital, are crucial to improve their QOL and reduce preventable hospital readmissions.

Despite substantial advancements in treatments and multidisciplinary care, HF management remains a global health challenge for healthcare providers. In HF management, hospital-to-home transitional care has become an important intervention to improve the clinical outcomes of chronic older patients as well as the rates of rehospitalization for HF (Murtaugh et al., 2017). Transitional care is defined as a set of actions designed to ensure the coordination and continuity of healthcare while patients are transferred between different locations or different levels of care within the same location (Coleman & Boult, 2003). Older patients, who are discharged to their homes, undergo a period of vulnerability in which they must learn to adjust and adapt to their new self-care regimen (Werner et al., 2019). In a study regarding the discharge experiences of patients with HF, it was found that these patients were struggling with daily self-care, symptom monitoring, severity judgment, medication management, inadequate discharge preparation, and poor care coordination (Nordfonn et al., 2019). Therefore, hospital-to-home transitional care is vital to the improvement in QOL of patients with HF and to ensure a smooth transfer from the hospital to their homes.

There have been several systematic reviews on transitional care interventions for patients with HF (Feltner et al., 2014; Fergenbaum et al., 2015; Mai Ba et al., 2020; Van Spall et al., 2017). However, none have included Japanese intervention studies. The Japanese healthcare system is extremely different from those in the United States, the United Kingdom, Sweden, Germany, Australia, and China, where many transitional care intervention studies have been conducted, and it is likely that patients and their families face different challenges. In Japan, older adults (primary insured adults aged ≥65 years and secondary insured persons aged 40-64 years) can use public long-term care insurance services, such as home-visit nursing. When the Japanese government promotes home care for older adults, it differentiates hospital care and home care in the acute, convalescent, and chronic phases. Therefore, to enhance transitional care, discharge support departments have been established in acute care hospitals. Nurses who specialize in discharge planning play an important role in smooth and timely care transitions for patients with high care needs (Tomura et al., 2011). Moreover, ward nurses play a key role in coordinating multidisciplinary tasks in transitional care in Japan. In contrast, transitional care in the United States and the United Kingdom is coordinated by transitional care nurses, who are known as nurse practitioners and advanced practice nurses. Transitional care nurses provide comprehensive discharge planning and home follow-ups through care transitions from hospital to home. Therefore, it is necessary to identify the characteristics of the components of hospital-to-home care interventions in Japan. Moreover, medical staff needs to identify the outcomes of these transitions to determine which clinical interventions can be implemented in practice (Son & You, 2015). Thus, this review aimed to analyze the characteristics of the components and outcomes of hospital-to-home care interventions for patients with HF in Japan and to consider recommended interventions in the Japanese healthcare system through comparison to transitional care in other countries.

Methods

Study Design

An integrative review approach was adopted to capture the effective components of hospital-to-home care interventions for patients with HF in Japan. The methodology described by Whittemore and Knafl (2005) was adopted, which involves identifying the problem, searching the literature, evaluating the data, and presenting the findings. Integrative reviews summarize previous literature to provide a more comprehensive understanding of a particular topic and allow for the inclusion of the broadest type of research. Various perspectives on components related to the effectiveness of existing transitional care interventions for patients with HF in Japan were collected, and the resulting synthesized information provides insights for nursing practice.

Problem Identification

The three research questions that we aimed to answer in this integrative review were as follows: “What are the characteristics of the components of hospital-to-home care interventions for patients with HF in Japan?,” “What are the outcome measures and endpoints of hospital-to-home interventions for patients with HF in Japan?,” and “What are the recommended hospital-to-home interventions for patients with HF in the Japanese healthcare system?” The evaluated characteristics included the nature of the interventions, composition of the target population, and outcome measures and endpoints.

Literature Search

Relevant English and Japanese articles were searched from the electronic databases MEDLINE, CINAHL, and Ichushi-Web. The following key words were used: “heart failure” AND “(home care OR discharge planning OR transitional care OR disease management)” AND “Japan.” Articles published until June 2020 were searched. Studies regarding (1) transitional care and discharge planning interventions in hospitals and (2) home care and disease management for patients discharged from acute care hospitals were included. Meanwhile, studies that involved no interventions, interventions that did not include hospital-to-home care, interven-

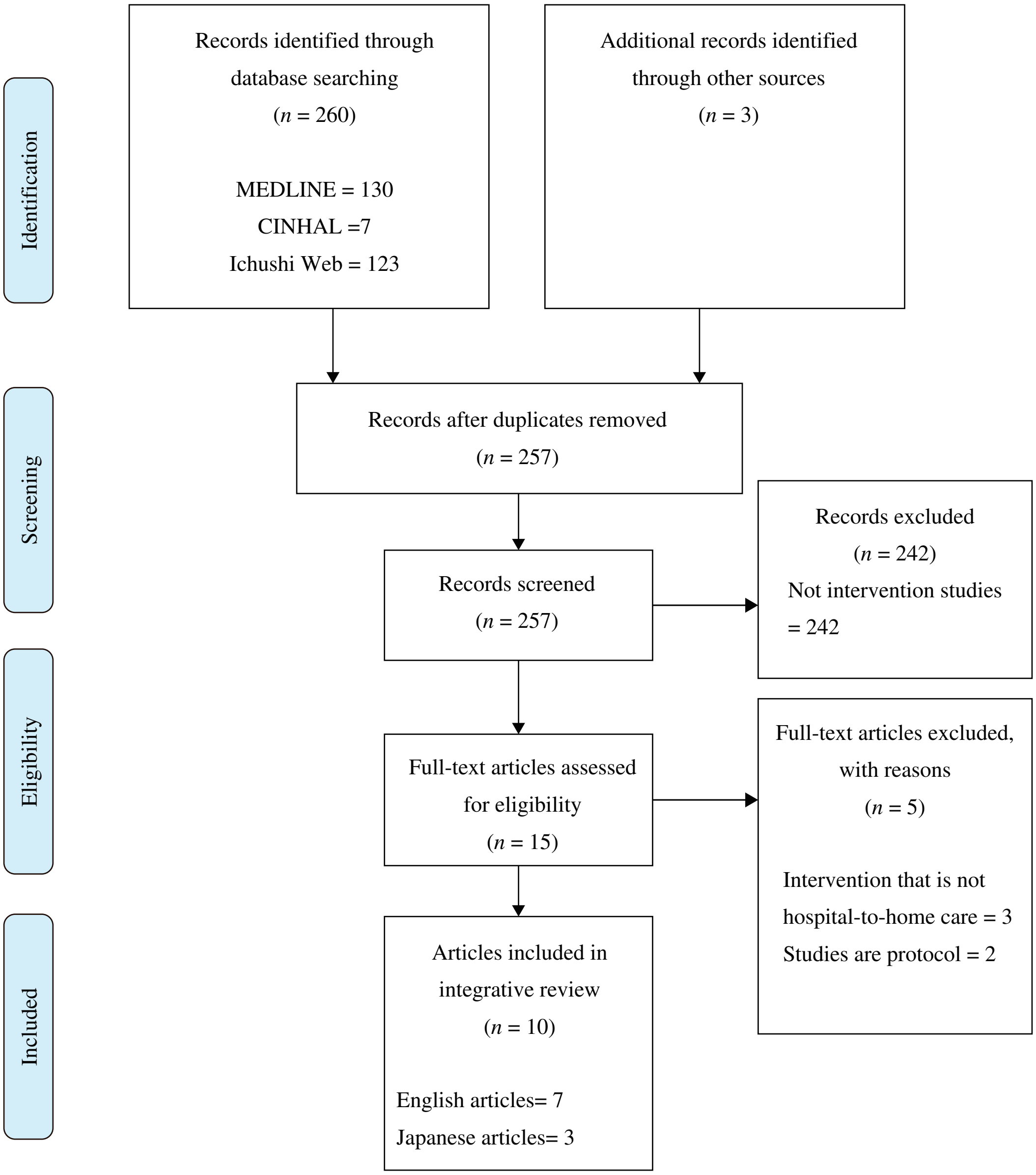

Figure 1. Flowchart of the study retrieval and selection process.

tions without nursing support, and study protocols were excluded. After duplicates were removed, 257 articles were initially identified in the three databases. A total of 242 articles were excluded because they were not intervention studies. The remaining 15 articles were retrieved mainly due to their contents of the intervention and results. Five articles were excluded because three articles did not include hospital-to-home care interventions and nursing support, and two articles were study protocols. Finally, 10 papers, 7 in English and 3 in Japanese, were reviewed. A flowchart of the article selection process is shown in Figure 1. Two authors independently screened and discussed the results of the literature search.

Data Evaluation

All included studies were critically assessed according to the Mixed Methods Appraisal Tool (MMAT, version 2018), which was developed to critically appraise different study designs (Hong et al., 2019). The MMAT allows for a critical appraisal process in reviews of systematic mixed studies, by providing methodological quality criteria for different study designs, within a single tool. First, two optional screening questions were evaluated. Secondly, the appropriate categories of study designs were applied to the five categories, with different methodological quality criteria used depending on the study design and methods: qualitative, quantitative randomized controlled trials (RCTs), quantitative nonrandomized, quantitative descriptive, and mixed methods (Hong et al., 2018). Excluding studies with low methodological quality is usually discouraged (Hong et al., 2018).

In our study, two screening questions obtained from the MMAT manual were applied to all the 10 reviewed articles, i.e., "Are there clear research questions?" and "Do the collected data address the research questions?" All 10 studies satisfied the two screening questions. The appropriate categories of studies to be appraised were then evaluated. The MMAT scores are presented in Table 1. Of the six RCT studies, two were unclear as to whether randomization was appropriately performed, and three were unclear as to whether outcome assessors were blinded to the intervention provided. Other quality appraisal criteria were satisfied in RCT studies. One non-RCT study showed that potential confounders could not be accounted for in the design and analysis. All three quantitative descriptive studies satisfied all quality appraisal criteria.

Data Analysis

The characteristics and results of the intervention studies are summarized in Table 1. It summarizes the following: (a) study information (i.e., authors' names, year of publication, sample size, and average age of patients); (b) information regarding hospital-to-home care interventions (i.e., intervention contents, intervention provider, and intervention duration); and (c) major findings regarding the outcomes. The intervention components were analyzed according to the categories included in the studies. These included predischarge and postdischarge interventions. The outcome measures/endpoints, evaluation times, and frequency of use are summarized. Finally, the components of the recommended practices were considered from interventions that were statistically effective.

Results

Characteristics of the Included Studies and Their Participants

This review included 10 articles regarding 9 hospital-to-home care interventions for patients with HF. We have summarized all the studies in Table 1. In total, 3 of the 10 studies were conducted in Japanese (Ishibashi et al., 2018; Ito & Tanaka, 2018; Yamazaki et al., 2016). Regarding the research designs employed, there were six RCT studies (Kato et al., 2016; Kotooka et al., 2018; Mizukawa et al., 2019; Otsu & Moriyama, 2011, 2012; Tsuchihashi-Makaya et al., 2013), three retrospective studies (Ito & Tanaka, 2018; Kinugasa et al., 2014; Yamazaki et al., 2016), and one pre- and post-test study (Ishibashi et al., 2018). The participants in these studies were patients with HF, not including their families. The sample sizes in the intervention groups ranged from 11 to 192, and the age of the participants averaged between 64 and 77.5 years old. All RCT studies excluded patients with cognitive impairment, severe comorbidities, and end-of-life diseases. In seven of the nine interventions, nurses served as the primary providers. In four studies, multidisciplinary teams provided the interventions. Members of multidisciplinary teams consisted of nurses, cardiologists, physiotherapists, pharmacists, dietitians, and social workers. Interventions lasted from approximately 1 hour to 15 months. Four of the interventions took place at hospitals, another four occurred at patients' homes or as outpatients, and one transpired at both a hospital and the patient's home.

Components of Hospital-to-home Care Interventions

We categorized nine components of hospital-to-home care transitions for patients with HF, as shown in Table 2. These were categorized into "hospital-based components," "home- and outpatient-based components," and "both hospital- and home-based components," respectively. Hospital-based components included discharge planning, including discharge screening, discharge conferences, and care coordination. Home- and outpatient-based components included lifetime counseling by nurses, follow-up telephone and video calls, self-monitoring support, telemonitoring, and nurse home visits. As for both hospital- and home-based components, these included nurse-led education, disease management, and multidisciplinary care. The component with the highest frequency was nurse-led education. All education interventions were predominantly delivered by nurses. Participants and intervention providers used printed materials, booklets, checklists, and calendars for lifestyle modification and self-monitoring. Face-to-face individual structured programs were delivered. There were no educational interventions for the patient population. The second most frequent form of intervention was lifetime counseling by nurses, particularly regarding lifestyle, self-care, and problems. Counseling was provided via individual educational programs, phone calls, home visits, and video calls.

Outcome Measures and Endpoints of Hospital-to-home Care Interventions

We summarized the outcomes and endpoints of hospital-to-home care transitions for HF in Table 3. Outcomes included all-cause death and rehospitalization due to worsening HF, HF status, health-related QOL, HF-specific QOL, anxiety and depression, self-care, self-efficacy, compliance, and HF knowledge. The highest frequency of measured outcomes was readmission or hospital admission, and all studies included readmission or hospital admission as outcomes. The second highest frequency of outcomes was death, or mortality, which was noted in six studies. The highest frequency of patient-reported outcomes was QOL in five studies. Outcomes were assessed at 1-24 months after the intervention.

Table 1. Summary table of included studies.

Author (year)	Study design (MMAT score)	Participant and setting (number (male %), age, HF severity)		Contents of intervention				Outcomes (significance)	
		Intervention group	Control group	Intervention	Provider	Setting	Duration	Primary outcomes	Secondary outcomes
Otsu and Moriyama (2011) Otsu and Moriyama (2012)	RCT (Yes 4/5, No 1/5)	*n* = 49 (63.3%) 71.6 years NYHA II 79.6%	*n* = 47 (63.8%) 74.6 years NYHA II 80.9%	Educational self-management program and routine counseling	Researching nurse	Outpatient	6 months	BNP, systolic blood pressure, weight, and shortness of breath (+/++) Paroxysmal dyspnea, ankle edema, and coughing at night (−) Death and hospital admission (not SA)	QOL (+++) Compliance (+++)
Tsuchihashi-Makaya et al. (2013)	RCT (Yes 3/5, Cannot tell 2/5)	*n* = 79 (53.2%) 76.9 years NYHA II 84.8% LVEF (mean) 47.4%	*n* = 82 (59.8%) 75.8 years NYHA II 76.8% LVEF (mean) 47.4%	Discharge education and home education, home-based disease management program, home visits by nurse, counseling, telephone follow-ups, and symptom monitoring	Mainly nurses Multidisciplinary team (cardiologists, dietitians, and pharmacists)	Hospital and home	6 months	Depression and anxiety (+)	Physical health QOL (−) Mental health QOL (+) All-cause death (−) HF-cause rehospitalization (+)
Kinugasa et al. (2014)	Retrospective study, intervention vs. control (Yes 5/5)	*n* = 144 (60.4%) 75 years NYHA III and IV 11.8% LVEF (mean) 45.9%	*n* = 133 (58.6%) 74 years NYHA III and IV 9.0% LVEF (mean) 44.9%	Multidisciplinary HF-management program, cardiac rehabilitation, education, team conferences, and discharge planning	Multidisciplinary team (cardiologists, physiotherapists, nurses, pharmacists, dietitians, and social workers)	Rural hospital	N/A	All-cause mortality and HF-cause rehospitalization (++)	N/A
Kato et al. (2016)	RCT (Yes 4/5, Cannot tell 1/5)	*n* = 15 (80%) 64 years NYHA II 27%	*n* = 17 (59%) 65 years NYHA II 29%	HF self-care program and counseling	Mainly nurses Multidisciplinary team (dieticians and pharmacists)	Hospital	Total time of education Mean = 68 min	Self-care (+)	HF-cause rehospitalization and cardiac death (+) HF-knowledge (+)
Kotooka et al. (2018)	RCT (Yes 4/5, Cannot tell 1/5)	*n* = 90 (56.7%) 67.1 years NYHA II 77.8% and III 22.2%	*n* = 91 (61.5%) 65.4 years NYHA II 79.1% and III 20.9%	Telemonitoring and contact by telephone follow-ups when monitoring was stratified and data were exceeded	Monitoring nurses	Home and monitoring center	Mean = 15 months	All-cause death and HF-cause rehospitalization (−)	Depression (−) Self-efficacy (−) QOL (−) HF-status (−)

Table 1. Continued.

Author (year)	Study design (MMAT score)	Participant and setting (number (male %), age, HF severity)		Contents of intervention				Outcomes (significance)	
		Intervention group	Control group	Intervention	Provider	Setting	Duration	Primary outcomes	Secondary outcomes
Mizukawa et al. (2019)	RCT (Yes 4/5, Cannot tell 1/5)	**Telemonitoring + self-management group** 70.5 years $n = 20$ (50.0%) NYHA III or IV 55% **Self-management group** $n = 18$ (83.3%) 69.4 years NYHA III or IV 38.9%	$n = 19$ (52.6%) 74.5 years NYHA III or IV 31.6%	Self-monitoring, disease management program, telemonitoring, education, and counseling	Mainly nurses and physicians	Home	12 months	QOL (+/++)	Self-efficacy (−) Self-care (−) HF-cause rehospitalization (+) All-cause mortality (−)
Yamazaki et al. (2016) in Japanese	Retrospective study, intervention vs. control (Yes 5/5)	$n = 192$ (58.3%) 77.5 years NYHA II 86.5%	$n = 194$ (63.9%) 75.6 years NYHA II 85.6%	Discharge planning	Multidisciplinary team (doctors, physical therapists, nurses, pharmacists, dietitians, and social workers)	Hospital	N/A	Rehospitalization (++)	N/A
Ito and Tanaka (2018) in Japanese	Retrospective study, intervention vs. control (Yes 5/5)	$n = 87$ (67%) 72 years BNP median 523 pg/ml	$n = 183$ (55%) 81 years BNP median 695 pg/ml	Education and counseling	Nurses	Hospital	N/A	All-cause death (+) HF-cause rehospitalization (++)	N/A
Ishibashi et al. (2018) in Japanese	Prospective study Pre vs. post (Yes 5/5)	$n = 11$ (63.6%) 72.7 years NYHA III (36.4%) BNP 75–1866 pg/ml	N/A	Telenursing intervention model, self-monitoring support, routine video call follow-ups, and counseling	Nurses	Home	12 months	QOL (−) Hospital admission (not SA) Blood pressure, weight, BNP, and symptom of HF (not SA)	N/A

Statistical significance; +: $p < .05$, ++: $p < .01$, +++: $p < .001$, −: $p > .05$. Not SA: not statistically analyzed. BNP: B-type natriuretic peptide. HF: heart failure. LVEF: left ventricle ejection fraction. MMAT: mixed methods appraisal tool. NYHA: New York Heart Failure Association's heart function level. RCT: randomized controlled trial. QOL: quality of life. N/A: not available.

Table 2. Components of hospital-to-home care interventions.

Components		Contents	No. of interventions
Hospital-Based	Home- and Outpatient-Based		
Discharge planning	N/A	•Screening of discharge planning, discharge support conferences, and care coordination with multiple multidisciplinary care provided inside and outside the hospital	2
N/A	Lifetime counseling by nurses	•Counseling support regarding lifestyle, self-care, and problems encountered during home visits, interviews during outpatient visits, telephone calls, and video calls	5
	Follow-ups via telephone and video call by nurses	•Two types of follow-ups: regular follow-ups and follow-ups only in the event of an abnormality •Regular follow-up assessments and care regarding HF symptoms, general health status, lifestyle, and self-care at home by nurses •When necessary, nurses consult a multidisciplinary team and coordinate social support and hospital visits.	3
	Self-monitoring support	•Self-monitoring support through face-to-face interventions at outpatient visits •The implementation of self-monitoring regarding patients' HF status and the interpretation of measured values using video calls are supported.	2
	Telemonitoring	•Participants measure their body weight, blood pressure, pulse, and body composition at home using a monitoring device. •The nurses at the monitoring centers check the measured data every day. •In case of abnormal data, the patient is called, and the causes of the abnormalities are assessed; then, either the patient is provided with advice, a visit by the physician is arranged, or home care is coordinated. •Families can also access the remote monitoring system.	2
	Nurse home visits	•Home-visit nursing care once every 2 weeks until 2 months after discharge for symptom monitoring, general health status assessments, education, and consultations •First visit is conducted within 2 weeks after discharge.	1
Nurse-led education		•Self-care and self-management education through a face-to-face individual program •Structured educational program and discharge education based on models (e.g., behavior change model, cognitive behavior, and health belief model) •Educational program using tools such as booklets and checklists by nurses, pharmacists, and nutritionists •The participants record information regarding their lifestyles, and the intervention nurses provide individual feedback. •Advice and consultation support regarding self-management methods at home are provided. •Long- and short-term goals with the participants are developed and evaluated. •Education is provided regarding items that a target participant is interested in. •Educational contents include "heart failure," "examination and treatment," "self-monitoring," "lifestyle," and "symptoms and urgency when consultation is required," as well as internal medication management, weight management, salt restriction, etc.	7
Disease management		•Includes symptom monitoring, education, consultations, and the adjustment of social support via home visits and telephone follow-ups by nurses in addition to follow-ups by cardiologists	2
Multidisciplinary care		•Patient education and conferences are conducted by a multidisciplinary team. •Cardiac rehabilitation •Progress sharing regarding the intervention with the team	4

HF: heart failure. N/A: not available.

No. of interventions: Number of interventions in which the applicable component was performed out of all nine interventions.

Table 3. Summary table of outcome measures/endpoints.

Outcome measures/Endpoints	Scale/Measure contents	Time of data collection (follow-up period)	No. of interventions
Rehospitalization	All-cause rehospitalization, rehospitalization due to worsening HF, hospital admission (patients with a history of hospitalizations), number of readmissions, period until readmission after discharge, and hospitalization period at the time of readmission	At 3, 6, 9, 12, and 24 months after discharge (31 months)	9
Death	All-cause death, cardiac death, and period until death	At 3, 6, 9, 12, and 24 months after discharge (31 months)	6
QOL	(HF-specific scales) MacNew Heart Disease Health-Related Quality of Life Questionnaire and Minnesota Living with Heart Failure Questionnaire (generic scales) SF-8 Health Survey and the MOS 36-Item Short-Form Health Survey	At 3, 6, 9, 12, and 24 months after discharge	5
Anxiety and depression	Hospital Anxiety and Depression Scale, Patient Health Questionnaire-9	At 2, 6, and 12 months after discharge	2
Self-care	European Heart Failure Self-Care Behaviour Scale	At 6, 12, 18, and 24 months after discharge	2
HF status	BNP, NYHA, blood pressure, weight, and deterioration in the symptoms related to HF	At 3, 6, 9, 12, and 24 months after discharge	2
Self-efficacy	Chronic Disease Self-Efficacy Scale and General Self-Efficacy Scale	At 6, 12, 18, and 24 months after discharge	2
Compliance	Four-point scale: sodium-restricted diet, medicine administration, activities or exercise, smoking and drinking cessation, self-monitoring of weight, and symptoms of HF	At 3, 6, 9, 12, and 24 months after discharge	1
Knowledge about HF	15-item Japanese HF-knowledge scale	At 1 and 6 months after discharge	1

BNP: B-type natriuretic peptide. HF: heart failure. QOL: Quality of life. NYHA: New York Heart Association's heart function level.
No. of interventions: Number of interventions that measured the applicable outcome/endpoints out of all nine interventions.

Effects of Hospital-to-home Care Interventions

The results of the outcome studies are shown in Table 1. Six out of the nine interventions led to a statistically significant reduction in the rate of readmission, compared to the control groups (Ito & Tanaka, 2018; Kato et al., 2016; Kinugasa et al., 2014; Mizukawa et al., 2019; Tsuchihashi-Makaya et al., 2013; Yamazaki et al., 2016). The studies that showed statistically significant readmissions included components of nurse-led education, lifetime counseling by nurses, regular follow-ups via telephone, nurse home visits, self-monitoring support, disease management, and multidisciplinary care. Three out of the six interventions led to a statistically significant reduction in the rate of death (Ito & Tanaka, 2018; Kato et al., 2016; Kinugasa et al., 2014). Of the five interventions (Ishibashi et al., 2018; Kotooka et al., 2018; Mizukawa et al., 2019; Otsu & Moriyama, 2011; Tsuchihashi-Makaya et al., 2013), three led to a significantly improved QOL in the intervention group, compared to the control group (Mizukawa et al., 2019; Otsu & Moriyama, 2011; Tsuchihashi-Makaya et al., 2013). The studies that showed statistically significant improvement in QOL included the components of education, counseling, follow-ups via telephone, nurse home visits, self-monitoring support, and disease management. One of two studies indicated a statistically significant improvement in anxiety and depression (Tsuchihashi-Makaya et al., 2013). Statistically, self-efficacy did not improve significantly. Telemonitoring and the assessment of acquired data, such as weight and blood pressure, and follow-up only at the time of abnormality, did not significantly change the clinical outcomes (Kotooka et al., 2018).

Discussion

In this integrative review, we revealed the components and outcomes of hospital-to-home care interventions for patients with HF in Japan. We analyzed components that were categorized into "hospital-based components," "home- and outpatient-based components," and "both hospital- and home-based components." We identified only one study in Japan that included both hospital- and home-based interventions (Tsuchihashi-Makaya et al., 2013), in contrast to the numerous intervention studies overseas. In Japan, there is still a lack of evidence regarding the effectiveness of intervention methods for the transitional care of patients with HF; thus, further studies evaluating both pre- and postdischarge interventions are needed. The studies we investigated show that nurse-led patient education, counseling, and discharge planning are important components in interventions. These findings are similar to those of previous studies (Bryant-Lukosius et al., 2015; Rice et al., 2018). Studies on transitional care for patients with HF have been predominantly conducted in the United States, the United Kingdom, Spain, Sweden, Canada, and Australia. Early follow-ups and contact, such as medication and symptom management within 3 days after discharge, were the main forms of intervention in transitional care for patients with HF (Coleman et al., 2006; Mai Ba et al., 2020). However, a few early postdischarge interventions in the investigated studies involved home visits within 14 days after discharge and follow-up assessments 2 months after discharge (Tsuchihashi-Makaya et al., 2013). Therefore, early postdischarge interventions and medication management at home may require further verification of their effectiveness. The evidence regarding home-visit nursing outcomes further promotes the need and effectiveness of home-visit nursing, immediately after discharge in Japan.

The participants of all the investigated intervention studies were patients, and the interventions did not involve the families of the patients. Older patients with HF often require long-term care, livelihood support, and social support. The transitional care model and the care transition interventions lead to the establishment of a trustworthy relationship with family caregivers and consider family needs involved in patient care (Coleman et al., 2015; Naylor et al., 2018). A patient's family also influences HF self-care and outcomes (Dunbar et al., 2008); hence, research on support and interventions that includes family members may be necessary, with investigation on caregiver education and engagement needed.

We uncovered the outcome measures, endpoints, and measurement times involved in the interventions. The most frequent outcome was rehospitalization. The most common patient-reported outcome was QOL, similar to that reported in a previous study (Mai Ba et al., 2020). Both the HF-specific QOL scale and generic QOL scale were significantly improved (Mizukawa et al., 2019; Otsu & Moriyama, 2012; Tsuchihashi-Makaya et al., 2013), and the recommended HF-specific scale, namely, the Minnesota Living with Heart Failure Questionnaire, was used (Kelkar et al., 2016; Kotooka et al., 2018; Mizukawa et al., 2019). However, emergency department visits and costs were not measured in the Japanese intervention studies investigated. For this reason, it can be said that there are few emergency visits in Japan due to outpatient visits being planned 2-4 weeks after discharge as well as the difficulty in collecting cost data. Little is known about the hospitalization costs associated with HF in Japan (Kanaoka et al., 2019; Kotooka et al., 2018). Cost evaluations may need to be assessed in the future to strengthen the evidence regarding the effectiveness of hospital-to-home care in patients with HF. Canadian and Chinese RCT studies on heart disease included patient-reported outcomes and patient-experience measures of discharge preparedness and care transition quality measure (Cao et al., 2017; Van Spall et al., 2018; Van Spall et al., 2019). The patient and caregiver's desired outcomes of care transitions can be identified from participant experience (Mitchell et al., 2018). The use of patient-experience measures that capture the quality of care transitions or patient concerns and anxiety should be implemented in Japan, and for this purpose, the use of a validated quality of care transition scale, such as the Care Transitions Measure (Coleman et al., 2005; Yoshimura et al., 2018), PREPARED (Graumlich et al., 2008), or the Readiness for Hospital Discharge Scale (Weiss & Piacentine, 2006), should be adopted. It is necessary to develop a validated tool for capturing patient experiences, such as those related to their concerns, lifestyle, and self-care, when counseling and assessing outcomes. Older patients immediately after discharge are also vulnerable to a higher risk of adverse health outcomes and experience feelings of uncertainty (Blakey et al., 2017; van Seben et al., 2019). Although the measurement times for the interventions were between 1 and 24 months after discharge or intervention in this review, it may be necessary to evaluate immediately after or 1 week after discharge.

Finally, recommended intervention components for patients with HF were considered, including regular and structured counseling and education, follow-ups via telephone by nurses, nurse home visits, multidisciplinary care, and disease management. Studies that combine multiple intervention components are shown to be effective. In previous meta-analyses on transitional care for patients with HF, nurse home visits were the most recommended care practice that care providers can apply (Feltner et al., 2014; Van Spall et al., 2017). However, only one intervention included nurse home visits in this review. In addition, most of the elderly patients are registered for long-term care insurance, but only a small proportion of these patients receive home-visit services in Japan (Takabayashi et al., 2016). Home-visit nursing care should be actively provided as well as visits immediately after discharge for older patients with HF. Research on the effectiveness of home-visit nursing for patients with HF in Japan is urgently needed.

A limitation of our study is that we did not search all gray literature, such as dissertations and non-peer-reviewed articles, and the limited number of intervention studies regarding HF in connection to hospital-to-home care transitions is also a limitation.

Conclusions

This integrative review uncovered the components of hospital-to-home care interventions for patients with HF, their related outcome measures, and their measurement times. Hospital-to-home care interventions should include both hospital- and home-based care and combine multiple intervention components by nurses and multidisciplinary teams. With respect to outcome evaluation, it is necessary to assess outcomes immediately after discharge, as well as the quality of care transitions. The findings from this literature review highlight the need for further research on the effectiveness of nurse home visits and interventions that involve the families of patients with HF.

Author Contributions

M. Y. and N. S. contributed to the conception and design of this study, carried out the analysis, drafted the manuscript, and approved the final manuscript.

Declaration of Conflicting Interests

The authors declare no conflict of interests.

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Original Research

Development of family empowerment programs for caregivers of children with disabilities at home: Interim report up to "implementation of pretesting"

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Abstract
Objective: For both children with disabilities and their families to continue living at home, families should achieve and maintain healthy family functioning. This is achieved by enhancing family empowerment. This pilot study systemizes the program development process and identifies the problems and results to move to the program implementation. **Methods:** The program was developed through a step-by-step process emphasizing on the previous research findings, theories, and collaboration with families. We identified the factors related to family empowerment from an in-depth interview study of 34 families and the Delphi method questionnaire survey of 158 professionals. Next, we identified a family empowerment model by a national survey of 1,659 families. We further reviewed literature on family intervention programs, set action goals based on the theoretical framework of program formulation, and finally developed a family empowerment program with the families. The problems and effectiveness of "implementation of pretesting" were qualitatively and quantitatively verified. **Results:** Through the program, the participants created eco-maps and life charts, dealt with issues in their daily lives, set goals for the life they wanted, worked toward those goals, and took actions to make adjustments in their lives and use resources. Due to the small number of participants, the efficacy of the program was not significantly confirmed; however, no adverse events were observed. **Conclusions:** We developed and pretested a participatory program to enhance family empowerment. As a pilot study, the results support the value of conducting the program on a larger scale. Further verification of the effects of our program is required.

Keywords
family empowerment, children with disabilities, intervention program, pretesting

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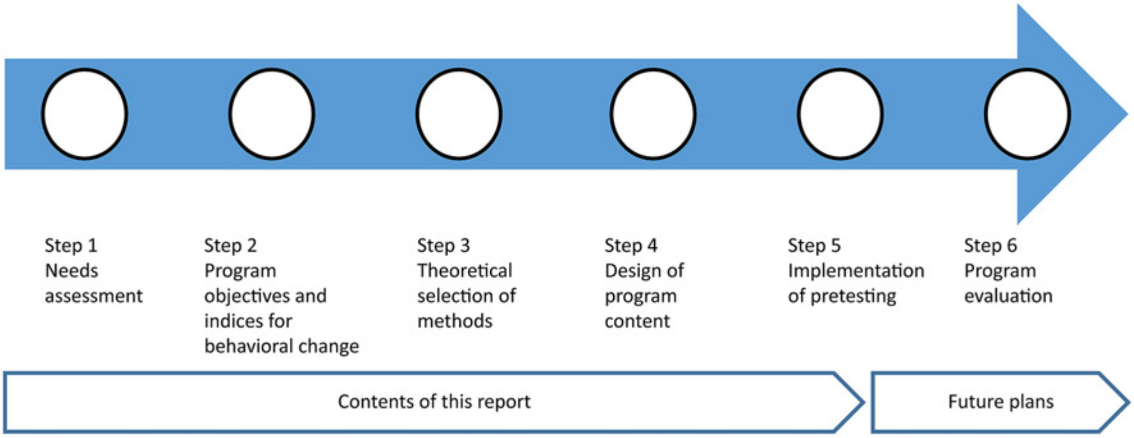


Figure 1. Six steps for the development of this program.

Introduction

Families raising children with disabilities face much higher risks to their own health and lives than families raising healthy children. Families caring for children with disabilities at home often do not enjoy a break. As such, this situation has a significant impact on these caregivers' mental and physical health. The mother, who is usually the primary caregiver, carries the burden of time and responsibility associated with providing the required care to the child and, thus, tends to have poor mental health (Raina et al., 2005). Families become increasingly fatigued; it is common for members to develop physical and mental disorders (Ozawa et al., 2011). Their capacity to participate in social activities, including their work, is constrained (Okumura et al., 2009).

In Japan, advances in pediatric medicine have led to a rapid increase in the number of children with disabilities, especially those with more severe conditions (Maeda, 2015); thus, direct support for families raising children with disabilities is an urgent need. However, most studies of families raising children with disabilities are observational studies, and how interventions are more effective in improving the health and quality of life of these families has not been fully tested.

There are intervention studies that are focused on the parent carer (Bradshaw et al., 2019; Edelstein et al., 2017). Edelstein et al. (2017) reviewed that several interventions tackled many types of stressors (i.e., emotional stress, social isolation) and changes (i.e., well-being, satisfaction with care). The most recent review by Bradshaw et al. (2019) addresses more interventional outcomes (i.e., family functioning) by including the parents of children with special healthcare needs as a scope. Families who care for disabled children at home should be cared for from several aspects (i.e., individual, family, social).

It is essential to enhance family empowerment, that is, the ability to appropriately control their own lives while utilizing social resources and working together with family members and professionals (Koren et al., 1992). This will enable the children and the family caring for children to continue with their lives at home (Noguchi & Ohmachi, 2020). The Family Empowerment Scale (FES) comprised three domains (i.e., family, social services, social-political) and total score. By assessing the FES from these four aspects, it is possible to examine measures to enhance family empowerment; however, no previous studies have directly considered these aspects (Bradshaw et al., 2019; Edelstein et al., 2017).

We are currently developing a program based on the intervention mapping (IM) approach model proposed by Bartholomew Eldredge et al. (2016; Figure 1). This program is implemented in six steps: needs assessment, program objectives and indices for behavioral change, theoretical selection of methods, design of program content, implementation of pretesting, and program evaluation. We have now implemented Step 5: implementation of pretesting. This study is a feasibility or pilot study that systemizes the program development process up to this point and identifies the problems and results to move to the next step, which is program implementation.

Materials and Methods

Program Creation (Step 1 to Step 4)

Based on the conceptual framework of family empowerment in caring for children with disabilities by Koren et al. (1992), we conducted a large survey of family caregivers raising children with disabilities at home (Wakimizu et al., 2018). In this survey, we measured family empowerment of children with disabilities and developed a Japanese family empowerment model for families raising children with disabilities. The theoretical framework of the program is based on this theory and model. This will be explained in more detail in Step 1: needs assessment. To reduce the caregiver burden of these families and promote the utilization of social resources, we developed a program to visualize the relationship between family, service, and community and lead to behavioral change based on the intervention theory steps.

Program creation was implemented in the following order: needs assessment, program objectives and indices for behavioral change, theoretical selection of methods, and design of program content. This order was based on the IM approach model proposed by Bartholomew Eldredge et al. (2016). This theoretical framework has also been used in intervention programs based on groups of parents caring for children with disabilities (Borek et al., 2018). The participants answered the questionnaire before and after the program implementation.

Step 1: Needs Assessment

We conducted various surveys on the empowerment of families with severely disabled children. We further conducted in-depth interviews with 34 families with severely disabled children living at home (mothers, fathers, and siblings aged 12 years or older; Wakimizu et al., 2015). We then extracted comprehensive information on each family member's experience and recognition of their roles living with a severely disabled child, expected roles of other family members, and support needs as a family. Along with mental support and nursing advice, support needs related to utilizing social resources were extracted from 56 people in families with severely disabled children living at home. These support needs include the expansion of effective and easy-to-use services and the provision of information and consultation to enable the use of services. A total of 48 nurses and 149 administrative staff were surveyed using the Delphi method on the content of families' support needs extracted from the said survey. Data were used to ascertain the importance and practicality of support for empowering these families (Wakimizu et al., 2016). The family support needs extracted from the survey results were as follows: "I would like to talk to someone when I do not know how to use the services," "I would like mental support for my family, including my siblings," and "I would like to be provided a place where I can interact with other severely disabled children and similarly situated families." However, while nurses and administrative staff are aware of support's importance, putting it into practice is impossible. We gradually visualized the direction of family support programs that we needed to work on from this point. The factors expected to define family empowerment were identified based on in-depth interviews with families with severely disabled children living at home (Wakimizu et al., 2015). A provisional family empowerment model was then formulated. A self-administered questionnaire based on this model was sent to 1,659 families nationwide with severely disabled children living at home. The goodness of fit and validity of the family empowerment model were verified using path analysis (Wakimizu et al., 2018). Consequently, family empowerment was mainly defined by the "utilization of social resources" and "long-term care burden." The model clarified the axis of content that should be included as an intervention to enhance family empowerment in the future. Studies on families with children with developmental disabilities have also revealed that social resources' utilization is directly involved in family empowerment (Nachshen & Minnes, 2005).

Step 2: Program Objectives and Indices for Behavioral Change

We reviewed the literature on the previously reported programs before considering the program methods and content. First, we set the selection criteria for the literature as intervention studies on families living with severely disabled children to serve as a reference for the methods and content of our program; case studies were excluded. Second, we selected literature on interventions for family members living at home; studies dealing with support for transfer to home at discharge from the neonatal intensive care unit (NICU) were excluded. We also selected literature on interventions aimed at parental or whole-family effects; however, literature addressing interventions affecting severely disabled children living at home was excluded. The type of disability was not specified.

First, we searched the literature on intervention studies for family members (main caregivers) of children with severe mental and physical disabilities living at home from "Ichushi" (https://www.jamas.or.jp/), a literature database listing many medical and nursing journals. We conducted a search on August 23, 2018 and identified 68 search results. After reading the titles and abstracts of all papers and selecting literature based on the criteria, one paper remained (the main literature excluded dealt with support for transfer to home at discharge from the NICU and literature dealing with the admission of mothers and children for education). This paper addressed the facilitation of interactions among families of homebound persons in remote areas with severe motor and intellectual disabilities by constructing an Internet telephone environment (Hiramoto et al., 2017). We found no English language literature published in Japan. Based on these findings, we concluded that, in Japan, there were almost no intervention studies that quantitatively assessed the effect on parents living in a family with severely disabled children.

Next, we searched Ovid Medline for literature on intervention studies on family members (main caregivers) of children with severe mental and physical disabilities living at home. We conducted the search on November 8, 2018 and found 30 search results. After reading the titles and abstracts of all papers and selecting literature based on the criteria, four papers remained (the main literature that was excluded dealt with ethical reviews, observational studies, and interventions aimed at influencing severely disabled children living at home; Kuo et al., 2013; Looman et al., 2015;

Table 1. Various interventions for parents caring for their children with severe disability from our literature review.

First Author	Year	Country	Setting and Intervention	Provider	Type of Children	Improved Outcomes
Looman, W. S.	2018	USA	Telehealth care coordination and consultation	Advanced practice registered nurse	CMC	Family impact Family functioning
Looman, W. S.	2015	USA				Healthcare satisfaction
Toly, V. B.	2014	USA	Resourcefulness training based on a cognitive–behavioral intervention with four-week, face-to-face sessions	Pediatric nurses	TDC	Mothers' mental health
Kuo, D. Z.	2013	USA	Multidisciplinary and comprehensive care oversight and tertiary care center-based care coordination, especially in usual care	Coordinate nurses	CMC	Parents' QOL
Cohen, E.	2012	Canada	Community-based complex care clinics integrated with a tertiary care center	Nurse practitioners via online	CMC	Healthcare utilization Parents' QOL Family-centered care

Note. CMC, children with medical complexity; QOL, quality of life; TDC, technology-dependent children.

Looman et al., 2018; Toly et al., 2014). One additional paper was included after conducting a manual search (Arksey et al., 2002). The five papers show that various parents' and families' outcomes are improved (Table 1); however, almost no intervention programs attempt to improve the family empowerment of families with severely disabled children living at home. Moreover, it is possible to provide effective and comprehensive interventions in line with the needs of families without limiting the type of disease or disability. Lastly, many interventions reported to be effective are provided by or heavily involve nurses.

Based on the results of the aforementioned literature review and the needs identified in Step 1, we decided to develop a program to enhance family empowerment. The program enables families to "utilize social resources" and "reduce the long-term care burden" for families with severely disabled children living at home. Family empowerment was set as the main outcome. Further, improving social resource utilization and reducing long-term care burden were set as the first secondary outcomes (other secondary outcomes will be added in the later steps).

Based on the concept of family empowerment, the family itself can grow and self-actualize by focusing on its advantages, abilities, and strengths rather than simply receiving assistance. Currently, interventions reducing caregiver stress in children with medical complexity (CMC) are categorized into "care coordination," "respite," "telemedicine," "peer and emotional support," "insurance and employment support," and "health support" (Arksey et al., 2002; Edelstein et al., 2017). The results of the literature review indicated that "care coordination" was the most common type of support (Cohen et al., 2012; Kuo et al., 2013; Looman et al., 2015; Looman et al., 2018), followed by "peer and emotional support" (Toly et al., 2014; Hiramoto et al., 2017). Therefore, we believe that "care coordination" and "peer and emotional support" are important elements in our program; however, in our program, families with severely disabled children living at home must develop a behavior that enables them to improve their own social resources and reduce the long-term care burden. This should be done rather than directly tampering with the amount of care and family relationships. Therefore, "enabling families with children with physical and mental disabilities living at home and their children to take the necessary action based on the gap between their current situation and their desired life" was set as the program's goal and the (target) behavioral change desired for the families participating in the program.

Step 3: Theoretical Selection of Methods

The goal of Step 3 is to select a theoretical method and an associated practical method to achieve the behavioral change objective. This program equips families raising children with disabilities, particularly the main caregiver, with the ability to coordinate their family life in cooperation with other families, medical and welfare service providers, local people, and government officials. It ultimately achieves family empowerment. We selected social cognitive theory (Bandura, 1986) for this program in anticipation of this behavioral change. Social cognitive theory regards human behavior as the interaction of behavioral, cognitive, and environmental factors; moreover, it emphasizes the interaction between individuals and the environment. We identified knowledge, skills, social support, and awareness as factors related to behavior modification in these families. These are the determinants of change, based on the main concepts of social cognitive theory. Self-compassion was also added to this list based on a review of previous studies (Bohadana et al., 2019).

The taxonomy of behavior change techniques (BCTs; Abraham & Michie, 2008) was used as a practical intervention method. This taxonomy, which involves 26 types of

BCTs, presents techniques to achieve behavioral change. Accordingly, techniques, such as encouraging clear goal-setting, self-monitoring, providing information, and identifying barriers for the benefits and risks of health and life, were selected based on the characteristics of families raising severely disabled children.

This program also confirmed that peer support's effect between parents of children with disabilities has already been verified in previous studies (Shilling et al., 2015; Bray et al., 2017); therefore, a group-based learning program emphasizing peer support is set. Based on the selected theoretical and practical intervention methods, this group was set up for primary caregivers raising severely disabled children at different developmental stages, with intervention by peer facilitators. These strategies provide opportunities to observe a model person performing the desired behavior (role model); thus, it facilitates modeling behavior.

When we developed this group session, we encouraged the families to imagine their goals and attempt to undertake their target actions on the basis of self-monitoring, which recognizes the current situation of their families, including their children and themselves. Subsequently, we decided that those experiences would be shared with the group; moreover, feedback and praise were provided when actual actions were taken to reinforce the outcomes. We intended to use a textbook for the participants and a booklet on family empowerment as tools to put the series of group sessions into practice.

Step 4: Program Design and Production

Adjustments were made in Step 4 to enable continuous implementation of the practical method in the program, based on the theoretical method found in Step 3.

First, four hours of discussions were held with three caregivers of children with disabilities (hereinafter referred to as concerned family members) to inquire about their opinions on the program structure's validity and feasibility, content, and management method. These caregivers support activities, such as patient associations and parent associations. The program structure was set once a week (two hours per session), using a group work format that would be completed in four sessions, based on the opinions expressed in the discussions. The concerned family members expressed their desire for a program content that would provide participants with an opportunity to allow deep self-disclosure, fun, and friends. Based on these expectations, a management method policy that focuses on activating the group work between concerned parties was adopted. This method is conducted by minimizing transmission from the program managers (comprising the research team) to inspire the participants themselves to realize child-rearing knowledge and skills and share local resource information, lifestyle benefits, and barriers related to risk. A policy was also established to assign the concerned family members as "program peer supporters" who participated in the program as observers or advisors, separate from the program managers.

We also incorporated work to create life charts and eco-maps (Hartman, 1995; Ray & Street, 2005), based on the BCTs, to allow the subjects to reflect on the lifestyle of their children and families. In the life chart, children and their family members were asked to describe their daily life on weekdays, holidays, and other days, and in the eco-mapping, the participants were asked to describe their family genogram, relationships among family members, and social relations outside the family, such as school and social resources. This work uses eco-mapping to self-monitor and visualize their ability to coordinate family life in cooperation with other families, medical and welfare service providers, local people, and government officials. It also helps them visualize family life and the collaboration and cooperation between families within this framework. Furthermore, modeling opportunities were provided by sharing the visualized work deliverables with other participants. This task allowed the participants to become aware of their ability to adjust family life and their situation of family empowerment, which they had not been conscious of until now. This will lead them to generate change (Tsuda et al., 2007). Mechanisms were prepared to promote these changes by imparting knowledge and skills to family empowerment. The first mechanism is a booklet on family empowerment created by the representatives of our research group, based on the results of our research to date. Presenting the three aspects of family empowerment clearly with illustrations will make it possible to immediately acquire knowledge about empowerment through self-work; moreover, sharing this information during group work also allows knowledge to be established by promoting discussion (Borek et al., 2018). The second mechanism is eco-mapping. Eco-mapping the lifestyles of their children and families enabled them to acquire natural knowledge about social support. Such a concept is difficult to understand with words alone. The third mechanism is the textbook and facilitator book. The textbook contained the structure of the program and the work to be done in each session of the program. The textbook systematically lists the work and clearly shows the goals to be achieved for each task. It is a tool for participants to look back on their work outcomes when needed. It was decided that facilitators do not need to have any specific qualifications to aim for use in peer support in the future. Using the facilitator book, the facilitators answered questions and encouraged group dynamics so that the subject's thinking could progress during the work. This program included parents of disabled children at home who responded to the call for participation in flyers and who signed up to participate in the program.

The content of the program completed throughout this process (Figure 2) is described below for each session every week.

Figure 2. Overview of each session in the program.

First session: The roles within the family, utilization awareness and utilization of social resources, and relationships with professionals were discussed through the participants' self-introduction and the creation of genograms/eco-mapping. Figure 3 shows an example of a participant's work. The participants were also given homework to record a week in their lives and that of their families. They were asked to summarize the information in a table. Figure 4 shows an example of a participant's entries.

Second session: The content of the previous group work and homework (i.e., a record of a week in their lives) was shared among the group. The participants thought about the problems they faced and the kind of life they wanted. The homework for this session was to set goals to achieve the lives that they wanted.

Third session: The lives that they wanted and their goals were shared among the group. The participants were then asked to set more positive and concrete goals. The homework for this session was to evaluate their own practices toward reaching their goals.

Fourth session: The actions, lifestyle changes, and self-evaluation practiced for working toward their goals were shared among the group. Then, the participants praised each other's efforts.

In the first session, the participants ascertained the current situation of their own lives and promoted awareness of family empowerment's current status. The second, third, and fourth sessions aimed at further promoting family empowerment awareness and enhancing self-compassion. Through these sessions, it was also hoped that the participants would enhance their own changes and awareness throughout their participation in the program.

The facilitator book was designed to present the facilitator method (such as approximate time for proceeding, how to

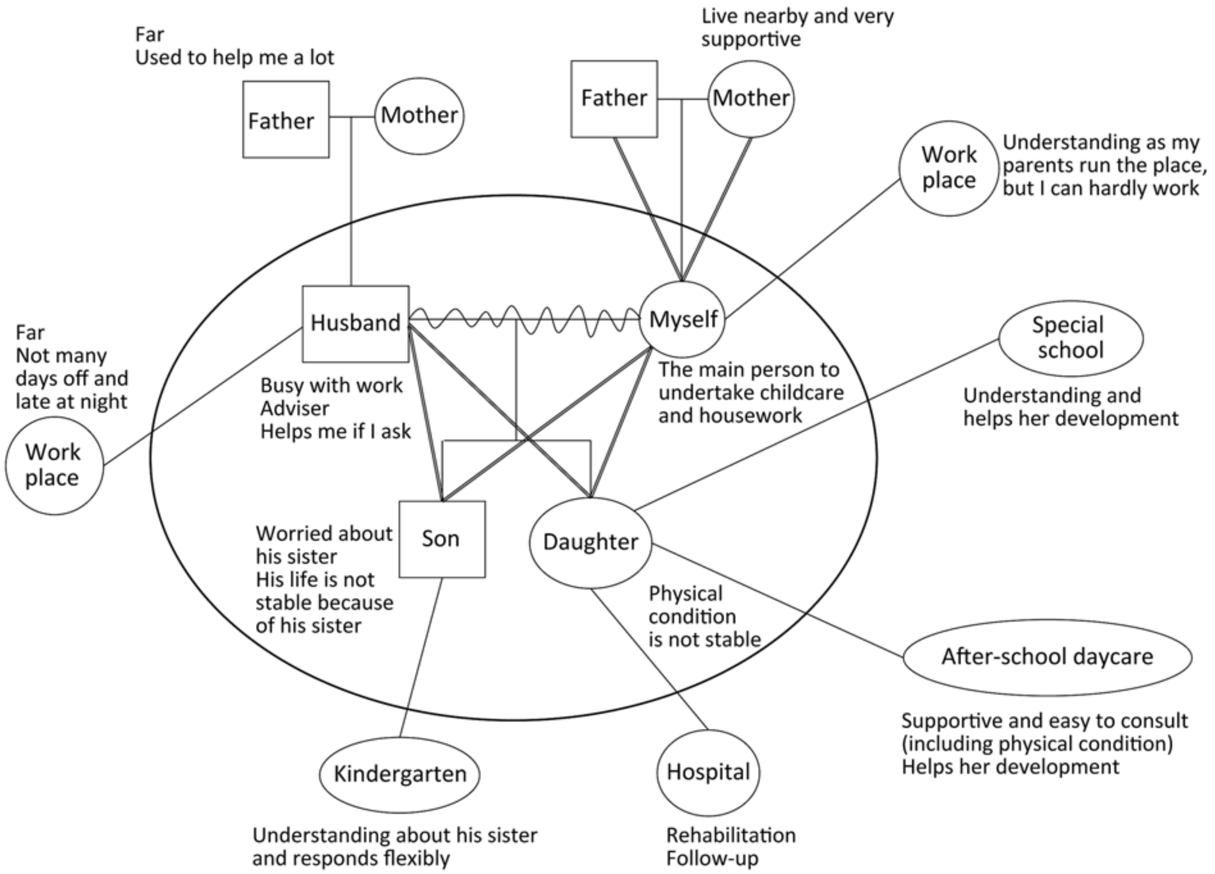


Figure 3. Example of the created eco-map. The participants directly wrote in japanese onto the map in the workbook. In the interest of sharing the contents, what they wrote is shown in english.

proceed with the work in the program, and what to say to participants) in detail in a form corresponding to the textbook to increase the program's versatility. Ultimately, we created a textbook and workbook as tools to enable the participants to conduct self-monitoring by visualizing their own learning and work throughout the program. The concerned family members also confirmed the content's validity and feasibility.

The program improved awareness, self-monitoring, and self-compassion of children and their families. This was achieved by combining group work with self-work at home using textbooks for participants and booklets on family empowerment. We also decided to set tasks in the latter half of the program to encourage participants to consider actions from the perspective of family empowerment, help them imagine the life they wanted for their family, and further promote change.

Implementation of Pretesting (Step 5)

Design

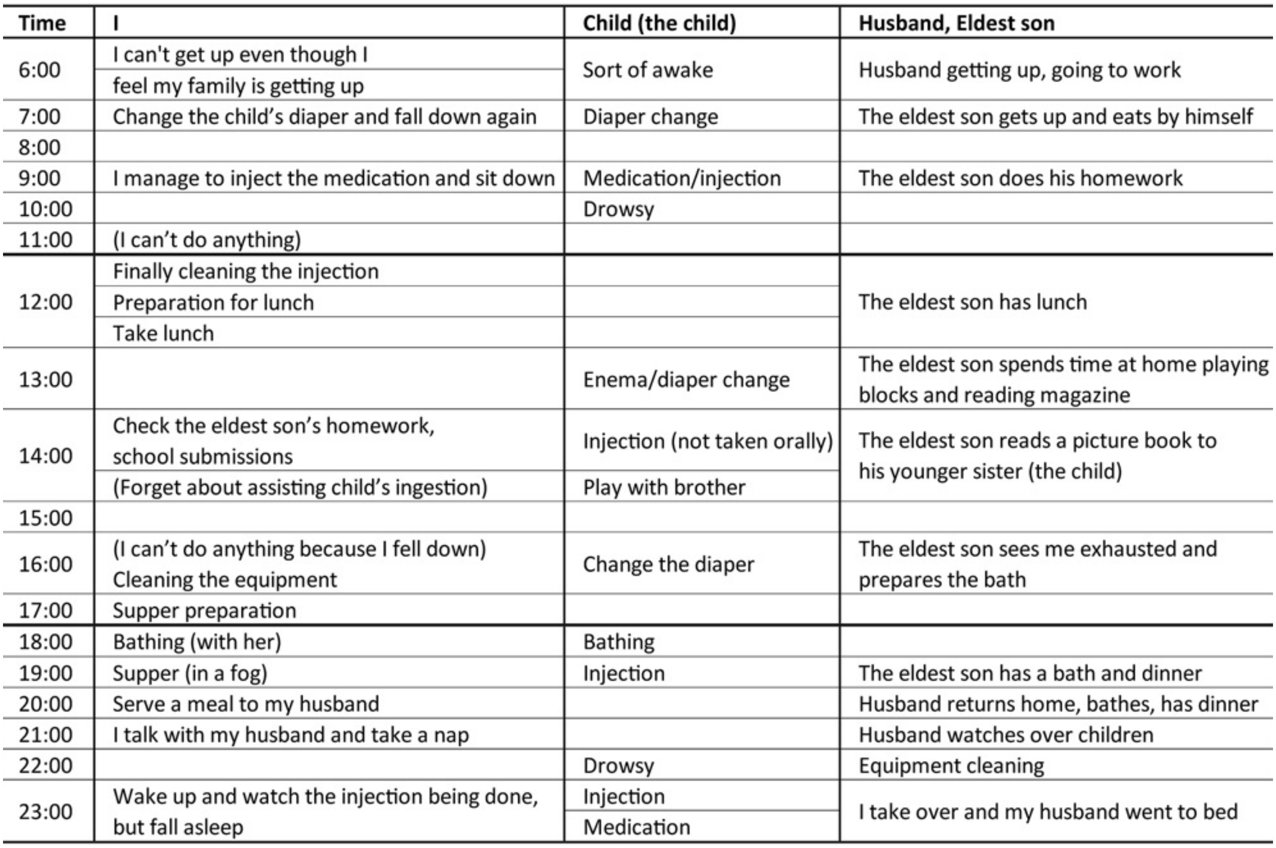
We conducted a controlled pretest to identify the likely effects of our program.

Procedure

Information leaflets were placed at medical treatment and care facilities near the program site to publicize the program and recruit participants. We provided detailed information about the date, time, venue, and who to contact for those who wished to participate. The applicants were divided into intervention and control groups. The program was implemented for the intervention group, whereas no particular intervention was used for the control group during that time, and they were asked to wait. The intervention group participants were asked to complete the questionnaire just before (the first session) and after the program. The control group participants were asked to complete the questionnaire at the same time as the intervention group via email.

The program (four times in total) was conducted in a seminar room that could be used for public purposes where privacy was assured. The group facilitator prepared snacks and drinks so that people would feel relaxed. The participants and supporters sat around the desk. When the group work was presented, the facilitator took a picture of the participants' workbooks. The facilitator then projected them so that the contents could be shared with the entire group.

The program was implemented from January to February



Time	I	Child (the child)	Husband, Eldest son
6:00	I can't get up even though I feel my family is getting up	Sort of awake	Husband getting up, going to work
7:00	Change the child's diaper and fall down again	Diaper change	The eldest son gets up and eats by himself
8:00			
9:00	I manage to inject the medication and sit down	Medication/injection	The eldest son does his homework
10:00		Drowsy	
11:00	(I can't do anything)		
12:00	Finally cleaning the injection Preparation for lunch Take lunch		The eldest son has lunch
13:00		Enema/diaper change	The eldest son spends time at home playing blocks and reading magazine
14:00	Check the eldest son's homework, school submissions (Forget about assisting child's ingestion)	Injection (not taken orally) Play with brother	The eldest son reads a picture book to his younger sister (the child)
15:00			
16:00	(I can't do anything because I fell down) Cleaning the equipment	Change the diaper	The eldest son sees me exhausted and prepares the bath
17:00	Supper preparation		
18:00	Bathing (with her)	Bathing	
19:00	Supper (in a fog)	Injection	The eldest son has a bath and dinner
20:00	Serve a meal to my husband		Husband returns home, bathes, has dinner
21:00	I talk with my husband and take a nap		Husband watches over children
22:00		Drowsy	Equipment cleaning
23:00	Wake up and watch the injection being done, but fall asleep	Injection Medication	I take over and my husband went to bed

Figure 4. Examples of life described. In actuality, the participants wrote directly in japanese onto the maps in the workbook. In the interest of sharing the contents, what they wrote is shown in English.

2020.

Questionnaire

Because of research feasibility, we set all outcomes of this pretest as parent (themselves)-reported outcomes. The questionnaire asked about the basic attributes of the participants and their families (including children with disabilities) and life-related matters and included measures of self-compassion (a secondary outcome defined at Step 3), caregiver burden (one of the first secondary outcomes defined at Step 2, including daily sleep time and nocturnal awakening), social resource utilization (one of the first secondary outcomes defined at Step 2), health-related quality of life (new outcomes from our literature review (Table 1)), and family empowerment (main outcome). Furthermore, the questionnaire was used after the program's implementation to seek the intervention group's input regarding their satisfaction level while attending the program. It also looked into their opinions on the number of sessions and program content.

The questionnaire included questions on the participant's age, relationship with the child or children, educational background, working status, the number of hours of sleep, nocturnal awakening frequency, marital status, total number of adults living in the same house, total number of children, total number of children with special needs, household income, child's age, severity score, diagnosis name, and age at diagnosis.

The short form of the Japanese version of the Self-Compassion Scale (SCS-J-SF) was used to measure self-compassion (Arimitsu et al., 2016). The SCS-J-SF comprises 12 items that are rated on a five-point scale, with two items each for the following six subscales: self-kindness, self-judgment, common humanity, isolation, mindfulness, and overidentification; the higher the total score, the more compassion one has for oneself.

The short version of the Japanese version of the Zarit Caregiver Burden Interview (J-ZBI_8) was used to measure the caregiver burden (Arai et al., 2003). The J-ZBI_8 is composed of eight items that are rated on a five-point scale. The questions posed relate to the physical and mental burden and social restrictions associated with elderly care; the higher the score, the greater the caregiver burden. This scale is also used in the context of parents raising children with disabilities (Toki et al., 2010).

The questions on social resource utilization were based on the original items used in a previous study (Wakimizu et al., 2018). Specifically, using a four-point scale, questions on the general awareness of social resource utilization were asked. More detailed questions on the service utilization status, type of service used (e.g., medical, nursing care, daycare), and social resource utilization awareness (e.g., public services, medical institutions, schools) were asked.

The SF-8 standard version was used to measure the health-related quality of life. It comprised eight items (Fukuhara & Suzukamo, 2005). A component summary score can be calculated, based on the responses received, for each of the two subscales: the physical component scale (PCS), which assesses physical health, and the mental component scale (MCS), which assesses mental health. Higher PCS and MCS scores indicate higher physical and mental health-related quality of life, respectively.

The Japanese version of the Family Empowerment Scale (J-FES) was used to measure family empowerment (Wakimizu et al., 2010). The J-FES assesses the ability to coordinate the lives of oneself and one's family; moreover, it collaborates with service personnel and government officials to raise children. It comprises 34 items rated on a five-point scale; the higher the scale score, the higher the level of family empowerment.

Analysis

Descriptive statistics were calculated relating to the subject attributes and each variable's score based on the questionnaire response results. The scores for the SCS "self-compassion" domain could not be calculated due to a printing error; therefore, these results were excluded from the analysis. The changes before and after the intervention were evaluated using the paired t-test for the intervention and control groups. The number of changes in the scores before and after the program was compared between the intervention and control groups. SPSS version 26 was used for statistical analysis. The significance level was set at 5%; moreover, the level of satisfaction, opinions, and free responses related to the program was all listed.

Ethical Considerations

We promised each participant that we would comply with the following to ensure that they participated in the program: participation was at the participant's free will, whether or not they could participate would not affect children's care and their families' lives, they could withdraw from participation in the middle of the program, and personal information collected for participation (completed questionnaires and group work contents) would be strictly managed so that no individual was identified when publishing the results. Written consent has been obtained from all participants to publish their information, including their comments for the program. This study was conducted with prior approval from the ethics committee of the institution to which the principal investigator belongs.

Results

Participant Attributes

The responses were obtained from seven participants. Three participants were from the intervention group and four from the control group. All subjects were mothers of children with congenital disorders, such as cerebral palsy or chromosomal abnormality, aged 4-12 years. The children were 8.14 ± 3.64 (mean ± standard deviation (SD)) years old. The participants (mothers) were in their 30s ($n = 2$), 40s ($n = 4$), and 50s ($n = 1$). The choices for the highest level of education were high school ($n = 2$), junior college ($n = 2$), and university ($n = 3$). The mothers' employment statuses were part-time employment ($n = 5$) and housewife ($n = 2$). There was no significant difference between the intervention and control groups, except for the highest level of education (Table 2).

Table 3 presents the scores for each variable before and after the program for the intervention and control groups. There was a significant improvement in total family empowerment scores in the intervention group.

There was no significant difference in any variable when the change in scores before and after the intervention was compared between the groups (Table 4).

Evaluation and Revision of the Program

The program was revised on the basis of the questionnaire responses from the intervention group ($n = 3$) at the program's completion, opinions provided during participation in the program, and the subsequent social conditions, including the COVID-19 pandemic. The comments and the program's revisions are listed in Table 5. The participants looked back on the course in general and commented, "I could tackle the problem, thanks to the company of other participants," "I gained confidence by performing plans toward the goal," "I got a positive feeling," and "It was good that an experienced mother led us to talk about our stories."

Discussion

This family empowerment program was systematically developed in collaboration with the participants using an IM approach model characterized by adapting theoretical interventions to each behavioral and environmental factor. The program improves the empowerment of caregivers of children with disabilities.

Consequent to the pretest for this program, there were only few participants in the intervention and control groups ($n = 7$). This resulted in insufficient statistical power, which may have been the reason for not detecting any significant difference between the two groups in the family empowerment score or any other variable. However, there was a significant improvement in the total family empowerment score

Table 2. Attributes of both groups.

		Intervention group (*n* = 3) N/mean ± SD	Control group (*n* = 4) N/mean ± SD	*p*
Relationship	Mother	3	4	
Age	30s	1	1	.65 [a]
	40s	2	2	
	50s	0	1	
Marital status	Married	3	4	
Living with partner	Living together	3	3	.35 [a]
	Husband living away for work	0	1	
Highest level of education	High school	0	2	.03 [a]
	Junior college	0	2	
	University	3	0	
Employment	Part time	2	3	.81 [a]
	Housewife	1	1	
Household income	≥3 to <5 million yen	1	2	.19 [a]
	≥5 to <7 million yen	0	1	
	≥7 to <10 million yen	2	0	
	Not answered	0	1	
Age of child with disability		6.67 ± 3.51	9.25 ± 4.35	.44 [b]

[a] Chi-squared test; b, t-test.

Table 3. Intragroup comparison before and after intervention.

	Intervention group (*n* = 3)			Control group (*n* = 4)		
	Pre Mean ± SD	Post	*p*	Pre Mean ± SD	Post	*p*
Mean daily sleep time (hours)	5.33 ± 0.58	4.67 ± 1.15	.18	4.75 ± 0.96	4.63 ± 0.95	.39
Frequency of nocturnal awakening 1 = every night 2 = several times a week 3 = several times a month 4 = only during attacks	2.67 ± 0.58	2.67 ± 1.15	1.00	2.25 ± 1.50	2.75 ± 1.26	.39
Social resource utilization 1 = do not utilize at all 2 = do not utilize very often 3 = utilize a little 4 = utilize often	2.67 ± 1.53	3.67 ± 0.58	.23	2.75 ± 1.26	2.25 ± 1.26	.18
SCS-J-SF self-judgment	5.00 ± 1.73	5.33 ± 1.53	.42	7.25 ± 0.96	6.25 ± 1.50	.31
SCS-J-SF common humanity	6.67 ± 2.52	9.00 ± 1.73	.07	7.50 ± 1.00	7.25 ± 0.96	.79
SCS-J-SF isolation	6.33 ± 3.51	7.00 ± 3.00	.18	6.75 ± 0.96	7.25 ± 1.50	.18
SCS-J-SF mindfulness	5.33 ± 1.15	7.33 ± 2.52	.18	7.50 ± 0.58	8.25 ± 0.96	.22
SCS-J-SF overidentification	4.00 ± 2.00	5.33 ± 3.06	.18	6.75 ± 1.50	5.50 ± 1.29	.55
J-ZBI_8	14.00 ± 9.54	17.33 ± 9.71	.15	9.00 ± 6.24	8.75 ± 5.12	.42
SF-8 PCS	46.00 ± 2.54	49.62 ± 6.89	.57	41.74 ± 5.00	49.28 ± 4.71	.20
SF-8 MCS	43.19 ± 7.39	47.76 ± 7.35	.54	46.24 ± 8.23	45.71 ± 7.95	.74
J-FES family	41.67 ± 8.14	46.67 ± 5.03	.14	38.00 ± 6.68	39.25 ± 3.50	.62
J-FES service system	45.00 ± 9.54	46.00 ± 8.72	.42	39.75 ± 7.68	41.75 ± 6.34	.12
J-FES community/political	28.33 ± 7.51	34.67 ± 16.77	.36	25.75 ± 6.29	29.50 ± 6.45	.09
J-FES total	115.00 ± 25.16	126.67 ± 26.27	.01	104.00 ± 18.02	110.25 ± 13.05	.19

Paired t-test.

Note. J-FES, Japanese version of the Family Empowerment Scale; J-ZBI_8, short version of the Japanese version of the Zarit Caregiver Burden Interview; MCS, mental component scale; PCS, physical component scale; SCS-J-SF, short form of the Japanese version of the Self-Compassion Scale; SF-8, scale measuring health-related quality of life and consisting eight items.

Table 4. Intergroup comparison of the amount of change before and after the intervention (after intervention–before intervention).

	Intervention group (*n* = 3) Mean ± SD	Control group (*n* = 4)	*p*
Mean daily sleep time (hours)	−0.67 ± 0.58	−0.13 ± 0.25	.15
Frequency of nocturnal awakening	0.00 ± 1.00	0.50 ± 1.00	.54
1 = every night			
2 = several times a week			
3 = several times a month			
4 = only during attacks			
Social resource utilization	1.00 ± 1.00	−0.50 ± 0.58	.05
1 = do not utilize at all			
2 = do not utilize very often			
3 = utilize a little			
4 = utilize often			
SCS-J-SF self-judgment	0.33 ± 0.58	−1.00 ± 1.63	.24
SCS-J-SF common humanity	2.33 ± 1.15	−0.25 ± 1.71	.08
SCS-J-SF isolation	0.67 ± 0.58	0.50 ± 0.58	.72
SCS-J-SF mindfulness	2.00 ± 1.73	0.75 ± 0.96	.27
SCS-J-SF overidentification	1.33 ± 1.15	−0.75 ± 2.22	.20
J-ZBI_8	3.33 ± 2.52	−1.00 ± 1.73	.07
SF-8 PCS	3.62 ± 9.42	7.54 ± 9.31	.61
SF-8 MCS	4.57 ± 10.68	−0.53 ± 2.88	.39
J-FES family	5.00 ± 3.61	1.25 ± 4.57	.30
J-FES service system	1.00 ± 1.73	2.00 ± 1.83	.50
J-FES community/political	6.33 ± 9.29	3.75 ± 3.10	.68
J-FES total	11.67 ± 1.53	6.25 ± 7.41	.28

t-test.

Note: J-FES, Japanese version of the Family Empowerment Scale; J-ZBI_8, short version of the Japanese version of the Zarit Caregiver Burden Interview; MCS, mental component scale; PCS, physical component scale; SCS-J-SF, short form of the Japanese version of the Self-Compassion Scale; SF-8, scale measuring health-related quality of life and consisting eight items.

in the intervention group after participating in the program. This result suggests that this program is effective for enhancing family empowerment.

The reason for the total family empowerment score's improvement is the visualization effect using the tools, participants' modeling, and the "program peer supporters." First, this program reflected on the children and family support systems and current life situations using eco-maps and life charts as part of group-based, participant-led work. This process promotes the visualization of behavioral and environmental factors related to the outcome of empowerment. Adams et al. (2017) qualitatively surveyed the experience of creating care maps by the parents of children who require medical care. They stated that creating care maps clarifies the priorities and needs of these families. The experience of objectively visualizing how family members spend their time in their daily lives by creating life charts has led to an understanding of their family's current situation within their busy lives.

The participants, who were mothers in similar situations, discussed specific behaviors to create the future of their children, their families, and themselves based on the eco-maps and life charts; moreover, they set life goals to achieve that end. They said that they could tackle problems more positively due to interactions with other participants. This finding suggests that self-compassion, an element of the program, was enhanced through positive exchanges among the participants. Furthermore, it may have had a positive effect on the participants' empowerment as well. In prior research, families caring for children with thalassemia, who have experienced family empowerment programs, reported that sharing information and other families' experiences and beliefs related to the care of their children improves their ability to make decisions about family problems and needs and manage the care of their children and family relationships (Wacharasin et al., 2015). This suggests that it is appropriate to set up group work with families of children with disabilities as a program format.

The participants' caregiver burden was significantly higher than the caregiver burden (8.9 ± 6.4; Matsuzawa et

Table 5. Comments identified by the participants through “implementation of pretesting” and improvements made for the program implementation.

Comments from the participants		Improvements made for the program implementation (specific details of how the program content and management format were revised in response to each issue)
Program overall	The program gave me pleasure.	All participants were generally positive. This content will be kept as is.
	The program was so good that I could confidently recommend it to my friends.	
	It would be better for everyone to make the most out of the opportunities, such as medical checkups, so basically, everyone raising children with disabilities can participate in this program.	
	Participating in the program was helpful. I felt positive. It was good that the experienced mothers led the discussions.	The presence of other participants and supporters was favorable. There is no problem with proceeding with this format.
	The input from other participants was inspiring.	
	Face-to-face implementation is no longer possible due to the COVID-19 pandemic.	The program’s format has been changed from face-to-face to online. Some of the textbooks and facilitator books will be modified to deal with this situation.
Participants	Parents with children aged around 1 year should be able to participate in the program.	This program was originally designed to include participants with children of any age up to school age, so the content and structure will remain unchanged. However, during the recruitment process, we will request the participation of parents with younger children.
	It would be better to participate in the program with my spouse.	Although the participation of spouses is expected to be effective, it is necessary to consider the consent and privacy of the other participants. This will be considered carefully in the future.
Program sessions	The number of program sessions is good as is.	The content will remain unchanged.
	It would be good if there were a number of different patterns for the days of the week when the program sessions will be held.	It was decided to set suitable times and days of the week for holding the program sessions based on the needs of the participants at the time the program is run.
	The length of one program session is perfect.	The content will remain unchanged.
Program content structure	The homework of setting goals for the future was a painful task that made me sad and distressed because I could not see any future or hope.	If the participants are distressed about setting future goals, they are unable to receive follow-up from the other participants. Therefore, it was decided to invite these participants to join a group work to enable them to make presentations and hold discussions on the spot.
	It may be easier to tackle the tasks by giving the participants time to discuss their efforts toward the goals.	It was decided to color-code the goals set representing the three levels of family empowerment so that the participants can discuss the tasks they can do at each level.
	The language used in the program is difficult to comprehend, which makes it challenging to understand the purpose and intent of the program.	It was decided to explain the purpose of empowerment and the programs at the beginning of the program using a separate pamphlet.
Communicating program to other family members	I told my family a little about the content of the program and what I had learned (n = 2) /I did not tell my family about it at all (n = 1).	The program includes a task where the participant is asked to share his or her problems with their family. However, some participants reported that they did not tell their families about it at all. Therefore, it was decided to use the individual consultations after the program to try to understand the situation of individual participants during the program.

al., 2019) of Japanese parents raising children with severe motor and intellectual disabilities in a previous study. The reason for the higher caregiver burden score among the participants in this study may be because the children’s mean age in the aforementioned study (Matsuzawa et al., 2019) was 12.0 ± 3.6 years, which was higher than that of the children in this study. Mothers tend to establish their own child-rearing style, their own lifestyle, and their family’s lifestyle while learning how to care for their child. This enables them to explore ways to incorporate rest and well-being into their lives; thus, it is assumed that the participants in this study were still in the process of establishing their child-rearing styles. Furthermore, the participants wished to participate in the intervention program to enhance their empowerment. They had a desire to improve their child-rearing styles and their own and their family’s lifestyles; therefore, it can be assumed that the participants were mothers with a high caregiver burden.

A characteristic of this program was that it was developed in collaboration with the participants. Consequently, there were no negative comments from the participants regarding the way the program was run, including ones regarding the length and number of sessions; moreover, no participants dropped out midway through the program. Therefore, incorporating the participants' viewpoints on the program's aspects, such as the length and number of sessions, is considered effective, without overburdening the participants. Furthermore, no participants reported any negative impacts, such as family discord and psychological instability, because of participating in the program. These findings suggest that Step 6 (program evaluation) can be performed, based on the program management and content in the pretest.

The program was conducted face-to-face; however, programs should be conducted online during the COVID-19 pandemic. The methods for advertising the program and facilitating group work should be adapted to support programs remotely.

Limitations and Future Research

The effect of this program on enhancing family empowerment was clearly confirmed by the statistical results from the data gathered through the questionnaire and participants' verbal responses; however, it is impossible to generalize its efficacy because there were only three participants in the group. Considering that this study is a pilot study, the results are promising; however, the efficacy of the program should be further evaluated, applying some revisions to the program as suggested above.

Additionally, feelings of family empowerment before the program could be characterized as "sometimes" for two participants and "often" for one participant. Future programs should be conducted and evaluated with participants who "seldom" or "never" have feelings of family empowerment. The efficacy of the program can then be verified on a larger scale.

Conclusions

We developed and implemented a participatory program to enhance family empowerment. The results indicate that the program was effective in enabling participants to take actions regarding adjustments to their lives and use social resources; therefore, their sense of family empowerment had increased. As a pilot study, the results support the value of conducting the program on a larger scale; however, further verification of the program's efficacy is needed in future research.

Author Contributions

All authors had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

- Conceived or designed the study: RW, HF, KN, IS, NI, and AM
- Performed research: RW, HF, KN, IS, NI, and AM
- Analyzed data: RW, HF, KN, IS, NI, and AM
- Wrote the paper: RW, HF, KN, IS, NI, and AM

Declaration of Conflicting Interests

We received no financial support or relationships that may pose a conflict of interest in connection with this manuscript.

Ethical Approval

This study was conducted with prior approval from the ethics committee of the University of Tsukuba (No. 1420).

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Original Research

Dehydration of nurses working in the day shift and its factors: A multicenter cross-sectional observational study

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Abstract

Objective: Dehydration has a risk of reducing cognitive function, which can lead to misjudgment by nurses. Nurses are required to be in optimal physical and mental conditions since their misjudgments affect the lives of patients. Therefore, it is desirable to prevent dehydration in nurses; however, the prevalence and factors of dehydration in nurses have not been clarified. This study aimed to clarify dehydration prevalence in nurses and examine dehydration factors before and after their shift. **Methods:** Data were collected during the day shift of 115 registered nurses in 19 wards of 2 hospitals in Japan. Urine specific gravity (USG) and body weight were measured before and after the shift to determine dehydration. Questionnaires, including demographic characteristics and fluid intake, were recorded before and after their shift. Multivariate analysis was performed based on the fluid intake, number of steps, and years of experience as dehydration factors. **Results:** Overall, 59 (51.3%) and 82 (71.3%) nurses were dehydrated before and after their shift, respectively. USG before the shift (odds ratio [OR]: 2.328, 95% confidence interval [CI]: 1.424-3.807) and years of experience (OR: 0.946, 95% CI: 0.899-0.996) were factors related to dehydration at the end of the shift. USG before the shift (OR: 2.573, 95% CI: 1.347-4.914) was also a factor related to dehydration factors after the shift for beginner nurses. **Conclusions:** Over 70% of nurses were dehydrated after their shift. USG before the shift and years of experience were related to dehydration after the shift. To prevent dehydration, it is desirable for managers to encourage beginner nurses to drink water.

Keywords
dehydration, fluid intake, nurse, shift work schedule, urine specific gravity

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Introduction

Dehydration has various physical and mental effects, regardless of the process (Sawka & Coyle, 1999). Mild dehydration of 1%-2% of the total body weight results in a delayed working memory response, decreased cognitive and psychomotor functions, such as attention, concentration, and mood, and an increased error and difficulty in work (Armstrong et al., 2012; Ganio et al., 2011; Grandjean & Grandjean, 2007; Shirreffs et al., 2004).

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Hydration in the workplace is a specific concern since dehydration can affect productivity, safety, and morale (Kenefick & Sawka, 2007). Most previous studies investigating the workers' hydration status in the workplace have focused on those performing physical activities in hot and humid environments (Butler-Dawson et al., 2019; Cvirn et al., 2019; Polkinghorne et al., 2013; Wagoner et al., 2020); however, only a few studies have investigated the hydration state of health care professionals (HCPs) working in several indoor workplaces where the temperature and humidity are controlled (Alomar et al., 2013; El-Sharkawy et al., 2016).

HCPs should be in optimal physical and mental conditions since their misjudgments affect the lives of patients. Previous studies investigating the dehydration of doctors and nurses (HCPs) in a hospital have shown that approximately half of them developed dehydration at the end of a shift (Alomar et al., 2013; El-Sharkawy et al., 2016). HCPs had an impaired cognitive function by measuring cognitive tests using a Personal Computer (El-Sharkawy et al., 2016). Another study reported that gender, age, and lack of fluid intake were related to the dehydration of HCPs in a hospital (Alomar et al., 2013). However, the tasks of nurses and doctors at work are different. Half of the nurses' tasks demand mild and moderate physical activities (Chen et al., 2011; Reed et al., 2018); therefore, we hypothesized that the prevalence and factors of dehydration in nurses differ from those found in previous studies when investigating only nurses.

If hospital nurses were dehydrated before or after a shift, impaired cognitive function and increased difficulty in work might result in an increased occurrence of mistakes and accidents. Such a situation is undesirable for the hospital as well as for the patients and should be prevented. This study aimed to clarify the prevalence of dehydration in nurses working in hospitals and examine factors related to the dehydration of nurses before and after a shift.

Materials and Methods

This multicenter cross-sectional observational study was conducted in Japan. Data were collected from July to November 2018. This study was conducted according to the Declaration of Helsinki and Strengthening the Reporting of Observational studies in Epidemiology (STROBE) checklist (von Elm et al., 2007). The protocol was approved by the Ethical Committee of the Graduate School of Nursing, Chiba University (No. 29-120) and the Ethical Committee of the Center Hospital of the National Center for Global Health and Medicine (NCGM-G-002513-00). Written informed consent was obtained from each participant before enrollment.

Recruitment was performed in all wards in two hospitals. All nurses working in the wards of the two hospitals were eligible for inclusion. Exclusion criteria were pregnant or menstrual women, those with existing renal disease, or those on diuretics or antihypertensive medication (El-Sharkawy et al., 2016). The criteria for discontinuing data collection were: (1) if no urination was observed on the day of data collection and it was difficult to measure the urine specific gravity (USG), (2) physical upsets during data collection (headache, nausea, malaise, and extreme thirst), (3) it was difficult to cooperate in research due to work conditions, and (4) it was not possible to meet the measurement time due to absenteeism or late arrival on the day of data collection. The sample size was 115 when calculated, assuming that the α value was .05 on both sides, β value was .2, prevalence of dehydration was 36%, and missing data were 20% (El-Sharkawy et al., 2016). Additionally, participants whose research cooperation was discontinued were not recruited again.

After waking up on the day of data collection, participants urinated to discard the urine accumulated in the bladder at night, which might affect the USG before their shift (Armstrong, 2007). Participants submitted urine samples before starting their shifts, and researchers or participants measured USG using a pocket refractometer (PAL-09S; ATAGO, Japan). Within an hour of collection, urine samples were tested only for specific gravity and immediately discarded. Considering the effect on USG, participants refrained from drinking water 5 min before the USG measurement (Kovacs, et al., 1999; Popowski et al., 2001). Body weight was measured using scales that can measure at 50-g intervals (HJ325; OMRON, Japan). Participants weighed only their bodies and clothes with their pockets empty. After the weight measurement, a pedometer was attached around the participant's waist to measure the number of steps as physical activity (Copeland & Chambers, 2017; Croteau, 2017; Irimagawa & Imamiya, 1993). Participants completed a questionnaire before and after their shifts. They were then asked to complete their shift as usual. After the shift, USG and body weight were measured again, as mentioned above.

In this study, dehydration was defined as having a USG of ≥ 1.020. Although USG >1.030 evaluates severe dehydration (Armstrong et al., 2010; Epstein & Armstrong, 2000), a USG cutoff of 1.020 results in a sensitivity of 96% and a specificity of 96% (Bartok et al., 2004). USG ≥ 1.020 has frequently been used as a criterion for dehydration (Armstrong et al., 1994; Bartok et al., 2004; Popowski et al., 2001; Polkinghorne et al., 2013) and has an impaired cognitive function (Piil et al., 2018). Participants were divided into the dehydrated group (DG) and the euhydrated group (EG) according to their USG values before and after their shift; moreover, the weight change rate was calculated using the following formula (Cheuvront et al., 2004):

%ΔBody Mass: %BM = [post-shift weight (BM post) − pre-shift weight (BM pre)] / pre-shift weight (BM pre) × 100.

Table 1. Participant characteristics grouped according to the hydration states at the end of their shift.

	Dehydrated (*n* = 82)	Euhydrated (*n* = 33)	*p*-Value
USG after shift	1.0294 (1.0228, 1.0294)	1.0164 (1.0101, 1.0182)	<.001*
Age (years)	25 (24, 31)	27 (25, 38)	.037*
Sex			
Female	70 (85.4)	29 (87.9)	.725
Male	12 (14.6)	4 (12.1)	
BMI	20.9 (19.6, 22.9)	21.1 (19.0, 22.6)	.740
Years of experience	2 (0, 5)	4 (1.25, 16.5)	.028*
%ΔBM (%)	−0.41 (−0.89, −0.08)	−0.51 (−1.03, 0.20)	.643
No. of steps	7,471 (6,352, 9,293)	6,982 (5,882, 8,112)	.217

Median (first quartile, third quartile). *n* (%). **p* < .05. USG: urine specific gravity. BMI: body mass index. %ΔBM: %ΔBody Mass.

%BM was used to determine mild dehydration of 1%-2% of the total body weight at risk of cognitive decline (Armstrong et al., 2012; Ganio et al., 2011; Grandjean & Grandjean, 2007; Shirreffs et al., 2004).

Questionnaires, including demographic characteristics and fluid intake, were recorded at the beginning and at the end of the shift. In the questionnaire, participants answered before and after their shift on a 10-cm visual analog scale (VAS): thirst, hunger, tiredness, and concentration (El-Sharkawy et al., 2016; Millard-Stafford et al., 2012). These were used to assess the effect of hydration on subjective sensations. In the case of thirsty, 0 shows not thirsty at all, and 10 shows very thirsty. Conversely, in concentration, 0 shows high concentration, and 10 shows no concentration at all.

Statistical analyses were performed using IBM SPSS Statistics ver. 23.0 (IBM, Chicago, IL, USA). Descriptive data were expressed as median (first quartile, third quartile) for continuous variables and *n* (%) for categorical variables. In this study, a two-tailed *p*-value (*p* = .05) was considered statistically significant. Kolmogorov-Smirnov test was conducted before data analysis. Each variable in the two groups was compared using the Mann-Whitney U test, χ^2 test, and Fisher's exact test. A logistic regression analysis was performed to search for the factors related to dehydration at the end of the shift. Variables with a *p*-value of <.05 were selected for the forced entry method in the analysis. For variables with a correlation coefficient of >.6, a variable was selected to exclude multicollinearity. If there was multicollinearity between age and years of experience, years of experience was selected as a variable. In the end, logistic regression analysis with the forced entry method was performed on the finally determined variables. At that time, age was used as an adjustment variable. When before-shift USG was used as an independent variable in the logistic regression analysis examining the factors of dehydration after the shift, it was adjusted to 0.01 as a unit.

Second, a subgroup analysis was performed between DG and EG before their shift. It was also performed between nurses experienced for 5 years or less (beginner group: BG) and nurses experienced for 6 years or more (expert group: ExG) since health and work environments are important for nurses with 5 years or less (Watanabe, 2011). After confirming dehydration at the end of the shift between the two groups, each variable was compared. Finally, a logistic regression analysis was performed to examine the factors of dehydration at the end of the shift due to the differences in years of experience.

Results

Data were collected in 19 wards from 2 hospitals, and 115 nurses participated in each shift. Participant characteristics are shown in Table 1. None of the participants dropped out or stopped from collecting the data. All nurses worked in the day shift and took a 60 min break (45, 60) during their shift and worked 585 min (525, 653). The median years of experience were 2 years (1, 10). Participants comprised of 86 (74.8%) direct care staff and 29 (25.2%) others, including managers. Twenty-seven (23.5%) participants consumed alcohol on the day before their shift. Thirty-five (30.4%) participants skipped breakfast. The nurses walked 7,288 (6,013, 9,172) steps during their shift.

The median USG at the start and at the end of the shift was 1.0204 (1.0117, 1.0251) and 1.0234 (1.0196, 1.0281), respectively. Of the 115 participants, 59 (51.3%) and 82 nurses (71.3%) were dehydrated before and after their shift, respectively (Figure 1). Of the 59 nurses dehydrated before their shift, 47 (40.9%) were still dehydrated after their shift; however, 12 (10.4%) nurses became euhydrated. Of the other euhydrated nurses (56 nurses, 48.7%) before their shift, 35 (30.4%) became dehydrated after their shift; however, 21 (18.3%) nurses were euhydrated. No significant difference was observed in the proportion of dehydrated participants before and after their shift between the two hospitals (*p* = .577, *p* = .680).

%ΔBM of participants determined to be dehydrated at the end of their shift was −0.41% (−0.89, −0.08) (Table 1), and no significant difference was noted between the two hospitals (*p* = .646). Of the dehydrated participants after their shift, 19 (23.2%) had a %ΔBM of 1% or more.

Each outcome was compared between DG and EG after their shift to examine the factors related to dehydration at the end of their shift (Tables 1, 2). DG was significantly younger and had significantly shorter years of experience than EG (*p* = .037, *p* = .028). Furthermore, DG had a significantly higher USG at the start of their shift than EG (*p* < .001). DG had a significantly lower frequency of urination than EG (*p* = .031). Nurses had a feeling of thirst after their shift, and no significant difference was observed between DG and EG. Lack of breakfast was ∼30% in both groups, and no significant difference was noted between the two groups. Additionally, no significant differences were observed in gender, body mass index (BMI), break time, shift time, fluid intake before shift, fluid intake during the shift, number of steps, %ΔBM, or VAS (Table 1, Appendix 1).

The logistic regression analysis was performed using the two variables, years of experience and before-shift USG (Table 3). USG at the start of the shift (odds ratio [OR]: 2.328, 95% confidence interval [CI]: 1.424-3.807) and years of experience (OR: 0.946, 95% CI: 0.899-0.996) were factors associated with dehydration at the end of the shift.

Each outcome was compared between DG and EG at the start of their shift; however, no significant difference was observed in age, gender, BMI, alcohol intake last night, lack of breakfast, fluid intake before the shift, and subjective symptoms (Appendix 2).

Grouping was performed according to the number of years of experience, and subgroup analysis was performed

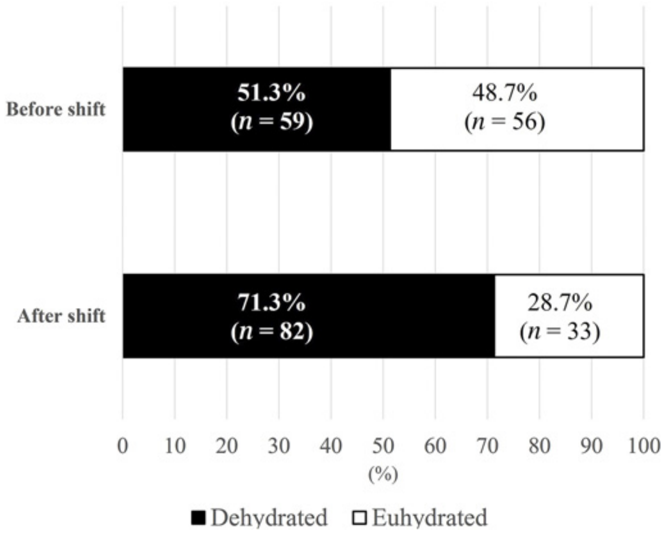

Figure 1. Hydration status of nurses before and after their shift. *n* (%), ■ Dehydrated: urine specific gravity ≥1.020, □ Euhydrated < 1.020.

Table 3. Predictors of dehydration at the end of the shift.

Variables	Adjusted odds ratio (95% CI)	*p*-Value
USG before shift	2.328 (1.424–3.807)	.001*
Years of experience	0.946 (0.899–0.996)	.034*

**p* < .05. Age is controlled as a factor. 95% CI: 95% confidence interval. USG: urine specific gravity.

Table 2. Hydration states, fluid intake, urination, and subjective feelings at the end of the shift.

	Dehydrated (*n* = 82)	Euhydrated (*n* = 33)	*p*-Value
USG before shift	1.0294 (1.0228, 1.0294)	1.0164 (1.0101, 1.0182)	<.001*
Urination (times)	1.0 (0, 1)	2.0 (1, 3)	.031*
Fluid intake (mL)			
Before shift	200 (100, 300)	200 (100, 225)	.398
During shift	350 (250, 500)	300 (300, 500)	.957
Before shift			
Thirst	3.8 (1.8, 5.6)	4.5 (1.9, 6.5)	.597
Hunger	1.6 (0.3, 3.3)	1.8 (1.0, 6.0)	.098
Tiredness	3.7 (2.4, 5.3)	5.0 (1.9, 6.2)	.483
Concentration	2.7 (1.3, 4.9)	2.8 (1.7, 5.2)	.355
After shift			
Thirst	8.9 (7.3, 9.6)	8.0 (4.9, 9.3)	.067
Hunger	7.3 (5.1, 9.0)	7.2 (5.0, 9.2)	.845
Tiredness	8.0 (6.5, 9.3)	8.1 (6.0, 9.2)	.901
Concentration	7.0 (4.9, 8.3)	7.3 (5.1, 8.8)	.275

Median (first quartile, third quartile). *n* (%). **p* < .05. USG: urine specific gravity.

Table 4. Participant characteristics in the subgroup analysis.

	Beginner group (*n* = 77)	Expert group (*n* = 38)	*p*-Value
Age (years)	24 (23, 25)	37 (32.3, 43.8)	.001*
Sex			
Female	65 (84.4)	34 (89.5)	.574
Male	12 (15.6)	4 (10.5)	
BMI	20.8 (19.5, 22.8)	21.1 (18.9, 22.5)	.041*
%ΔBM (%)	−0.55 (−1.04, −0.09)	−0.19 (−0.72, 0.18)	.076
No. of steps	7,594 (6,800, 9,839)	6,272 (5,396, 7,521)	<.001*
USG before shift	1.0238 (1.0210, 1.0288)	1.0224 (1.0168, 1.0266)	.022*
Hydration after shift			
Dehydrated	60 (77.9)	22 (57.9)	.030*
Euhydrated	17 (22.1)	16 (42.1)	
Urination (times)	1.0 (1, 2)	2.0 (1, 3)	<.001*
Fluid intake (mL)			
Before shift	200 (100, 300)	250 (150, 400)	.006*
During shift	300 (250, 500)	300 (300, 500)	.313
Before shift			
Thirst	3.6 (1.8, 5.7)	4.8 (2.0, 6.5)	.439
Hunger	1.6 (0.7, 3.6)	1.7 (0.2, 3.6)	.846
Tiredness	4.0 (2.5, 5.8)	3.6 (1.7, 5.8)	.475
Concentration	3.2 (1.7, 5.1)	2.4 (1.2, 5.1)	.282
After shift			
Thirst	8.6 (7.2, 9.6)	8.1 (5.8, 9.6)	.282
Hunger	7.4 (5.0, 9.2)	6.9 (5.1, 8.6)	.534
Tiredness	8.1 (6.8, 9.3)	7.6 (5.9, 8.7)	.104
Concentration	7.5 (5.3, 8.8)	6.2 (4.5, 7.4)	.012*

Median (first quartile, third quartile). *n* (%). *$p < .05$. USG: urine specific gravity. BMI: body mass index. %ΔBM: %ΔBody Mass.

Table 5. Predictors of dehydration at the end of the shift in the subgroup analysis.

Variable	Adjusted odds ratio (95% CI)	*p*-Value
USG before shift	2.573 (1.347–4.914)	.004*

*$p < .05$. Age is controlled as a factor. 95% CI: 95% confidence interval. USG: urine specific gravity.

since it became clear that the number of years of experience was related to dehydration at the end of the shift. BG had a significantly lower BMI than ExG (*p* = .041) (Table 4). Furthermore, BG had a significantly lower fluid intake before their shift than ExG (*p* = .006). Additionally, BG had significantly more number of steps than ExG (*p* < .001). BG had a significantly worse concentration after their shift than ExG (*p* = .012). BG worked significantly more as the direct care staff than the manager in their shift (*p* < .001). BG had a lack of breakfast at 35.5% and ExG at 21.6%, and no significant difference was observed between the two groups (Appendix 3). Concerning other variables, no significant difference was noted between the two groups.

Logistic regression analysis was performed to examine the dehydration factors at the end of the shift in BG (Table 5). Consequently, USG before the shift (OR: 2.573, 95% CI: 1.347-4.914) was related to dehydration at the end of the shift in BG.

Discussion

This is the first study to examine the prevalence of dehydration in nurses and its factors before and after a shift. Of the 115 participants, 59 (51.3%) and 82 (71.3%) nurses were dehydrated at the start and at the end of their shift, respectively. It was also found that 25% of the dehydrated nurses at the end of their shift lost more than 1% of their weight after their shift, which is associated with a declined cognitive function (Ganio et al., 2011; Shirreffs et al., 2004). Additionally, it was clarified that USG before the shift and years of experience was related to dehydration after the shift in nurses. In nurses experienced for 5 years or less, USG before their shift was associated with dehydration at the end of their shift.

Regarding our hypothesis, the prevalence of dehydration in HCPs could be different. The prevalence of dehydration in nurses revealed in this study was higher than that of the

HCPs in a previous study (El-Sharkawy et al., 2016). In the previous study, ∼1 l of water was drunk during the shift (El-Sharkawy et al., 2016), whereas in this study, only ∼ 350 ml of water was drunk. It is possible that the absolute amount of water consumed during the shift made a difference in the prevalence of dehydration between the previous study and this study. In this study, of 82 nurses who were dehydrated after their shift, 19 (23.2%) had a %ΔBM of 1% or more. Several previous studies have reported that dehydration with %ΔBM of 1% or more has a risk of cognitive decline (Armstrong et al., 2012; Ganio et al., 2011; Grandjean & Grandjean, 2007; Shirreffs et al., 2004); therefore, nurses should be aware of dehydration.

It was clear that USG at the start of the shift was associated with hydration status at the end of the shift. Based on this result, if nurses start a shift with dehydration, there is a possibility that the dehydration cannot be hydrated during their shift. It is possible that the nurse would end their shift with insufficient drinking water since the nurse could only drink 300 ml of water during their shift. In this study, there was no significant difference in fluid intake at the start of the shift between EG and DG. This result showed that fluid intake before the shift was unrelated to the dehydration of nurses at the end of their shift. If people drink water in a dehydrated state, the ingested water is excreted as urine without being absorbed by the body (Kovacs et al., 1999; Popowski et al., 2001). It is probable that those who were dehydrated at the start of their shift had an inappropriate fluid intake before their shift. Each outcome was compared between DG and EG at the start of their shift since the USG before the shift was related to dehydration after the shift. However, there was no significant difference in any outcome. Future research should further investigate the factors of dehydration before the shift for the development of interventions to prevent dehydration.

In this study, there was no significant difference between DG and EG; however, fluid intake during a shift is a factor related to dehydration after a shift (Alomar et al., 2013; El-Sharkawy et al., 2016). It is likely that DG drank water only during their break time since the number of urination times during a shift was significantly lower in DG. A previous study also reported that participants with oliguria had lower fluid intake and micturition than those without oliguria (El-Sharkawy et al., 2016). Therefore, it is desirable to drink water frequently rather than drinking a large amount of water at once during the shift (Kenefick & Sawka, 2007; American College of Sports Medicine et al., 2007).

The results of this study showed that beginner nurses (younger people) were more likely to become dehydrated. Older people were more likely to become dehydrated (Bossingham et al., 2005). From a physiological perspective, it is expected that younger people are less likely to become dehydrated in the case of nurses. The results of this study, in which young nurses are more likely to become dehydrated, may have been influenced by work content and performance abilities that are not physical factors. Additionally, beginner nurses are supposed to have a tendency to have some troubles in health and work environments compared with experienced nurses because these factors are more important for nurses with 5 years or less than experienced nurses to continue the work (Watanabe, 2011). Therefore, it is necessary to pay attention to the hydration status of the beginner nurse.

Because of the subgroup analysis between BG and ExG, the USG before the shift was related to the dehydration in nurses experienced for 5 years or less at the end of their shift. BG had a significantly lower amount of water consumed before their shift than ExG. This is because beginner nurses often start working before their shift and cannot afford to drink water until the shift ends. BG worked significantly more in direct patient care than the manager's role in their shift. Expert nurses have more management opportunities, such as adjusting patient numbers and staff workload, other than direct patient care; therefore, BG had a significantly higher number of steps than ExG. Physical activity is a factor in dehydration (Benelam & Wyness, 2010; American College of Sports Medicine et al., 2007). The high number of steps in BG means that there are several opportunities to provide direct care for patients, and it is possible that they are performing a moderate-intensity physical activity, such as patient transfer. Additionally, it is assumed that young nurses have not been accustomed to working and tend to make several unnecessary movements. Compared with ExG, BG had a significantly decreased concentration at the end of their shift. Nurses with less years of experience probably need more concentration since they have not been accustomed to working.

Two significant considerations exist for nurses to prevent dehydration. First, nurses should understand the prevalence of dehydration before and after a shift. Comparing EG and DG, there was no significant difference in thirst before and after their shift, as reported in a previous study (El-Sharkawy et al., 2016). Despite feeling thirsty, nurses are unaware of their own hydration status. Some nurses started work dehydrated and needed adequate hydration before their shift. Education on drinking water is significant in maintaining water balance for shift workers (Kenefick & Sawka, 2007). Regardless of being thirsty or not, managers should encourage nurses to drink water since it is expected of them to drink water.

Second, it is necessary for nurses to be conscious of drinking water outside of breaks. A short break of <5 min enables behavioral activities, such as eating and drinking, which can ameliorate executive function deterioration (Stachenfeld et al., 2018), improve attention, and reduce mistakes (Kopardekar & Mital, 1994; Tucker, 2003). Therefore, fluid intake at any time during a shift, other than breaks, prevents dehydration and maintains executive function, which can help promote a better quality of nursing. Regarding the prevention of dehydration in organizations, it is desirable for managers to coordinate the workload of beginner nurses and encourage them to drink water.

This study had some limitations. First, it is possible that the prevalence of dehydration can include false positives since the USG reflects the previous hydration status by measuring the urine collected in the bladder generated after the last urination. In this study, USG was used since it is easy to measure in the clinical setting and can reflect the hydration status during a shift. Second, lunch was not investigated. A previous study has reported that diet affects the body's water balance (Shirreffs et al., 1996). It was not possible to investigate the diet because the number of participants could decrease if the dietary items were added to the measurement and became complicated. However, even if the nurse was rehydrated during the break, the problem is serious because the nurse was dehydrated after the shift. Third, it is unclear as to what type of work affects dehydration at the end of a shift since physical activity was estimated only by the number of steps. For example, moving a patient from bed to wheelchair is a physical activity that is not measured as a step. There is a possibility that moving a patient induces dehydration due to sweating; therefore, it is necessary to investigate various physical activities during nursing care that affect dehydration. Fourth, there are restrictions on generalization since data were collected during the day shift. Additionally, it is possible that the difference in wards is related to the prevalence of dehydration. In the future, it will be necessary to research nurses working the night shift and to compare nurses among different wards.

In conclusion, this is the first study to examine the prevalence of dehydration in nurses and its factors related to dehydration before and after a shift. It was revealed that 51.3% and 71.3% of nurses were dehydrated at the start and at the end of their shift, respectively. USG before the shift and years of experience was related to dehydration at the end of the shift as predictors. It is desirable for nurses to prevent dehydration after their shift by preventing dehydration before their shift and managers to coordinate the workload of beginner nurses and encourage them to drink water.

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Author Contributions

Substantial contributions to the conception or design of the work: R.K., Y.L.T., A.A., H.S., E.M., H.Y., and M.K.,

Acquisition, analysis, or interpretation of data for the work: R.K., Y.L.T., A.A., H.S., E.M., M.S., A.O., and M.K.,

Drafting the work or revising it critically for important intellectual content: R.K., Y.L.T., A.A., H.S., E.M., M.S., A.O., H.Y., and M.K.,

Final approval of the version to be published: R.K., Y.L.T., A.A., H.S., E.M., M.S., A.O., H.Y., and M.K.,

Declaration of Conflicting Interests

The authors report no relevant conflict of interests.

Ethical Approval

The protocol was approved by the Ethical Committee of the Graduate School of Nursing, Chiba University (No. 29-120) and the Ethical Committee of the Center Hospital of the National Center for Global Health and Medicine (NCGM-G-002513-00).

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Technical Report

Effectiveness of using near-infrared vein visualizers by nurses in promoting successful peripheral venous catheterization in patients receiving chemotherapy

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Abstract

Objective: Visibility and palpability of peripheral veins may affect peripheral intravenous catheterization (PIVC) failure and complications. A near-infrared (NIR) vein visualizer is recommended to select peripheral veins with low visibility. Chemotherapy reduces the number of peripheral veins suitable for PIVC; however, no study has shown that NIR vein visualizers can prevent PIVC failures during chemotherapy. We investigated the effectiveness of using an NIR vein visualizer by nurses for PIVC during chemotherapy. **Technical Report:** We investigated the vein characteristics (i.e., visibility, palpability), PIVC difficulty before puncture, and success or failure. The study field was a chemotherapy room at the General Hospital (Shizuoka, Japan). The study participants were nurses who performed PIVC in patients receiving chemotherapy. Six nurses were enrolled, and eighty-four PIVC cases were obtained (with duplicate patients). There were 34 cases in the NIR vein visualizer group and 50 in the standard insertion group; the NIR vein visualizer group had a significantly higher number of difficult PIVC cases ($p < .01$). Peripheral veins with successful PIVC in the NIR vein visualizer group had significantly higher visibility and palpability than those with PIVC failure ($p < .05$). **Conclusions:** During chemotherapy, nurses used an NIR vein visualizer for the peripheral veins deemed difficult to catheterize; PIVC was successfully performed in the peripheral veins with high palpability. The results showed that an NIR vein visualizer facilitates successful PIVC during chemotherapy.

Keywords
peripheral intravenous catheterization, vein visualizer, chemotherapy, infusion therapy, near-infrared

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Introduction

To safely perform peripheral intravenous catheterization (PIVC), determining the appropriate site, thickness, and length of the peripheral vein by visually examining the contours of the peripheral vein and palpating it with the fingertips is necessary (Gorski et al., 2021). However, puncture failure or complications occur in 20%-70% of PIVC cases (Jacobson & Winslow, 2005; Murayama et al., 2017; Wallis et al., 2014). Visibility and palpability of peripheral veins may affect PIVC failure and complications (Jacobson & Winslow, 2005; Piredda et al., 2017). The visibility of peripheral veins decreases with the distance from the skin surface, starting at a distance of 3 mm (Kimori et al., 2011). Palpability decreases with the distance from the surface of the skin and a smaller cross-sectional area (Ichimura et al., 2015). Additionally, the contact of the PIVC needle with the vein's inner wall may cause edema in the peripheral veins (Murayama et al., 2015; Takahashi et al., 2017), resulting in the extravasation of the chemotherapy medications. Deter-

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mining visible and palpable peripheral veins may lead to safer and successful PIVC.

A vein visualizer is recommended to select peripheral veins with low visibility (Gorski et al., 2021). Near-infrared (NIR) vein visualizers are based on the absorption of NIR light by hemoglobin in the peripheral veins. AccuVein®, an NIR vein visualizer, can visualize superficial peripheral veins by projecting lasers of two different wavelengths, visible and infrared, onto the skin to depict peripheral veins as black lines on the skin. However, no previous study has shown that NIR vein visualizers can prevent PIVC failures. In a study of pediatric to elderly patients with hemophilia requiring multiple PIVC, there was no association found between PIVC success and failure with the use of an NIR vein visualizer (Guillon et al., 2015). A similar previous study, wherein a randomized controlled trial of patients in their 50's-60's was conducted in the emergency room also found no association between success and failure of PIVC with the use of an NIR vein visualizer (Aulagnier et al., 2014). Because the NIR vein visualizer assists with peripheral vein visibility, it may not be effective for highly visible peripheral veins. Since the visibility and palpability of peripheral veins and the difficulty of PIVC in patients were not uniform in previous studies, it is necessary to limit the study to peripheral veins with a high difficulty of PIVC.

Chemotherapy reduces the number of peripheral veins suitable for PIVC due to multiple PIVC within the treatment period. Regardless of chemotherapy, patients undergoing PIVC complain of pain, anxiety, despair, and fear of repeated punctures, making failed punctures unbearable (Plohal, 2021). Furthermore, anticancer drugs can cause ulceration and necrosis if even a small amount leaks outside the vessel; therefore, a peripheral vein must be carefully selected, which makes PIVC more difficult for nurses. No report has investigated the efficacy of NIR vein visualizers for PIVC in patients receiving chemotherapy. We used NIR vein visualizers because PIVC for chemotherapy is difficult due to low visibility and palpability. Visibility assisted by an NIR vein visualizer may promote the success of PIVC. We investigated whether NIR vein visualizers promote the success of PIVC in patients receiving chemotherapy.

Technical Report

Objective

We investigated whether the use of an NIR vein visualizer by nurses promotes successful PIVC in patients receiving chemotherapy.

Methods

Study Design

This study used a quantitative, descriptive research design. The study field was a chemotherapy room in a general hospital in Japan. The study period was from December 2019 to March 2020. The participants were nurses who had performed PIVC in patients receiving chemotherapy. The nurses used an NIR vein visualizer for PIVC during their routine work. A questionnaire was created by the researchers, and the nurses were asked to complete the questionnaire.

Study Participants

Nurses were not restricted by their years of experience. The patients were adults, and there were no restrictions on age, sex, or disease.

Recruitment of Research Participants

The researchers made a documented and oral research request to the head nurse of a general hospital in Japan and obtained her consent. The researchers explained the research to the nurses in writing and orally and obtained their consent. For the patients, the researchers provided the nurses with oral and written explanations and obtained the patients' consent.

Data Collection

Survey Questionnaire

The nurses' data regarding gender, years of experience, final education course, and frequency of PIVC were collected. The nurses filled out questionnaires for difficult-to-perform PIVC cases. The items on the questionnaire were the patient's gender, age, body size, peripheral vein characteristics (i.e., thickness, elasticity, tortuous veins, rolling veins, visibility, and palpability), PIVC difficulty before puncture, and success or failure. Peripheral vein characteristics and PIVC difficulty were rated using a 10-point scale, ranging from 1 to 10, to define peripheral vein catheterizations that ranged from easy to difficult, respectively.

Investigational Devices

The NIR vein visualizer AccuVein® AV400 was used in this study and purchased from a Grant-in-Aid for Scientific Research (Grant-in-Aid for Early-Career Scientists B: 17K 17409).

Statistical Analysis

A database was created based on a survey questionnaire. Based on the database, the cases were divided into two groups as follows: a standard insertion group without an NIR vein visualizer and an NIR vein visualizer group using the AccuVein® AV400. Furthermore, the PIVC was divided into success and failure groups. The difference between the groups in the contingency table was determined using the chi-squared test, and the 10-point scale was determined using the Mann-Whitney U test. Multiple logistic regression analysis was used for the ordinal scale to explore the association between each of the success of PIVC and vein characteristics. Data were analyzed using the IBM SPSS Statistics version 27 (IBM Corp., Armonk, NY, USA).

Ethical Considerations

This study was conducted after obtaining approval from the University of Shizuoka Research Ethics Review Committee

Table 1. Description of PIVC.

NIR vein visualizer group *n* = 34		Standard insertion group *n* = 50	
Success *n* (%)	Failure *n* (%)	Success *n* (%)	Failure *n* (%)
20 (58.8%)	14 (41.2%)	38 (76.0%)	12 (24.4%)

Note. *p* = .095 (chi-squared test).

Abbreviations: NIR, near-infrared; PIVC, peripheral intravenous catheterization.

Table 2. Comparison of the PIVC difficulty.

	NIR vein visualizer group *n* = 34			Standard insertion group *n* = 50			*p* value
	Mean	SD	Median	Mean	SD	Median	
Difficulties with PIVC	9.06	1.63	10.00	7.06	2.58	8.00	<.01
			**				

Note. Results tested by Mann-Whitney U test.

$^{**}p < .01$; a score of 10 is more difficult than a score of 1.

Abbreviations: PIVC, peripheral intravenous catheterization; SD, standard deviation.

(Approval No. 30-37). The researchers explained to the nurses that they could freely decide not to participate in the study, to withdraw their consent at any time, the invasiveness of the measurements and how to handle them, the protection of personal information, and the publication of the study results. For patients, the nurses explained the research and obtained their consent.

Results

Demographics of the Nurses

The study participants were six nurses, with an average of 28.3 ± 7.1 years of nursing experience, four in the 3-year final education program and two in the certified nursing program. All nurses performed at least one PIVC per day.

Description of the PIVC

In total, 84 PIVC cases (duplicate patients) were included. The gender was male in 40 cases (47.6%) and female in 44 cases (52.4%). The mean age was 67.1 ± 10.2 years, with a minimum of 42 years and a maximum of 87 years. The body types were thin, 14 (16.7%); normal, 55 (65.5%); and obese, 15 (17.9%). The NIR vein visualizer group included 34 cases, of which 20 (58.8%) were successful and 14 (41.2%) failed. The standard insertion group included 50 cases, of which 38 (76.0%) were successful and 12 (24.4%) failed. There was no significant difference in the success and failure of PIVC between the NIR vein visualizer and the standard insertion groups (*p* = .095, Table 1).

Comparison of the PIVC Difficulty

With respect to PIVC difficulty, the NIR vein visualizer group had a significantly higher number of difficult PIVC cases than the standard insertion group (*p* < .05, Table 2).

Table 3. Vein characteristics in the NIR vein visualizer group.

Vein characteristic	NIR vein visualizer group						*p* value
	Success (*n* = 20)			Failure (*n* = 14)			
	Mean	SD	Median	Mean	SD	Median	
Thickness	7.65	3.15	9.00	9.43	1.02	10.00	.05
Elasticity	7.45	2.56	8.00	9.07	1.21	10.00	.06
Tortuous veins	8.05	2.26	9.00	9.21	1.31	10.00	.07
Rolling veins	7.35	2.64	8.00	8.29	2.05	8.50	.30
			*				
Visibility	7.45	3.02	9.00	9.14	1.99	10.00	.02
			*				
Palpability	6.95	3.07	7.00	9.21	1.31	10.00	.01

Note. Results showed by Mann-Whitney U tests.

$^{*}p < .05$; a score of 10 is more difficult than a score of 1.

Abbreviations: NIR, near-infrared; SD, standard deviation.

Table 4. Vein characteristics in the standard insertion group.

Vein characteristic	Standard insertion group						*p* value
	Success (*n* = 38)			Failure (*n* = 12)			
	Mean	SD	Median	Mean	SD	Median	
Thickness	5.58	2.89	5.00	6.58	2.71	6.50	.26
Elasticity	6.11	2.63	5.00	5.75	3.02	5.00	.65
Tortuous veins	6.21	3.01	7.00	6.50	2.61	6.00	.77
Rolling veins	7.11	2.49	7.50	5.08	3.65	5.00	.09
Visibility	5.63	3.31	5.00	5.08	3.23	3.00	.58
Palpable vein	4.84	3.12	4.50	5.00	3.13	3.00	.95

Note. Results showed by Mann–Whitney U tests. A score of 10 was more difficult than a score of 1.

Relationship between PIVC Success and Vein Characteristics

Peripheral veins with successful PIVC in the NIR vein visualizer group had significantly higher visibility and palpability than those with PIVC failure (*p* < .05, Table 3). We performed a logistic regression analysis in the NIR vein visualizer group using peripheral vein visibility and palpability as independent variables and PIVC success as the dependent variable. The results showed a significant association between palpability and PIVC success (*p* = .04), with an odds ratio of 1.67 (95% IC 1.03-2.69). In the standard insertion group, no significant association was observed between peripheral vein characteristics and PIVC success or failure (Table 4).

Discussion

This study investigated if the use of an NIR vein visualizer by nurses can promote successful PIVC in patients receiving chemotherapy. We compared the outcome of using an NIR vein visualizer with that of using standard insertion. The results showed that nurses used NIR vein visualizer on peripheral veins with high PIVC difficulty; hence, PIVC was successful in peripheral veins with high palpability.

This study examined patients receiving chemotherapy, assuming a high degree of difficulty in PIVC; however, similar to previous studies (Aulagnier et al., 2014; Guillon et al., 2015), the NIR vein visualizer was not associated with PIVC success or failure (Table 1). We speculated that since the NIR vein visualizer group had a higher PIVC difficulty than the standard insertion group (Table 2), there was no difference between PIVC success and failure. There was no significant difference in the characteristics of the peripheral veins between PIVC success and failure cases in the standard insertion group; however, peripheral vein visibility and palpability in the NIR vein visualizer group significantly differed between the PIVC success and failure cases (Table 3, 4). Furthermore, in the logistic regression analysis, palpability was associated with PIVC success. The results showed that PIVC was successful in peripheral veins with high palpability when the NIR vein visualizer was employed. Using NIR vein visualizers in patients with difficult PIVC facilitated the identification of peripheral veins. Peripheral vein palpability was associated with PIVC success. Therefore, PIVC success can be enhanced if nurses select a palpable peripheral vein using the NIR vein visualizer. The NIR vein visualizer can assist in detecting peripheral veins (Guillon et al., 2015); however, it cannot assess their depth (Kaddoum et al., 2012) and thickness. The depth and thickness of the peripheral veins can be assessed via palpation. Since these parameters are important for PIVC, previous studies have investigated the promotion of peripheral vein size (Ichimura et al., 2015; Yamagami et al., 2017). Therefore, although it is difficult to visualize the veins, the success rate of PIVC can be increased if nurses promote peripheral vein size and select palpable peripheral veins using an NIR vein visualizer. In chemotherapy, if the palpability of peripheral veins can be assessed using an NIR vein visualizer, PIVC may be successful.

This study showed that the palpability of peripheral veins is important. The palpation technique used to determine suitable peripheral veins for PIVC is challenging to explain; however, no standardized method for teaching palpation techniques has yet been established. In the future, investigating the palpation technique will be required for peripheral veins that skilled nurses cannot visualize. Our study showed that using an NIR vein visualizer in chemotherapy patients increased the ability of nurses to select more palpable peripheral veins, which promoted the success of PIVC. Specifically, in the NIR vein visualizer group, the success rate of PIVC was higher when the peripheral veins were more palpable. The use of vein visualizer devices is recommended for difficult PIVC; therefore, this study provides a new indication of the extent to which the NIR vein visualizers can be effectively operated. This result is clinically significant because it can impact the success rate of PIVC.

Conclusion

During chemotherapy, nurses used an NIR vein visualizer for peripheral veins evaluated as difficult to catheterize, and PIVC was successfully performed in peripheral veins with high palpability. The results showed that the use of an NIR vein visualizer by nurses facilitates successful PIVC in patients receiving chemotherapy.

Limitations

The nurses subjectively surveyed the depth and thickness of the peripheral veins; therefore, objective measurements are needed. Furthermore, for a successful PIVC, the application of NIR vein visualizers and properties of peripheral veins need to be investigated.

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Author Contributions

NK designed the study, coordinated the research sites, collected the data, and analyzed and interpreted the data. YW supervised the study design and data analysis and was a major contributor in writing the manuscript.

Conceptualization: NK; methodology: NK, YW; formal analysis and investigation: NK, YW; writing-original draft preparation: NK; writing-review and editing: NK; funding acquisition: NK; resources: NK; supervision: NK, YW. All authors read and approved the final manuscript.

Declaration of Conflicting Interests

There are no conflicts of interest to declare.

Ethical Approval

This study was conducted after obtaining approval from the University of Shizuoka Research Ethics Review Committee (Approval No. 30-37).

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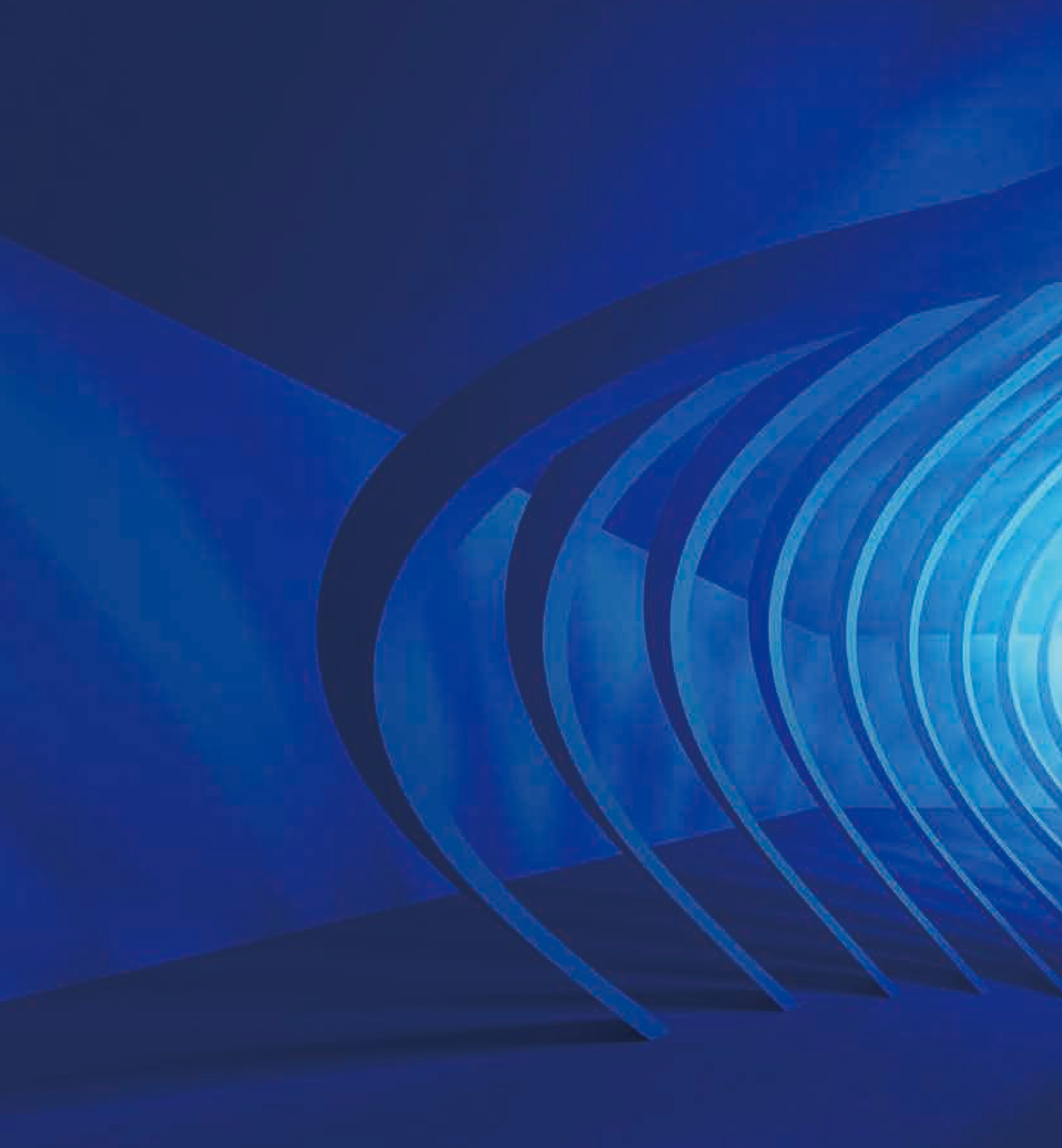

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