

Promoting infection prevention behaviors in family caregivers of preschoolers with acute lymphoblastic leukemia: the application of self-care deficit theory

Su-ari Lamtrakul¹, Jintana Yunibhand¹, Waraporn Chaiyawat¹

¹Faculty of Nursing, Chulalongkorn University, Bangkok, Thailand

Corresponding Author: Jintana Yunibhand **Email:** Yuni_jintana@hotmail.com

Received: 8 October 2021 **Revised:** 17 November 2021 **Accepted:** 17 November 2021 **Available online:** January 2022
DOI: 10.55131/jphd/2022/200114

ABSTRACT

The infection prevention behaviors of family caregivers are critical for the survival of preschoolers with acute lymphoblastic leukemia. As a result, nurses must devise an effective strategy for encouraging family caregivers to engage in these behaviors. The purpose of this quasi-experimental, pretest-posttest design was to compare infection prevention behaviors between family caregivers of preschoolers with acute lymphoblastic leukemia who received the infection prevention behavior program (PIPB) and those who received conventional nursing care. Forty-five family caregivers of preschoolers with acute lymphoblastic leukemia were selected, of which 23 were assigned in an experimental group who received conventional nursing care and 22 in a control group who received the PIPB. The intervention, which was based on the Self-Care Deficit Theory, aimed to enable the potential of the dependent-care agency regarding infection prevention behaviors of family caregivers. On the first and twelfth days of the study, all family caregivers were assessed for infection prevention behaviors using the Infection Prevention Behaviors Questionnaires (IPBQ). At the statistical level of .05, the experimental group's mean difference scores for infection prevention behaviors (Mean=4.78, SD=3.93) were significantly higher than those in the control group (Mean=0.64, SD=0.73). The efficacy of the nursing intervention based on Self-care Deficit Theory was demonstrated in this study. The theory was used to successfully improve family caregivers' infection prevention behaviors for preschoolers with acute lymphoblastic leukemia.

Key words: infection prevention behaviors, family caregivers, children with acute lymphoblastic leukemia, self-care deficit theory, dependent-care agency, preschooler

Citation:

Su-ari L., Jintana Y., Waraporn C. Promoting infection prevention behaviors in family caregivers of preschoolers with acute lymphoblastic leukemia: the application of self-care deficit theory. J Public Hlth Dev. 2022;20(1):175-187. (<https://doi.org/10.55131/jphd/2022/200114>)

INTRODUCTION

The infection-prevention behaviors of family caregivers are crucial for the survival of preschoolers with acute lymphoblastic leukemia (ALL).¹ Thus, nurses must establish an effective strategy for encouraging family caregivers to engage in these behaviors. One of the conceptual models developed to influence nursing practice is the Self Care Deficit Theory (SCDT)². This model, however, should be derived to correspond to a specific nursing area.

Medication administration, infection control, and infection surveillance are three major dimensions of infection prevention behaviors that must be performed to bring out appropriate infection prevention behaviors^{1,3-4,7}. Infection prevention behaviors are critically important when caring for preschoolers (3-5 years old) with ALL^{1,3-7} because the peak incidence of ALL is between 2-5 years of age.^{8, 9} Strong evidence suggests that infection remains the leading cause of death in children with ALL, which is caused by cancer, its treatment, or both.⁸⁻¹² However, preschoolers do not achieve self-care for themselves in many daily routines due to their lack of development and maturity.^{2,4,9, 13} To achieve optimal neurophysiological, physical, and psychological development, preschoolers require delicate care from their caregivers¹⁴ to perform self-care on their behalf. This includes performing appropriate infection prevention measures. It is possible that the risk of infection cannot be eliminated. Alternatively, pediatric oncology professionals advocate the value of infection prevention for reducing the complication and severity of infections in pediatric leukemia.^{1,3-7,13,15}

Considering the current nursing role of promoting infection prevention behaviors among family caregivers of children with ALL, the focus on individual demands and requirements must be supplemented. Evidence reveals a plethora

of impressive nursing interventions in promoting infection behaviors among family caregivers.^{13, 15-18} For overcoming accidental situations, a care agent (family caregiver) with adequate competency is highly required.^{13, 15-20} A family caregiver should possess the ability to seek information other than existing knowledge. Moreover, the ability to make sound judgments seems to be highly necessary for unpredictable situations.^{2,13,16,20} Hence, appropriate nursing interventions in promoting infection prevention behaviors of family caregivers of preschoolers with ALL should comprise exercises for developing their own agency regarding infection prevention behaviors.

Theory-based nursing intervention attributes are purposefully and systematically used in nursing practice.^{2,15, 20-24} One of the conceptual models proposed to guide nursing practice is the Self Care Deficit Theory (SCDT). The SCDT provides a strong basis for nursing practice. It is useful in a variety of nursing contexts.²⁵ The primary characteristic of SCDT is that it is a general theory with a broad model that can be applied in a range of situations. SCDT has been used in studies because it concerns an individual's health-related limitations to engage in the performance of on-going care. The concept of dependent-care agency (DCA) in SCDT was used in this study, which is the reason by which the concepts and relational statements are consistent with the variables and hypotheses. Nonetheless, the use of DCA has been demonstrated in behavioral modification nursing research.²⁴⁻²⁷ However, while existing studies have referred to the SCDT theoretical framework on which the interventions under evaluation were based, there has been minimal explanation for the linkage between the concepts of the framework and the content of the intervention. Researchers often derive concepts without critical analysis or theoretical substruction to support a specific nursing area.^{2, 15, 27, 29, 30}

The application of SCDT should be evaluated by incorporating the theory to identify the factors causing the problem, determining the linkage between variables, and deducing the construct or concept at implication level.^{2, 20, 24} This study is an attempt to improve nursing care for preschoolers with ALL by applying the SCDT in promoting family caregivers' agency. For the purpose of successful completion of the course of chemotherapy and diminishing its side effects, improving the quality of life for preschoolers with acute lymphoblastic leukemia is needed.

Application of the Theory

The application of theoretical perspective in this study involved implying the theory to identify the factors causing the problem, determining the linkage between variables and deducing the construct or concept at the implication level, and developing the program to promote infection prevention behaviors (PIPB). The concept of dependent-care agency (DCA) appears in the second edition of Orem's basics text.²⁴ Three types of personal characteristics enable an individual to perform self-care actions. The first is foundational traits, the second is enabling traits (power components or PCs), and the third is operational traits (dependent-care operations), which are related to an individual's ability.^{2, 25, 30} In order to perform dependent-care operation, a set of 10 PCs are required. From 10 PCs,

however, a person can develop some PCs on their own with sufficient physical maturity.²⁵ In addition, some PCs are influenced by specific external factors, such as social and cultural conditions. Therefore, in reviewing relevant evidence under the SCDT theoretical framework, empirical data were found on whether a person would have enough DCA to develop health care behaviors.

According to SCDT, the grand theory with a high level of abstraction, theoretical substruction was utilized to transform the construct level into a variable level. DCA is a construct of great interest, the DCA learning results in the development of the powers for action previously identified as DCA power components.²⁵ This discussion of theory substruction aimed to identify the dependent variable in the study, analyze the levels of abstraction among variables, and identify the operational definition of those variables. The results of theoretical construction supported by evidence of trustworthiness provide four important power components that influence DCA.^{2, 25–}

³⁰ There are four essential power components affecting health care behaviors, including *the motivation to provide dependent care, the ability to make dependent care decisions, the ability to acquire technical knowledge about dependent care, and the ability to provide dependent care*^{2, 26–30} (Figure1).

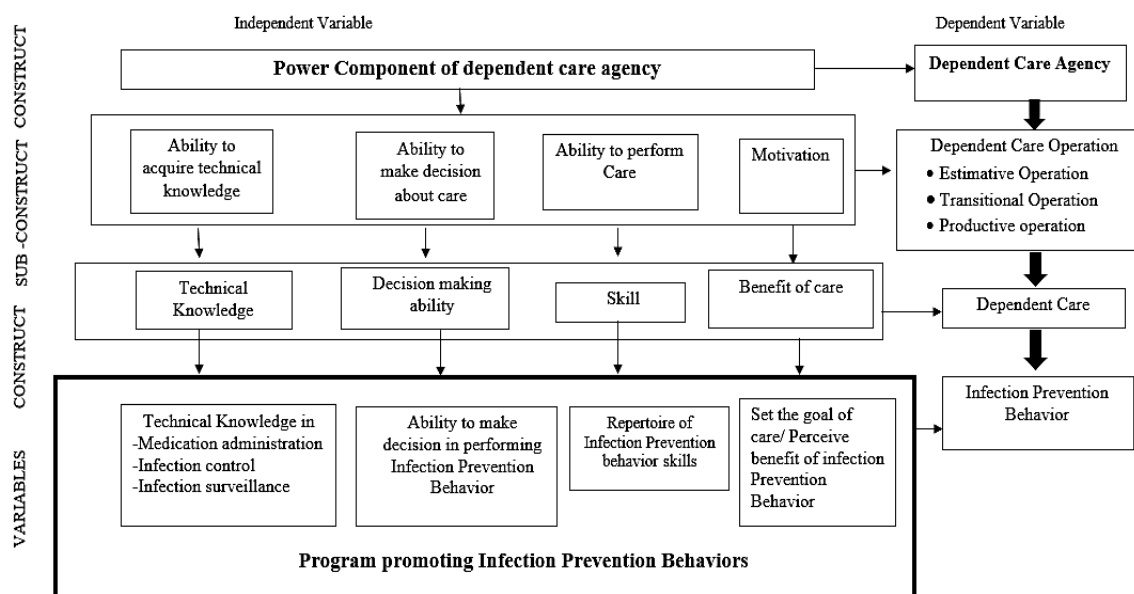


Figure 1 Theoretical Substruction

The PPIPB was developed with the specific goal of improving the dependent care agency in mind by intervening in four major power components with the SCDT-derived helping method, which includes guiding, teaching, coaching, and providing a developmental environment ²⁵. The PPIPB enhances the ability to acquire technical knowledge, the ability to make

decisions, the ability to perform infection prevention behavior, and the motivation to perform infection prevention behavior. This can lead to increased levels of dependent-care agency, resulting in improved infection-prevention behaviors among family caregivers. The following was the conceptual framework: Figure 2.

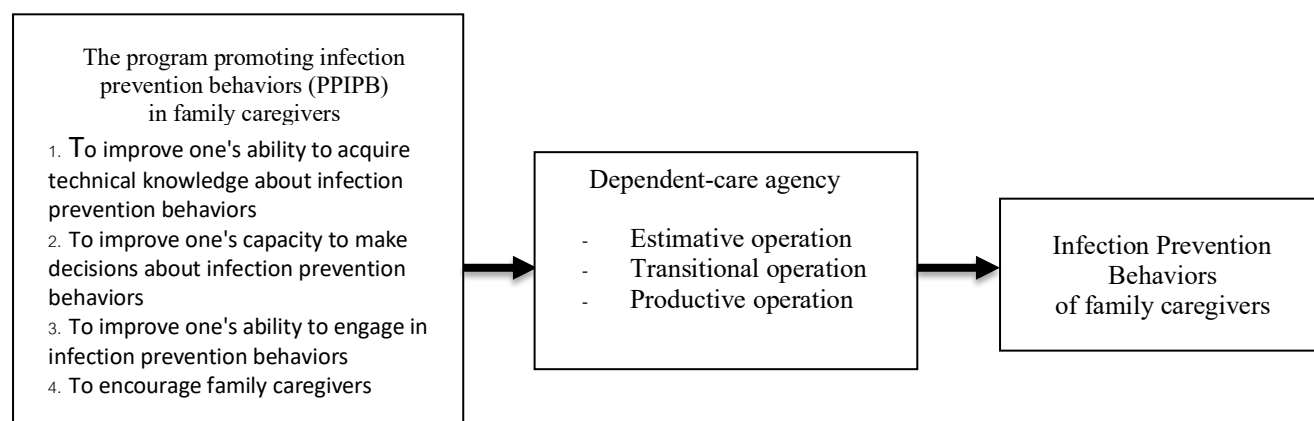


Figure 2 The conceptual framework

It was presumed that family caregivers of preschoolers with ALL who received the four important power components would have more dependent care agency and infection prevention

behaviors than those who received conventional care. Besides, the family caregivers would have better infection prevention behavior than before participating in the program.

METHOD

A quasi-experimental, pretest and posttest design was used to compare infection prevention behaviors between the control and experimental groups of family caregivers for preschoolers with ALL. This study was conducted at the pediatric inpatient unit, Phramongkutklao Hospital, Thailand from May to October 2020.

Population and Sampling

The sample size was determined using the power analysis technique used in previous experimental research designs¹³. Calculation of the effect size (d) showed a medium sample group requiring groups of 26 subjects each. Convenience sampling was used to select participants who met the inclusion criteria of being a principal family caregiver for a preschooler with ALL, having experience in caring for a child who had received chemotherapy treatment, being between the ages of 18 and 60, and being able to use online communication tools. Forty-six participants who met the inclusion criteria were recruited. The exclusion criteria were family caregivers who did not consistently participate in the program for any reason.

Out of 45 participants, 23 were assigned to a control group and the other 23 participants to an experimental group by unit random assignment. One of twenty-three participants in the control group was eventually excluded due to incomplete participation, giving an effective sample size of 45.

Research Instrument

1) The instrument for data collection was the infection prevention behaviors questionnaire (IPPBQ). The IPPBQ was modified by the researcher from the original version¹⁵, and the

modified IPBQ consisted of 35 items with three dimensions. Items 1-7 comprised medical administration dimensions, while items 8-31 were concerned with infection control dimensions, and items 32-35 were under infection surveillance dimensions. The answers were a checklist with "DO", indicating the caregiver always performed = 1 point, or "DON'T", indicating the caregiver sometimes or never performed = 0 point. The total range of scores was between 0-35, with higher scores representing greater infection prevention behaviors. The modified IPBQ was done with construct validity (known group technique), content validity (I-CVI=1.0, S-CVI (AVE) = 1.0), and internal consistency testing with 30 caregivers of preschoolers having any kind of malignancy undergoing chemotherapy by using the Cronbach's alpha coefficient of 0.78.

2) The program promoting infection prevention behaviors (PPIPB) is a nursing intervention developed by the researcher. The theoretical substruction illustrated the construct of the program. Therefore, the PPIPB was developed within the specific goals of enhancing DCA through the nursing intervention. Those nursing interventions use the methods of guiding, teaching, coaching, and providing a developmental environment to manipulate all four significant power components. The contents of the program were based on infection prevention behaviors in the pediatric cancer guideline and intensive literature reviews^{1, 4, 7, 30} emphasizing infection prevention behaviors agency based on SCDT²⁴. The PPIPB also includes the program's instructional media comprising a booklet for family caregivers, a video clip scenario with the title of "Which one would you choose", and a caregiver's memo booklet. The details of the intervention are presented in Table 1.

Table 1 Summary of the intervention

Session	Nursing activities
Session 1 1 st admission date Time: 30 minutes	1) Discussing and analyzing one's ability to perform infection prevention behaviors 2) Encouraging participants to establish specific short and long-term goals for achieving infection prevention behaviors
Session 2: 2 nd admission date 2 parts of activities Part 1: Personal guidance Time: 30 minutes Part 2: Personal coaching Time: 40 minutes	1) Using the teaching method by providing the teach-back technique for personal guidance on the topic of "Infection Prevention Behaviors in children with ALL" 2) Demonstrating and returning to demonstrate the critical skills for infection prevention, including drug administration, hand washing, the use of facial masks, and care for children's oral hygiene
Session 3: 3 rd admission date Time: 30 minutes	Simulation teaching by providing a VDO clip scenario called "Which one would you choose". After watching the video clip scenario, the participant would be encouraged to make a decision in certain situations. The researcher would convince the participants to discuss alternative situations, provide reasons for those decisions, and how to overcome or compensate for limitations.
Session 4: Fourth meeting 4 th admission date Time: 30 minutes	Reviewing all significant content / discussing how to supply and manage the essential environment by encouraging the participant to evaluate any limitations that may arise when returning home, and plan a solution to manage the home environment for promoting infection prevention behaviors/ Infection prevention behaviors planning
Session 5: Fifth meeting on the last admission date Time: 40 minutes	1) Reviewing all content by discussing the capabilities and limitations of the caregivers. Providing motivation and empowerment for proper behaviors. Adjusting or providing useful information for improving inappropriate behaviors. 2) Evaluating infection prevention behavior plan 3) Assessing the ability to practice preventive behaviors and providing additional suggestions for incomplete sections 4) Summarizing care plans for prevention of infections at home 5) Guiding communication methods in case caregivers need additional advice

3) The Infection Prevention Behavior Agency Visual Analogue Scale (IPBAVAS)

The researchers formulated this instrument, which was used to monitor the intervention. It consists of three parts for the evaluation of three dependent care agency operations (estimative operation, transitional operation, and productive operation).

3.1 The ability to acquire knowledge regarding infection prevention VAS

3.2 The ability to make judgments regarding infection prevention VAS

3.3 The ability to perform infection prevention behavior VAS

Instead of continuous numbers, the instrument is a VAS on a horizontal straight line with a length of 100 millimeters. The caregivers drew a horizontal straight line to represent their own level of ability. From the far left position with the lowest level of ability to the far right position with the highest level of ability, calculate points for all items combined; the score range is 0-100. A higher score means the greater the participants' infection prevention behavior agency. The instrument was administered at the first and fifth meetings, with the experts recommending the passing mark be set at

90 percent of the total score. If any participants did not meet the passing level, they were allowed to review their agencies again until they achieved those abilities under the researcher's supervision. The IPBAVAS were done with content validity (I-CVI=1.0, S-CVI (AVE) = 0.96 -1.0). Internal consistency was also tested with 30 caregivers of preschoolers with any kind of malignancy by using the Cronbach's alpha coefficients, which were 0.84, 0.89 and 0.93, respectively.

Ethical consideration

All forty-five family caregivers signed informed consent forms before any interventions were conducted. Authorization to conduct human subject research was obtained from the Royal Thai Army Medical Department's institution review board (IRBRTA) (certificate No. Q012q/63).

Data Analysis

Using the Statistical Package for the Social Sciences for Personal Computer (SPSS/PC), descriptive statistics were used to delineate the characteristics of the samples and examined the distribution of demographic variables as well as the variables of interest in this study. For the analysis of the differences between the infections prevention behaviors' difference scores obtained by using the IPBQ for the control and experimental groups, an independent t-test was used, with statistical significance established at .05.

RESULTS

Forty-five family caregivers participated in this study (n=22 in the

control group and n=23 in the experimental group). Most participants were females (73.33%), mothers (53.33%), and lived with a spouse (82.22 %). The average age of participants was 39.48 years. The majority of participants had a family income of approximately 50,000 baht or over (42.22%), possessed at least a bachelor's level education (53.33%), and worked as general employees (31.11%). Approximately 60% of participants reported a history of receiving infection prevention information from a variety of resources. The characteristics of preschoolers with ALL in both groups were slightly different. The number of boys and girls was similar in the control group, whereas most of those in the experimental group were girls (56.52 %). Approximately one-third of preschoolers in the control group (31.82%) had been re-admitted due to infection causes within 3 months before being recruited, as were 43.48% in the experimental group.

The chi-square test was used to investigate the differences in characteristics between the two groups. There was no statistically significant difference in gender, marital status, education level, occupation, or relationship status between the control and experimental groups. In terms of the demographic characteristics of preschool-aged children with ALL, there was no statistically significant difference between the control and experimental groups in terms of the gender of preschool-aged children and history of re-admission due to infection in three months. As a result, it could be assumed that both groups had similar demographic characteristics.

Table 2 Mean and standard deviation of pretest scores, posttest scores and difference scores of IPBQ

Infection prevention behavior	Pretest	Posttest	Difference Score
	MEAN(SD)	MEAN(SD)	MEAN(SD)
Control (N=22)			
Total scores	28.27 (3.79)	28.90 (3.98)	0.64 (0.73)
- medical administration (7)	6.36 (0.73)	6.36 (0.66)	0.00 (0.53)
- infection control (24)	19.09 (3.24)	19.68 (2.92)	0.59 (0.59)
- infection surveillance (4)	2.81 (0.80)	2.86 (0.71)	0.04 (0.48)
Experimental (N=23)			
Total scores	28.96 (4.23)	33.74 (1.32)	4.78 (3.93)
- medical administration (7)	6.30 (0.97)	7.00 (0)	0.70 (0.97)
- infection control (24)	19.87 (2.82)	23.22 (0.80)	3.35 (2.52)
- infection surveillance (4)	2.79 (0.85)	3.53 (0.73)	0.74 (1.01)

Table 2 demonstrates the mean and standard deviation of pretest, posttest, and difference scores for the three dimensions in the IPBQ. The total score is comprised of seven points for medical administration, twenty-four points for infection control, and four points for infection surveillance.

As shown in Table 3, the mean of difference scores for infection prevention behaviors in the experimental group

(Mean=4.78, SD=3.93) was higher than those in the control group (Mean=0.64, SD=0.73). Moreover, the findings yielded a significant difference at the statistical level of .05 when considering the mean of difference scores in all dimensions. Caregivers receiving the PPIPb had higher scores for infection prevention behaviors of all dimensions than those of the control group.

Table 3 The total scores and all dimensions scores for infection prevention behaviors between the control group and experimental group

Infection prevention behaviors	n	Difference Score		t	df	p-value
		MEAN	SD			
Total IPBQ score				-4.87	43	.00*
Control group	22	0.64	0.73			
Experimental group	23	4.78	3.93			
Medical administration				-2.95	43	.00*
Control group	22	0.00	0.53			
Experimental group	23	0.70	0.97			
Infection control				-5.01	43	.00*
Control group	22	0.59	0.59			
Experimental group	23	3.35	2.52			
Infection surveillance				-2.926	43	.00*
Control group	22	0.46	0.49			
Experimental group	23	0.74	1.01			

*($p < .05$)

Infection prevention behaviors agencies

Table 4 Comparison of pre-intervention and post-intervention agencies percentage among family caregivers in the experimental group

Infection prevention behaviors agencies	Pre-intervention (%)	Post-intervention (%)	df	t	p-value
	Mean (SD)	Mean (SD)			
Ability to acquire knowledge	86.02 (4.82)	94.01 (1.30)	22	-8.17	0.00*
Ability to make judgments	86.03 (4.84)	94.83 (3.50)	22	-6.95	0.00*
Ability to perform behaviors	80.64 (4.91)	93.68 (1.51)	22	-13.12	0.00*
Infection prevention behaviors agencies	84.34 (4.86)	94.12 (2.11)	22	-9.41	0.00*

*($p < .05$)

Finally, all participants of the experimental group met the test criterion. The participants in the experimental group had a mean score of 94.12 percent, which was a three-aspect score. Table 4 reveals that the experimental group's infection prevention behavior agency percentage had a statistically significant difference between pre-intervention and post-intervention in all three aspects at the .05 level.

DISCUSSION

The results revealed that the experimental group's mean of difference scores for infection prevention behavior (Mean=4.78, SD=3.93) was higher than that of the control group (Mean=0.64, SD=0.73). Thus, family caregivers who received PPIPB had higher difference scores (d) for infection prevention behaviors than family caregivers who received conventional nursing care.

This result demonstrated the efficacy of SCDT application. The PPIPB could affect infection prevention behaviors by improving the DCA. When providing dependent care, a person must have enough

DCA to do so efficiently²⁵. By using the monitoring instruments in this study, the researcher was able to confirm the effectiveness of the PPIPB in improving DCA among the participants in the experiment group. The results revealed that the participants met the standard criteria at approximately 90%, the mean score for the participants in the experimental group was 94.12%, and the score for three aspects likewise met the standard criteria at about 90%.

Qualitative data collected from participants following receipt of the PPIPB demonstrated an increase in demand for DCA. There were numerous examples of participants improving DCA. Participants reported feeling more confident in their ability to learn about infection prevention behaviors. In particular, elderly caregivers had discretion in selecting reliable information. Moreover, some feedback showed that the participants learned how to gain knowledge on their own. For example, one said, *"I am now more confident in seeking knowledge or asking questions to healthcare personnel, whereas previously I was reluctant to ask my doctor or nurse for information about caring for my child."*

Participants likewise stated that making decisions for children's care in unexpected situations was challenging. Some of them improved their decision-making abilities because of the program. In situations where decision-making was required, caregivers felt more confident. Despite the fact that some situations could not be resolved, caregivers learned where to look for assistance. *"I had been in a situation where I didn't know what to do for over two years, even when it came to choosing appropriate food for my child. I was aware that certain foods were prohibited, but my child needed to eat. Following the simulation teaching session, I had the opportunity to discuss with you how to overcome some situations. Despite the fact that I was unable to make a decision regarding the program's scenario, I learned and attempted to seek the knowledge that I lacked. Now, I believe I am more capable of handling certain difficult situations, particularly in terms of how to negotiate with my child about having appropriate food and wearing a facial mask when leaving the house."*

The PPIPb influenced caregivers' infection prevention behaviors by improving the DCA through intervention in four critical power components of the dependent-care agency. Additionally, the researcher used a combination of helping techniques including instruction, support guidance, consultation, and provision of a suitable environment, using the circumstances of a good relationship among the researcher, caregivers and preschool-aged patients. These techniques build a good relationship and trust between the researcher and caregivers. All of these methods stimulated caregivers' concerns about infection prevention behaviors and provided them with internal motivation to change their behavior. The findings in this study are in accordance with previous studies³²⁻³³ in the application of teaching and training techniques for improving the

knowledge and behaviors of caregivers to prevent infection in children with leukemia.

Considering the details of crucial behaviors, the results of the pretest revealed that the behaviors of children's oral checkups are the most neglected. The caregivers in the experimental group improved their behavior after using the personal coaching method, which combined demonstration and return demonstration with the technique of oral investigation guidance. In this study, the results of motivation improvement for family caregivers following the PPIPb program indicated that the strength of using SCDT was supported. Hence, motivation is one of the crucial components for achievement in dependent-care. Further, the evidence from this study illustrated the effect of SCDT in improving motivation. The findings are comparable to the findings of other studies concerning the promotion of positive reinforcement and empowerment of caregivers of children with cancer¹³. As a result, the psychological dimension has remained a theoretical concern. Some of the PPIPb participants expressed satisfaction with the researcher's emotional support throughout the program.

LIMITATIONS

Despite the COVID-19 outbreak pandemic situation, the data collection process was carried out. The threat to internal validity should be justified. The effect of the circumstances may interfere with the outcome of intervention by causing a behavioral change in caregivers. Awareness of some infection prevention behaviors, particularly hand washing and the use of facial masks, usually increased. This appears to be a threat to internal validity. However, this threat affects the influences on both groups equally. Before enrolling in the study, participants in both groups demonstrated these two behaviors. In conclusion, the threat interfered with

both groups, and the study's findings remained valid.

RECOMMENDATION

This study should be replicated with a longer duration of follow-up and an evaluation of sustainable behaviors. Participants from various geographical locations should be included to increase the generalizability of this study. The application also demonstrated that the dependent-care agencies could be improved successfully. To strengthen the state of science in using theory, it is recommended that the theory of substruction be applied in another concept within Orem's theory for further studies.

CONCLUSION

The DCA was used to improve infection prevention behaviors of family caregivers of preschoolers with ALL. It demonstrated that the program provides family caregivers with dependent-care agency. The nursing interventions in the PPIPb intervened with all four significant power components using the methods of guiding, teaching, coaching and providing a developmental environment. The caregivers who received the PPIPb had sufficient ability to acquire technical knowledge, make decisions and perform infection prevention behaviors. Consequently, all these methods stimulated the caregivers to achieve infection prevention behaviors agency, and finally, the caregivers improved their infection prevention behaviors.

ACKNOWLEDGMENTS

I would like to applaud the authors, Associate Professor Dr. Waraporn Chaiyawat, and Associate Professor Dr. Jintana Yunibhand, for their hard work.

They have given up their time to provide support, and encouragement, as well as valuable advice, to help me complete this manuscript. Furthermore, I would like to express my heartfelt gratitude to the medical staff of the pediatric hematology unit at Phramongkutkloao Hospital for their support and assistance.

REFERENCES

1. Lighter-Fisher J, Stanley K, Phillips M, Pham V, Klejmont LM. Preventing infections in children with cancer. *Pediatr Rev.* 2016;37(6):247–58.
2. Biggs A. Orem's self-care deficit nursing theory: update on the state of the art and science. *Nurs Sci Q.* 2008;21(3):200–6.
3. Drachtman RA, Masterson M, Shenkerman A, Vijayanathan V, Cole PD. Long-term outcomes for children with acute lymphoblastic leukemia (ALL) treated on The Cancer Institute of New Jersey ALL trial (CINJALL). *Leuk Lymphoma.* 2016;57(10):2275–80.
4. A report from the United Kingdom Childhood Cancer Study (UKCCS). *Eur J Cancer.* 2007;43(16):2396-03.
5. Barton CD, Waugh LK, Nielsen MJ, Paulus S. Febrile neutropenia in children treated for malignancy. *J Infect.* 2015;71 Suppl 1:S27-35.
6. Howlader N, Noone AM, Krapcho M, Miller D, Brest A, Yu M, et al. SEER Cancer Statistics Review 1975-2018. National Cancer Institute. 2020.
7. Schlesinger A, Paul M, Gafter-Gvili A, Rubinovitch B, Leibovici L. Infection-control interventions for cancer patients after chemotherapy: a systematic review and meta-analysis. *Lancet Infect Dis.* 2009;9(2):97-107.
8. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2020. *CA Cancer J Clin.* 2020;70(1):7–30.

9. Lustosa de Sousa DW, de Almeida Ferreira FV, Cavalcante Félix FH, de Oliveira Lopes MV. Acute lymphoblastic leukemia in children and adolescents: prognostic factors and analysis of survival. *Rev Bras Hematol Hemoter.* 2015;37(4):223-9.
10. Bunyatisai W, Jia-Mahasap B, Chitapanarux I. Treatment Outcomes of Acute Lymphoblastic Leukemia in both children and adults using the Thai Pediatric Oncology Group-based protocol at Chiang Mai University hospital. *J Thai Assn of Radiat Oncol.* 2019 [cited 2019;25(1):12-8.
11. Reinecke J, Lowas S, Snowden J, Neemann K. Blood stream infections and antibiotic utilization in pediatric leukemia patients with febrile neutropenia. *J Pediatr Hematol Oncol.* 2019;41(4):251–5.
12. Viale PH. The American cancer society's facts & figures: 2020 edition. *J Adv Pract Oncol.* 2020;11(2):135–6
13. Yooyen P, Sanasuttipun W, Srichantaranit A. The Effect of a Teaching Program on Knowledge and Behavior of Caregivers to Prevent Infection in Preschool-aged Children with Leukemia. *Nurs Sci J Thai.* 2019;37(4):79-92.
14. Akiko K, Kiewkarnka B, Sillabutra J. Factors related to drowning preventive behavior among caregivers with children aged one to four in rural areas of Thailand. *J Public Health Dev.* 2013;11(2):31-48
15. Siripoon P, Tangvoraphonkcha J. Effects of a supportive education program on care behavior of beginning to end-stage leukemia school-age children's dependent-care agents. *Journal of Nursing Science and Health.* 2014;37(2):48-56
16. Jansong W, Chiyawat W. The effect of the nursing intervention based on Pender's health promotion model on infection prevention behaviors in mothers of 1-5-year-old children with cancer undergoing chemotherapy. *Journal of Nursing Science and Health.* 2016;9(2):159-72
17. Heiser Rosenberg CE, Terhaar MF, Ascenzi JA, Walbert A, Kokoszka KM, Perretta JS, et al. Becoming Parent and Nurse: High-Fidelity Simulation in Teaching Ambulatory Central Line Infection Prevention to Parents of Children with Cancer. *Jt Comm J Qual Patient Saf.* 2017;43(5):251-8.
18. Fuengfoo A, Leelathanaporn S, Mekrungharas T, Sakulnook K, Owjinda S, Noipong P, et al. Effectiveness of the Hospital Learning Center (Queen Sirikit National Institute of Child Health): Satisfaction with service and parents' attitudes towards children's illness. *F1000Res.* 2019; 8:1616.
19. Boonchuay N, Sanasuttipun W, Chintanadilok N, Sanpakit K. The Effect of the Educational Program on Knowledge and Care Behaviors of Caregivers of Children with Thalassemia. *Nurs Sci J Thai.* 2016; 34(3):41-53.
20. Ghanbari A, Pouy S. Designing Nursing Care Program Based on Johnson Behavioral Model in Children with Acute Lymphoblastic Leukemia: A Case Study. *Int J Caring Sci.* 2018;11(1):631-8
21. Burley Moore J, Beckwitt AE. Children with cancer and their parents: Self-care and dependent-care practices. *Issues Compr Pediatr Nurs.* 2004;27(1):1–17.
22. Kuennen Y J. Critical Reflection: A Transformative Learning Process Integrating Theory and Evidence-Based Practice. *Worldviews on Evidence-Based Nursing.* 2015;12(5):306-8.
23. Shoghi M, Shahbazi B, Seyedfatemi N. The Effect of the Family-Centered Empowerment Model (FCEM) on the Care Burden of the Parents of Children Diagnosed with Cancer. *Asian Pac J Cancer Prev.* 2019;20(6):1757-64. doi: 10.31557/APJCP.2019.20.6.1757.

-
24. Shah M, Abdullah A, Khan H. Compare and contrast of grand theories: Orem's and Roy's adaptation model. *J Sci Res.* 2013;4(1):1834-7.
 25. Orem D, Taylor S, Renpenning K. *Nursing.* St. Louis: Mosby. 2001.
 26. Ohns MJ, Oliver-McNeil S, Nantais-Smith LM, George NM. Nonurgent Use of the Emergency Department by Pediatric Patients: A Theory-Guided Approach for Primary and Acute Care Pediatric Nurse Practitioners. *J Pediatr Health Care.* 2016;30(4):339-46.
 27. Gwin L. Fragmentation of health care in the lives of transitional cerebral palsy patients: a preliminary case analysis of the relationship between functional social support and self-care agency. *Self Care Depend Care Nurs.* 2008; 16:8-13.
 28. Sonkongdang W, Kantawang, S, Niyomkar S. Factors Influencing Caregivers' Behaviors Regarding Nutritional Care for Preventing Infection in Leukemic Children with Chemotherapy induced Neutropenia. *Nursing Journal.* 2015;42(Suppl 2):94-106.
 29. Wilson FL, Baker LM, Nordstrom CK, Legwand C. Using the teach-back and Orem's Self-care Deficit Nursing theory to increase childhood immunization communication among low-income mothers. *Issues Compr Pediatr Nurs.* 2008;31(1):7-22.
 30. Gligor L, Domnariu C. Patient Care Approach Using Nursing Theories - Comparative Analysis of Orem's Self-Care Deficit Theory and Henderson's Model. *Acta Medica Transilvanica.* 2020;25(2):11-4.
 31. Maia R, Wunsch Filho V. Infection and childhood leukemia: review of evidence. *Revista de Saúde Pública.* 2013;47(6):1172-85
 32. Sen-Ngam K, Pratepchaiku L, Phuwanananon K. Maternal knowledge and practice development in caring for children with leukemia. *Songklanagarind Med J.* 2005;23:261-8
 33. Yip J. Theory-Based Advanced Nursing Practice: A Practice Update on the Application of Orem's Self-Care Deficit Nursing Theory. *SAGE Open Nursing.* 2021;7:237796082110119.
 34. Khalil H. Evidence-based quality improvement. *Int J Evid Based Healthc.* 2017;15(3):81.
 35. Polit D, Beck C. *Nursing Research: Generating and Assessing Evidence for Nursing Practice.* Lippincott:Williams & Wilkins; 2008.
-