The development and effects of a foot care program for nurses and care workers at in-home service providers

A dissertation

submitted to the Department of Nursing of University of Human Environments

The requirements for the Degree of Doctor of Nursing

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1st assessor: Prof. Mariko Nishikawa

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References

List of published papers related to this research (English)

Fujii, K. (2019). Effect of foot care interventions for older adults using day care services. *Nursing Open, 6*(4), 1372-1380

Fujii,K., Komoda, T, Maekawa A, & Nishikawa M (2020). Foot care knowlede and practices among Japaneses nurses and care workers in home care and adult service center: a cross-sectional study. BMC Nursing, doi.org/10.1186/s12912-020-00467-1 (CHAPTER3)

Fujii, K., & Stolt, M. (2020). Evaluation of the development process and effects of a foot care program with educational tools for nurses and care workers at in-home service providers.BMC Research Note, DOI：10.1186/s13104-020-05263-3 (CHAPTER 4)

Fujii, K., & Stolt, M. (2020). Intervention study of a foot-care programme enhancing knowledge and practice among nurses and care workers at in-home service providers. *Nursing Open*, 1-13. doi:10.1002/nop2.479 (CHAPTER 5)

Oral presentation (English)

Fujii.K (2018, Dec). The association between educational program on foot and self-efficacy among people with chronic disease. Presentation at Japan Academy of Nursing Science, Matsuyama, Japan.

Fujii.K (2019, Oct). Integrating nursing education. Presentation at the world congress on Nursing & health care, Osaka Japan.

Fujii.K (2020, Jan). The development of integrated foot care educational packages for nurse and care workers. Presentation at EAFONS2020, Chiang Mai, Thailand.

Fujii.K (2020, Sep). Foot health for the Elderly living in the community as an integrated product of nurses and care workers literature review. Presentation at TWING2020, Taiwan.

Fujii.K (2020, Dec). Development process of foot care questionaries for nurses and care workers in community. Presentation at Japan Academy of Nursing Science, Japan.

***Other: Published papers and oral presentations in Japanese**

Abbreviations

ANCOVA	Analysis of covariance
CG	Control group
CRF	Chronic renal failure
CVI	Content Validity Index
ECG	Electrocardiogram
HD	Hemodialysis
HCP	Health care provider
HV	Hallux Valgus
I-CVI	Item Content Validity Index
IHSPs	In-home service providers
IV	Intervention Study
IVG	Intervention Group
KF	Kashiko Fujii
LPN	Licensed Practical Nurse
LTCI	Long-Term Care Insurance
MEXT	Ministry of Education, Culture, Sports, Sciences and Technology
MHLW	Ministry of Health, Labor and Welfare
METI	Ministry of Economy, Trade and Industry
MPs	Motion pictures
NCWs	Nurses and care workers
NHI	National Health Insurance
OSF	Open Sciences Framework
PAD	Peripheral Artery Diseases
PPT	Power point presentation
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RA	Rheumatoid Arthritis
RCT	Randomized Controlled Trial
RN	Registered Nurses
SD	Standard Deviation
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
TREND	Transparent Reporting of Evaluations with Nonrandomized Designs
UMIN-CTR	University Hospital Medical Information Network Center Clinical Trials Registry

Ethical considerations

This study was conducted in accordance with the 2000 Helsinki Declaration. Trial was registered at UMIN -CTR (University Hospital Medical Information Network Center Clinical Trials Registry UMIN 000036307, July 25, 2019). The Ethical Committee of the University of Human Environments approved the entire study (2019N-002). The parts of the study were approved by Nagoya University (2019-0088, 2019-0150).

Each client participant, the family members of some clients, and the nurses and care workers attending the foot-care program provided written informed consent. Information related to the purpose of the study, privacy, the right to discontinue, and future publication has been included in the informed consent. For the cross-sectional study, consent for study participation was implied by the submission of a completed questionnaires. For the intervention study, written informed consent was obtained from each of the participants. I have no conflict of interest.

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Abstract

Background: Aging accelerates foot discomfort and problems as well as reducing the ability of people to care for their feet. Therefore, knowledge and practice of foot care among nurses and care workers at in-home service providers (hereafter IHSPs) determine the maintenance of foot health and prevention of foot problems in older people. In Japan, the ongoing demographic change characterized by the aging society poses serious challenges for in-home service providers. Protecting foot health is imperative from a quality of life perspective, and it also leads to reduction in medical and nursing costs. However, the majority of foot care research both in Japan and overseas is focused on research related to diabetes. Foot issues have been reported overseas, however, internationally, foot research on care providers for the elderly living in a community is lacking. In Japan, foot care research is not well- reported regarding perception, knowledge, and practice among nurses and care workers in IHSPs as well as elderly foot issues in a community. The intervention studies for IHSPs are also lacking.

The purpose of this study is twofold; (1) to explore and examine the current knowledge and practice along with demographic data, daily care, perception of foot care among nurses and care workers in IHSPs (phase 1) , and (2) to develop an educational program to enhance foot care knowledge and practice for nurses and care workers and evaluate the effects of the program based on the outcomes (phase 2).

Ethics: The ethical committee of the University of Human Environments approved this study (2019N-002). The parts of the study were approved by the ethical committee of Nagoya University (2019-0088, 2019-0150). Information related to the purpose of the study, privacy, the right to discontinue and future publication is explained. There were no conflicts of interest. Phase 2 study is registered with UMIN (UMIN 000036307 University Hospital Medical Information Network Center Clinical Trials Registry)

Methodology: Phase 1

Study design: Cross sectional study with random cluster sample method. Followed by STROBE confession.

Outcome data: Data was collected via questionnaires developed for the study. The questionnaire consists of two sections: 1) questions on demographic characteristics, daily care (number of clients cared for the day, or number of clients seen with foot problem e.g.), and perception of foot care; 2) self-administrated questionnaires consisting of 30

questions on foot care knowledge; and 20 questions on foot care practice designed for both nurses and care workers working at IHSPs.

Setting and participants: IHSPs, including home visit nursing provider, home care service provider or one-day care services center or one-day care center emphasizing rehabilitation for seniors were randomly selected from the list of IHSPs in the selected City of Aichi prefecture in Japan, which was originally made by the Ministry of Health Labor and Welfare. Sample size was calculated based on a 95% confidence interval. Invitation mails were sent to 450 facilities and 48 responded. Questionnaires were sent out to 46 facilities after the author obtained the approval from facilities via telephone contact or visit.

Development of the instruments: A total of 339 literature reviews on foot and foot care were thoroughly reviewed. Interviews with experts were conducted beforehand. It led to creation of the flow chart for dimensions and concept of foot care. Initially, the author created questionnaire with 51 items of knowledge (7 subscales; Nails, Skin, Vascular and neurologic, Toe and arch deformity, Infections, Shoes and socks, Sedentary behaviors) and 45 items of practice (6 subscales; Skin assessment, Nail, Skin, Hygiene, Movement and toe exercise and Consultation). Reviews by 4 experts and two researches specializing in toe movement, 2 field nurses and 1 care worker, 9 experts via CVI (Content Validity Index) methods by mail, 6 experts (including the author) at panel discussion, and advice from a doctor with extensive knowledge of feet aided in refinement of the questionnaires draft. Questionnaire with 33 items of knowledge and 25 items of practice on foot care was distributed to 100 nurses and care workers in the pilot study. The responses from 87 of them were statistically analyzed. Given the results of accuracy rates of answers in knowledge and ceiling effects and Cronbach alpha score, 30 knowledge items and 20 practice items were used for the main survey.

Data analysis: Data was analyzed with descriptive statistics, T-test, Chi-square test, Wilcoxon rank sum test, Spearman Rank Correlation test by SPSS 24.

Result: Total of 232 nurses and care workers (62 nurses and 170 care workers from 35 facilities out of 305 (76.1%) responded. After cleaning the data, 225 were included in this analysis. Although a total of 57 nurses (91.9% of the sample size) and 142 care workers (83.5%) showed an interest in foot care, 33 nurses (53.2%) and 133 care workers (78.2%) felt there was insufficient education on foot problems. 53 nurses (85.5%) and 120 care workers (71.7%) were willing to learn more about foot care. Both nurses and care workers recognized and reported foot problems. For the knowledge category, significant differences between groups were recognized in the items related to early detection of foot problems (34.3%) and skin tear on lower limbs (25.5%). Accuracy rate was lower in the

subscale regarding shoes for subjects of both occupations. For the practice category, there were significant differences in the subscale of Skin assessment, Nail, Skin, Hygiene and Consultation. Lower mean scores were found in checking shoe related cause of skin issue, a method of reducing ingrown nails and opportunities to talk about foot care with others. There was significant correlation between knowledge and practice in nurses (0.331, $p<0.05$) and care workers (0.339, $p<0.001$).

Methodology Phase 2:

Study design: Non-randomized controlled trial with random cluster sample method, followed by TREND statement (for nurses and care workers). Before-after intervention study (for clients).

Outcome data: Four outcomes were evaluated. Primary outcome: Score increases for questions on knowledge and practice of foot care among nurses and care workers. Secondary outcome: Participation, perception and learning of nurses and care workers from the program. Tertiary outcome: Changes of clients' foot conditions as well as referral status change. The fourth outcome: Perception of clients.

Setting and participants:

1) The author sent invitation letters and a post cards for responses to 450 randomly selected facilities. 40 facilities expressed the interest of participation. The author visited 34 facilities and contacted six via telephone and explained the contents of the program. Sample sizes were determined based on G*Power. For this study, targeted sample size was a set of 100 for each group. 21 facilities agreed to participate on the study and were divided into intervention group (IVG hereafter) and control groups (CG hereafter). Some of the facilities were willing to be in the control group due to their work environment and situation. Nurses and care workers were gathered from IHSPs, all of which expressed interest in foot care program. Inclusion criteria were nurses and care workers who provide physical care for clients working at IHSPs which never provided foot care program.

2) Client: Of clients at facilities where nurses and care workers work, two or four clients were gathered. Each facility picked up clients who have one or more foot problems, and were willing to participate in the study. 28 clients were selected in total.

Program creation: Educational tools for intervention were developed for this study. All tools were made based on conceptual domains as stated in phase 2. Tools consist of 1) a 68-slide power point presentation materials (PPT), 2) 10 minutes of motion picture material 3) 19-page picture flip card, 4) 78-page foot care booklet and assessment sheet, 5) foot care one-point advice card. A nail file for each participant and a foot file for each facility was given during intervention period. The tools of motion picture materials and

foot care booklet were evaluated by 8 nurses before intervention. The tools of motion picture materials and PPT were evaluated by 29 nurses and care workers right after 1st session.

Intervention: The intervention was deployed by using the tools in a package. The intervention consists of 3 to 5 sessions for each facility. The author consulted with chief of each agency for the schedules and visited facilities. During the first session, the author presented the PPT and explained various aspects of feet and foot care. After that, motion picture material was shown for practical skills. During the second session, the author presented foot care practice. In the third and fourth sessions, the author conducted follow up foot care practice. At the early stage of intervention, picture flip cards, foot care booklet, and assessment sheets were introduced to use during the study. At the end stage of intervention, foot care one-point advice cards were delivered to the staff. At the follow-up session, the author presented foot problems of participating clients to available staffs at facilities for the day and demonstrated foot care. Author asked staffs to perform the procedure after a short demonstration. For the control group, nurses and care workers performed regular care as usual during the survey period. At pre-and post-intervention, the same questionnaire was used to measure foot knowledge and practice among subjects. At the post-intervention, nurses and care workers answered questions on the usage of each tool and perception of the program. Client's feet were compared pre-and post-intervention.

Analysis of nurses and care workers: The data was analyzed with descriptive statistics. After observing histogram on the differences of means of each section, T test was used for comparison of the groups. The propensity score was calculated with logistic regression analysis. Then, analysis of covariance (ANCOVA) was applied to analyze the intervention effects by using propensity score. Pearson Correlation was used to analyze the association between tool usage and the knowledge and practice scores.

Analysis of clients: (n=23) Changes in foot conditions and client's perceptions after the study were analyzed. Descriptive analysis, and a McNemar test were used for analysis.

Result of nurse and care workers: Total 54 and 56 nurses and care workers respectively participated in the study in IVG and CG, yet, 43 in IVG and 44 in CG were recorded in the analysis respectively due to unanswered questions or non-matching study participants. Before adjusting the background, total scores of knowledge and practice categories were higher than baseline in the intervention group. After background correction due to potential bias of non-random cluster sampling, significant differences between groups were observed in mean score changes of skin and consultation subscales of the practice category ($p<0.05$). The practice score of nail and movement and toes exercise were higher in the control group compared with intervention group. 90.7% of participants of the

intervention group answered "I agree" (53.5%) or " I somewhat agree"(37.2%) on increasing the interest on foot care. As for intervention tools, study participants were most exposed to motion picture materials and the PPT.

Result of clients: Although dramatic changes in foot conditions were not observed, all conditions were improved or maintained. Clients started perceiving that foot health is important and discussed their feet with staffs more often.

Discussion, Nouveaute, originality, academic rating, social value:

The first phase of study identified the strengths and weaknesses of both professions for provision of foot care and lead to making a strategy for the future to improve the level of care. At the second phase of study, the author developed a unique foot care program which has never been conducted in the field of the study in both Japan and overseas. The cost performance of the foot care booklet was questionable. The author identified that further improvement of this tool. Nurses and care workers clearly understand the importance of foot care although there are many barriers. The study opened the first door for nurses and care workers at in-home service providers to deal with the complexity of foot-care for older people in the community.

Nurses and care workers gave a good impression on the program in terms of enhancing knowledge and practice. Foot care is really complex and has a lot of variety. Learning about feet and foot care requires time and motivation. The program was an introductory one and performed within limited time. In spite of that, this study discovered tremendous future possibilities for foot health of older people.

Outline of the thesis

This thesis describes the prevalence of foot care knowledge and practices among nurses and care workers in-home service providers (IHSPs) including home visit nursing providers, home care service providers or one-day care service centers or one-day care centers emphasizing rehabilitation for seniors. The effects of an intervention study of a foot care program for nurses and care workers are presented. The effects on client's foot by the intervention are also presented.

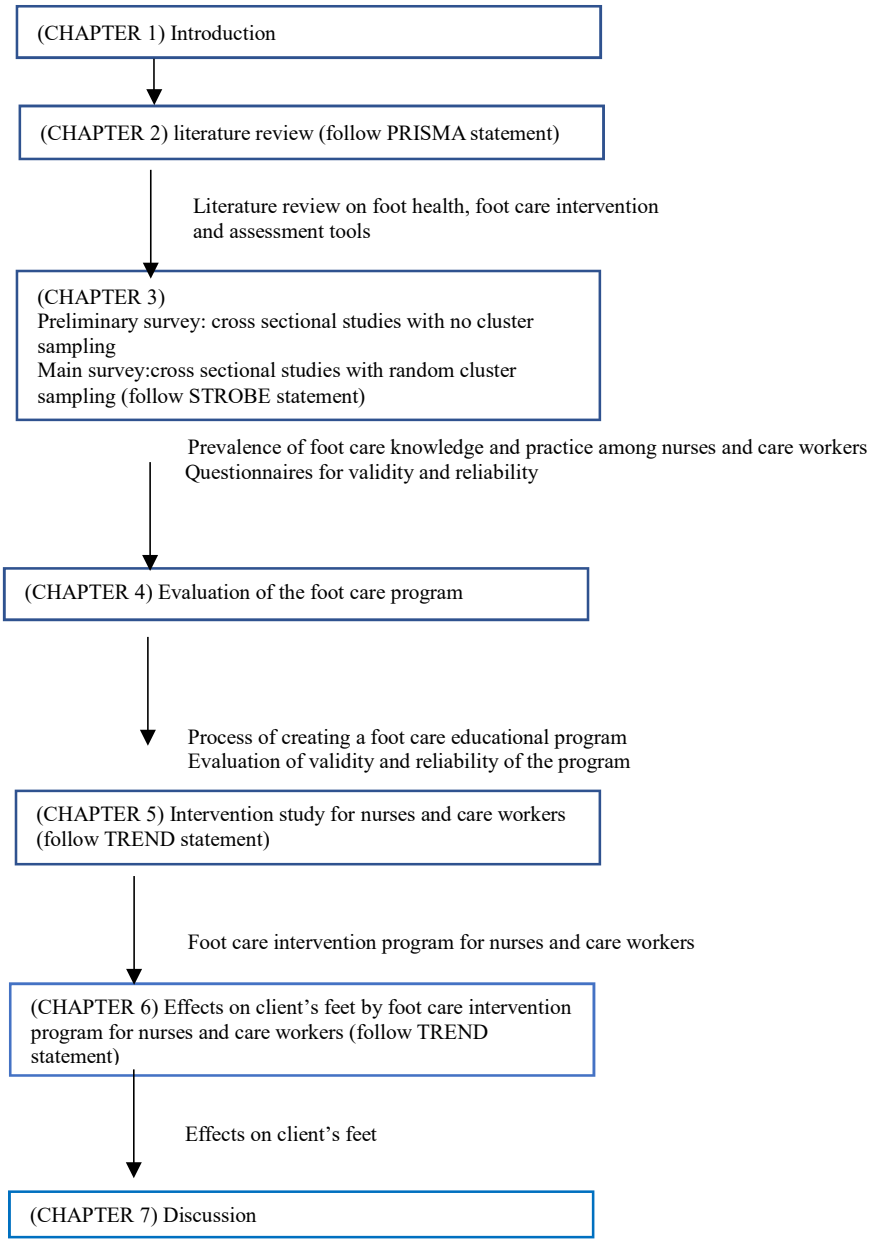
The chapter 1 presents the significance of the study, problem statement, previous literature, current foot-care and education, social changes, and the foot-care roles of nurses and care workers, e.g.in Japan. It also explains the conceptual framework and the algorithm which led to the creation of new foot-care concepts for the study.

The second chapter presents a literature review on the foot health. The literature was classified into topics, and the contents were examined from the perspective of foot health.

The third chapter demonstrates the prevalence of foot-care knowledge and practice among nurses and care workers. The process of assessing questionnaires for validity and reliability is also presented.

From the fourth to six chapter, the contents of the foot care intervention study is demonstrated. The fourth chapter describes the process of creating a foot-care program and evaluation of the development process. The fifth chapter discusses changes in foot care knowledge and practice scores in pre-and post-intervention for nurses and care workers. In the sixth chapter, the effects of the program on client's foot conditions is presented. The seventh chapter discusses the novelty, limitations of the study and possible future contribution.

This thesis structure design as follows



CHAPTER 1

Introduction

CHAPTER 1

1.1. The significance of the study

The foot health of older people is one of the key components in maintaining activities of daily living and quality of life. As age progresses, systemic physical changes may trigger foot problems. Previous studies have reported the association of foot problems with pain, imbalance of the body, falling and depression among older people (Awale, Dufour, Katz, Menz, & Hannan, 2016; Garrow, Silman, & Macfarlane, 2004; Hawke & Burns, 2009; Menz & Lord, 2001a).

Medical foot care has been developed to treat various foot problems, including wound care, diabetic or ischemic-related foot lesions, and gangrene. Foot education in the nursing area has focused on assessment methods and treatments with the development of medical foot care in the hospital setting. However, a research focus on foot issues and basic foot care for healthy older people or the prevention related to foot problems for older people using home care has been limited worldwide (Stolt et al., 2013). The foot care knowledge and skills, confidence, and concern for nurses and care workers working in the community have not been well reported.

The extent of health conditions varies among older people living in the community. Some live independently without any assistance, while some seek nursing care from nurses or care workers. Job tasks differ among nurses and care workers based on job qualifications. However, both nurses and care workers have opportunities to provide physical care to observe the client's body, including the foot, and to listen to clients' foot complaints. Foot self-care ability decreases due to various factors, including lower vision, inability to reach down to the foot, and diminished manual dexterity (Menz, 2016a; Mitty, 2009; Stolt et al., 2013). Similar to the findings regarding aging, the association between self-management and frailty has been previously reported (Cramm, Twisk, & Nieboer, 2014). Since ongoing frailty may hinder foot care, the role of nurse and care workers in the community is imperative to maintain foot health. Early detection, basic foot care, and referral to doctors are excellent ways to prevent worsening foot conditions. The foot health of older people represents the integrated efforts of nurses or care workers and older people as clients. This research focuses on the essence of foot health for community-dwelling older people who need assistance to maintain their activities of daily living.

1.2. Problem statement

International empirical studies have reported that 30 to 87% of older people over the age of 65 years have more than one foot problem and often complain of pain (e.g.,

Menz & Lord, 2001b; Muchna et al., 2018). Foot problems include nail deformation and discoloration, skin dryness and cracking, toe deformation, foot arch deformation, ulcers, numbness to the foot, nail and skin with sign of fungal infection, e.g. (Dunn et al., 2004; Stolt et al., 2012). The circulatory disturbances, neuropathy and the decline of the immune system may contribute to generating the foot problems. Furthermore, structural, functional and physiological body changes with aging influence the bone, muscle, circulatory, muscle, nervous, and dermatological systems.

In the circulatory system, peripheral arterial blood flow decreases due to arteriosclerosis, and venous and lymphatic perfusions are impeded due to the obstaction of lower limb pump function. The change in the condition of peripheral blood vessels and the decrease in the number of capillaries with aging affects nail color and nail growth (Myers, 2009; Turner & Quine, 1996). In the dermatological system, dryness and decreased elasticity are generated due to decreases in sweat and sebum secretion and barrier function, leading to skin tears. Muscle changes cause limited openness between toes or overlapping toes. Furhtemore, fungal infections may enter minor skin marceration or fissures which can lead to cellulitis (Stolt et al., 2012; Bristow & Spruce, 2009). Previous research has shown that local injury or maceration between toes is one of the major factors in creating cellulitis (Cox, Colver, & Paterson, 1998). Odema is also a risk factor for developing cellulitis (Cox, 2006).

External factors, such as shoes or walking style and posture, also trigger foot problems (Menz, 2016b). For example, forward movement of the center of gravity of the whole body with aging may lead to an increased load on the heel, which may generate keratin of the soles. Previous literature has reported that foot problems are negatively associated with basic activities of daily living, balance, falling risk, walking speed, quality of life and depression (Awale, Dufour, Katz, Menz, & Hannan, 2016; Guidozzi, 2017; Menz & Lord, 2001a). The association between the structural and functional changes of the foot, including nail and toe deformities and toe force, as an indicator of lower limb muscle strength has been reported (Anzai et al., 2014; Fujii, 2019; Imai, Takayama, Satoh, Katoh, & Yokozeki, 2011). When inappropriate foot conditions remain untreated, the risk of infection and pain in the foot increase, leading to immobility, falling and the possibility of becoming bedridden.

Frail older people living in the community are at high risk of foot problems. Financial constraints, a lack of access to transportation to a doctor who can treat foot problems, and a lack of foot care due to age-related physical changes hinder the maintenance of foot health.

CHAPTER 1

In Japan, older people can receive care at home or at adult service centers if they are certified to use long-term care services (Please see Appendix A). Nurses and care workers provide various nursing care in these locations. Nurses and care workers who provide care to clients at in-home service facilities play a significant role in identifying foot problems and maintaining the foot health of their clients. Howell and Thirlaway (2004) stated that foot and toenail assessment and care are considerable challenges for nurses in all healthcare settings, and both clients with diabetes and nondiabetic clients suffer from foot problems and require preventive procedures (Howell & Thirlaway, 2004). Currently, the empirical data regarding the knowledge and practice of foot care among nurses and care workers in all healthcare settings, particularly in-home care or in community care, remain limited although there are many factors related to foot care problems among older people. Although rehabilitation is encouraged at adult service centers in Japan to receive additional medical fee (Appendix B), the concept of incorporating foot care into rehabilitation is lacking. Awareness of foot and foot care by the government of Japan still lacking (Appendix C).

Figure 1-1 shows the factors related to foot care problems among older people.

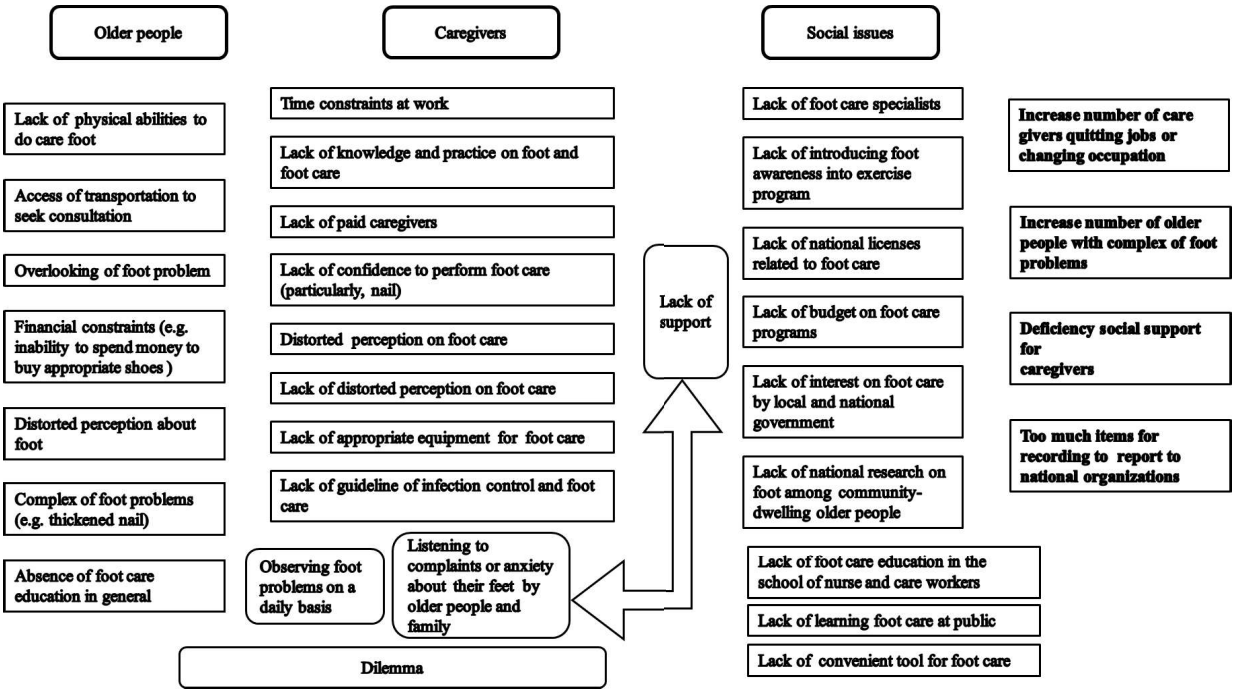


Figure 1-1: Hinderance of foot care program targeting for older

The effect of educational intervention of foot care for nurses and care workers in this area has not been well reported. This thesis examines the prevalence of the foot care knowledge and practice of in-home nurses and care workers in Japan. In addition, this study examines the effects of foot care educational program to enhance the knowledge and practice of nurses and care workers.

1.3. Conventional research trends of foot care

Conventionally, the majority of foot care research both in Japan and overseas has focused on diabetes-related topics. Peripheral arterial occlusions, peripheral neuropathy, and susceptibility to infection are risk factors for diabetic feet. In recent years, due to changes in lifestyle and habits, the number of patients with diabetes has increased rapidly and has become a global concern (Mathers & Loncar, 2006). Untreated and undiagnosed foot problems may lead to the generation of ulcers, gangrene, and systematic infections. The literature in German presented an association between major amputation and the visits by podologic foot care (PFC) (Kröger et al., 2016). According to the literature, “Podologists are nurses who care for the diabetic foot” (Kröger et al., 2016, p686). There are also abundant reports related to rheumatoid arthritis and peripheral arterial diseases. Although particular diseases may have a greater likelihood of generating foot problems, foot problems are a concern for the older population in general.

Menz et al. reported a tremendous number of studies related to foot issues among community-dwelling older people (e.g., Menz et al., 2013; Menz & Lord, 2001a; Menz & Lord, 2001b; Menz, Morris, & Lord, 2006). However, in general, research that targets the foot issues of community-dwelling older people is limited internationally. In particular, little research has targeted foot issues of frail older people and the knowledge and practice of the nurses and care workers who care for them. Stolt et al. (2013, 2015) and Pierson (1991) conducted research on nurses working in the community. Previously, some researchers have noted the lack of foot care education for nurses and care workers (Christensen, Funnell, Ehrlich, Fellows, & Floyd, 1990; Howell & Thirlaway, 2004). Although podiatry practices in some countries have been reported, research on the foot care knowledge and practice of nurses and care workers in the community has remained limited.

The effectiveness of foot care practice has been shown in studies targeting specific diseases such as diabetes. One study also examined physical therapists who define foot care as foot bathing and other dynamic massage (Yasuda & Murata, 2014).

However, the current knowledge and practice of nurses and nurse care workers in home-based service facilities in the community are unknown although they may recognize foot problems in clients and the necessity of foot care.

1.4. Social changes in Japan and foot health

In Japan, the ongoing demographic change characterized as the 'aging society' poses serious challenges for in-home service facilities. Japan is the most aged society in the world. As of 2012, 24.1% of the population was older than 65 years, and this number is expected to reach 40% by 2060 (National Institute of Population and Social Security Research, 2014). The dataset by World Bank indicated that the population rate of people aged 65 years and above has changed from 5.6% to 28% from 1960 to 2018 in Japan (World Bank, 2018; Figure 1-2).

This rapidly increasing number of older people will have to be supported by a decreasing number of young people. Young people, those aged 19 and under, are expected to account for a mere 13% of Japan's population by 2060 (National Institute of Population and Social Security Research, 2014). Concern about the effects of an aging population is not limited to Japan. Worldwide, aging populations are rapidly increasing; according to the World Bank report, the global aging rate was 4.75 % in 1960 but reached 9.03% in 2018 (World Bank Group, 2018. Figure 1-2). Given the rapid social and demographic change, there is increasing concern that the necessary medical and nursing care will not be available (MHLW, 2016a). The Japanese government has sought to decrease the number of people who receive inpatient care. There have been attempts to implement community-based integrated care systems (Hatano et al., 2017; Tsutsui, 2010), and the increase in pay for family doctors is also indicative of this policy (Otake, 2016). It is essential to have a preventive strategy for the elderly to maintain independence for as long as possible before entering a care situation. Therefore, protecting foot health is important from a quality of life perspective and leads to reductions in medical and nursing costs.

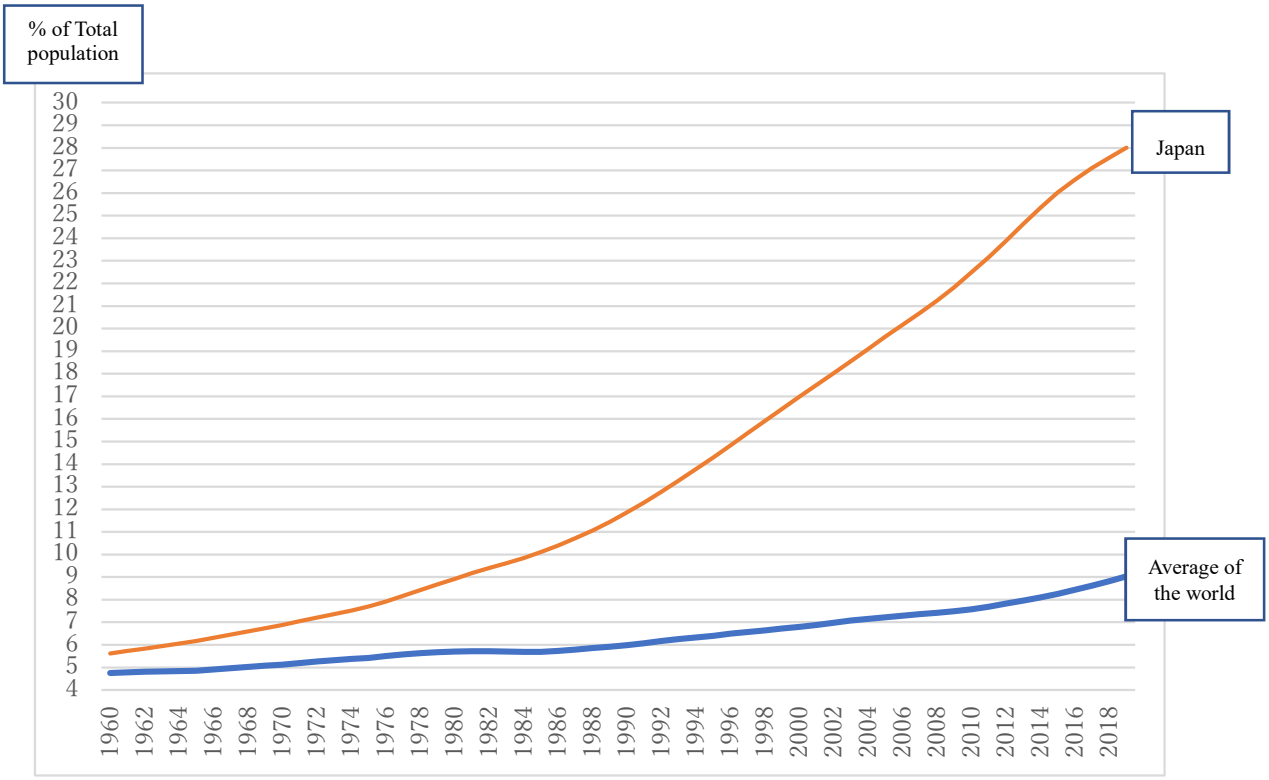


Figure 1-2: Population ages 65 and above (Japan and 264 countries in the world)
Note: From 1960 to 2018, rate has changed from 5.6 to 28% (Japan) Author calculated the figures based on dataset

1.5. Foot care practice in overseas and Japan

In Japan, the concept of foot care is broad and the definition is not constant. At foot care salons, foot care treatment includes nail care (e.g., for longer or thickened nails), keratin care (e.g., for corn and callus), and footbath. Although no podiatry system has been implemented, a private certified foot care worker conducts various foot care service at salon. In some salons, they combine other items with regular foot care treatment. Furthermore, the background of the workers varies, for example, some workers learned about foot care for a certain period and obtained only a certificate from a private foot care school, whereas others have both a nursing license and a foot care certificate.

In Japan, with the revision of medical fees in 2008, a new management for diabetic complication was established. At diabetic foot care outpatient centers in Japan, nurses provide foot care, teach daily care methods (e.g., nail clipping, moisturizing care, and bathing) to cope with foot problems and provide guidance for daily life. When the nurse gives instructions and management on foot and foot care based on doctor's instructions for patients with high risk factors for diabetic foot lesions, additional

medical fee would be added. Although foot care outpatient for diabetes has been established in many hospitals in Japan, the researches regarding on the prevalence and practice of foot care are limited.

In the revision of medical fees in 2016, additional medical fee related to lower limb peripheral artery diseases instruction management was newly established. The fee is related to an evaluation regarding ischemia of dialysis patient, referral to a specialized hospital, e.g. (MHLW, 2020; Todays' clinical support, 2018; Ooura et al.,2017, p155).

Outside of Japan where there is podiatry system, foot care practice is exercised in different way. Detail is stated in Appendix D.

1.6. Scope of foot care practice in Japan

Selecting the range of foot care services by in-home service providers is difficult because of different conditions of the feet of clients. It requires much knowledge and experience of foot care. Usually several difficult cases are needed to be looked after, there is the so-called gray zone of foot care. Presently, there are few guidelines regarding where to identify the so-called gray zone, that is, which state or condition should be looked after by doctors and other professionals besides nurses.

The following articles should be considered when conducting foot care (Appendix E).

1) Article 17 the Medical Practitioners Act, Article 17 of the Dental Practitioners Act, and Article 31 of the Act on Public Health Nurses, Midwives and Nurses and other related laws and regulations.

2) Ministry of Health, Labor and Welfare "Interpretation of Article 17 the Medical Practitioners Act, Article 17 of the Dental Practitioners Act, and Article 31 of the Act on Public Health Nurses, Midwives and Nurses and other related laws and regulations." This interpretation was notified from the Ministry of Health, Labor and Welfare Bureau to the prefectural care insurance representatives.

3) Ministry of Economy, Trade and Industry answers whether or not the regulation regarding foot care applies to workers with non-medical license in elderly care facilities based on the utilization of the "gray zone elimination system" of the Industrial Competitiveness Enhancement Act.

1.7. Foot care education in Japan.

Foot care programs for nurses and care workers are limited in Japan. Training in foot care is part of the program of the certified diabetic curriculum according to the

Japan Nursing Association. However, the training programs or classes of foot care targeted for nurses and care workers in general were limited.

Referring to the training curriculum for care workers of the Ministry of Health, Labor and Welfare (MHLW, 2016b; MHLW, 2018), the item of dementia, mobility, and improvement of the living environment are found, but foot care is excluded. Foot care education in nursing schools is also limited.

In various places, a nurse who received a certain number of foot care training play the roles of foot care, particularly for the patients with complicated cases including those that are related to diabetes or rheumatoid arthritis, with a doctor's order. However, since foot care training in these places are limited, some of them learn foot care at private foot care schools in order to obtain certain foot care knowledge and practice.

Although there are several private schools that provide foot care education, the amounts of time needed to acquire sufficient knowledge and skills varies among schools. The contents of the foot care curriculum vary among schools since their curriculum are not stipulated by law.

In Japan, foot care workers or foot care therapists may be misunderstood as a podiatrist or podiatrist. In this system, foot care workers are not allowed to conduct medical practice unless they have a license, such as doctor or nurse, e.g., as stated in the related acts. The majority of schools introduced the German-style or Finland methods. It is assumed that some foot care practitioners in Japan Fusspflege learned foot care at German or Finland regardless of longer or shorter time. Since the original materials regarding the school curriculum of foot care in Germany and Finland were not available, the contents of their methods can be assumed based on the foot care school curriculum in Japan, which incorporated the from overseas. In foot care schools that have introduced the German-style Fusspflege system in Japan, the students learn more profound foot care skills, including sharpening of thickened nails and keratin care of corn or callus using a grinder.

Tuition of private foot care school is not reasonable in general compared to the one of other class such as the educational class offered by Japanese Nursing Association, e.g. It is not easy to attend foot care school. Although they receive training, obtaining skills are limited as compared to the other countries.

At day care service centers or homecare or facilities other than hospitals, nurses and care workers encounter older people with foot problems, such as thickened nails, longer nail, hallux valgus, and maceration. They face difficult cases to deal with and feel dilemma because they wanted to support, however, they have only limited foot care

skills. They conduct foot care including foot washing during assisting bathing, applying ointment or cutting healthy long nails, however, limitation exist due to high complexity of foot problems of older people and lack of confidence due to insufficient foot care education.

Stolt (2013a) pointed out that, in the United States, Canada, and Finland, the protocol for nurses who have undergone a certain number of training program for foot care is insufficient and the consensus and regulations are vague. Nursing and foot care are generally considered to be a major hurdle for nursing staff in both Japan and all over the world. The extent to which foot care education is actually provided in nursing-related education in universities in each country has not been sufficiently researched by the principal investigator, which necessitates further investigation in the future.

1.8. Why did the study target nurses and care workers?

Nurses and care workers who provide care to clients at in-home service facilities play a significant role in identifying foot problems and maintaining the foot health of their clients. They have many opportunities to have physical contact with clients by assisting with bathing, toilet activity, and hygiene care. In Japan, research on the role of care workers in nursing is limited. Previous literatures in other countries, such as Norway and Sweden reported that care workers play big role in detecting signs and symptoms of health issues in home services (Haugstvedt, Aarflot, Igland, Landbakk, & Graue, 2016; Tingström et al., 2015). A previous study (Fujii, 2019) found that care workers were concerned with clients' foot issues and were willing to learn foot care equivalent to the level of nurses.

1.9. The frequently used terms

This section gives definitions of the terms which are frequently used in the study.

Foot and foot problems

Although other journals such as the "Journal of Foot and Ankle International", "Journal of Foot and Ankle Surgery", and "International Journal of Foot and Ankle" stated the foot and ankle separately, this study considered foot as the portion from the knee to the toes. Ankle is included. Foot problems include changes in the nail or skin, toe or arch deformities, foot neuropathy and circulation.

Foot care

In this study, the definition of foot care includes basic assessment and foot care that both nurses and care workers practice on the clients under the laws and regulations (Appendix E). Foot care in this study is an integrated process that transcends the conventional concept of foot care by considering the foot as the body part that connects the mind and whole body in order to protect the daily activities of living and the quality of life of older people.

As stated in detail later, foot care concept is newly and originally established by the author. The term "foot care" has different uses in the field as well as in the literature. Foot care is a term that is frequently used in foot care salons in Japan. This term is also used in the nursing and medical fields for various purposes and in various situations. Since there is no podiatry register in Japan, foot care is defined by each doctor or nurse or their facility. In private foot care salons, clients can receive nail care, care for corns and calluses, and foot baths under the regulations of the Japanese government.

Community-dwelling older people/frail older people

In Japan, people aged 65 and over are usually considered older people. All people aged 65 and over are eligible to access services under long-term care insurance as the Category 1 group (MHLW 2002). People aged 40 and over with disabilities due to particular diseases are also eligible as the Category 2 group. Under long-term insurance, people using care are categorized into support level (2 stages) and care level (5 stages). Details are stated in Appendix A. Currently, only approximately 18% of 65-year-olds are certified to use the insurance (MHLW2019a). Furthermore, about 10% among 18% use home-based services based on the author's calculation (MHLW2019b). Because these numbers are changing by month, it does not reflect the whole picture of older people in Japan.

In this study, community-dwelling older people are defined as older people who live in a place that is considered home, including homes, nursing homes, and care houses. Majority of targeted clients for foot survey were aged 65 and above. However, some of them below aged 65 who uses services under long-term care insurance were included. They had already been categorized into a certain care level of category 2 who attend those facilities under long-term care insurance.

There is no consistency in the interpretation of age provided. In 2019, the Japan Geriatric Society suggested a new definition of older people as 75 years and older.

According to World Health Organization 2020, "Most developed world countries

have accepted the chronological age of 65 years as a definition of 'elderly' or older person, but like many westernized concepts, this does not adapt well to the situation in Africa. While this definition is somewhat arbitrary, it is often associated with the age at which one can begin to receive pension benefits. At the moment, there is no United Nations standard numerical criterion, but the UN agreed cutoff is 60+ years to refer to the older population" (WHO, 2020).

The researchers provided the definition of "frail" (Cesari, Calvani, & Marzetti, 2017; Gobbens, Luijkx, Wijnen-Sponselee, & Schols, 2010). In this thesis, frail older people indicated that individuals who are physically weak or need some care assistance, and are approved for long-term care insurance.

In-home service providers

In-home service providers include facilities that provide home services such as home care and adult service centers. The general terms of "home care" include visit care by nurses and care workers. In this thesis, the providers dispatching nurses to homes are referred to as "home visit nursing providers", or "home nursing centers". The providers which dispatch nurse care workers to homes are referred to as "home visit care providers", or "home care centers". The adult care centers consist of "day care service centers" and "day care centers offering rehabilitation". Day care centers offering rehabilitation are also referred to as "outpatient rehabilitation" and the purpose is to provide rehabilitation by rehabilitation professional such as Physical Therapists or Occupational Therapist under the direction of the attending physician. Usage fees are higher there comparing with the day care service centers.

People with multiple occupations, such as Registered Nurses (RN), Licensed Practical Nurses (LPN), Certified Care Workers, Noncertified Care Workers with different qualifications, Physical Therapist, Occupational Therapist are working at in-home service providers. In Japanese law translation, the terms "assistant nurse" is often used instead of LPN (Ministry of Justice, Japanese law translation, 2020).

The number of workers of each of these occupations varies depending on the facilities' standard although they need to meet national standard. In Japan the qualification and experience of nurses are categorized into RN and LPN. Nursing is a medical profession that provides care and assists in examinations and medical treatments. The major differences in RN and LPN are qualification requirements and issue of place (Appendix F). Care workers are not allowed to engage medical conduct. They provide nursing services, such as assisting in oral care, bathing, eating, going to

the toilet, e.g., to sustain the daily life of clients at facilities. The term, “Care Workers” includes certified care workers who are qualified after passing the certified care workers examination and non-certified care workers. Many non-certified care workers have at least one certificate of novice training or practitioner training. The major differences between certified and non-certified care workers are the contents and duration of training they have undergone to achieve the certification (MHLW 2018). Their tasks are similar; however, certified care workers have more tasks like providing instruction to clients and their family and consulting them.

1.10. Purpose of the study and research hypothesis

This thesis is based on the second phase of the study. The studies were built by using abundant resources including literature review, interview, my clinical and research experiences (Chapter 2).

In the first phase of the study, regarding the prevalence of current foot care knowledge and practice of nurses and care workers at home and adult service centers (Chapter 3), three hypotheses are proposed.

1) Both nurses and care workers show interest in learning foot care but may perceive insufficient education on and time for foot care and display a lack of confidence, 2) No significant differences in foot care knowledge and practices exist between nurses and care workers regardless of working status or experience due to the fundamental lack of foot care education in Japan, 3) Nurses obtain and demonstrate better foot care knowledge and practices related to vascular, neurologic, and skin disorders compared to care workers due to differences in the educational curriculum.

In the second phase of the study, the author developed a foot care program aimed at improving the foot care knowledge and practical skills of nurses and care workers and verify the effects of the intervention. The second phase of the study consists of three studies.

Firstly, a developing process and evaluation of a foot care program was presented (Chapter 4). For this stage, two research questions were proposed.

1) Was the evaluation process of the development of the educational tool effective?

2) Is there an association between performance scores obtained using educational tools and improvement in foot care?

Secondly, the intervention program was performed and the effects on nurses, care workers and clients were evaluated (Chapter 5). Two research questions were

proposed

1) What are the effects of the foot-care educational program on the knowledge and practice of foot-care among nurses and care workers?

2) What are their perceptions of foot-care educational program?

Thirdly, the effects of a foot care program on clients were presented (Chapter 6). Two research hypotheses were proposed:

1) The foot care program for nurses and care workers will show some improvement in the foot conditions of clients, but dramatic changes will not be observed due to the physical characteristics of older people.

2) The foot care perception of older people will be positively affected after the foot-care program.

1.11. Conceptual framework

Conceptual framework and composition of this research

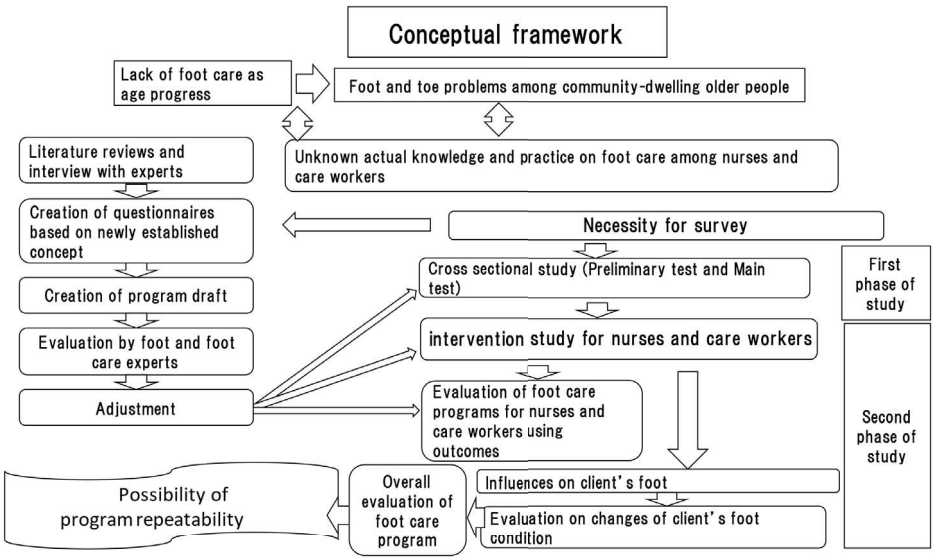


Figure 1-3: Conceptual framework
Note: This chart shows how the study was conducted. Left side of the chart describes the creation of questionnaires and program. Right side of the chart describes the cross-sectional study and intervention study. Program reparability is the future perspective.

Figure 1-4 shows the new foot-care concept algorithm constructed for this study, which is the foundation of the conceptual research framework. The author made new foot care concept called, “KashikoNF”

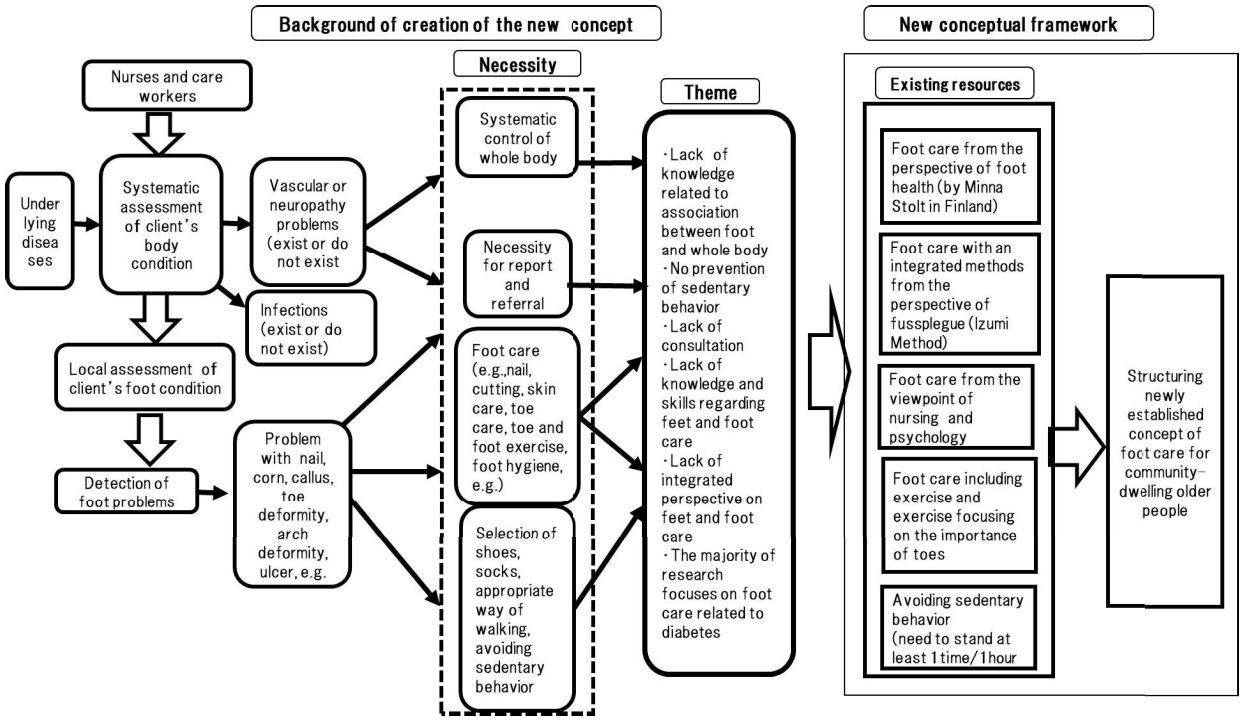


Figure 1-4: New Foot Care Concept Algorithm
Note: Nurses and care workers who perform care have opportunities to observe the client's systemic body including foot. If they find any abnormality on the feet, it is necessary to report their finding to others and provide necessary care. At present, there are many issues to be addressed, however, there is no existing concept to maintain foot health for older people in the community. Therefore, a new concept was built by referring to the existing concepts

CHAPTER 1

The contents of this study were constructed based on the new concept by using the following five major concepts as references.

1) Foot-care based on the perspective on foot health of Minna Stolt, Finnish researcher. In the preparation stage of this research plan, the author obtained abundant knowledge about foot health for the community-dwelling elderly by mail exchange with Ms. Minna Stolt and reviewing her literature (Stolt et al., 2012, 2013, 2015).

Proper foot care is an important aspect of maintaining foot health. The concept is adopted from the viewpoint of podiatry. Podiatry is a profession that examines the foot from a comprehensive perspective while observing the relationship between the body and the symptoms of disease that can occur throughout the body.

2) Foot-care based on the viewpoint of Izumi-style Fusspflege is the foot-care that Izumi Yamamichi developed. She developed her knowledge into more integrated care. For example, she studied Fusspflege in Germany and developed it into her own style. She believes that foot problems are not solved by foot-care alone. She developed comprehensive foot-care with beauty and healing by incorporating it into O-leg correction, nail care, aroma therapy and thalassotherapy[1] (Yamamichi, 2005). Arch adjustment, the way of walking, and shoes are also incorporated into her style. She has owned a foot-care school and a salon in Tokyo for more than 20 years (interview on 2019, Feb, 11). The author learned foot-care in several schools and eventually obtained more in-depth knowledge of foot-care and obtained a certification at her school.

3) Foot-care based on nursing viewpoints means that all parts of the body are connected to the whole body. The physiological, functional, and morphological characteristics of the foot with aging can be considered from the perspective of whole-body management. Early detection of foot problems and reports to other foot-care professionals are exercised based on this perspective. For example, the concept considers symptoms such as coldness of one leg by palpation, wound healing delay, pain when walking, the knee gradually becoming O-leg [2]and what should be predicted.

The concept is related to deeper insight into the connection between the foot and the whole body. Previous literature and recollections of scenes encountered in the

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[1] Thalassotherapy:A method of foot care using seawater, seaweed, and sea mud. By using the principle of osmotic pressure of seawater, the method aims to remove waste products from the body and adjust the mineral balance.

[2] “O leg” called in Japan seems to be same as “Genu valgum (knock knee) and genu varum(bowleg)” as knee joint deformities (A. Samaei et at., 2012, p469).

author's previous clinical experience at the hospital or home visiting station were used as references. Although there are differences in education on anatomy and physiology of the human body between schools for nursing and care workers, basic knowledge is necessary for early detection. This made this concept especially valuable for developing the concept of this thesis.

Foot-care based on psychology viewpoints are derived from author's experiences of foot care for older people. The author had opportunities to assess, touch and provide care on feet of older people. Narrative of their life demonstrated that foot care had psychological effects on them. Narrative included past experience and present experience. The collection of narrative data provides the significant information (Greenhalgh, T, 1999). Each care, such as touching colder feet, providing foot bath, trimming nails that caught their socks created the feeling of bliss and produced narratives that they never talked about before. One older person stated her toes were deformed because only one pair of shoes was distributed during the war and it was too tight for her feet. The other one recounted that she worked hard to make sandals because no shoes were distributed. The other one recounted she walked a lot on unpaved road with high heel in the 1960's and realized her toes and arch were deformed. Several people stated the gratitude that they could sleep better than before and it became easier to walk.

From a physiological perspective, the oxytocin hormone which is released by skin contact stimuli such as a hug or a touching act as a protective function against heart and vascular conditions.

4) Internationally, there have been abundant studies on the foot and ankles. The weight-bearing role of the foot has been studied by researchers (e.g., Guidozzi, 2017). The toes play a critical weight-bearing role in standing and walking, and toe force is a critical indicator of lower muscle strength. However, international research on toes is limited. The majority of studies were conducted by Japanese researchers and used machines to measure toe force (e.g., Suwa et al., 2018; Uritani, Fukumoto, Matsumoto, & Shima, 2015).

In Japanese history, the role of toes has been recognized. The toe was considered as an organ who plays an important role in maintaining body's balance. Many Japanese martial art schools introduce toe exercises to utilize the body power and fight the

enemy[3].

Ninja who served feudal lords and acted as agents, tactical infiltration and, plotters on individual bases from Muromachi period (1338-1573) to the Edo period (1603-1868) used the health method called “guiding technique”. By stimulating the ends of the body, such as palms, toes and ears, e.g. they enhance the functions of the internal organs.

Foot health is maintained by the integration of hygiene and exercise. Likewise, the current trend of research on toes needs to be expanded to incorporate exercise and hygiene. Previously, the author noticed that many older people suffer from skin maceration between toes, discomfort due to nail problems, and difficulty moving and opening toes. In clinical experience and pilot studies, the author has encountered many elderly people whose skin between the toes is exfoliated or macerated and whose toes are not sufficiently open. However, as a result of providing care, such as care of skin between the toes, care between the nails and the skin, encouraging the wearing of five-finger socks, avoiding contact with the skin between the toes, and encouraging toe exercise, many clients provided positive remarks, saying, things like “My toes are becoming more open”, “I began to sleep well”, and “Temporary convulsions of the foot improved”. The author developed a measurement method for toe opening. The reliability and validity have not yet been verified, but evidence is being accumulated for future development. Toe force measurements have been developed before. Previously, the author conducted an intervention study by using one of these measurements (Fujii, 2019). Based on a survey that has already been verified, it was assumed that there would be physical and psychological effects by incorporating toe care, including hygiene and exercise, into the concept of foot-care.

5) Prevention of prolonged sitting posture involves actions to reduce adverse effects on the legs and the whole body in consideration of blood flow due to long sitting posture. As noted in the literature review, a large-scale study was conducted to search for a negative influence on blood flow due to long-term sitting behavior.

Foot issues are conventionally limited to consideration only in the context of foot issues. However, the newly established concept has unique features. First, foot issues were considered and addressed from various perspectives. Second, foot care was considered as an integrated effort by both clients and caregivers, including nurses and

[3] https://www.iganinja.jp/old/english/menu.html (About Ninja in English)
https://www.iganinja.jp/old/japanese/bou/bou/kemuri/6.html Ninja training in Japanese)

care workers. The cross-sectional studies and intervention studies in this thesis were planned and performed based on the newly established concept of foot care. A series of studies in this thesis test various hypothesis using tools with the concept.

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CHAPTER 1: Introduction

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CHAPTER 2

Foot health in older people living in the community: A scoping review

Abstract

Aim: Foot health indicates the impact of daily activities as well as the quality of life. Feet problems are common in older people because aging decreases an individual's ability to perform self-footcare owing to physical limitations. This review aimed to explore foot health studies conducted worldwide and to aid in developing strategies of foot health care for older people.

Methods: A literature review was conducted using search engines such as PubMed, Google Scholar, Cochrane Library, Online version of Cumulative Index to Nursing and Allied Health Literature（CINAHL)[4], and Japanese Nursing Association Library Latest Nursing Search Web. The search period from the earliest records from up to September 2020. The literature search yielded more than 20,000 articles. Relevant articles were screened, selected, and read in detail. The included studies were classified as foot health issues, foot care interventions, and foot instruments.

Results: Overall, 139 articles were eligible for analysis. Relevant information on foot health issues, including 19 sub-categories such as pain, disorder, disease-related to nail, toe, skin shed, etc. and various methods of foot care interventions for health care professionals or clients and patients were extracted. Data on existing foot instruments were divided into scale, measurement tool, and useful information associated with foot items.

Conclusions: Summarizing the available research evidence and identifying foot issues and interventions broadly is meaningful to determine the needs in foot healthcare for community-dwelling older people. The findings of this study may serve as a basis for developing instruments dedicated to improving foot healthcare.

Key words: aged, database, evidence-based intervention, foot, quality of life

[4] Cumulative Index to Nursing and Allied Health Literature, a database of nursing and allied health literature produced by CINAL Information Systems, a division of EBSCO.

2.1. Introduction

The foot health of community-dwelling older people is a growing concern, with an increase in the aging population worldwide. Aging can trigger foot problems as a result of physiological, functional, and structural changes in the body and can decrease the ability of older people to adequately care for their feet (Mitty, 2009). Therefore, foot health is essential to maintain a high quality of life (Lópes-López et al., 2018). Unattended foot problems can trigger foot pain, imbalance, immobility, cosmetic issues, and depression (Awale, Dufour, Katz, Menz, & Hannan, 2016). Previous studies have revealed a high prevalence of foot problems (30–87%) in community-dwelling older people (Dawson et al., 2002; Dunn et al., 2004; Menz & Lord, 2001a, Muchana et al.,2018).

Frail older people, in particular, are at a higher risk for foot problems, which include nail and skin issues (e.g., corns and calluses), toe deformities (e.g., hallux valgus), sensitivity, and circulation-related foot issues (Muchna et al., 2018). Moreover, barriers in transportation, to reach foot health professionals, are another concern (Syed, Gerber, & Sharp, 2013), as older individuals often need assistance outside their homes (Miikkola, Lantta, Suhonen, & Stolt, 2019). Countries—like Japan—with a lack of footcare professionals have a tremendous limitation in promoting foot health among community-dwelling older people. Although older people may experience various types of foot problems due to unsolved factors, no studies have provided an ample view of the foot health issues of this population.

The foot health of community-dwelling older adults can be improved by integrating efforts of caregivers such as nurses and healthcare workers. To the best of my knowledge, research on this topic has mostly focused on chronic diseases such as diabetes and rheumatoid arthritis. Furthermore, the available studies are more hospital oriented. This study aimed to explore previous studies on foot health worldwide and aid in developing future strategies of foot healthcare for older people.

The following research questions were defined: 1) “What are the possible foot health issues among community-dwelling older adults?,” 2) “What is the available content of current on-going interventional studies?,” 3) “What types of foot instruments exist?,” and 4) “What types of key elements can be incorporated into foot health strategies for older people?.” To answer these questions, an extensive search of the literature was conducted to identify and analyze current evidence on this subject. Additionally, studies were reviewed on overlooked aspects of foot health-related issues, such as long-term sedentary behavior and toe diseases.

2.2. Methods:

Figure 2-1 shows the process of the screening and final selections of the studies. Figure 2-2 shows the classification of subcategories of studies.

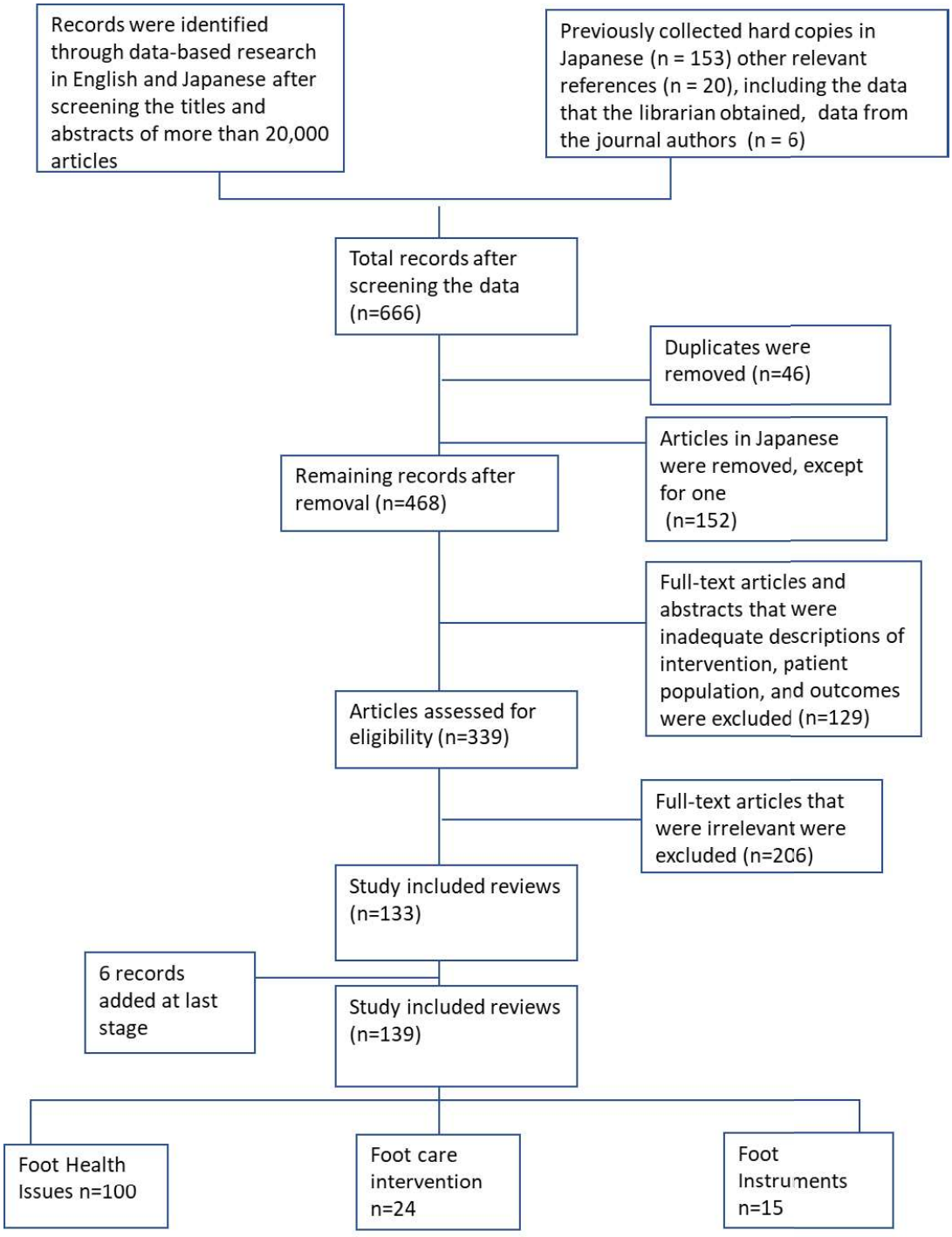

Figure 2-1: Flow chart of literature classification
Note: Process of screening and final selection of studies. 139 articles were classified into 3 major categories

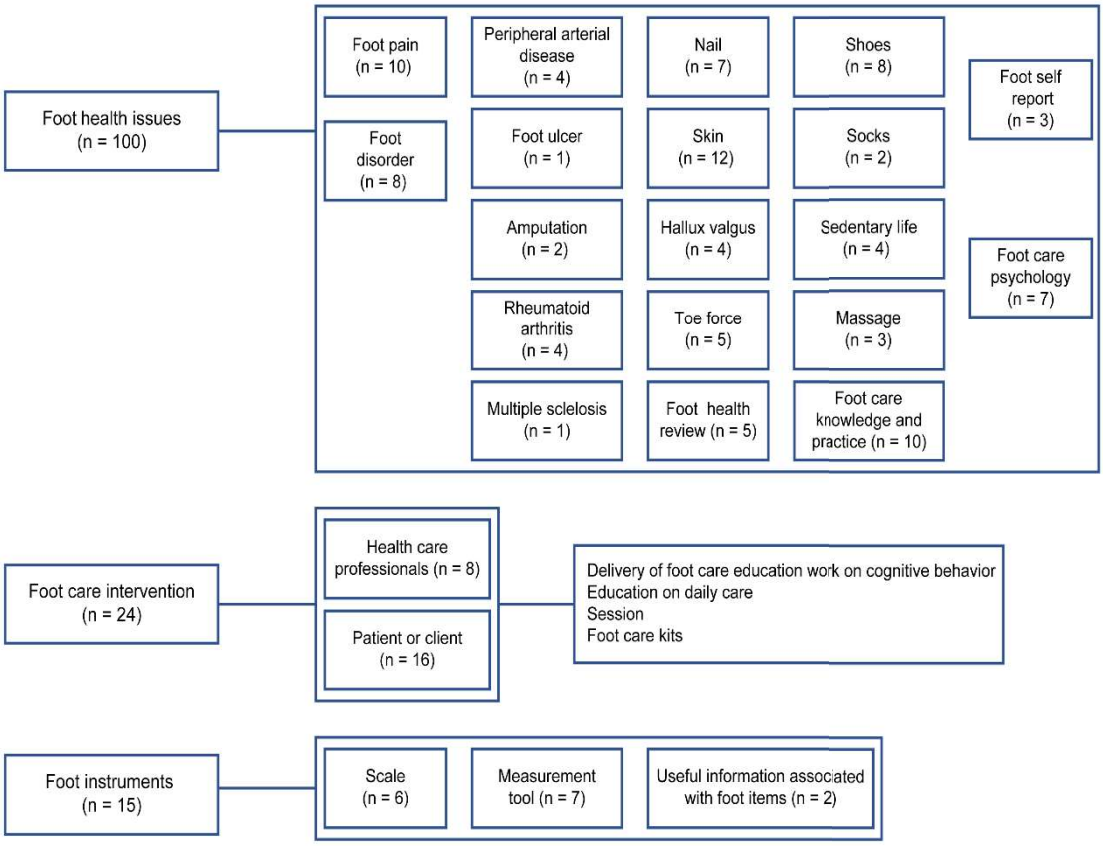

Figure 2-2: Classification of subcategories of studies
Note: Foot health issues were categorized into 19 items. Foot care intervention was categorized into two items. Foot instruments were categorized into three items.

2-2-1. Design

This study chose the scoping review of literature to cover the broad research questions and to identify the potential scope for meta-analysis and systematic review for the future. A scoping review protocol was prospectively submitted to the Open Science Framework[5] database, and PRISMA guidelines were followed. The main aut created and conducted a few studies in July to Oct, 2019 (Fujii, 2020 a, b).

2-2-2. Search strategy and selection criteria

The search period from the earliest records from up to September 2020. Literature regarding foot health was extracted from databases such as PubMed, Google Scholar, Cochrane Library, online version of Cumulative Index to Nursing and Allied

[5] http://osf.io

Health Literature CINAHL [6](EBSCO), and Japanese Nursing Association Library Latest Nursing Search Web.

The sentences used in the search were（elderly or Older AND foot assessment or foot health or foot care or foot problems or foot pain, n=9371, EBSCO), (Elderly or older AND foot education, foot intervention, n=9325 EBSCO). Other search terms were nail, foot skin, callus, corns, shoes, socks, foot education, foot infection, toe function, toe exercise, sedentary life, fungal infection, skin moisture, peripheral arterial disease, foot neurology, foot massage, foot lesions, foot arch, foot deformity, foot moistening, foot hygiene, toe deformities.([n=107868, n=9899: PubMed: (Or for All items) AND Elderly or Older])

Search terms were generated from the researchers' foot care experiences in hospitals and home visiting stations. The search was performed without any restrictions in country. A total of 153 abstracts and articles on foot-related studies in Japanese (the author previously had hard copies), pertinent documents on the websites of relevant organizations, and additional records extracted from references were screened. Additionally, librarians assisted to obtain original articles retrieved from the reference list. Moreover, six articles were obtained from the researchers who wrote the original articles via personal contact e-mail.

All non-English articles had an abstract in English. Inclusion criteria for studies were mainly original articles, research articles, systematic reviews, literature reviews, and opinions. Several opinions were included in this study because literature concerning the emotional and physical difficulties of older people with foot issues was considerably limited. Previous literature on the role of toes in balance, walking, and foot function (Fujii, 2019; Mickle, Caputi, Potter, & Steele, 2016) and the health risks related to sedentary behavior (Keevil et al., 2015) were included. Although the search terms "elderly" and "older" were used, studies including 18- to 101-year-old participants were included depending on the study content. Adults under 65 years of age were included to avoid losing important insights on foot issues regardless of age.

Exclusion criteria included literature with an in-depth description of foot anatomy and physiology and studies that did not obtain approval from ethical committees. References related to nutrition, socioeconomic issues, and those on diabetes, which rarely addressed the foot were also excluded from the review.

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[6] Cumulative Index to Nursing and Allied Health Literature, a database of nursing and allied health literature produced by CINAL Information Systems, a division of EBSCO.

2-2-3. Data extraction

The initial screening yielded 666 studies from the titles and abstracts of more than 20,000 articles in English. The next stage included selection and hard copy creation. Author-selected relevant articles by abstract were screened again. A 46 duplicate articles were removed from the study database. Of the 153 Japanese articles, 152 were removed due to inadequate content of English summary.

Overall, 468 articles remained for the next stage. Data were input into EndNote Software, and hard copies of the included abstract and original articles at hand were prepared. The next stage was a further in-depth selection. Of all the articles included in this stage, 129 irrelevant abstracts and articles, including inadequate description of intervention, patient population, and outcomes were eliminated, resulting 339 full-text articles at the final stage.

In the final stage, an in-depth reading of the remaining articles was conducted. A total of 206 articles were removed because they were majorly focused on diabetes-related foot issues, had no ethical considerations, or contained obsolete information. After this stage, 133 articles remained and 6 articles were added on the advice of experts. Finally, 139 articles were analyzed in this study. Figure 2-1 shows the flowchart of the screening process and final selection of the studies.

2-2-4. Data analysis

The studies included in this review were classified into three categories: foot health issues, foot care interventions, and foot instruments (Figure 2-2). The foot health issues category was further classified into 19 sub-categories: foot pain, foot disorder, peripheral disease, amputation, foot ulcer, rheumatoid arthritis, multiple sclerosis, nail, skin, hallux valgus, toe force, shoes, socks, sedentary, massage, foot care knowledge and practice, foot care psychology, foot self-report, and foot health review. Table 2-1 showed the classification of foot health issues. Each article in this category was analyzed by author, country, design, data collection, number of participants/initial sample size (if stated), age range and mean age (if stated). In the case of literature reviews, the analyzed number of studies was presented instead of the number of participants.

The foot care interventions category included into two sub-categories: interventions for clients or patient and for health care professionals, including doctors, nurses, and nursing assistants. Subsequently, articles in this category were analyzed by country, type of study, method of intervention, number of participants, and outcomes

(Table 2-2). The analysis on foot instruments was divided into scale, measurement tool, and useful information associated with assessment tool (Table 2-3). Articles in this category were divided into author, country, design, and number of participants or initial sample size, mean age (if stated) or manuscript. Three research assistants involved in the search counted the number of hard copies and checked the references.

2.3. Results:

Before assessing the articles' eligibility (n=468 articles), 49%, 10%, and 18% of the studies respectively focused on foot issues related to diabetes, rheumatoid arthritis, and peripheral artery diseases, respectively. Amputation as a consequence of worsening diabetes was identified as a major issue (Ang, Yap, & Saxena, 2017; Kröger et al., 2016). After the final selection stage, most diabetes-related articles were removed. However, Of the 24 articles included in the foot care intervention category, 16 (67%) were diabetes-related interventional studies.

Most studies originate from Australia and the UK, followed by the USA, Finland, and Spain; studies from several other countries in Europe, Asia, and the Middle East were also found. The studies that focused on pain-related foot conditions were associated with nails, hallux valgus, and shoes. Interventional studies on skin problems—such as corns, calluses, and a variety of nail problems—were scarce worldwide. Most studies on toes were conducted in Japan and reported in English, but studies regarding sedentary behavior were limited. Studies on hemodialysis were related to topics regarding nail health (Dyachenko, Monselise, Shustak, Ziv, & Rozenman, 2007) and onychomycosis (Kuvandik et al., 2007).

Foot care intervention studies on nurses, healthcare workers, older people, and frail older people were lacking worldwide. Foot care reports from developing countries were limited. The studies from 20 to 30 years ago provided essential points of foot care surveys or descriptions of foot care research in older people regardless of diabetes status or patients in hospitals (Gorter, Kuyvenhoven, & de Melker, 2000; Pierson, 1991)

2-3-1. Analysis of foot health issues according to categories

Table 2-1 presents classification of foot health issues. The articles which are valuable to be informed, however, not categorized into each item were presented as note.

Foot pain (n=10) and foot disorders (n=8)

Cross-sectional studies identified the factors related to foot pain, physical functions affected by foot pain, and a variety of foot disorders. Middle to Large numbers of participants (1500–7000 individuals) were involved in several studies (Garrow, Silman, & Macfarlane, 2004; Hill, Gill, Menz, & Taylor, 2008; Menz et.al., 2013). A variety of foot problems, including toe deformities, plantar hyperkeratosis, corns, nail problems, and bunions, were commonly associated with foot pain (Menz & Lord, 2001a). Footwear was also a factor in foot pain (Guidozzi, 2017). Furthermore, studies showed that foot pain leads to physiological effects, such as depression (Awale, Dufour, Katz, Menz, & Hannan, 2016). Keratotic lesions (e.g., corns and calluses) were considered a factor in foot pain (Menz, 2016a).

Note: Patel et al. (2014) stated the role of chronic pain and falling and fear of falling. Feet are categorized one of pain sites. Dawson et al.(2002) stated the association between foot pain and footwear.

Peripheral arterial disease (n=4), foot ulcer (n=1), amputation (n=2), and rheumatoid arthritis (n=4), multiple sclerosis (n=1)

Kröger et al. (2016) reported a correlation between the number of visits to a podiatrist and reduction in foot amputation rates. Risk factors related to foot amputation in dialysis patients with peripheral arterial diseases have been reported (Locking-Cusolito et al., 2005). In a large-scale study, Ang, Yap, & Saxena (2017) reported that the lower limb amputation rate in patients with diabetes was 20 times greater than that in those without diabetes. Several studies, which originated outside of Japan reviewed foot issues related to rheumatoid arthritis (Walmsley, Williams, Ravey, & Graham, 2010; Stolt, Suhonen, & Leino-Kilpi, 2017) and multiple sclerosis (Stolt, et al, 2020); in Japan, reports on this topic by nurse researchers were limited.

Nails (n=7)

Descriptive studies on nails explained various types of nail problems. Studies conducted outside of Japan have reported nail issues associated with a disease in a description form or a survey, and related issues despite the lack of interventional studies (Abdullah & Abbas, 2011; Malkin & Berridge, 2009). Patients with chronic renal failure had higher rates of nail disorders (Dyachenko, Monselise, Shustak, Ziv, & Rozenman, 2007). Studies suggested that nail problems are associated with cosmetic issues and psychological distress (Abdullah & Abbas, 2011; Radtke et al., 2011).

Note: The articles related to onychomycosis (Gupta, 2000, Kuvandik et al., 2007) were presented in Skin item.

Skin (n=12)

Skin problems associated with the feet were covered in a variety of studies (Laube, 2004; Gupta, 2000). In a parallel group-controlled trial, Farndon et al. (2013) reported that corn plasters were effective on corns care compared with typically used scalpel treatment. Many clinicians have reported negative effects of scalpel treatment; however, evidence reports were minimal.

Onychomycosis in the elderly is a concern (Gupta, 2000). An increase in the prevalence of dystrophic nail changes and onychomycosis among hemodialysis patients has been reported (Kuvandik et al., 2007). Mitty stated that "it is caused by dermatophytes, as well as some yeasts and molds" (Mitty,2009, p3/6). Therefore, the articles related to onychomycosis was categorized skin item.

A study including a large number of samples (n = 67,448) in Japan indicated that tinea pedis was common in individuals over 41 years of age. The disorder including eczema, tinea unguium, and tinea pedis were mainly observed in individuals of 76–85 years (Furue et al., 2011). Voegeli (2008) experimented with the washing and drying technique and suggested that washing with soap and water and towel drying had disruptive effects on the skin. Skin tears were common incidents seen at clinical sites. Serra et al (2018) reported the issues associated with skin tears through a systematic review; however, investigations related to risk factors of skin tears are limited. A multicenter cross-sectional study indicated that 48.8% of patients had skin dryness (Lichterfeld, Lahmann, Blume-Peytavi, & Kottner, 2016). The reduction in pain and improvement of functional ability as a result of debridement on plantar hyperkeratosis among older people has been reported (Balanowski & Flynn, 2005).

Hallux valgus (n=4)

Studies concerning toe deformities were predominantly focused on the hallux valgus. The association between foot pain and shoes was also reported. A population-based case-control study (n = 2,627) identified the association between hallux valgus, shoe wearing, and foot pain. The study indicated that developing hallux valgus later in life (between the ages of 20 and 39 years) may be associated with the type of footwear that an individual wear (Menz et al., 2016b). First findings regarding the heritability of foot disorders, including hallux valgus, were also reported (Hannan et al., 2013).

Toe force (n=5)

The motion of toe grip involves several muscles and affects various movements (Uritani, Fukumoto, Matsumoto, & Shima, 2015; Soma et al., 2016). Cross-sectional studies on toe grip force conducted in Japan were reported in English. Among these, the study by Suwa et al. (2018) involving 1,390 Japanese males identified that toe flexor strength could be an indicator of the prevalence of diabetes mellitus in middle-aged males.

Shoes (n=8) and socks (n=2)

The association between footwear and foot problems was well-reported in studies conducted outside of Japan (e.g., López-López, D et.al., 2016, Palomo-López, P et. al., 2017). Between 65 and 3,378 participants were involved in cross-sectional studies. The association between incorrectly fit footwear, foot pain, and foot disorders were identified (Dawson et al., 2002; Burns, Leese, & McMurdo, 2002; Buldt & Menz, 2018). A unique study of self-reported data in the elderly population revealed a lack of feet checking and the tendency to mismatch footwear (López-López,D et al., 2015). Five-toed socks are widely used in Japan despite scarce evidence reports: a limited number of studies on this topic were reported in English (Shinohara, 2011).

Note: Author previously reported that the combined foot care intervention including five-toed socks was effective (Fujii,2019).

Sedentary life (n=4)

The health risk of sitting for extended periods has been reported in studies originating outside of Japan. A large community-based study (n = 8,623) on sedentary behaviors measured by TV watching time indicated that a shorter time spent watching TV is associated with a faster walking pace (Keevil et al., 2015). Other studies identified the association between sitting time and postprandial glucose and insulin response (Dunstan et al., 2012), and medial temporal lobe thickness (Siddarth, Burggren, Eyre, Small, & Merrill, 2018).

Massage (n=3)

There are a variety of foot massage techniques (Ernst,2003). However, studies regarding paid caregivers providing foot massages for older people were minimal. The comparison of the effects of manual lymph drainage therapy and connective tissue massage in a particular illness was used as a reference (Ekici, Bakar, Akbayrak, &

Yuksel, 2009).

Foot care knowledge and practice (n=10)

Cross-sectional studies, reviews, and descriptive explorative designs were identified (e.g., López-López, D et.al., 2017). However, most studies were focused on the foot care of diabetic patients. Studies regarding foot care knowledge and practice were for healthcare providers, such as nurses, and patients or clients. Pierson (1991) and Stolt et al. (2013a, 2015) developed an instrument that measured the foot care knowledge and activities of nurses working in a home setting and conducted cross-sectional studies (Pierson, 1991; Stolt et al., 2013a; Stolt et al., 2015). The role of nursing in promoting foot health, necessities of gaining knowledge, and activities for nurses working in the context of home care were presented. Li et al. (2014) conducted a cross-sectional study on foot care knowledge and behaviors in 5,961 type 2 diabetes patients and presented a positive correlation between knowledge scores and behavior scores. Although the correlation was not exceedingly strong, it was statistically significant. A unique method of measuring nail knowledge and confidence of caregivers was reported in 1996 (Turner & Quine, 1996), however, this method has not been presented thereafter.

Foot psychology (n=7) and foot self-report (n=3)

Foot psychology was defined as features of the mind such as “confidence, complaints, thoughts, and motivations related to the foot care of patients/clients or medical and nursing personnel.” A self-report was used to evaluate the perception on foot. A population-based cross-sectional study (n = 5689/7,200) (Gorter, Kuyvenhoven, & de Melker, 2000) identified the association between individuals with nontraumatic foot complaints and those with limited mobility. Furthermore, an exploratory qualitative study grasped the potential barriers to foot care in both patients and health care professionals in developing countries (Guell & Unwin, 2015).

Foot health review (n=5)

Foot health reviews and descriptions presented an overview of foot health issues. Stolt et al. (2010) presented a literature review on the foot health of older people and roles of nurses in foot care. Wiley et al. (2019) revealed the significance of podiatry intervention for older people with a fall risk.

2-3-2. Analysis of foot care intervention

Table 2-2 presents the information retrieved from interventional studies. A total of 16 foot care intervention programs for patients or clients and 8 programs for nursing personnel were analyzed. The session of the each program was unique and creative The time duration for interventions varied from 15 minutes to 2 h, and interventions were conducted for individual, groups, or both.(Mickle, Caputi, Potter, & Steele, 2016; Fan, Sidani, Cooper-Brathwaite, & Metcalfe, 2013; Hassan, 2017; Pendsey & Abbas, 2007; Mackie, 2006; Jones & Gorman, 2004; Borges & Ostwald, 2008). Tools such as PowerPoint presentations, telemedicine, iPads, foot care kits, pamphlets, and diaries were used (Keller-Senn, Probst, Imhof, & Imhof, 2015; Spink et al., 2011; Ahmad Sharoni, Abdul Rahman, Minhat, Shariff-Ghazali, & Azman Ong, 2018; Mackie, 2006).

2-3-3. Foot instruments

Table 2-3 shows studies related to foot instruments. A step-by step procedure was required during scale development, to test their validity and reliability. The simple and time-saving assessment tools, such as the 3-min diabetic exam (Miller et al., 2014), 60-second foot exam (Inlow, 2004), Ipswich Touch Test (Rayman et al., 2011), were presented. These scales and measurement tools were generated in response to the demand from the field.

Table 2-4 showed the structure of foot care program intervention by extracting 10 literature from different countries. Table 2-5 provided in-depth methods of foot care education.

2-4. Discussion

This review highlighted the important aspects of foot health studies. The number of foot health studies worldwide were limited. The first three research questions were answered by analyzing the research data. The papers mainly published in Italy in 2020 were added at the last stage of screening, however, nothing did not affect the creation of the foot care questionnaire and foot care program developed in 2019. The process of about two thirds on literature review led to the extraction of key elements of foot health studies and the creation of questionnaires and programs (Fujii et al., 2020 a,b). Therefore, the fourth question was partially answered. This literature review can be a resource foundation to provide strategies for creating instruments or programs in the future. In addition, further studies using meta-analysis or systematic reviews are needed on individual topics.

Overall, several gaps in foot health studies were identified. First, foot care studies including those originating from developed countries focused on patients with diabetes (Ramachandran, 2004; Tulley, Foster, van Putten, Urbancic-Rovan, & Bakker, 2009). Second, studies on roles and interventions in foot care for nurses and healthcare workers providing daily care at assisted-living or nursing facilities were lacking. Third, the research areas of foot health in older and frail older adults were limited despite the worldwide trend of growing older people population (World Bank Group, 2018). Fourth, the participant drop rate in cross-sectional and interventional studies was found to be high, indicating a barrier in foot health research.

Therefore, it was difficult to select articles, which included older people only. Lastly, foot disorders have been treated as independent issues and have not been addressed as conditions related to daily activities and footwear type and with psychological impact on patients.

The sub-categories generated differed slightly from those initially expected for the category of foot health issues. For instance, hallux valgus tends to trigger foot pain (Menz, 2016a); therefore, it was included among toe deformities studies. An independent foot pain sub-category was added because there were numerous reports on it. Furthermore, an amputation category was necessary because it is a major concern worldwide (Kröger et al., 2016) and it is related to independent issues; undiagnosed, unrecognized, and overlooked ulcers or small wounds may lead to foot amputation.

A variety of unique methods and tools for foot intervention were used in patients, clients, and caregivers. A foot care program may be effective in improving knowledge and practices for both older people and health care professionals and in recognizing the significance of foot, foot care, daily care, foot care kits, and conducting useful educational sessions. Many of these methods were not tested in Japan and may be significant resources for developing future strategies. Reports on foot care interventions on community dwelling older people were lacking due to an absence of evidence-based research among community-dwelling older adults. However, novel programs conducted in other countries were not tried in Japan.

Access or referral to podiatric care was lacking despite its existence in other countries (Campbell et al., 2002). Studies revealed that foot care programs in both higher- and lower-income countries have issues that need to be resolved (Borges & Ostwald, 2008; Campbell et al., 2002; Guell & Unwin., 2015). Interventional studies on skin lesions such as corns, calluses, and nails were limited. Frail older people have a high risk of developing nail disorders. Although frail people have a low risk for skin

lesions due to limited physical activity, skin lesions caused pain (Balanowski & Flynn, 2005) and discomfort.

Overall, foot care intervention programs focused on feet alone. Since the foot is associated with general health, foot interventions for older people should include other health aspects such as footwear-, posture-, and sedentary lifestyle-related issues. Moreover, most foot studies focus on the foot, ankle, and lower limbs. Thus, studies focusing on toes may be limited.

Worldwide, the majority of foot health scales for community-dwelling older people were focused only on the feet; although, the issue of maceration between toes and shoes are included.

The effectiveness of using these scales or measurement tools on older people, particularly the frail ones, is unknown. A detailed demographic-specific foot health-instrument should be developed on the basis of accumulating evidence.

This study has several limitations. Due to time and personnel constraints, search topics had to be selected. While there are enormous amounts of publications related to foot and foot care around the world, it was hard to select studies for analysis alone with time constrains. Most studies included in this study are from high-income regions such as Australia and Europe, where podiatry exists. Hence, it was difficult to evaluate the foot health of older people in Asian countries with individuals having a similar body type.

Of the references not listed in the literature review categorization, literatures on the posterior tibial artery and dry skin are listed in the reference list in Chapter 6.

Despite these limitations, this scoping review identified areas requiring attention and difficulties encountered in previous studies, thereby revealing potential areas of study for future research.

2.5. Conclusions

The research related to foot health covered a variety of topics. This study indicates that evidence-based research to support foot health for older people in the community is lacking, even though foot problems among community-dwelling older people are extremely prevalent. The lack of attention and difficulties of the studies in this area were identified. Therefore, potential areas of study for future research were identified, regardless of the provision of foot care services or doctors available in different countries.

Table 2-1: Classification of foot health issues

	Focused items	Authors	Country	Design	Data collection	Analyzed number of participants/initial sample sized, if stated	Age range and mean age, if stated	Analyzed number of studies/initial numbers of search, if stated, or number of references
1	Foot pain	Foot pain, toe deformities (hallux valgus, plantar hyperkeratosis, lesser digital deformity, digital lesion), postural sway	Menz & Lord, 2001b	Australia	Cross-sectional	Assessment, Performance test	135 community-dwelling older people	75-93, mean 78.9 SD 4.1	
2	Foot pain	Prevalence, risk factor, common disorder, routine foot care, footwear, foot orthoses	Menz, 2016a	Australia	Review				89 /136
3	Foot pain	Pain, arching, stiffness, SF36	Hill, Gill, Menz, & Taylor, 2008	Australia	Cohort study	Questionnaires, Clinical assessment	3206/4060 community-dwelling cohort		
4	Foot pain	Plantar heel pain	Thomas et al., 2019	UK	Cross-sectional	Questionnaires	5109/ 9344 participants who registered at one of four general practices	Above 50 years old, mean 71	
5	Foot pain	Foot pain, mobility limitation	Menz et al., 2013	Australia	Cross-sectional	Questionnaires, Performance test	1544 participants from the Framingham Foot Study	Mean men 71 SD 10.9; women 71.1 SD11.9	
6	Foot pain	Nail problems, callosities, corns, athletes' foot, verrucae, bunions	Garrow, Silman, & Macfarlane, 2004	UK	Cross-sectional	Interview, Foot examination	3417/4780 random community sample	18-80	
7	Foot pain	Antilogy, classification,	Hawke & Burns., 2009	Australia	Review				129

		qualifying foot pain							
8	Foot pain	Foot pain, footwear	Guidozzi, 2017	South Africa	Review				34
9	Foot pain	Foot pain, posture, foot function	Awale et al., 2017	Australia	Cross-sectional	NHANES-style questions, MatScan	1375 community-dwelling ambulatory adults	40-98, Mean 69, SD 10.9	
10	Foot pain	Foot pain, depression	Awale, Dufour, Katz, Menz, & Hannan, 2016	Australia	Cross-sectional	Assessment Questionnaires	1464 men, 1857 women/3429 a community sample from the Framingham Foot Study	Mean 66, SD 10	
11	Foot disorder	Foot deformities, foot dermatoses, foot diseases	Dunn et al., 2004	USA	Cross-sectional	The orthopedic examination	784/7755 community-dwelling older people	65-101, mean 74.5	
12	Foot disorder	Foot posture, range of motion, strength, deformity, physical fall risk factors	Menz, Morris, & Lord, 2006a	Australia	Cross-sectional	Characteristic, tests, questionnaires	176 (104 non-faller, 71 faller) participants residing in a retirement village	62-96	
13	Foot disorder	Foot problems (hallux valgus, lesser toe deformities, hyperkeratotic lesions, other abnormal bony prominences), balance test, functional test, sensorimotor assessment	Menz & Lord, 2001a	Australia	Cross-sectional	Assessment, clinical tests	684 participants for the survey, 135 for the foot problem assessment	75-93	
14	Foot disorder	Foot disorders	Mitty, 2009	USA	Column				
15	Foot disorder	Aging, foot, foot deformities, foot disease, quality of life	Rodríguez-Sanz et al., 2018	Spain	Review				153
16	Foot disorder	Diabetic foot	Boulton, Vileikyte, Ragnarson-Tennvall, & Apelqvist, 2005	USA	Global collaborative studies				75

17	Foot disorder	Foot health, podiatry service	Campbell et al., 2002	UK	Cross-sectional		343 participants from podiatry services	
18	Foot disorder	Foot pain, deformity, neuropathy, frailty, fall ascertainment, gait balance, diabetes	Muchna et al., 2018	USA	Cohort study	Questionnaires assessment	117 (41 non-frail, 56 pre-frail, 20 frail) participants from community providers, assisted living facilities, retirement homes, and aging service organizations	65 years and old
19	PAD	Peripheral arterial occlusive disease, hemodialysis	Locking-Cusolito et al., 2005	UK	One-time assessment	Assessment	232 willing and competent HD patients	21-91, mean 65.1
20	PAD	Peripheral arterial disease	Prompers et al., 2008	European countries INTERNATIONAL COLLABORATION NET WORK	Cross-sectional	Recorded data by investigator	1088/1232 participants with a new foot ulcer	40-125, mean 88
21	PAD	Peripheral artery disease, diabetes, lower extremity functioning	Dolan et al., 2002	USA	Cross-sectional	Physical exam, performance test	147 PAD patients with diabetes 313 patients with no diabetes	55-91, aged 69.2 SD 8.3 55-93 aged 73.1 SD 8.2
22	PAD	Foot ulceration (diabetes)	Crawford et al., 2007	UK	Review			5 case-control, 11cohort studies （1752）
23	Amputation	Diabetic foot, amputation	Kröger, et. al., 2016	Germany	Nurse, amputation rate, diabetic foot	Open access federal report	Concrete numbers are not stated (Within a 5-year time period,	

							population-based major amputations per 100,000 people dropped from 21·7 in 2007 to 17·5 in 2011) (18·5%)	
24	Amputation	Lower extremity amputation	Ang, Yap, & Saxena, 2017	Singapore	Retrospective cohort study	Assessment, clinical examination	8150 (foot screening at least once during the 2-year follow-up), 8150 (control) participants with diabetes	Mean 68.1 SD 12.4, 67.8 SD 14.4)
25	Foot ulcer	Foot ulcer prediction	Boyko, Ahroni, Cohen, Nelson, & Heagerty, 2006	International working group	Cohort study	Questionnaire	1285 diabetes veterans without foot ulcers	Mean 62.4
26	RA	Recommendations for management of RA-related foot problems	Tenten-Diepenmaat, Leeden, Vlieland, & Dekker, 2018	Netherlands	Development of recommendation based on research evidence and the consensus of experts	Interview, consultation, discussion	2 patients and 22 experienced professionals	
27	RA	Patient-reported outcome measures, foot region specificity, e.g.	Walmsley et al., 2010	UK	Review			12 (6055)
28	RA	Rheumatoid arthritis, foot health, footwear, foot self-care	Stolt, Suhonen, & Leino-Kilpi, 2017	Finland	Review			32 (1205)
29	RA	Arthritis, foot pain, shoes	Riskowski, Dufour, & Hannan, 2011	USA	Opinion	Questionnaires		62

30	Multiple Sclerosis	Multiple sclerosis, lower extremity	Stolt et al., 2020	Finland	Review				42 /466
31	Nail	Different nail conditions	Abdullah & Abbas, 2011	Lebanon	Review				32 /2496
32	Nail	Nail psoriasis	Radtke et al., 2011	Germany	Cross-sectional	Questionnaires	2449/6923 participants with psoriasis	18-92, mean 57.0 SD 11.7	
33	Nail	Nail disorder hemodialysis	Dyachenko, Monselise, Shustak, Ziv, & Rozenman, 2007	Israel	Case-control	Dermatology examination, interview	73 participants with chronic renal failure (CRF), 77 with regular hemodialysis (HD), 77 healthy individuals (CG)	24-90, mean 74 SD 11.4 (CRF), 34-66, mean 60 SD 7.3, (HD) 23-98, mean 65.6 SD 13.5, (CG)	
34	Nail	Nail disorder	Murdan, 2016	UK	Description				97
35	Nail	Hygiene, nail care	Malkin & Berridge, 2009	UK	Description				51
36	Nail	Nail disorders	Reich & Szepietowsk, 2011	Poland	Description				60
37	Nail	Nail disorder elderly people	Cohen & Scher, 1992	USA	Description				48
38	Skin	Dermatologic disorder	Furue et al., 2011	Japan	Cross-sectional	Data from clinics, hospital	67448 participants who visited dermatology clinics or hospitals for four seasons		
39	Skin	Skin tear, risk factors	Serra, Ielapi, Barbetta, & de Francisci s, 2018	Italy	Review				17/166
40	Skin	Tines pedis, trichophyton	Suzuki, Mano, Furuya, &	Japan	Cross-sectional		71 participants living at nursing	Above 65 years old (IVG)	

			Fujitani, 2017				homes and those living at homes (IVG) 88 adults (CG)		
41	Skin	Onychomycosis (Fungal infection of the nail may cause by a dermatophytes, some yeasts, and mold)[7]	Gupta, 2000	Canada	Description		NA		101
42	Skin	Onychomycosis [8], hemodialysis	Kuvandik et al., 2007	Turkey	Cross-sectional	Observation, microscopic	109 hemodialysis patients	Mean 54.6, SD16.7	
43	Skin	Corns, scalpel debridement	Farndon et al., 2013	Australia	Cross-sectional	Assessment, questionnaires	42 corn plaster group, 51 scalpel group (note stated age) (People with one or more corns)/randomized 202	Mean 58.5 SD15.6 Mean 15.6 SD 17.5	
44	Skin	Corns, scalpel debridement	Landorf et al., 2013	Australia	Randomized trial	Assessment, MatScan, performance test, visual analogue scale	41 participants from the real debridement group 39 participants from the sham debridement group (Patients from clinics or from residents at retirement villages)	Mean 71.8, SD 5.5 Mean 73,3, SD 5.4	
45	Skin	Efficacy of an emollient cream	Martini, Huertas, Turlier, Saint-Martory, & Delarue, 2017	France	Randomized, double-blinded contralateral Vehicle-controlled study	Qualitative and quantitative assessment	54/65 participants with diabetes	18-70, mean 58.3, SD 9.8	

[7] Mitty, E. (2009). Nursing care of the aging foot. *Geriatric Nursing*, *30*(5), 350-354. https://doi.org/10.1016/j.gerinurse.2009.08.004

[8] same as above.

46	Skin	Washing and drying practice skin damage	Voegeli, 2008	US	Experimental cohort study	Trial	15 healthy volunteers	18-65, mean 27.5 SD 10.6	
47	Skin	Type of skin infection	Laube, 2004	UK	Review				57
48	Skin	Keratoses debridement, foot pain, balance, function	Balanowski & Flynn, 2005	UK	Intervention	Visual analogue scale, performance test	19 /21 participants from a podiatry clinic patient cohort	65-84, mean 72, SD 5.6	
49	Skin	Dry skin, long-term care, hospital	Lichterfeld et al., 2016	Germany	Cross-sectional	Assessment	1091 long-term care residents, 619 in-patients	mean 81.6 SD12.3 mean 69.1 SD 17.1	
50	Hallux valgus	Hallux valgus	Nguyen et al., 2010	USA	Cross-sectional	Validated foot exam, questions to participants,	386 women and 214 men from the MOBILIZE Boston Study / 4303	Above 70 years	
51	Hallux valgus	Hallux valgus	Nix, Vicenzino, & Smith, 2012	Australia	Cross-sectional	Questionnaire	30 volunteers with hallux valgus and 30 matched control participants (Community-dwelling people)	20-76, mean 44.4 SD 15.1	
52	Hallux valgus	Hallux valgus, shoe wearing, pain	Menz et. al., 2016b	Australia	Population-based case-control study	Questionnaires	2627 participants registered with four general practices	50-89 mean 65.6 SD 9.9	
53	Hallux valgus	Hallux valgus, lesser toe deformities, plantar soft tissue atrophy	Hannan et al., 2013	USA	Cross-sectional	Validated foot exam by trained examiner	1370/2446 participants from the Flamingo foot study	39-99, mean 66 years	
54	Toe force	Toe grip force, hallux valgus angle	Uritani, Fukumoto, Matsumoto, & Shima, 2015	Japan	Cross-sectional	Measurement with Toe grip dynamometer, etc.	227 community-dwelling people	20-79	
55	Toe force	Toe grip force, handgrip dynamometer	Suwa et al., 2018	Japan	Cross-sectional	Measurement with Toe grip	1390/1410 participants from the	35-59, mean	

						dynamometer, etc.	Toyota Motor Corporation Physical Activity and Fitness Study	48.0, SD 8.1
56	Toe force	Toe grip force, isometric knee extension strength, timed Up-and-Go test	Uritani et al., 2017	Japan	Cross-sectional	Measurement with Toe grip dynamometer, etc.	120 participants with knee OA 108 healthy participants without complaints of knee pain, community dwelling women	69.4 SD 3.6 67.3 SD 3.6
57	Toe force	Toe grip force, electro goniometer, muscular activity	Soma et al., 2016	Japan	Cross-sectional	Measurement with Toe grip dynamometer, etc.	12 healthy women with no known orthopedic impairment	Mean 21.2, SD 0.4
58	Toe force	Toe grip force, toe flexibility, total trajectory length, envelope area, functional reach test, insoles	Nakano et al., 2017	Japan	RCT	Measurement with Toe-grip dynamometer, toe flexibility	28 healthy women	
59	Shoes	Foot length and width, size, sensation, foot pain	Burns, Leese, & McMurdo, 2002	UK	Cross-sectional	Measurement, assessment, visual analogue scale	65 consecutive patients admitted to a rehabilitation ward	46-93, mean 82
60	Shoes	Foot, shoe, footwear, size, fit, length, width,	Buldt & Menz, 2018	Australia	Review			56/1681
61	Shoes	Shoe type, heel height, heel counter height, heel width, critical tipping angle, e.g.	Menz, Morris, & Lord, 2006b	Australia	Cross-sectional	Assessment	176 participants residing in a retirement village	62-96, mean 80.1 SD 6.4
62	Shoes	Foot pain, footwear	Dawson et al., 2002	UK	A pilot case-control study	Interview	127 women (30 cases, 96 controls), participants with osteoarthritis of the knee	50-70

63	Shoes	Frequency checked their feet, sensitivity, foot size, shoe size	López-López,D et al., 2015	Spain	Cross-sectional	Questionnaires	100 participants who attended outpatient clinics	Mean 81,6 SD 8.26
64	Shoes	Foot pain, shoe wear	Dufour et al., 2009	USA	Cross-sectional	Population-based Foot examination	3372/3378 participants from the Framingham Study	36-100, mean 66
65	Shoes	Shoes, foot deformities, foot disease	Palomo-López, P et al., 2017	Spain	Observational study	self-reporting questionnaire	100 participants/117	Mean 74.9 SD 7.01
66	Shoes	shoes size	López-López, D et al., 2016	Spain	Descriptive observational study	Foot health status questionaries, Spanish version	64 participants	Mean 75.3 SD 7.9
67	Socks	Five-toed socks with grippers and ankle bracing, postural control	Shinohara, 2011	USA	Intervention	Test	24 participants with unilateral chronic ankle instability and 24 without unilateral chronic ankle stability	18-30
68	Socks	Non-slip socks, barefoot, conventional socks, backless slippers	Hübscher et al., 2011	Germany	Intervention with randomized balanced order	Test	24 healthy subjects	Mean 29.3, SD10.4
69	Sedentary	Self-reported measurement, device-based measures of sedentary time, descriptive epidemiology of sedentary time	Healy et al., 2011	Australia	Review	Trial		75
70	Sedentary	Thickness of the medial temporal lobe, physical activity, sedentary behavior	Siddarth, Burggren, Eyre, Small, & Merrill, 2018	USA	Cross-sectional		35/49 non-demented middle-aged and older adults	45-75, middle-aged older
71	Sedentary	Television viewing time, walking speed, grip strength	Keevil et al., 2015	UK	Cross-sectional	Health examination,	6086/8623 a third health examination	48-92

						questionnaires	/25639 community-based participants		
72	Sedentary	Glucose, uninterrupted sitting	Dunstan et al., 2012	Australia	Randomized three-period, three-treatment crossover trial	Trial	19/22 overweight or obese adults	45-65, mean 53.8, SD 4.9	
73	Massage	Massage, adverse effect	Ernst, 2003	UK	Review				31
74	Massage	Hand massage, leg swelling	Nakano et al., 2019	Japan	Randomized cross-over study	ECG	12 elderly people mean age 81.9 SD3.9	Mean age 47.5 SD 16.2	
75	Massage	Lymph drainage therapy, connective tissue massage	Ekici et al., 2009	Turkey	Randomized cross-over study	Visual analogue scale, questionnaires, health profile	25 manual lymph drainage therapy, 25 connective tissue massage, female patients with fibromyalgia	At least 25 years old	
76	Foot care knowledge and practice	Questionnaires, photographs showing nails	Turner & Quine, 1996	Australia	Cross-sectional	Questionnaires	132 (RNs, enrolled nurses, assisting in nursing)	72% were 36 years or older	
77	Foot care knowledge and practice	Assessment, foot health, foot self-care, home care, nursing	Stolt et al., 2012	Finland	Descriptive explorative design	Assessment	309 older people	65-101, mean age 83.4, SD 6.82	
78	Foot care knowledge and practice	Nurses' knowledge of foot care	Stolt et al., 2015	Finland	Cross-sectional	Questionnaires	322/651 (RN Public health nurses, LPNs)	19-62, mean age 41	
79	Foot care knowledge and practice	Foot care activities questionnaires	Stolt et al., 2013a	Finland	Cross-sectional	Questionnaires	322/651 (RN Public health nurses, LPNs)		
80	Foot care knowledge and practice	Foot, perception	López-López, et al., 2017	Spain	Cross-sectional	Standard clinical exam, patient's self-reporting data	282 participants	mean 39.46 SD 16.026	

81	Foot care knowledge and practice	Nurse Information Format, Nurses' Knowledge level	Kaya & Karaca., 2018	Turkey	Cross-sectional	Questionnaire	435/540 RNs	18-44. mean age 26.37, SD 4.8
82	Foot care knowledge and practice	Nurse, diabetes, preparation, diabetes	Aalaa, Malazy, Sanjari, Peimani, & Mohajeri-Tehrani., 2012	Iran	Review			81
83	Foot care knowledge and practice	Foot-care knowledge, behavior, diabetes	Li et al., 2014	China	Cross-sectional	Questionnaires	5961/6043 participants with type 2 diabetes	16-94 mean 59.50 SD12.48
84	Foot care knowledge and practice	Knowledge, perception	Pierson, 1991	USA	Cross-sectional		180 RNs (hospital, home health, extended care facilities)	
85	Foot care knowledge and practice	Knowledge, practice, foot care, diabetes	Pollock, Unwin, & Connolly, 2004	UK	Cross-sectional	Questionnaires	365/550 participants with diabetes	18-94, mean 62.3
86	Foot psychology	Foot care, confidence, diabetes	Perrin, Swerissen, & Payne, 2009	Australia	Cross-sectional, descriptive investigation	Questionnaires	55 participants with diabetes	51-90
87	Foot psychology	Barrier of foot care	Guell & Unwin, 2015		Qualitative study	Semi-structured interviews	9 participants with diabetes and 10 health care professionals	Age not stated
88	Foot psychology	Foot complaints, morbidity	Gorter, Kuyvenhoven, & de Melker, 2000	Netherlands	Cross-sectional	Questionnaires	5689/7200 participants with type 2 diabetes	65 years or older
89	Foot psychology	Diabetes, risk perception, amputation	Scollan-Koliopoulos, Walker, & Bleich, 2010	USA	Cross-sectional descriptive	Questionnaires	70 adult volunteers with type 2 diabetes	61% over age of 60

90	Foot psychology	Diabetes foot ulcer, wound healing	Itani, Gandoura, Ahmed, & Ahmad, 2015	UAE	Descriptive			52
91	Foot psychology	Nail, disorder, SF 36, Skin dex-29 social functioning scale	Tabolli et al., 2007	Italy	Cross-sectional	Questionnaires	111/114 patients with nail disorders	Mean men: 48 SD15 women: 49 SD 14
92	Foot psychology	Foot ulcer, depression, podiatry clinics	Pearson, Nash, & Ireland, 2014	Australia	Cross-sectional	Questionnaires	60 participants with diabetes and one or more-foot ulcers	18 years older
93	Foot self-report	Foot problem, the Foot Health Status Questionnaire (FHSQ)	López-López et al., 2018	Spain	Cross-sectional	Foot Health Status Questionnaire (FHSQ)	1647 participants with foot problems	18-96 Mean 43.24 SD 19.89
94	Foot self-report	Foot self-care	Miikkola, Lantta, Suhonen, & Stolt, 2019	Finland	Qualitative descriptive design	Focus group interview	17 participants living in their own home	65 years older
95	Foot self-report	Foot and leg problems, functional status	Barr, Browning, Lord, Menz, & Kendig, 2005	Australia	Cross-sectional	A structured interview and brief physical examination	533 females, 467 males	65-9, mean 73.4, SD 5.87
96	Foot health Review	Diabetic foot, developing country	Ramachandran, 2004	India	Description			17
97	Foot health Review	Podiatry, education, developing countries	Tulley, Foster, van Putten, Urbancic-Rovan, & Bakker, 2009	International Research	Description	N/A		9
98	Foot health Review	Foot health, healthcare, intervention	Stolt Gattinger, Böstrom, & Suhonen, 2019	Finland	A scoping of review			36/762
99	Foot health Review	Foot health problem, foot care, knowledge	Stolt, Suhonen, Voutilain	Finland	Review			35/1537

			en, & Leino-Kilpi, 2010				
100	Foot health Review	Podiatry, foot pain, falls	Wylie et al., 2019	UK	Systematic review		9/35857 tiles and 5201 screened abstracts

NOTE: SD: standard deviation – abbreviations: HD, hemodialysis, OA, osteoarthritis; RA, rheumatoid arthritis; ECG, electrocardiogram; CRF, chronic renal failure, LPN, licensed practical nurse; PAD: peripheral artery disease; IVG, intervention group

Table 2-2: Intervention to enhance the knowledge and practice of foot care

	Participants: patients or clients	Country and author	Type of study	Method of intervention	Type of tools used	Analyzed number of participants	Outcome
1		Singapore (Carter, Cheung, Rome, Santosa, & Lahiri, 2017)	Intervention	Revision of workflows, patient empowerment, clinical practical guidelines	Patient information leaflet	655 participants with inflammatory arthritis	Referral rate increased from 8 to 11%
2		China (Ren et al., 2014)	Cohort	Individual education, instruction on podiatric care	Not mentioned	185 patients with diabetes with a high risk for foot diseases (mean 60.23, SD 8.77)	Significantly improved in IVG
3		Japan (Fujii., 2019)	Quasi-experimental study	Medical foot care, foot hygiene, five-toe socks	A foot bath, foot file, nail file, nail clipper, grinder, and five-toe socks	(IVG 1) 6 medical foot care (80.2 SD 7.5), (IVG2) 6 combined foot care (86.8 SD 3.6), (CG) 6 (86.6 SD 4.5)	Right foot toe-gap force improved in medical foot care group
4		Canada (Fan, Sidani, Cooper-Brathwaite, & Metcalfe, 2013)	One group-repeated measures	A 1-hour 1-on-1 provider-patient interaction, 1-hour hands-on practice of strategies, two 10-minute telephone contacts	Foot assessment form, telephone	56 type 2 diabetes patients with a low risk of foot ulceration (mean 55.8, SD 13.2)	Effective
5		Iran (Seyyedrasooli et al., 2015)	RCT	Attending a training program consisting of three sessions (individual training group and collective control group)	Foot-care self-efficacy questionnaires (Evaluation) *Tools are not stated	50 participants in individual training, 50 in group training, 50 CG with type 1 and type 2 diabetes (18 years or older)	Comparison scores increased but there were no significant references
6		USA (Hunt, Sanderson, & Ellison, 2014)	A two-group crossover, repeated measures	(IV) Given an Apple iPad device and instructions on using a diabetes self-management application to log behaviors and how to email logs to	iPad	17 participants with type 2 diabetes (19 years or older)	No differences in self-care scores between groups

			the primary investigator.			
7	Switzerland (Keller-Senn, Probst, Mahrer-Imhof, & Imhof, 2015)	RCT	Educational sessions based on nurses' best practice guidelines	Three specially developed brochures, a foot care kit with foot care materials, and a foot care diary	(IVG) 8 (CG) 11 diabetes, (44-84)	Foot Care Confidence Scale scores higher in IVG
8	USA (Borges & Ostwald, 2008)	RCT	A brief 15-min foot self-care intervention and a follow-up one-month visit	Pictorial form, foot care kit (a basin, a gallon of water, soap, a hand towel, a washcloth, an emery board, a lotion, and a mirror)	(IVG)55, Risk assessment (55), CG (57) participants with a diagnosis of type 2 diabetes	Significant difference in observed foot self-care between group
9	UK (Donohoe et al., 2000)	RCT	Explanatory practice visit, education of the whole primary care team	The Semmes Weinstein monofilament, standard foot care leaflets	(IVG) 981 (18.7-95.8, mean 66.7) (CG) 958 (18-93.6, mean 64.8) Initial total sample, 2028	Knowledge score improved in IVG
10	Japan (Yamashita et al., 2019)	RCT	Foot technicians provided foot and toenail care	The measurement results, feedback paper	(IVG) 74 participants with foot problem, (CG) 106 in good health (mean 80.3 SD 7.5)	Care of the feet and toenails can improve lower-limb muscle strength
11	Japan (Imai, Takayama, Satoh, Katoh, & Yokozeki, 2011)	IV	Medical foot care	Cotton packing, grinder	263 (21-85, mean age 49.7, SD 18.8) with great toe problems and volunteers	Improvement in IVG
12	Vietnam (Nguyen, Edwards, Do, & Finlayson, 2019)	Quasi-experimental study	Small group intensive education hands-on skills session	Foot care kit, phone call	(IVG) 59, (CG) 60, with type 2 diabetes at low risk of developing a foot ulcer (mean 62.22, SD 9.33) (initial sample size 175)	Significant improvement in IV
13	Australia (Spink et al., 2011)	RCT	Multifaceted podiatry intervention	Foot orthoses, advice about and provision of footwear, daily diary, a booklet	(IVG) 153, (CG) 152 with disabling foot pain, above 65 years	Significant improvement in IV

14	Jordan (Hassan, 2017)	Pre-test/post-test design	A 1-hour instructional program, 4 text messages per week (12-week interval)	Mobile phone	225 patients who attended a public diabetic clinic (about 20 years old)	Significant gain in knowledge of foot care practices
15	Australia (Mickle, Caputi, Potter, & Steele, 2016)	RCT	45 min group-exercise classes each week for 12 weeks, the home-exercise group received a booklet	Exercise program run by an accredited exercise physiologist, a booklet containing a series of eight general foot exercises	(IVG 1) 43 participants doing progressive resistance training (mean 70.6, SD 5.6), (IVG 2) 42 participants doing home-based exercise (mean 69.5, SD 6.0), 32 (CG) participants living independently in the community (mean 68.3, SD 5.3)	Progressive resistance improved toe strength
16	Malaysia (Ahmad Sharoni, Abdul Rahman, Minhat, Shariff-Ghazali, & Azman Ong, 2018)	RCT	Educational program	A PowerPoint presentation, a pamphlet, a checklist reminder, a manual file, a foot care kit, and goodies	(IVG) 38 (mean 70.13, SD 7.73), (CG) 38 (mean 69.30, SD 7.38) with diabetes, presented with or without diabetic foot problems	Improved foot self-care behavior
Participants: nurses, doctors, nursing assistants	Country	Type of study	Method of intervention	Type of tools used	Participants (number of participants age, type of participant if stated/initial number if stated)	Outcome
17	Intervention to enhance knowledge and practice of foot care	India, Bangladesh, Sri Lanka, Nepal, and Tanzania (Pendsey & Abbas, 2007)	Quasi-experimental study	2-day basic practical training program in 2004, 2-day advanced course in 2005	Educational materials, books on diabetic foot, video and CDs, special diagnostic and therapeutic information kits, sweet limbs to imitate diabetic foot	115 teams of doctors and nurses	900 lower limbs and 1943 limbs were saved in the first and second years, respectively

18	USA (Christensen et al., 1990)	IVC	In-service educational program	Knowledge assessments, chart audit, clinical practice evaluation	23 registered nurses (22-51, mean 32.8)	91 % of nurses reported that their foot assessment and care practices had changed
19	England (Mackie, 2006)	Quasi-experimental study	1-hour session	PowerPoint presentation, handout of presentation, monofilament, Doppler	15/18 district nurses	Favorable evaluation
20	England (Jones & Gorman, 2004)	Quasi-experimental study	Two-days training		(IVG) 41, (CG) 40 (56 nurses and 25 podiatrists)	Mean score increased in IV
21	Norway (Kolltveit et al., 2016)	RCT	Interactive telemedicine platform with a web	Mobile phone	29 nurses, 1 nurse assistant, 1 podiatrist, and 2 physicians	More knowledge, better assessment and confidence
22	Switzerland (Pataky et al., 2007)	IV	Consultation	Structured educational program	236 Health care providers (doctor, nurses, nursing aids, other HCPs)	Significant improvement in knowledge
23	Hong Kong (Chan et al., 2012)	Pre-test/post-test with a non-equivalent group design	IVG: foot and toenail care by nurses and health care assistants CG: 2-hour training workshop at discharge	Foot and toenail assessment checklist	the staffs were trained for foot and toe nail care intervention, however, number of trained staff are not stated. The participants number was stated as follow (IVG) 78, (CG) 72 at a geriatric rehabilitation ward of an acute general hospital (65-97, mean 78.9, SD 7.6)	
24	Egypt (Waheida, Elshemy, & Basal, 2015)	Quasi-experimental study	Nursing teaching programs, 24 sessions	Sociodemographic and knowledge assessment structure questionnaires, observational checklist for nurses' practices about neurovascular assessment for diabetic patients	30 nurses (mean 35, SD 13), 40 patients (mean 50, SD 10)	Improvement in knowledge and practice

NOTE: CG: Control Group, the number of participants were the final numbers; IVG: intervention group; RCT: randomized controlled trial; SD: standard deviation; HCP, health care provider; RCT, randomized control trial; IV, intervention study

NOTE for NO 23. the training regarding foot and toe nail interventions were delivered to all ward staffs (nurses and care assistants)

Table 2-3 The list of foot instruments

	Items	Focused items	Author	Country	Design	Analyzed number of participants/initial sample sized if stated, (age ranged, mean age, if stated) or manuscript
1	Scales	Summary of Diabetes Self-Care Activities	Toobert, Hampson, & Glasgow, 2000	USA	Review	7 studies involving 1988 patients
2	Scales	Foot Care Confidence Scale	Sloan, 2002	Brazil	Validity study	122 community-dwelling older adults
3	Scales	Diabetes foot self-care behavior scales	Chin & Huang, 2013	China	Cross-sectional	295 diabetes patients (mean, 66.93, SD 11.05)
4	Scales	Validation of a new measure of protective foot care behavior: the Nottingham Assessment of Functional Foot Care	Lincoln, Jeffcoate, Ince, Smith, & Radford, 2007	UK	Validity and reliability study of the development of the scale	Test1:100/137 out-patients with diabetes 61 healthy controls (mean 57, SD 17.1) Test 2 :71/100 with diabetes (mean 65.4, SD 12.5)
5	Scales	Validity of the Foot Health Status Questionaries	Bennett et al., 1998	Spain	Validity study	111 volunteer from podiatric clinic (mean 54, SD 20)
6	Scales	Development process for psychometric testing instrument	Stolt et al., 2013b	Finland	Cross-sectional methodological design	309/ 651 visiting home nurses (mean 41, SD 11)
7	Tool	Neuropathy symptom score, neuropathy disability score, vibration perception threshold, Semmes Weinstein monofilaments	Pham et al., 2000	USA	Prospective study	175 Non-ulcerated foot (mean 58, SD 13), 73 ulcerated foot (mean 59, SD 11) patients at large diabetic foot centers
8	Tool	3-minute diabetic foot exam	Miller et al., 2014	UK	Description	N/A
9	Tool	Radiographic validation, Manchester scale	Menz & Munteanu, 2005	Australia	Validation study	95 (mean 78.6, SD 6.5)
10	Tool	The 60-second foot exam	McDonald, Shah, & Wallace., 2013	Canada	Pre-post survey	25/55 medical students, family medicine residents

11	Tool	Ipswich Touch Test	Rayman et al., 2011	UK	Respective performance study	at-risk feet 265 individuals
12	Useful information associated with foot item	The 60-second foot exam	Inlow, 2004	Canada	Description	
13	Useful information associated with foot item	Ipswich touch test	Sharma, Kerry, Atkins, & Rayman, 2014	UK	Short report	331 participants with diabetes
14	Useful information associated with foot item	Diabetic mellitus, mortality, diabetic foot	Scain, Franzen, & Hirakata, 2018	Brazil	Retrospective longitudinal study	918 medical records of convenient samples
15	Useful information associated with foot item	Foot health, characteristics	Campbell, 2006	UK	Cross-sectional	1202/5000 patients (65 years and older who were discharged from podiatry services)

Note: The table include articles related to development process of instrument of foot assessment or assessment methods.

Table 2-4: The structure of foot care intervention program in selected literatures overseas

NO	Country	FOOT CARE PROGRAM INTERVENTION
1	Iran	Group or individual training group to enhance knowledge
2	Egypt	Self-care program with small group and foot care kit
3	Italy	Two-hour program provided to groups of 5-7 patients, 30-minute face-to-face lessons and 90-minute session with practice
4	Malaysia	Health education program with group seminar
5	Canada	1 hour 1-on-1 interaction, hands-on practice, telephone
6	Jordan	1-hour instructional program
7	Switzerland	1-hour weekly educational session and foot care kit
8	The Netherlands	Physical exercise and educational program
9	Singapore	A 6-month quality improvement program
10	Australia	90-min educational program in group 7-12

Note: Details is also shown in Table 2-2

Table 2-5: Methods of foot care education

Delivery methods of foot care education	Contents of foot care education for daily are	examples of foot care kit as tools of education.	Delivery of foot care education that works on cognitive behavior
Sessions with a small group (4 to 5 people)	Foot hygiene and cleanliness	Nail clipper	Awareness of risk factors for foot complications
Both individual and group sessions	Moisturizing	Lotion	Importance of thorough annual examination of feet by a health professional
Face-to-face interactive teaching	Massaging foot and foot exercise	Towel	Prevention of foot-related complications
Telephone contact booster session	Wearing proper shoes and socks	Reminder check list	Inspecting foot for problems
PowerPoint presentation (PPT) oral and visual information	Toe nail care	Foot care diary	When to seek help from a healthcare professional
Pamphlets (written and visual information)	Foot protection	Moisturizing cream	Awareness of risk factors for foot complications
Foot care bag or kits	Usage of useful products	Small mirror	Importance of thorough annual examination of feet by a health professional

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CHAPTER 3

Foot care knowledge and practices among Japanese nurses and care workers at in-home care and adult service center: A cross-sectional study

CHAPTER 3

Abstract

Background: Foot care knowledge and practices among nurses and care workers in the community greatly impact foot health maintenance and prevention of foot-related problems among older people. This study aimed to explore and examine the current foot care knowledge, practices, and perceptions among nurses and care workers at home care and adult day service center, along with their demographic characteristics and daily care for clients.

Methods: This study analyzed 232 randomly selected front-line nurses and care workers working at home care or adult day service center in one of the selected cities, Aichi Prefecture, Japan. Data were obtained using questionnaires and subsequently analyzed using descriptive statistics, t-tests, Chi-square tests, Wilcoxon rank-sum tests, and Spearman's rank correlation tests.

Results: Among the 305 surveyed, 232 (62 nurses; 170 care workers) provided data. Although 57 nurses (91.9%) and 142 care workers (83.5%) showed interest in foot care, 33 nurses (53.2%) and 133 care workers (78.2%) stated that foot care education was insufficient. Knowledge and practice scores were associated with working status. Higher accuracy differences in the early detection of foot problems and skin tears on lower limbs in knowledge category were observed between nurses and care workers. The nurses as well as the care workers had low accuracy rates of knowledge questions regarding the use of shoes and socks subscale.

For practice, both nurses and care workers had low mean scores for checking client's shoes (2.0/5.0 and 2.1/5.0, respectively), method for reducing ingrown nail pain (2.6/5.0 and 1.9/5.0, respectively), and opportunity for discussing foot care with others (2.7/5.0 and 2.2/5.0, respectively). A significant correlation between knowledge and practice scores was observed among nurses (0.331, $p < 0.05$) and care workers (0.339, $p < 0.001$).

Conclusions: Despite the presence of several barriers toward enhanced care delivery to clients needing it most, nurses and care workers clearly understood the importance of foot care. These findings indicate that foot care should be focused on by nurses and care workers to improve the knowledge and practice of foot care and to suggest future implications that efficient and understandable tools are needed considering their current working situation.

Keywords: foot care, knowledge, practice, nurse, care worker.

CHAPTER 3

3.1. Background

As the population worldwide continues to rapidly age (World Bank Group, 2018), growing demands and expanding costs for health care, particularly for geriatric care, have been greatly concerning for many countries. To reduce elderly care expenditure and hospital loading in Japan, the Japanese government has promoted the use of home health care services (Japanese nursing assocation, n.d). Studies have shown an increasing trend in the number of older people receiving home care services (MHLW 2016), with nurses and care workers playing a key role in maintaining the health of older individuals at home or within a community.

Foot problems have been one of the most prevalent concerns among older individuals. As the body ages, structural, functional, and physiological changes within the circulatory, skeletal, nervous, and dermatological systems can cause a range of foot problems, including toe nail problems, toe deformities, corns, calluses, fungal infections, cracks, fissures, macerations, and edema (Dunn et al., 2004). These conditions can lead to foot pain (Garrow, Silman, & Macfarlane, 2004), which has been associated with reduced mobility and balance and increased risk for gait disorders, falls, and depression (Awale, Dufour, Katz, Menz, & Hannan, 2016; Dawson et al., 2002; Hawke & Burns, 2009; Menz et al., 2013; Menz & Lord, 2001) Many older people are frail and live alone with limited access to medical care. Moreover, reduced vision, physical function, and manual dexterity (Stolt et al., 2013), muscle alternations (Volpi, Nazemi, & Fujita, 2004), are some of the factors that inhibit their ability for foot self-care. Abdullah and Abbas (Abdullah & Abbas, 2011) stated that nail problems are common among older adults and are often overlooked by primary caregivers despite their various physical and physiological characteristics.

The increasing number of older people within communities throughout Japan provides greater opportunities for nursing care at home, at day care service centers, or at day care centers offering rehabilitation. Japan has two insurance programs that allow older people access to medical or nursing care (Appendix A) according to their condition (i.e., some are vulnerable and bedridden, while others have good health). After matching procedural demand and supply, older people subsequently receive the necessary medical or physical care, as well as assistance with activities of daily living, from nurses and care workers providing home care services (MHLW, 2013). Both nurses and care workers have equally high opportunities for physical contact with older individuals. Moreover, care workers' subjective observations regarding the client's physical and emotional condition are often shared with nurses and care managers in

Japan. Previous studies in other countries have investigated nursing assistants' detection of early signs of infection or acute or chronic illness in nursing homes (Boockvar, Brodie, & Lachs, 2000; Haugstvedt, Aarflot, Igland, Landbakk, & Graue, 2016; Tingström et al., 2015; Tingström, Milberg, & Sund-Levander, 2010). Thus, both nurses and care workers function autonomously in detecting foot problems, making decisions regarding foot care, and reporting to other health care professionals.

Foot problems have been widely studied internationally. However, literature regarding foot conditions and foot care has predominantly focused on diabetes (Stolt et al., 2015), while limited studies have been available on foot care knowledge, practices, and perceptions among nurses and care workers in home or community settings. Considering that podiatry is not considered as a specialty in Japan, foot care knowledge and skills can be obtained at private schools that charge relatively high tuition fees. Moreover, the lack of foot care education within the academic curriculum may lead to insufficient foot care knowledge and practices among nurses and care workers. The present study aimed to explore and examine the current knowledge, practices, and perceptions among nurses and care workers at in-home service providers, along with their demographic characteristics and daily number of clients. This survey can serve as a reference for the future development of more effective foot care tools for nurses and care workers in home or community settings. The present study hypothesizes the following:

1. Both nurses and care workers show interest in learning foot care but may perceive to have insufficient education on and time for foot care and display a lack of confidence in the same.

2. No significant differences in foot care knowledge and practices exist between nurses and care workers regardless of working status or experiences due to the fundamental lack of foot care education in Japan.

3. Nurses obtain and demonstrate better foot care knowledge and practices related to vascular, neurologic, and skin disorders compared to care workers due to differences in educational curriculum.

3.2. Methods

3.2.1. Research design

This was a cross-sectional study using random cluster sampling. Target participants comprised nurses and care workers from 35 different in-home service providers in one of the selected cities, Aichi Prefecture, Japan. Data were collected from

July to August 2019.

3.2.2. Instruments

Data were collected via questionnaires called *Kashiko XJP*, which were developed specifically for nurses and care workers included in this study. The questionnaires consisted of the following: (1) questions on demographic characteristics, daily number of clients or number of clients with foot problems, and perceptions regarding foot care; (2) 30 questions on foot care knowledge; and (3) 20 questions on foot care practices.

3.2.3. Sampling and participants

In Japan, the qualification of nurses are as follows: Registered nurse (RN) and licensed practical nurse (LPN). Both RN and LPN are medical professions that provide medical treatment and assist in examination. The major differences in RN and LPN are in terms of the place that issues the qualification, and the qualification requirements. The license for a registered nurse is given by the Minster of Health, Labor and Welfare, whereas that for a LPN is given by the Prefectural Governor. According to the Act on Public Health Nurses, Midwives and Nurse, Article 5[9], LPNs perform their job under the direction of a physician, dentist, or nurse.

As of 2018 (survey in 2017), there are 147,827 nurses and 747,370 care workers working at home care and adult day service centers in Japan. (taken from data set of MHLW, 2018). This study targeted nurses and care workers working at centers providing home care, home nursing, adult day care centers including day care services, or day care services with rehabilitation. Registered nurse (RN), licensed practical nurse (LPN), certified care workers, and noncertified care workers with different types of qualifications were included. In Japan, the term of “Assistant nurse” is used in accordance to the Japanese law translation (Ministry of Justice., 2020) in place of "LPN". The job contents of Assistant nurse and LPN are similar because they are nurses but not registered nurses. In this paper, the term “LPN” is used since "LPN" is well known in overseas. However, the job profile of “Assistant nurse” in Japan might slightly differ from that of “LPN” defined by the United States of America.

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[9] Ministry of Justice.(2020). Japanese law Translation. Act on Public Health Nurses, Midwives, and Nurses. Retrieved from July 15, 2020 from http://www.japaneselawtranslation.go.jp/law/detail/?id=2075&vm=04&re=01

Care workers were not allowed to provide medical conduct. They provided nursing services such as assisting in oral care, bathing, eating, going to the toilet, e.g., to sustain the daily needs of clients at facilities. The care workers include Certified Care Workers who are qualified after having passed the certified care workers examination and noncertified care workers. Many noncertified care workers have a certificate of novice training or practitioner training. The major differences between certified and noncertified care workers are the contents and duration of training they have undergone to achieve the national certification. Their tasks are similar; however, certified care workers have more tasks of consultation or providing instruction to clients and their family. Details of Acts of LPN (assistant nurse) and Certified Care Workers were cited in Appendix F.

Other countries identify care workers as “nursing assistants” nursing aides (Haugstvedt, Aarflot, Igland, Landbakk, & Graue, 2016; Tingström et al., 2015). The sample size was calculated based on a 95% confidence interval and 5% margin of error using a sample size chart. Accordingly, an initial sample size of 530 nurses and care workers was targeted with a nurse/care worker ratio of 20%/80% (1:4) and a 10% participant rejection rate. The inclusion criteria were nurses and care workers who (1) worked part time or full time, (2) provided physical care, including but not limited to walking assistance, diaper changing, bathing assistance, exercise promotion, and oral care assistance, and (3) worked for centers that never participated in any other foot care programs besides the current study. MHLW provided a list of in-home service providers in one of the selected cities, Aichi Prefecture, Japan, among which 350 centers were initially randomly selected via computer for our study. An invitation mail and a postcard with a check box indicating the level of willingness to participate in the survey and the number of possible participants in each center were sent to all randomly selected centers. However, the target number of replies was not reached. Thus, 100 day care service centers were added using the same methodology. Overall, postcards from 78 centers were returned, among which 46 were willing to participate in the study and indicated the possible number of study participants. After confirming participation via telephone and personal visit by the main author (KF), questionnaires were sent to the 46 centers (305 nurses and care workers). Among the 305 nurses and care workers who had received questionnaires, 232 (76%) from 35 centers responded with written approval (62 nurses and 170 care workers) (Table 3-1).

Table 3-1: Number and type of providers contacted and replies received

Provider type	Number of centers contacted	Questionnaires sent	Questionnaires returned	Collection rate
Day care service centers	370	36	25	69%
Day care centers offering rehabilitation	30	2	2	100%
Home nursing centers	20	6	6	100%
Home care centers	30	2	2	100%
Total number of centers	450	46	35	76%

Note: Author sent questionnaires after confirming participation via telephone and personal visit. Therefore, collection rate was quite high.

3.2.4. Development of foot care knowledge and practice questionnaires

The questionnaires used herein were developed in Japan and were initially based on foot care knowledge and practice questionnaires for nurses in Finland (Stolt et al., 2013; Stolt et al., 2015). However, given the inclusion of care workers in the present study and the geographical differences in the standards of care between Japan and Finland, modifications to these questionnaires were required in order to address the purpose of this study. Therefore, a new questionnaire was developed utilizing three phases.

Phase 1: draft creation

The item pool (Table 3-2) and subscales for the draft questionnaires were created based on a thorough literature review of 339 studies. Personal face-to-face contact or e-mail correspondence with foot researchers, including a foot care specialist (IY), and the main author's (KF) clinical experiences in nursing and foot care also contributed to the creation of the draft. Draft questionnaires consisted of 51 questions on knowledge covering seven subscales (Nail, Skin, Vascular and Neurologic Disorder, Toe and Arch, Infection, Shoes and Socks, and Sedentary Behavior) with three possible answers (yes,

1 point; no, 0 points; and I do not know, 0 points) and 45 questions on practices covering six subscales (Skin Assessment, Nail, Skin, Hygiene, Movement and Toe Exercise, and Consultation) with five possible answers (strongly relevant, 5 points; more relevant, 4 points; neutral, 3 points; less relevant, 2 points; and not relevant, 1 point). Other specific questions included demographic characteristics [age, sex, profession, part-time or full-time employment, working experience in the current profession, working experience in the current center (this question was later removed)], the daily number of clients, number of clients with foot problems in the previous month, and perceptions regarding foot care (interest in foot care, impression on the current foot care education, confidence in foot care, source of foot care knowledge, opinion on foot care manuals, sufficient time for foot care, willingness to learn more about foot care, and self-use of toe socks).

Table 3-2: Item pool for draft questionnaires

Foot care guidelines by the Ministry of Health, Labor and Welfare
Checking physical conditions (e.g., blood pressure, pulse) before starting foot measurements and exercises
Morphological, functional, and physiological structures and roles of the toe, foot, and leg, demographic and social changes in Japan
Fall risks at home
Type of foot problem
Toenail problems
Foot skin problems
Foot vascular problems and assessment
Foot neurologic problems and assessment
Diseases causing foot problems
Difference between corns and calluses and how to find the difference via assessment
Foot skin and toenail fungus
Characteristics of body change anatomical changes among elderly individuals
Foot skin conditions among elderly individuals
Influence of sedentary behavior on the body
Foot muscles and capillaries
Influence of shoes and socks on toe and foot problems
Selection of shoes and socks
Types of foot massage
Sitting and standing posture
Foot hygiene
Procedures for nail cutting with nail filing
Reducing corns and calluses through foot filing
Appropriate procedure for nail cutting
Cotton packing to reduce ingrown nail pain
Taping to reduce ingrown nail pain
Locating the posterior tibial artery of the foot
Identifying neurologic impediments
Infection control
Toe and foot exercises
Ointment application
Consultation and referral to doctors or other health professionals

Phase 2: Content validity

Four experts, including a nurse researcher, a previously contacted foot care specialist (IY), and two researchers specializing in toe movement, as well as two nurses and a care worker with field experience, were contacted to review the draft questionnaires and provide their opinion regarding the usability and necessary adjustments at this stage. The validity of draft questionnaires was evaluated using two processes. Firstly, questionnaires were mailed to eight experts and hand-delivered to one expert for evaluation using the Content Validity Index (CVI), an internationally recognized scale and the most widely used approach for assessing content validity (Zamanzadeh et al., 2015). These experts included a foot care specialist (n = 1), nurses with extensive foot care experience (n = 3), a nursing academic researcher (n = 1), physical therapists specializing in foot and toe therapy (n = 2), a surgeon with extensive knowledge on foot physiology (n = 1), and a doctor with extensive knowledge on wound care (n = 1). Secondly, a panel of experts consisting of a surgeon, three nurse researchers with expertise in foot research, a foot care specialist, and a nurse with foot care expertise, discussed the clarity, wording, relevance, and necessity of each question. During panel discussions, the mean CVI scores provided by the nine experts who initially evaluated the questionnaires were used as reference. After further refinement, the questionnaires included 33 questions on foot care knowledge and 25 on foot care practices, along with 16 other specific questions regarding demographic characteristics, daily number of clients, and perceptions regarding foot care.

Phase 3: Pilot study

A pilot study was conducted among 100 nurses and care workers from in-home service providers and geriatric facilities excluding hospitals, among whom 87% and 73% responded to knowledge and practice questions, respectively. Their answers were subsequently analyzed using SPSS 24 (SPSS Inc, Chicago, IL) to determine their validity and reliability. Descriptive statistics was used to describe data characteristics and questionnaire scores. Questions regarding knowledge were then thoroughly reviewed based on accuracy rates. Five questions on practices demonstrated the ceiling effect and were thus removed. Cronbach's alpha values, which were calculated to evaluate internal consistency, were between 0.5 and 0.7, with 0.70 being considered an acceptable value. However, acceptable Cronbach's alpha values vary between researchers (Taber, 2018). Thereafter, the final format of the self-administrated questionnaires, which consisted of 50 questions on knowledge (30 questions across

seven subscales) and practices (20 questions across six subscales) along with 15 questions on demographic characteristics, daily number of clients, and perceptions regarding foot care, was established.

3.2.5. Data analysis

Data were recorded by two separate teams working simultaneously with the same information without being observed by the researchers using an outsourcing company. Data were then categorized into two groups, nurses and care workers, and subsequently analyzed using SPSS 24. Descriptive statistics, Chi-square tests, and the Wilcoxon rank-sum test were utilized for data analysis. Content validity was analyzed using the ceiling effect with means ± standard deviations (SDs), while reliability was analyzed by calculating Cronbach's alpha values. Spearman's rank correlation was used to determine the correlation (1) between knowledge and practice scores and gender, working experience in the current profession, and number of clients cared for per day and (2) between knowledge scores and practice scores. The association between age and working status and knowledge and practice scores was analyzed using Student's t-test.

3.3. RESULTS

3.3.1. Demographic characteristics, daily number of clients, and perceptions on foot care

Among the 232 respondents, (52 RNs, 10 LPNs, 98 certified care workers, and 72 noncertified care workers with different types of qualifications), 225 were ultimately analyzed after excluding two nurses and five care workers for non-response to questions (Figure 3-1).

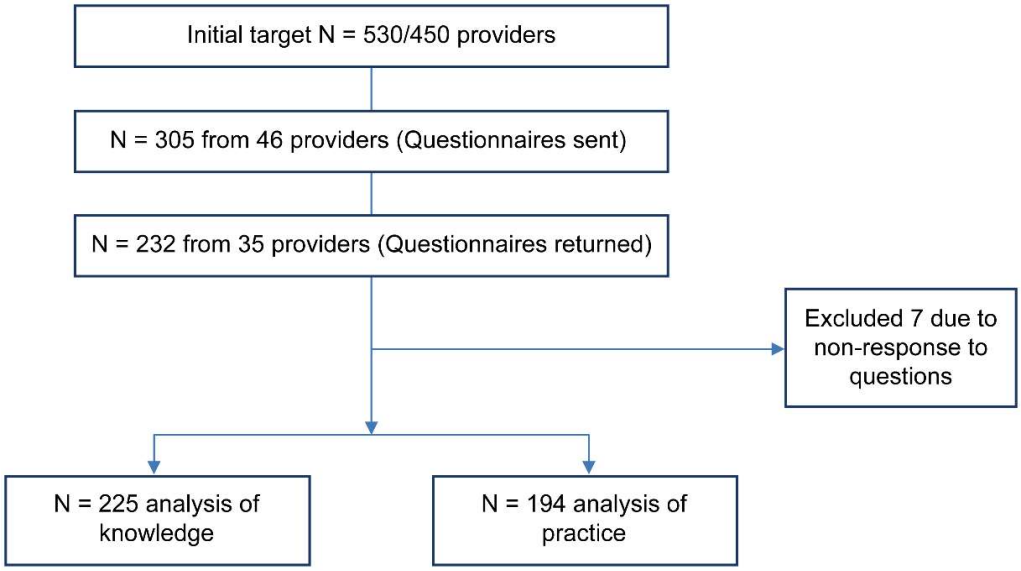

Figure 3-1: Trial profile

Effect size was calculated using EZR for both knowledge and practice:

Formula

$$\frac{(\text{mean scores for nurses} - \text{mean scores for care workers})}{(\text{SD for nurses} + \text{SD for care workers})/2}$$

The number of nurses and care workers used in the formula included those who answered all questions. Although an effect size of 0.6 was calculated, a statistical power of 0.95 was obtained. Therefore, the final number of participants (225) was acceptable despite the initial target being 530.

The ratio between nurses and care workers was 1:3, which was quite close to the initially targeted ratio of 1:4. Complete results for demographic characteristics, daily number of clients, and perceptions regarding foot care are presented in Tables 3 and 4.

Nurses and care workers had a mean age of 51.2 (SD 12.2) and 47.8 (SD 11.6) years, respectively. Nurses and care workers provided care to a mean of 7.9 (SD 8.3) and 9.5 (SD 11.6) clients with foot problems in the last month, respectively (Table 3-4). Moreover, 34 (54.8%) and 28 (45.2%) nurses worked part time and full time, while 64 (37.3%) and 106 (62.7%) care workers worked part time and full time, respectively (Table 3-3).

Table 3-3: Demographic characteristics, daily number of clients, and perceptions on foot care

N = 232

Items	Category	Nurses (n = 62) n (%)	Care workers (n = 170) n (%)	*p* value
Sex	Male	2 (1.6)	29 (17.1)	0.002**
	Female	60 (98.4)	141 (82.9)	
Profession	Registered nurses	52 (83.9)	N/A	0.000***
	Licensed practical nurses	10 (16.1)	N/A	
	Certified care workers	N/A	98 (57.6)	
	Noncertified care workers	N/A	72 (42.4)	
Work status	Part time	34 (54.8)	64 (37.3)	0.017*
	Full time	28 (45.2)	106 (62.7)	
Number of clients cared for per day	1–5	29 (46.8)	14 (8.4)	0.000***
	6–10	7 (11.3)	37 (22.2)	
	11–20	13 (21.0)	53 (31.7)	
	21–30	10 (16.1)	34 (20.4)	
	31+	3 (4.8)	29 (17.4)	
Interest in foot care	Yes	57 (91.9)	142 (83.5)	0.105
	No	5 (8.1)	28 (16.5)	
Impression on current foot care education	Sufficient	2 (3.2)	1 (0.6)	0.000***
	Neutral	27 (43.5)	36 (21.2)	
	Insufficient	33 (53.2)	133 (78.2)	
Confidence in foot care	Confident	3 (4.8)	1 (0.6)	0.000***
	Neutral	31 (50.0)	43 (25.4)	
	Not confident	28 (45.2)	125 (74.0)	
Source of foot care	Not obtained	10 (17.2)	72 (43.4)	0.000***

knowledge	Work	18 (31.0)	24 (14.5)	0.005**
	Outside work	15 (25.9)	22 (13.3)	0.026*
	Journal/magazine	19 (32.8)	26 (15.7)	0.005**
	Internet	16 (27.6)	23 (13.9)	0.018*
	Colleagues	18 (31.0)	59 (35.5)	0.534
	Television	13 (22.4)	22 (13.3)	0.098
Opinion on care manuals	Required	48 (78.7)	128 (75.7)	0.472
	Neutral	13 (21.3)	37 (21.9)	
	Not required	0 (0.0)	4 (2.4)	
Sufficient time for foot care	Agree	19 (31.7)	26 (15.6)	0.007**
	Disagree	41 (68.3)	141 (84.4)	
Willingness to learn more about foot care	Yes	53 (85.5)	120 (71.0)	0.057
	Neutral	9 (14.5)	44 (26.0)	
	No	0 (0.0)	5 (3.0)	
Self-use of toe socks	Used	12 (19.4)	49 (29.0)	0.274
	Neutral	9 (14.5)	17 (10.1)	
	Not used	41 (66.1)	103 (60.9)	

Note: Chi-square distribution. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 3-4: Age, working experience, and number of clients with foot problems cared for

N = 232

Item	Nurses			Care workers			*p* value
	n	Mean	SD	n	Mean	SD	
Age	62	51.2	12.2	170	47.8	11.6	0.062
Working experience in the current profession (Year)	58	23.2	12.2	162	9.2	5.7	0.001***
Number of clients with foot problems cared for within past month.	57	7.9	8.3	165	9.5	11.6	0.346

Note: SD, standard deviation. Student's t-test ***$p < 0.001$

About 29 (46.8%) of the nurses cared for 1–5 clients a day, whereas 37 (22.2%) care workers cared for 6–10 clients and 53 (31.7%) care workers cared for 11–20 clients per day. An overwhelming majority of nurses (57, 91.9%) and care workers (142, 83.5%) were interested in foot care. A total of 33 (53.2%) nurses and 133 (78.2%) care workers thought foot care education was lacking. Only 3 (4.8%) nurses and 1 (0.6%) care worker had confidence in their foot care practices. More than three quarters of nurses (48, 78.7%) and care workers (128, 75.7%) thought foot care guidelines were necessary. Furthermore, 41 (68.3%) nurses and 141 (84.4%) care workers thought they did not have sufficient time for foot care, whereas 53 (85.5%) nurses and 120 (71.1%) care workers were interested in learning more about foot care. A total of 59 care workers (35.5%) obtained foot care knowledge from colleagues, whereas 83% of nurses obtained it from various sources. Meanwhile, 72 care workers (43.4%) did not obtain foot care knowledge from any sources. A total of 12 (19.4%) nurses and 49 (29.0%) care workers used toe socks.

As shown in Table 3-5, practice scores were significantly associated with work status (part time and full time) for both nurses and care workers. Mean practice scores were higher among full-time providers than part-time providers in both groups. There was negative correlation between total knowledge/practice score and number of clients cared for per day for nurses.

Table 3-5: Correlation between knowledge/practice scores and demographic characteristics and daily number of clients

	Total knowledge score			**Total practice score**		
	n	**Spearman's correlation coefficient**	***p* value**	**n**	**Spearman's correlation coefficient**	***p* value**
Nurse (n = 62)						
Age	57	0.087	0.521	50	0.109	0.451
Working experience in the current profession (Year)	56	0.012	0.929	48	0.013	0.928
Number of clients cared for per day	60	−0.073	0.580	52	−.301	0.030*
Care workers (n = 170)						
Age	164	−0.080	0.306	142	0.117	0.165
Working experience in the current profession (Year)	158	0.069	0.387	137	0.332	0.001***
Number of clients cared for per day	162	0.128	0.104	139	0.112	0.189

	Total knowledge score				Total practice score			
	n	Mean	SD	*p* value	n	Mean	SD	*p* value
Nurse (n = 62)								
Male	0	-	-	-	0	-	-	-
Female	59	25.1	2.4		51	65.5	13.6	
Work status: part time	33	25.3	2.5	0.708	25	61.4	13.8	0.023*
Work status: full time	27	25.0	2.4		27	69.9	12.3	
Care workers (n = 170)								
Male	26	22.6	5.7	0.875	25	55.1	13.4	0.26
Female	139	22.4	4.6		117	58.3	13.1	
Work status: part time	63	21.8	5.2	0.195	51	53.1	12.4	0.001**
Work status: full time	101	22.8	4.4		90	60.5	12.9	

Note: Age, working experience (year and months) in the current profession, and number of clients for per day were analyzed using "test for no correlation"
Sex and working status were analyzed using Student's t-test *$p < 0.05$, **$p < 0.01$, *** $p < 0.001$
There was negative correlation between total knowledge/practice score and number of clients cared for per day for nurses.

Mean practice scores were found to be associated with the number of clients cared for per day among nurses and working experience in the current profession among care workers.

3.3.2. Foot care knowledge

Among the 232 participants included, 225 (96%) completely answered all questions regarding knowledge, while 7 (4%) did not answer parts of the questions. Table 3-6 details the accuracy rates of the answers. Significant differences were observed in the early detection of foot problems (Vascular and Neurologic 2) and skin tear on lower limbs (Skin 5) between nurses and care workers, with an accuracy difference of 34.3% and 25.5%, respectively, which was highest among knowledge items. Accuracy rates in both groups were low for the Shoes and Socks subscale.

Table 3-6: Accuracy rates for knowledge questions according to profession

N = 225

Subscales	Item	Nurses		Care workers		Differences	*p* value
		n	% Accuracy	n	% Accuracy		
Nail 1	Cutting a toenail shorter than the tip of the toe may cause a curly nail, and/or an ingrown nail.	58	96.7	125	75.8	20.9	0.000**
Nail 2	A toenail can be cut easier after soaking nails in warm water for 5–10 minutes.	57	95.0	148	89.7	5.3	0.216
Nail 3	Toenails protect the end of the foot and support body weight when walking.	55	91.7	120	72.7	19	0.003**
Nail 4	When a nail is yellowed and rough, a fungal infection is the suspected cause.	55	91.7	146	88.5	3.2	0.494
Nail 5	The color of the nail can be used as barometer of general health.	57	95.0	154	93.3	1.7	0.647
Skin 1	Moisturizer should be applied immediately after taking a bath.	50	83.3	129	78.2	5.1	0.397
Skin 2	Corns and calluses have the same meaning.	45	75.0	103	62.4	12.6	0.079
Skin 3	Repeated friction and stimulation cause the keratin in the sole of the foot to become thicker.	49	81.7	118	71.5	10.2	0.124
Skin 4	Skin tear on an older person’s upper arms or elbow joints are often produced when a caregiver adds extra pressure when assisting movement.	38	63.3	66	40.0	23.3	0.002**
Skin 5	Skin tear on lower limbs often occurs by coming into contact with appliances such as footrests.	52	86.7	101	61.2	25.5	0.000***
Skin 6	Because there are no sebaceous glands on the soles, oil is unavailable, and the sole becomes dry	38	63.3	95	57.6	5.7	0.437

	easily.						
Vascular and Neurologic 1	If the client suffers from severe diabetes, foot sensitivity is reduced and pain may not be noticed even though he/she was injured.	60	100.0	143	86.7	13.3	0.003**
Vascular and Neurologic 2	When only one foot only suddenly becomes cold, blood vessels may be blocked by blood clots.	58	96.7	103	62.4	34.3	0.000***
Vascular and Neurologic 3	Small wounds on an older person may develop into an ulcer if left without treatment.	58	96.7	134	81.2	15.5	0.004**
Vascular and Neurologic 4	Signs of infection are flares (reddish tinge), swelling, pain and a feeling of heat.	56	93.3	134	81.2	12.1	0.027*
Vascular and Neurologic 5	Even though pain is felt on one foot after a period of walking, it will go away after rest. Consequently, there is no need to worry.	52	86.7	144	87.3	−0.6	0.905
Toe and Arch 1	There is no relationship between foot or toenail deformation, and pain in the waist or neck.	51	85.0	121	73.8	11.2	0.078
Toe and Arch 2	When one of the three arches on the foot collapses, various problems occur.	52	86.7	112	67.9	18.8	0.005**
Toe and Arch 3	A stiff ankle is more likely to make a person stumble or fall.	59	98.3	137	83.0	15.3	0.002**
Toe and Arch 4	Toe deformity influences the muscular strength of lower limbs.	58	96.7	152	92.1	4.6	0.227
Toe and Arch 5	Toe flexor exercise increases the calf muscle pump function of lower limbs.	60	100.0	128	78.0	22.0	0.000***
Infection 1	Fungal bacteria can be removed from the nail clippers using alcohol.	43	71.7	126	76.4	−4.7	0.471
Infection 2	When medical appliances are shared among clients without sufficient sterilization,	59	98.3	155	93.9	4.4	0.176

	infection spreads.						
Infection 3	The bucket used for foot baths is cleaned only by rinsing with hot water.	45	75.0	126	76.4	−1.4	0.832
Shoes and Socks 1	The client's shoes have approximately 1-1.5cms space, measured from the longest toe, and allow the toes to move freely.	34	56.7	83	50.3	6.4	0.398
Shoes and Socks 2	Corns and calluses are not influenced by the type of socks worn.	31	51.7	97	58.8	−7.1	0.340
Shoes and Socks 3	Shoe sizes are not absolute and vary by a maker.	53	88.3	142	86.1	2.2	0.657
Shoes and Socks 4	Shoes with a well-fixed heel prevent foot slippage.	29	48.3	98	59.4	−11.1	0.139
Sedentary Behavior 1	Walking for one hour a day is enough to compensate for long sedentary periods.	54	90.0	146	88.5	1.5	0.749
Sedentary Behavior 2	Falls that happen when an older person moves from sitting to standing can be prevented by planning from the care worker.	44	73.3	117	70.9	2.4	0.722

Note: Chi-square test *$p < 0.05$, **$p < 0.01$, *** $p < 0.001$. Among the 232 participants, 225 (96%) answered all questions regarding knowledge.
Answer: yes = 1, no = 2, I do not know = 3

3.3.3 Foot care practices

Results for questions regarding practices among nurses and care workers are presented in Table 3-7. Among the 232 participants, 194 (84.4%) answered all 20 questions regarding practice. The results demonstrated some differences in foot care practices between nurses and care workers. Accordingly, significant differences between nurses and care workers were found in the daily assessment of clients' feet, assessment of the skin between the toes and on the heel, use of nippers, method for reducing ingrown nail pain, the use of a grinder, drying of the skin between the toes, the use of soap, awareness regarding foot baths, and talking about foot care with other staff members. Both groups had close mean scores for the three items on Movement and Toe Exercises.

Table 3-7: Mean scores for questions regarding practices according to profession

N = 225

Item	Item content	Nurses (62)			Care workers (170)			*p* value
		n	Mean	SD	n	Mean	SD	
Skin Assessment 1	I (as care giver) check the clients' feet every day.	59	3.1	1.0	158	2.7	1.1	0.007**
Skin Assessment 2	When I check each foot, the skin between the toes and on the heel is included.	59	3.1	1.1	158	2.5	1.1	0.000***
Skin Assessment 3	I check the clients' shoes before they wear or take off their shoes.	58	2.0	0.8	156	2.1	0.9	0.631
Nail 1	When I clip the clients' nails, they are clipped straight with a curve at the corners.	58	3.6	1.2	155	3.3	1.3	0.113
Nail 2	I always use the nipper when I cut the clients' nails.	59	3.2	1.5	156	2.4	1.5	0.000***
Nail 3	When there is a slight ingrown nail, I know the method to reduce pain by taping and packing with cotton.	58	2.6	1.5	157	1.9	1.3	0.000***
Nail 4	I use a nail file or grinder to reduce the thickness of nails that require this treatment.	59	3.0	1.4	157	2.3	1.4	0.001***
Nail 5	Sterilizing method is the same within an institution after the use of a nipper.	59	2.7	1.4	155	3.1	1.5	0.070
Skin 1	After I wash the clients' feet, the area between the toes is dried thoroughly.	59	3.7	1.3	156	3.0	1.3	0.000***
Skin 2	When heels are cleaned every	57	3.5	1.2	154	3.5	1.2	0.952

	day, they become cleaner.							
Skin 3	Moisturizer is used on dry feet because dryness reduces the barrier function of skin.	59	4.2	1.0	158	3.9	1.2	0.140
Skin 4	I sometimes apply Vaseline or an ointment to the skin without first wiping away previous excess Vaseline or ointments.	58	2.9	1.4	158	2.5	1.4	0.078
Hygiene 1	It is beneficial to bathe in acidic bubble soap.	58	4.0	1.1	157	3.6	1.2	0.036*
Hygiene 2	Bathing opens the skin's pores more effectively than showers; therefore, a bath is more effective in removing dirt.	58	4.0	1.2	156	3.9	1.1	0.842
Hygiene 3	I understand the purpose, method and awareness points for care of a foot bath.	59	3.7	0.9	157	2.8	1.1	0.000***
Movement and Toe Exercise 1	I provide advice to clients when they stand from a chair.	59	3.5	1.0	157	3.4	1.1	0.746
Movement and Toe Exercise 2	I always promote toe exercises to clients.	59	3.6	1.2	157	3.4	1.3	0.423
Movement and Toe Exercise 3	I encourage clients to stand when they have been sitting for more than one hour.	57	3.2	1.2	158	3.0	1.2	0.303
Consultation 1	I have an opportunity to talk about foot care with other staff members.	59	2.7	1.4	158	2.2	1.1	0.005**
Consultation 2	I always consult with others regarding which doctor or specialist the client should visit.	59	3.2	1.3	158	2.2	1.2	0.000***

Note: SD, standard deviation

Mann–Whitney U *$p < 0.05$, **$p < 0.01$, *** $p < 0.001$
Five answers: strongly relevant = 5, more relevant = 4, neutral = 3, less relevant = 2, not relevant = 1 (points)
Among the 225 participants, 194 answered all of the questions.

Nurses and care workers had low mean scores for "checking clients' shoes" (2.0 and 2.1, respectively), "method for reducing ingrown nail pain" (2.6 and 1.9, respectively), and "talking about foot care with other staff members " (2.7 and 2.2, respectively). However, nurses and care workers had relatively high means scores for skin moisturizing (4.2 and 3.9, respectively) and bathing effects (4.0 and 3.6, respectively).

Although a ceiling effect was observed for items Nail 3, Skin 3, and Hygiene 2, they were statistically acceptable given their SD of 1.4, 1.1, and 1.1, respectively (Table 3-8).

Table 3-8: Observed ceiling effects on mean scores for questions regarding practices (nurses and care workers)

Items	Mean	SD	M – SD	M + SD	Ceiling effect
Skin Assessment 1	2.8	1.1	1.8	3.9	0
Skin Assessment 2	2.7	1.1	1.6	3.8	0
Skin Assessment 3	2.0	0.9	1.1	2.9	0
Nail 1	3.3	1.3	2.1	4.6	0
Nail 2	2.6	1.6	1.0	4.1	0
Nail 3	2.1	1.4	0.7	3.4	1*
Nail 4	2.5	1.5	1.0	4.0	0
Nail 5	3.0	1.5	1.5	4.5	0
Skin 1	3.2	1.4	1.9	4.6	0
Skin 2	3.5	1.2	2.2	4.7	0
Skin 3	4.0	1.1	2.9	5.2	1*
Skin 4	2.6	1.4	1.2	4.1	0
Hygiene 1	3.7	1.2	2.5	4.9	0
Hygiene 2	4.0	1.1	2.8	5.1	1*
Hygiene 3	3.0	1.1	1.9	4.1	0
Movement and Toe Exercise 1	3.4	1.1	2.4	4.5	0
Movement and Toe Exercise 2	3.4	1.3	2.1	4.7	0
Movement and Toe Exercise 3	3.0	1.2	1.8	4.2	0
Consultation 1	2.4	1.2	1.2	3.6	0
Consultation 2	2.6	1.3	1.3	3.9	0

Note: *ceiling effect.

Results for Cronbach's alpha are detailed in Table 3-9. Accordingly, items on Skin Assessment, Nail, Skin, Hygiene, Movement and Toe Exercise, and Consultation had Cronbach's alpha values of 0.72, 0.67, 0.65, 0.65, 0.73, and 0.63, respectively.

Table 3-9: Cronbach's alpha values for subscales on practice

Subscale (practice)	Number of items (n = 20)	Cronbach's α	Mean	SD	Min-to-max value
Skin Assessment	3	0.72	7.6	2.5	3.0–14.0
Nail	5	0.67	13.5	4.7	5.0–25.0
Skin	4	0.65	13.3	3.6	4.0–20.0
Hygiene	3	0.65	10.7	2.7	3.0–15.0
Movement and Toe Exercise	3	0.73	9.9	2.9	3.0–15.0
Consultation	2	0.63	4.9	2.1	2.0–10.0

3.3.4. Correlation between knowledge and practice scores

The correlation between knowledge and practice scores is presented in Table 3-10. A significant correlation between overall knowledge and practice scores was observed among both nurses (0.331; $p = 0.017$) and care workers (0.339; $p = 0.000$). Spearman's rank correlation test showed that the association between knowledge scores and Movement and Toe Exercises was above 0.4 for nurses, while correlation between knowledge scores and Skin, Hygiene, and Movement and Toe Exercise were above 0.3 for care workers.

Table 3-10: Correlation between knowledge and practice scores among nurses and care workers

N = 194

Subscale (practice)	Nurses (n = 52)			Care workers (n = 142)		
	n	**coefficient**	***p* value**	**n**	**coefficient**	***p* value**
Skin Assessment	52	0.227	0.105	142	0.101	0.236
Nail	52	0.259	0.064	142	0.188	0.026*
Skin	52	0.186	0.186	142	0.313	0.000***
Hygiene	52	0.191	0.176	142	0.350	0.000***
Movement and Toe Exercise	52	0.417	0.002**	142	0.304	0.000***
Consultation	52	0.190	0.178	142	0.235	0.005**
Total	52	0.331	0.017*	140	0.339	0.000***

Note: Spearman's rank correlation. *$p < 0.05$, **$p < 0.01$, *** $p < 0.001$

3.4. Discussion

The results of the present study showed a significant association between foot care knowledge and practices among both nurses and care workers. The purpose of this study was to explore the strengths and weaknesses of both professions with regard to the provision of foot care and to suggest future strategies that improve the level of care within this area. One of features of the present study was the inclusion of care workers among the study participants. Care workers working in in-home service providers have countless opportunities to assess and come in contact with the client. Thus, statements like “he/she is not as usual” by non-nurses should be taken seriously and require follow-up.

Our results showed that both nurses and care workers were interested in learning about foot care and observing clients’ foot problems despite having low confidence, insufficient time, and limited foot care education. Indeed, 57 (92%) nurses and 165 (97%) care workers had cared for a mean of 7.9 and 9.5 clients with foot problems a month before the survey.

In contrast to our hypothesis, a significant correlation between working experience and practice scores had been observed, with full-time participants having higher mean scores. Moreover, working experience was significantly associated with practice scores among care workers. This is consistent with results presented in previous studies (Stolt et al., 2015) and could perhaps be attributed to increased chances for foot care practice with greater working hours.

Higher accuracy differences in the early detection of foot problems had been observed between both groups in contrast to our hypothesis. Despite nurses having received more in-depth anatomy and physiology education compared to care workers, only slight differences had been expected given the lack of foot care education in both professions. Previous studies indicated nursing assistant’ detection of early signs of symptom contribute to health care (Tingström et al., 2015; Tingström, Milberg, & Sund-Levander, 2010). Older people with low risk of foot problems might be undiagnosed and overlooked; therefore, they need medical help (Campbell, 2006) and with high risk may develop worse conditions (Boyko, Ahroni, Cohen, Nelson, & Heagerty, 2006; Diehm et al., 2004).

Early detection and reporting of foot problems by care workers may lead to early treatment, which could potentially be life-saving. Therefore, enhancing knowledge on early detection among care workers should be emphasized.

The present study found that knowledge on shoes and socks had been lacking

among both professions given the lower accuracy rates of related answers. Despite having more opportunities to observe the client's foot when assisting with the wearing of shoes and socks or bathing, care workers were less aware of foot arches compared to nurses. Inappropriate shoes can cause calluses or corns, as well as toe and arch deformity (Buldt & Menz, 2018; Nix, Vicenzino, & Smith, 2012). This is significant considering that the arch of the foot plays a vital role in balancing and walking. Although the effect of inappropriate footwear on the structure of the foot has been extensively studied in other countries (Buldt & Menz, 2018; Burns, Leese, & McMurdo, 2002; Hubscher et al., 2011; López-López et al., 2015; Menz, Morris, & Lord, 2006; Shinohara, 2011), limited research on the same has been available in Japan.

Nurse and care workers were aware of the protective effects of moisturizers on the skin barrier; however, the 25.5% knowledge difference between both groups regarding skin tears should be emphasized in future foot education program. Considering the decreased elasticity, dryness, and fragility of older people' skin, identifying factors that trigger skin tears on their arms and feet can prevent further skin problems. Accordingly, Serra et al. had reported risk factors for skin tears among frail populations (Serra, Ielapi, Barbetta, & de Franciscis, 2018). Notably, small stones or objects inside the shoes may lead to skin breakage on the foot. Observing for signs on skin from improper footwear is imperative (Ren et al., 2014). Assessment of the skin between the toes and on the heel has also been poor among Japanese studies, unlike those in other countries (Kaya & Karaca, 2018; Lincoln, Jeffcoate, Ince, Smith, & Radford, 2007; Miller et al., 2014). Skin maceration between the toes may increase the risk for developing cellulitis from fungal infections. Indeed, a hospital based-study in Japan reported fungal infections among older people individuals (Furue et al., 2011), with another study on older people living at home and in nursing homes also showing the same (Suzuki, 2017). Hence, assessing the skin between the toes should be included in a health care provider's daily routine.

The present study found that more nurses than care workers practiced nail care. However, nurses had the lowest scores for ingrown nail care among the items on nail care practice. Admittedly, foot nail care, particularly nail cutting, among older people individuals can be challenging for both of nurses and care workers. Changes in nail characteristics may be normal and related to the natural aging process. However, nail disorders, including thickened, elongated, and ingrown nails, can be painful and disabling (Menz, 2016). The MHLW has provided interpretation reports on "Article 17 of the Medical Practitioners Act, Article 17 of the Dental Practitioners Act, and Article

31 of the Act on Public Nurses, Midwives and Nurses and other relevant laws and regulations." and listed items, regarding foot care, that are not considered as medical practice as a general rule. (MHLW 2005). Such information would be beneficial for the safe and regulated practice of foot care among nurses and care workers. Learning to use a grinder and toenail clipper requires time and knowledge. Care providers may also learn to use a nail file for reducing nail thickness to some degree or shape the nail edge. Nail disorder not only caused cosmetic problems but also showed negative effects on health-related quality of life and psychological problems (Abdullah & Abbas, 2011; Reich & Szepietowski, 2011). Thus, nail care among older people individuals greatly contributes toward maintaining and improving quality of life.

Nurses and care workers had close mean scores for Movement and Toe Exercise. The present study included prevention of sedentary behavior and toe exercises in the general definition of foot care. A wide range of studies outside Japan have shown that sitting for long durations without standing every hour may have adverse effects on the body (Dunstan et al., 2012; Keevil et al., 2015; Siddarth, Burggren, Eyre, Small, & Merrill, 2018). Hence, monitoring sedentary time and promoting hourly standing among older individuals should theoretically be promoted. However, this becomes challenging for nurses and care workers due to time constraints and the need for careful observation related to safety.

The current study identified several challenges for future program. Firstly, time constraints continue to be a universal issue for the nursing profession. Evidence has clearly shown that workload and access to equipment are among the challenges nurses and care workers face, which could lead to insufficient time allotted toward caring for clients (Lavallée, Gray, Dumville, & Cullum, 2018; McDonald, Shah, & Wallace, 2013), most of whom are vulnerable. When caring for several clients at one time, nurses and care workers observe them carefully and assist with walking or bathing, taking extreme caution due to the risk for falls. To account for this situation, efficient and comprehensive "hands-on" foot care tools, which can be learned and implemented quickly during regular working hours, can be developed for nurses and care workers. Previous studies can also be used as reference (Borges, & Ostwald, 2008; McDonald et al., 2013; Miller et al., 2014).

Secondly, the lack of foot care education in the school curriculum as well as in the work field has hindered foot care practice in Japan. According to one study, 78.7% (48) of nurses and 75.7% of care workers (128) stated that foot care manuals are necessary. Moreover, the results presented herein showed that foot care knowledge

came from various sources, with some care providers not even knowing the source (Table 3-3). Hence, a certain structured system for foot care education should be incorporated into the current academic curriculum. Detecting foot problems or providing foot care for particular foot problems among older individuals has remained challenging. Stolt et al. stressed the necessity of having regular, organized continuing education for all professional nurses engaged in clinical practice (Stolt, et al., 2013)

Gaining knowledge and practical experience through education or training sessions has been shown to foster confidence. Lack of confidence may affect the delivery of care (Turner & Quine, 1996). Self-efficacy and confidence have often been associated with self-care behavior among patients with diabetes (Sharoni, Rahman, Minhat, Shariff-Ghazali, & Ong, 2018). Both the nurse's and care worker's confidence may supplement foot self-care insufficiency among older people due to aging. Coping with nail thickness or reducing edema however may require further foot care education and training.

Thirdly, the lack of foot care specialists has hindered appropriate treatment of foot problems in Japan. Accordingly, Japan does not provide a national license for foot care specialists or foot care doctors equivalent to a podiatrist or pomologist. Moreover, the present study suggested that the current consultation system is lacking due to an absence of podiatry referral system in Japan compared to other countries (Carter, Cheung, Rome, Santosa, & Lahiri, 2017; Spink et al., 2011). While the incorporation of referral recommendations may be influenced by many factors (Edwards, Davies, Ploeg, Virani, & Skelly, 2007), communication channels represent the strength of an organization. Considering that nurses and care workers in in-home service providers do not immediately receive orders from doctors, unlike those in the hospital, they may have more autonomy over decisions regarding further referral after observing or assessing the foot problem.

The present study has explored the requirements for future foot care program targeting nurses and care workers. Given the various current limitations, new approaches toward enhancing knowledge and practice among nurses and care workers need to be developed and exercised in the future. Additional large-scale studies on nurses and care workers in in-home service providers will be essential. However, researchers need to formulate strategies that address potential participation bias with the current Japanese working situation.

3.5. Study limitations

The participants included herein were collected using cluster sampling. Thus, once a field manager of a service center expressed willingness to respond to this study, nurses and care workers were more likely to cooperate with the study. Nonetheless, we need to accumulate evidence and provide reasons for the achieved response rates. Although 530 participants were initially targeted, this number could not be met due to time and budget constraints. Nonetheless, the final sample size was determined to be statistically appropriate. Noncertified care workers had several different types of certificates, the differences in which could not be analyzed due to the small number of participants. Moreover, some nurses worked as home care providers, which allowed them more time to assess the skin and toes of their clients. The time allocated for foot care might differ depending on provider types and their roles. To properly account for and analyze potential differences, future studies need to include a large enough sample from each type of provider. The present study obtained Cronbach's alpha values of 0.63–0.73 for all subscales on practice, which could have been attributed to the number of items included in each subscale.

3.6. Conclusions

It was clarified that the nursing care staff's interest and willingness to learn about foot care and the actual situation of foot care education are inversely proportional to the actual situation of foot care education. In addition, the findings provide suggestion that specific foot care education is needed for items that had a statistical difference between both occupations, including early detection for foot problems and skin tears, and questions with a low accuracy rate or low average value even if there was no statistical difference between the groups.

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CHAPTER 3: Foot care knowledge and practice among Japanese nurses and care workers in-home service providers: A cross-sectional study

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CHAPTER 4

Evaluation of the development process and effects of a foot care program with educational tools for nurses and care workers as in-home service providers

Abstract

Objective: Nurses and care workers providing in-home services play important roles in assessing and providing care for the feet of older people lacking foot self-care abilities. Herein, we aimed to evaluate the development process and effects of a foot care program with educational tools for nurses and care workers as in-home service providers.

Results: Foot care education tools were developed to address the issues faced by participants with various work patterns and insufficient foot care education in Japan. Contents of these tools were discussed by a panel and reviewed by experts. Three outcomes were analyzed using descriptive statistics and Pearson's correlation. Changes in foot care knowledge and practice scores were significantly correlated to performance scores. Five of the eight field nurses evaluated that excess information was included in the foot care booklet. Overall, 29 nurses and care workers showed higher evaluation than average scores [3.8–4.1 (standard deviation, 0.62–0.91)] for motion pictures and PowerPoint presentation. Enhanced performance using educational tools resulted in improved foot care practices. A program according to this conceptual framework

must be established and periodically evaluated for refinement.

Keywords: in-home service providers, foot care education, nurses and care workers

4.1. Introduction

Nurses and care workers (NCWs) working at in-home settings or communities face serious challenges because of the markedly increasing aging population worldwide (World Bank Group, 2018). The Japanese government urgently prompts a community based integrated system (Tsutsui, 2010).

Community-dwelling older people in Japan experience various health conditions, with some requiring assistance for medical treatment or performing activities of daily living and some using long-term care insurance (Fujii, 2019). Older people may request foot care from NCWs or may refuse to seek active care (Mitty, 2009) despite the high prevalence of foot problems among them. However, studies on this topic are limited (Fujii, 2019; Miikkola, Lantta, Suhonen, & Stolt, 2019).

In older people, lack of foot self-care due to the inability to bend to cut the nails, impaired vision, and lack of fine hand movements (Campbell, 2006; Stolt et al., 2013a) causes neglect of foot problems including edema, toenail issues/deformity calluses, corns, bunions, fungal infections, and macerations (Guidozzi, 2017; Menz, 2016).

NCWs may often overlook foot care or related issues (Abdullah & Abbas, 2011). A study reported lack of training on toenail cutting in nursing education programs in 1996 (Turner & Quine, 1996). Even currently, the limited number of reports on foot care indicates researchers' lack of interest in this topic.

NCWs are the key people responsible for identifying foot problems because care activities often require physical contact. In Japan, given the lack of foot care specialists and inadequate foot care education, NCWs require more autonomy to assess and care for foot problems. Therefore, a foot care program was developed with various educational tools to comply with NCWs' diverse work patterns and foot care knowledge or practices. We evaluated the development process and effects of a foot care program with educational tools for NCWs. The research questions were as follows: (1) Is there an association between performance scores obtained using educational tools and improvement in foot care? (2) Was the process evaluation of educational tool development effective?

4.2. Methods

4.2.1. Study design

This is a process evaluation with a descriptive mixed-methods study of quantitative and qualitative data conducted from July to October 2019 in Japan.

4.2.2. Conceptual framework

Educational tools for the foot care program comprised materials and kits. Tools were used in training sessions and were created based on a conceptual framework generated using all collected resources. The main author (KF) performed extensive literature review of articles on foot problems and interviewed experts via email or meetings in person.

This study was not limited to item pools of other studies on foot care (Kaya & Karaca, 2018; Stolt et al., 2013a,b); it included effects of prolonged sedentary or toe movements (Keevil et al., 2015; Mickle, Caputi, Potter, & Steele, 2016; Suwa et al., 2018; Uritani, Fukumoto, Matsumoto, & Shima, 2015) and differentiation between soft tissue and lymphatic massages based on their physical implications (Ernst, 2003; Hampton, 2010). Educational tools were created using five steps: full planning, draft creation, evaluation initiation (before implementation), process evaluation (immediately after

implementation), and impact evaluation (after intervention).

4.2.3. Tool creation

Most ideas for the present study tools were based on previously reported interventions for diabetic patients. PPTs, pamphlets, foot care kits, and hands-on skill sessions were used (Fan, Sidani, Cooper-Brathwaite, & Metcalfe, 2013; Keller-Senn, Probst, Imhof, & Imhof, 2015; Mackie, 2006; Nguyen, Edwards, Do, & Finlayson, 2019; Sharoni, Rahman, Minhat, Shariff-Ghazali, & Ong, 2018). Interventions using telemedicine or mobile phone text messages and telephone follow-ups previously reported were also used as references to get ideas as previosuly reported (Hassan, 2017; Kolltveit et al., 2016; Nesari, Zakerimoghadam, Rajab, Bassampour, & Faghihzadeh, 2010; Tchero et al., 2017). To create tools, an illustrator created original drawings suiting the contents. The animation characters were developed for this study for originality and familiarity. The effects of illustrations have been investigated (Kasmaienezhadfard, Pourrajab, & Rabbani, 2015). Reviews of previous studies using video lectures (Brame, 2016; Giannakos, Jaccheri, & Krogstie, 2016;

Kinnari-Korpela, 2015; Toppin, 2011) and picture story cards (Clements, 1998) as well as developing guidelines (Manchikanti, Abdi, & Lucas, 2005; Shekelle, Woolf, Eccles, & Grimshaw, 1999) were used as references to create the program. All practice programs were based on laws and regulations of Japan and the interpretation reports of the related article by the Ministry of Health Labor and Welfare, which determine foot care practice that can be performed based on qualifications.

4.2.4. Program evaluators

Overall, 3 types of evaluators were set in this study:

1) A total of 36 NCWs working as "in-home service providers," e.g., those providing home-visit services, one-day service, or day care service (MHLW, 2016) who participated in a 2-month intervention study of foot care programs (Fujii& Stolt, 2020a). This study focused on the evaluation of the development process and overall effects of the program. Therefore, 36 of the 54 initial participants in the intervention group answered all performance questions at post-intervention and 80% or more of the knowledge and practice questions at pre- and post-intervention were considered evaluators.

2) Eight field nurses who attended a monthly pressure ulcer study group in the T area (similar to province) in Japan.

3) A total of 29 randomly selected participants from the intervention group after the first intervention session.

4.2.5. Procedure of program evaluation

Before foot care intervention started, eight nurses had evaluated foot care booklet and motion pictures (MPs) using an evaluation sheet for convenience and comprehension. After the first intervention session, randomly selected participants from the intervention group evaluated the MPs and Power point presentation (PPT) by KF. KF visited 11 providers three to five times to intervention groups. During the first session, PPT and MPs were shown to a participant group. During the second to fourth sessions, KF demonstrated foot assessment and practice techniques and requested one/two participants to assess and care for clients in front of them. Throughout the program, the participants were asked to use tools including the foot care booklet , picture flip cards, MPs, and foot assessment sheet. In the last intervention stage, a one-point advice card

was provided to each participant to review foot care knowledge and practice. Performance scores and changes of knowledge and practice scores of NCWs as program participants were calculated.

4.2.6. Outcomes

The primary outcome was the correlation between changes in foot care knowledge and practice scores and performance scores obtained using the evaluated tools. The secondary outcome was the evaluation by eight field nurses before the intervention. The tertiary outcome was process evaluation by the 29 participants after the first intervention session.

4.2.7. Instruments

Five types of evaluation sheets (evaluation sheet for motion pictures and foot care booklet, for motion pictures and power point presentation, foot care knowledge and practice questionnaires, evaluation of program participation sheet including perception and performance categories and a tool package comprising the program) were used for evaluation. Table 4-1 and Table 4-2 showed the performance categories and the contents of instrument respectively.

Table 4-1: Questions about exposure to each tool

		0 point	1 point	2 points	3 points
1	Power point presentation	No participated	Participated		
2	Watching motion picture	No participated	Participated		
3	One-point advice card	Never read	Read a little	Read	
4	Number of foot-care Practice (practice with author or practice alone)	0 time	1 time	2 to 3 times	4 times
5	Number of watching Motion pictures besides	0 time	1 time	2 to 3 times	4 times

	first session			
6	Picture story cards	Never used	Used a little	Used
7	Foot-care note	Never used	Used a little	Used
8	Foot assessment sheet	Never used	Used a little	Used

Table 4-2: Program instruments

Type of tool	When was it used?	Who used it and for whom?	Contents	Development process
Power point presentation (68 slides)	First session of the intervention	KF[10] presented it to the participants.	Overall, 15–20 minutes. Association of social demographic changes and foot issues, various inconvenient policies and social factors that may affect foot care, foot care regulations by the Ministry of Health, Labor and Welfare, health checkups before exercise or measurement, anatomy and physiology, and assessment and care for nails and skin. Vascular- and neurologic-related foot problem and their assessment and care. Toe and foot exercises, various types of foot-associated care, including shoes and socks, infection management, and sedentary behaviors.	KF developed this presentation based on item pools and repeated discussions with an illustrator to place appropriate drawing on the slides (Majority of drawing were made on an iPad by illustrator, F, NODA).
Motion picture materials (10 min)	First session of the intervention	KF provided it to the participants.	Selected topics included (1) foot bath, (2) cutting nails using a nail clipper, (3) scaling sole of the foot using a foot file, and (4) taping for reducing pain of ingrown nail.	KF planned the contents and allocation time for each topic in the motion pictures. KF contacted a foot care specialist (IY) to be a main performer on the motion pictures and discussed the contents. Then, repeated adjustments were made to the motion pictures to

[10] KF: Kashiko Fujii (the author)

				create a more professional appearance. Professional maker created and edited the motion pictures under the supervision of KF
Picture story cards (19 pages)	Former part of the intervention	Participants demonstrated this in front of clients.	Story: History of human beings. Human beings on the planet. Human body as a small universe. Life review: Importance of foot exercises. Pictures of foot and toe exercises.	KF created the story and asked an illustrator to draw 19 pages of pictures. Illustrations were drawn using an iPad.
Foot care booklet (78 pages)	Former part of the intervention	Participants	Contents of this note were similar to those in the power point presentation, with some additional information.	KF created this booklet based on item pools and repeated discussions with an illustrator to place appropriate drawing in the booklet. Contents of the foot care booklet were reviewed by experts.
Foot care assessment sheet (1 page)	Latter part of the intervention	Participants		Based on the scoring system developed in other researcher's study, KF created the foot care assessment sheet in the booklet. KF obtained approval for translation and the use of some portions of this scoring system (KF keeps records in email exchange with the researcher). Contents of the foot care assessment sheet were reviewed by experts.
Foot care advice card	Distributed after the third or fourth	Participants	Majority of the content are answers to foot care knowledge and practice questionnaires.	KF summarized the essence of foot care including the answers to foot care knowledge and practice

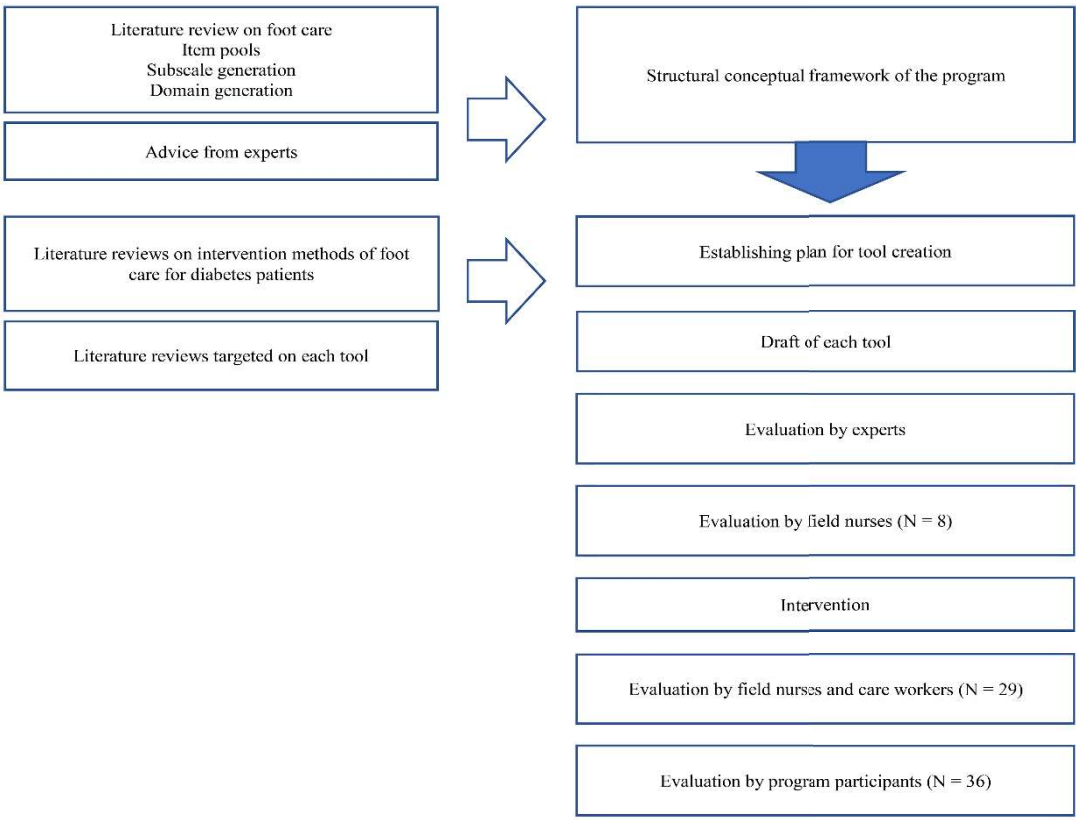
	session of the intervention			questions and then condensed this information into a telephone card-sized sheet that can easily be put in a wallet. KF asked the participants to read it before answering the questionnaires after the intervention and to put it in their purse so they could always review it.
Foot care kit (foot and toe nail files)	A foot file was given to a provider. A toe nail file was given to each participant	KF and participants used these for clients.	The foot file was used for corns, calluses, or thickness of sole keratin.	KF purchased these from a foot care salon in Tokyo, where KF acquired skills for foot care.
Bamboo stepping equipment foot point stimulation device (for sole stretching)	On rent for use during the sessions	KF and participants used this for clients.	When a person steps on the bamboo stepping equipment, it stimulates the overall sole, including the bones, muscle, circulation, and nerves, which achieve better body improvement.	KF purchased this from a manufacturing company and used it during the intervention.

4.2.8. Data analysis

Data were analyzed with descriptive statistics. Correlations of changes in foot care knowledge and practice scores with performance scores for each tool were analyzed using Pearson's correlation coefficient. Changes in foot care knowledge and practice scores were analyzed using t-test; performance scores were calculated by summing up scores from descriptive statistics.

4.3. Results

The flow chart of the study participants is shown in Figure 1.



4.3.1. Primary outcomes

Performance scores correlated with skin assessment, skin practices, and consultation in the practice category subscales and the total practice score (Table 4-3), with no correlations between knowledge and performance scores. Skin assessment and consultation of practice subscale items and total practice scores were significantly associated with performance score (p-value, 0.005, 0.027, 0.017 respectively).

Table 4-3: Correlation between foot care knowledge/practice and performance scores (N = 36)

Subscale Items: knowledge	Pearson	*p*-value
Nail	0.076	0.661
Skin	−0.207	0.226
Vascular and neurological disorders	−0.259	0.128
Toe and arch	−0.109	0.526
Infection	0.094	0.584
Shoes and socks	−0.076	0.661

Sedentary behavior	0.070	0.686
Total	**−0.200**	**0.242**

Subscale Items: practice	**Pearson**	***p*-value**
Skin assessment	0.457	0.005**
Nail	0.161	0.350
Skin	0.307	0.069
Hygiene	0.198	0.248
Movement and toe exercise	0.153	0.374
Consultation	0.369	0.027*
Total	**0.397**	**0.017***

Note: *$p < 0.05$, **$p < 0.01$, *** $p < 0.001$

Performance scores means questions about exposure to each item

(See Chapter 5 Table 5-2) Question items: (1) Power point presentation; (2) Watching motion picture materials; (3) one-point advice card; (4) Number of foot-care practice (practice with author or practice alone); (5) Number of watching motion pictures besides the first session; (6) Picture story cards; (7) Foot-care booklet ; and, (8) Foot assessment sheet. Each item was scored from 1 to 3 points depending on exposure.

4.3.2. Secondary outcomes

Secondary outcomes

The MPs and foot care booklet were evaluated (Table 4-4). Five questions were asked regarding ease of understanding, appropriate length, gaining new knowledge, and the future usability of the MPs and PPT. Given the limited number of evaluators, qualitative comments were weighted as references based on two classifications of skill learning possibility and the structure of the contents. Five participants noted that excess information was included in the foot care booklet and that the main points should be emphasized to create a smaller pamphlet. For the motion pictures, two of the participants also noted that a large amount of information was included, while other topics that were not included in the MPs were extracted as additional learning topics from the respondents.

Table 4-4: Qualitative comments by the eight evaluators

Tool	Skill	Structure
Motion pictures	It was the first time I learned how to use nail and foot files (1). I learned how to wash the foot correctly before performing foot care (1). I would like to learn how to cut nails with a regular nail clipper (2). I wanted to learn more about nails and skin with fungal infection (1). I wanted to watch NG points of foot care. I wanted to watch how to use cotton packing for an ingrown nail (1).	Much information was included; therefore, it is difficult to retain all the information at one time (2). Motion pictures were more useful than the foot care booklet (1). It was difficult to watch the introduction part (1). Scripts should be provided for the motion pictures (1). It might be difficult to understand proper care of ingrown nails (1).

Foot care note		Much information was included, so only the important points should be included for use in the work field (5). It might be better to use a small pamphlet or picture flip card (1). It might be difficult to retain all the knowledge and information (3). Some pictures and explanation did not match (3). The title should have larger font (1). We must consider how and when we can perform foot care in the field (1).

Note: (number) means number of person who answered the question.

4.3.3. Tertiary outcomes

Twenty-nine participants evaluated the PPT and MPs [mean scores: 3.8–4.1 (SD 0.62–0.9), which are above average] (Table 4-5). Three participants noted that the presenter's speed was extremely fast to follow. Three participants stated the desire to learn about nail cutting. Some participants recommended including rehabilitation for foot and practical cases. Twenty-nine participants evaluated the PPT and MPs [mean scores: 3.8–4.1 (SD 0.62–0.9), which are above average].

Table 4-5: Quantitative and qualitative comments by the 29 evaluators

Questions	Mean	SD
MP: It was easy to understand	4.1	0.66
MP: Length was appropriate	3.8	0.91
MP: I could learn new knowledge from the motion pictures	4.1	0.72
MP: I can use it in the field hereafter	3.9	0.65
PPT: It was easy to understand	3.9	0.62
PPT: The length was appropriate	3.9	0.79
PPT: I could acquire knowledge from the PPT	4.0	0.78

Answers:	Comments on both tools (motion pictures and power point presentation): Knowledge and skills: I wanted to learn more about how to cut toenails with problems, such as thicker toenails, ingrown nails, e.g., for practical use in the field (3). I wanted to learn more about practical skills hereafter (1). I learned the association between foot problems and the whole body, including clench (2).

	It might be better to include the exact or prospective effects of foot care on frail older people (1). I wanted learn more about foot rehabilitation (1). Structure: The speed of the talk was extremely fast and difficult to follow (3). More practical cases should be presented (1). The entire flow of presentation and motion pictures were fine, but more in-depth information might be better for each part (1). I learned how to cut nails and assess skin (1). My interest in foot care has developed (1). I would like to learn more about foot care (1).

Note: MP: Motion pictures, PPT: Power point presentation. (number) means number of person who answered the question.

4.4. Discussion

We evaluated the association between performance scores obtained using the created tools and improvement in foot care knowledge and practices and evaluated the development process of these tools and their effectiveness.

Correlation analysis revealed that participants' performance scores were related to skin assessment, skin practice, and consultation total practice scores. The original tools as a package helped obtain the essence of most learning methods and pyramids proposed by the National Training Laboratories for Applied Behavioral Sciences (Wood, 2004).

Skin assessment and practice were emphasized in the PPT, MPs, foot care booklet, and one-point foot care card. Foot parts that tend to be overlooked, such as the heel, sole, or skin between the toes, were emphasized in the program so that the participants could learn assessment skills for these. Given the high prevalence of nail and skin fungal infections (Suzuki, Mano, Furuya, & Fujitani, 2017), signs for detecting these were covered in some tools. KF described the adverse effects of daily sole washing, risk area of the skin between the toes, and importance of applying ointments after wiping or washing the skin to avoid

stacking them. Foot hygiene was covered in the program and has been reported previously (Martini, Huertas, Turlier, Saint-Martory, & Delarue, 2017; Voegeli, 2008); however, it was not included in the practice session owing to the provider's work circumstances.

Time spent on foot care practices should be considered by in-home service providers using hands-on practical materials with appropriate training personnel. Points of care stated in other scales (nail, hygiene, and sedentary) were also explained; however, additional hands-on practice regarding subscales may be necessary. Nail practice is particularly difficult because of the complexity of nail problems with aging. Studies limited to specific areas in Japan have reported an association between nail problems such as ingrown nails and reduced limb function (Imai, Takayama, Satoh, Katoh, & Yokozeki, 2011; Yamashita et al., 2019). NCWs may encounter feet with various nail problems; however, limited resources or lack of access to foot care professionals may cause uncertainty among NCWs regarding their capability to provide foot care. Therefore, appropriate nail care methods and materials for in-home NCWs should be developed. There was no significant association between changes in

knowledge and performance scores, indicating that time constraints affect the ability to learn various topics in a short time.

Community-dwelling older people often have complex diseases such as those requiring hemodialysis (Locking-Cusolito et al., 2005); among them, people with foot problems must seek help (Miikkola et al., 2019; Stolt et al., 2012). Tinea pedis and tinea unguium are among the top five skin disorders in individuals aged ≥ 60 years (Furue et al., 2011). Early problem detection and consultation with other professionals for referral judgment by NCWs are important for foot and general health. Predicting foot ulcers via early screening prevents further worsening of the condition (Ang, Yap, & Saxena, 2017; Boyko, Ahroni, Cohen, Nelson, & Heagerty, 2006; Campbell, 2006). As NCWs provide services in environments with lack of doctors for consultation, early problem detection and consultation with other professionals for referral judgment requires certain autonomy. PPT, foot care booklet , and one-point foot care card contents include a topic related to when and what type of foot problems require doctor referrals, highlighting urgent (e.g., sudden coldness of one foot) and recommended (fungal infection on nails or skin) examples.

4.5. Limitations

This program included the importance of consultation with other professionals, including referral. However, because a national license for foot care doctors or other professionals is not provided in Japan, unlike for podiatrists in other countries (Wylie et al., 2017), there is no guarantee that referred patients will see a doctor with adequate foot care knowledge. Such patients may feel disappointed or are referred to a different doctor. Furthermore, despite the presence of some foot care related certificates from different associations, foot professionals are limited.

Foot care programs may include excess information to exercise in a short period, and NCWs may require additional practical and hands-on information. Acquiring proper nail care skills requires time, extensive learning, and experience. Basic treatments skills such as using nail files or treatment for reducing pain due to ingrown nails should be emphasized.

As participants were NCWs, the same tools were used for the intervention because both professions offer the majority of care through in-home or

community settings. Additional tools might be considered in the future to adjust differences in caregivers' educational backgrounds.

4.6. Conclusions

Overall, the described program is important as an introductory intervention for NCWs caring for older people. As successful educational foot care programs for patients or clients (Scain, Franzen, & Hirakata, 2018; G. Wylie et al., 2019), multifaceted interventions modify emotions and perceptions (Scollan-Koliopoulos, Walker, & Bleich, 2010), leading to changes in behavior and care practices and fall prevention (Spink et al., 2011). Although we observed an association between the overall practice and performance scores, each tool should be evaluated in detail in the future.

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CHAPTER 4: Evaluation of the development process and effects of a foot care program with educational tools for nurses and care workers at in-home service providers

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CHAPTER 5

Intervention study of a foot-care programme enhancing knowledge and practice among nurses and care workers at in-home service providers

CHAPTER 5

Abstract

Aims

To evaluate the foot-care educational programme for nurses and care workers at in-home service providers.

Design

A non-randomised, controlled study with quantitative methods.

Methods

Study participants were nurses and care workers of 21 in-home service providers, including home-visit nursing and care providers, one-day care service centres or care centres with rehabilitation program in Japan. Foot-care programme with foot-care tools as a package, or standard care comprising 3-5 sessions over 2 months was provided to 110 participants. The outcomes were changes in foot-care knowledge and scores in before-after-interventions. Data was analysed with descriptive statistics, t-test, logistic regression analysis, ANCOVA, and Pearson correlation.

Results

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Before adjusting for background, total scores for knowledge and practice categories were higher than the baseline in the intervention group (43 participants) compared with the control group (44 participants). After background correction, group comparisons showed significant differences in skin and consultation subscale scores between both groups.

Keywords: Nurse, foot, self-care, aging

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5. 1. Introduction

Aging poses serious foot-care challenges for older people. Aging is associated with structural, functional and physiological changes in the circulatory, skeletal, nervous and dermatological systems, resulting in a range of foot problems, such as thickened or ingrown nails, corns and calluses; structural toe defects, such as hallux valgus, arch deformity, maceration, fissures or cracks between toes and fungal infections (Guidozzi, 2017; Rodríguez-Sanz et al., 2018). Previous studies have emphasised that foot problems are associated with pain (Garrow, Silman, & Macfarlane, 2004), poor balance and increased risk of gait anomalies, falls and depression (Awale, Dufour, Katz, Menz, & Hannan, 2016; Hawke & Burns, 2009; Menz & Lord, 2001; Muchna et al., 2018; Awale et al.,2017). Appropriate foot self-care may promote general health; however, it is deterred by physical decline and psychological perceptions as well as inadequate foot-care methods by older people (Stolt et al., 2012). In particular, older people have difficulty in administering foot self-care due to reduced ability to bend, vision impairments and lack of fine hand movements (Mitty, 2009; Stolt et al., 2013).

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5.2. Background

A lack of knowledge, practice and perception regarding foot-care among caregivers and health professionals negatively affects the efficacy of foot-care. Older people are more likely to seek professional help than help from family members (Miikkola, Lantta, Suhonen, & Stolt, 2019). In particular, community-dwelling older people living without any family support (Kim, Yang, & Lee, 2016) frequently seek physical care from nurses or care workers (Ergin, Belgin, & Tanyer, 2018). These individuals require foot-care regardless of the presence of foot-related illnesses.

Healthcare demands and costs are expected to increase worldwide as the global population ages (World Bank Group, 2018). The Japanese society is aging due to ongoing demographic changes, posing serious challenges for community-based healthcare systems (World Health Organization, 2017). Accordingly, the Japanese government has promoted in-home healthcare (Japanese Nursing Association (n.d)) to address the dramatic increases in nursing burden as well as the elevated costs of medical care (MHLW, 2016).

In the Japanese system, older people use two types of insurance system to obtain health services (Appendix. A). Nurses and care workers who work at in-home service providers play a great role in supporting clients who need some assistance in relation to maintaining their health, the daily activities of living and simple rehabilitation. They have contacts with the client's body during care, thus, have better opportunities to observe their foot-related problems. There is no podiatry care in Japan, unlike in other countries such as the UK, Finland and Australia (Boulton, Vileikyte, Ragnarson-Tennvall, & Apelqvist., 2005; Miikkola et al., 2019). Although nurses and care workers take care of the foot, they may overlook some foot-related issues due to the complexity of the problem in the community. The current prevalence rate of foot diseases in the community is unknown in Japan.

Previous research on foot health has focused largely on chronic diseases that affect the feet, including diabetes, rheumatoid arthritis, psoriasis and peripheral arterial diseases (Stolt, Suhonen, and Leino-Kilpi, 2017; Tenten-Diepenmaat, van der Leeden, Vlieland, Dekker, & RA Foot Expert Group, 2018; Walmsley, Williams, Ravey, & Graham, 2010; Carter, Cheung, Rome, Santosa, &

Lahiri, 2017). As such, there has been limited research on the role of nurses and care workers in foot-care for community-dwelling older people, regardless of the type of foot disease concerned (Miikkola et al., 2019; Stolt et al., 2013).

Diabetes is the predominant disease for which foot-care studies have been conducted. Stolt, Gattinger, Boström, and Suhonen (2019) have presented a summary of educational interventions in foot health, which were not limited to studies concerning diabetes; however, most of their foot-care studies have focused on diabetic patients. Various interventions have been considered to improve foot-care in older people, including the development of instruments to assess foot health (Chin & Huang, 2013; Toobert, Hampson, & Glasgow, 2000), podiatrist care (Quinton, Lazzarini, Boyle, Russell, & Armstrong, 2015), educational programmes comprising foot-care sessions for diabetic patients (Hunt, Sanderson, & Ellison, 2014; Sharoni, Rahman, Minhat, Ghazali, & Ong, 2017; Borges & Oswald, 2008; Fan, Sidani, Cooper-Brathwaite, & Metcalfe, 2013, Donohoe et al., 2000) and educational programmes for nurses to increase awareness of diabetic foot problems (Mackie, 2006; Pataky et al., 2007; Waheida, Elshemy, & Basal, 2015).

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Drawing from and analysing previous research on foot-care and clinical experiences, this study develops a foot-care programme for nurses and care workers and seeks to evaluate it *vis-à-vis*, enhancing the knowledge and skills among these professionals who assist older people as in-home service providers.

Research question

The specific research questions were: (1) What are the effects of the foot-care program on nurses' and care workers' knowledge and practice of foot-care? (2) What are nurses' and care workers' perceptions of foot-care programmes?

5.3. The study

5.3.1. Design

This was a non-randomised controlled trial with random cluster sampling method conducted in N city of A prefecture in Japan (August to October, 2019). This study followed the TREND statement (Des Jarlais, Lyles, Crepaz, & Trend Group, 2004). We have chosen EQUATOR – TRENDS checklist for describing the study.

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The participants (nurses and care workers) were recruited from 21 in-home service providers that expressed interest and willingness to incorporate the foot-care programme. Beforehand, invitation letters were sent to randomly selected 450 providers of in-home service listed by the Ministry of Health, Labour and Welfare (hereafter, MHLW). The providers include home-visit care providers, home-visit nursing providers, a day care service centre and a day care centre offering a rehabilitation programme covered by the national care insurance programme. Providers who agreed to participate in the study were non-randomly allocated to the intervention and control groups because some providers decided to participate in the control group due to their circumstance, such as summer events or shortage of personnel because of summer vacation. Each provider did not know one-another as well as the type of intervention.

The sample size was determined based on G*Power. Cohen's (Cohen, 1988) parameters for effect sizes (small= 0.2, medium= 0.5, and large= 0.8) were used. When the effect size was calculated with use of 0.5, the number of participants was 64 for each group. By considering 15% as the percentage of those predicted to discontinue their participation, 200 nurses and care workers with a ratio of

20/80% (1:4) were set as the initial target. Within the recruiting period, however, a total of 110 nurses and care workers were expected to enrol in the study. The inclusion criteria were: 1) providing physical care for clients at in-home service providers which never receive intervention programme form other studies, 2) working either part-time or full-time and having no plan to quit the job during the study.

In Japan, many care-related tasks overlap between the duties of nurses and care workers. Job exceptions are the clinical and medical practices that nurses perform under the law. In the absence of podiatry licences, unlike those reported in other countries (Boulton et al., 2005; Carter et al., 2017; Miikkola et al., 2019; Wylie et al., 2019), the number of physicians with extensive knowledge of foot and foot-care are limited. Nurses and care workers also have limited knowledge. Therefore, those working for in-home service providers have tremendous limitations in terms of reference and care.

The primary outcome was knowledge and practice scores collected at a before-after intervention for both groups. Before the intervention, demographic data were obtained, including, sex, profession, working status, age, working

experiences and the number of clients cared for in a day. The instrument was employed to assess foot-care knowledge and practices of the nurses and care workers. The knowledge category consisted of 7 scales (nail, skin, vascular and neurologic disorder, toe and arch, infection, shoes and socks and sedentary behaviour) with 30 questions coded as a 'yes' (1 point), 'no' (0 point), or 'I do not know' (0 point). The practice category consisted of 6 subscales (skin assessment, nail, skin, hygiene, movement and toe exercise and consultation) with 20 questions coded as a 'strongly relevant' (5 points), 'more relevant' (4 points), 'neutral' (3 points), 'less relevant' (2 points) and 'not relevant' (1 point). Higher scores indicated higher knowledge and practice of foot-care. Content validity of the instrument was well examined by a review of the abundant literature, 4 experts, 2 nurses and 1 care worker on the field, 9 experts with CVI method, a panel of 6 experts consisting of 3 university faculty members with relevant experience in foot research, one surgeon with extensive knowledge of foot, one field nurse with foot-care certification from a private school, and one foot-care worker with more than 20 years' experiences. The reliability coefficient of practice subscales was evaluated with Cronbach's alpha and the ceiling effects

via two-stage studies. A high accuracy rate of knowledge items was achieved.

The second outcome was programme-related learning. The instrument measured participants' perception of increasing knowledge on hygiene and exercise, the effect on sedentary behaviour on a body, early detection of foot, vascular and neurologic impediment, skin and nails. It was also asked if they were willing to learn about foot in future and they want to increase interest in foot. Participants were asked 9 questions coded as 'I do not think at all' (1 point), 'I do not think' (2 point), 'I do think so relatively (3 points) and 'I think' (4 points) at the post intervention period.

5.3.2. Method

The foot-care programme was developed with integrated tools as a package for this study. Foot-care knowledge and practice of nurse and care workers as well as working circumstances of them are different. Therefore, a variety of tools were prepared as introductory educational foot-care program.

The tools included: 1) an 68-slide power point presentation material (hereafter PPT), 2) a 10-minute motion picture material (hereafter MP), 3) a

19-page picture story card, 4) a 78-page foot-care note, 5) a one -page foot-care assessment sheet, 6) a one-point foot-care advice card. A nail file for each participant and a foot file for each provider were given. Animation characters, 'Hikaru, Mamoru, and Spica' (character names) coming from a planet called 'foot star,' were developed for the study and used in all the tools.

The design and contents of foot-care programmes were conceived from previous studies regarding foot-care management for diabetic patients or from those regarding nursing and other health professions, in which foot-care needs were noted (Keller-Senn, Probst, Imhof, & Imhof, 2015; Mackie, 2006; Pataky et al., 2007; Jones & Gorman, 2004; Kaya & Karaca, 2018; Menezes, Lopes, & Nogueira Lde, 2016; Pendsey & Abbas, 2007; Scain, Franzen, & Hirakata, 2018; Seyyedrasooli et al., 2015). Dorresteijn (2016) has detailed the essential concepts for foot-care programmes.

Previous studies have demonstrated the use of various tools to enhance diabetic patients' knowledge and practice on foot-care through intervention studies. Some of these tools include power point presentations, pamphlets, iPads, forms to review on foot self-care, foot-care kits (soap, towel, washcloth

mirror etc.), assessment tools (monofilaments) and webpages linked to PDF (Borges & Oswald, 2008; Hunt et al., 2014; McDonald, Shah, & Wallace, 2013; Sharoni et al., 2017; Waheida et al., 2015).

Three to five sessions were held with the tools during a 2-month survey period. Each session was conducted at the daytime or nighttime, depending on provider's work condition. Table 5-1 shows the procedure of the programme. Interventions and data collection were conducted by the primary researcher who is a registered nurse with an authorised certificate in foot-care from the Japanese Society of Foot-care and Podiatric Medicine (Web site available only in Japanese, 2019) and a foot-care related certificate from the Japan Fusspflege school (Web site available only in Japanese, 2019). Participants in the control group offered regular care. At the end of the interventions, we collected the information on the exposure to the tools by asking the participants in both the pre- and -post intervention groups anonymous questions (Table 5-2).

Table 5-1: Contents of intervention sessions

Session	Contents	Setting
Session 1	PPT: Introduction of the programme, Discuss the purpose and necessity of the study, foot-care regulation, association between national budget/social issue and foot problem, anatomy, physiology of nail, skin, toe, foot, a variety of foot-care practice. 10-minutes motion pictures: Foot-care practice including method of foot bath, cutting nail, arrange nail edge with file, removing pain for ingrown nail. Other materials (19-page picture story card, 78-page foot-care note, one-page foot-care assessment sheet) were given to each provider. Toenail file was given to each participant	Daytime or nighttime 5 to 10 participants
Training Session 2	The main researcher (KF) demonstrated participants how to assess client's feet and to use foot file or nail file or foot massage. Foot file was given to each provider.	Daytime or nighttime 1 (individual training) to 10 participants (group training)
Follow up Session 3	Follow up session: The researcher demonstrated participants how to assess client's feet and to use foot file or nail file or foot massage. Foot file was given to each provider. One-point advice card was given	Day tome or nighttime 1 to 3 participants for one-day service centre or one-day care centre offering rehabilitation. 5 participants for home visiting provider
Follow up Session 4	Follow up session. The researcher shared foot assessment and skills with one or two available participants and asked her/him to do same thing at the time Foot models were clients with consent	Same as above
Items of practice	Corn or callus on the sole	How to use and reduce the corn and callus with foot file.
	Nail edge was not even	How to use nail file to arrange the edge smoothly.
	Oedema on the foot and low extremity	How to exercise lymph massage and teach to prevent further oedema by introducing foot exercise or recommending the feet to place higher from the bed height when sleeping and move foot as much as you can when sitting.
	Maceration of skin between toes	After washing, dry skin between toes. Place gauze and tissue between toes, but regularly change it and watch the gauze

	or tissue create another problem on skin.
Thickness of keratin	How to use foot file.
Ingrown nail	How to do cotton packing or taping. How to assess toe between and prevention with use of tissue or gauze.
Together toes	Advise staff and client to see dermatology doctor or if it difficult to see, to ask doctor regularly to be seen.
Obviously suspected feet with fungal infection on skin and nails redness no skin of toes due to deformity of toe	Selection of shoes was introduced to clients.
Skin was dry,	To apply ointment or moisturiser.

Table 5-2: Questions about exposure to each tool

		0 point	1 points	2 points	3 points
1	Power point presentation	No participated	Participated		
2	Watching motion picture	No participated	Participated		
3	One-point advice card	Never read	Read a little	Read	
4	Number of foot-care Practice (practice with author or practice alone)	0 time	1 time	2 to 3 times	4 times
5	Number of watching Motion pictures besides first session	0 time	1 time	2 to 3 times	4 times
6	Picture story cards	Never used	Used a little	Used	
7	Foot-care note	Never used	Used a little	Used	
8	Foot assessment sheet	Never used	Used a little	Used	

5.3.3. Analysis

The participants included in the analysis were those who answered 80% or more of the knowledge (24 out of 30) and practice questions (16 out of 20) at both. We excluded one person who answered 'I don't know' for all the questions. Data was analysed with descriptive analysis. For knowledge score, an answer of 'I do not know' was counted as 'no'. In the case of 'no answer', knowledge problems were counted as incorrect answers. The background of each group was first compared for the comparability between the intervention and control groups. The Chi-square test or student's t-test was applied. After confirming that the distribution of each evaluation item was not significantly different from the normal distribution, student's t-test was applied for the score change between the intervention and control groups. The t-test was used for the score changes for the before and after intervention of each group. Because randomisation was not possible, propensity scores (predicted probability that each participant belongs to the intervention group) were calculated with multiple logistic regression analysis for background adjustment. To calculate the propensity score, the following variables were used; the dependent variable was intervention (intervention or

control), the independent variables were gender (male or female), profession (nurse or caseworker), work status (part time or full time), age, year of work experiences in the current profession, the number of clients cared for per day.

The reason for using the propensity score is that the number of subjects in this study was not sufficiently large, and there was a concern about the decrease in power due to a decrease in the degree of freedom in the adjustment by ordinary analysis of covariance (ANCOVA). The effects of intervention were verified by analysis of covariance (ANCOVA) with the change of each evaluation item (after-before) as dependent variables. The independent variables were interventions (intervention /control), the propensity scores and the pre-intervention performance of the evaluation item. Data were input by two separate teams simultaneously with the same information using an outsourcing company.

5.3.4. Results

Figure 1 shows the consort. The analysis was 43 for 11 providers in the intervention group and 44 for 10 providers in the control group.

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Mean ages were 47 (SD = 11.8) and 50 (SD = 11.6) years in the intervention and control groups, respectively. Working experiences were 12.1 (SD = 10.2) and 14.8 (SD = 11.6) years, respectively. Data indicated that the educational foot-care program resulted in significant improvements in some areas of practice (question 1). Participant perceptions were quite high (>50% responded ‘I think so’) in the understanding of hygiene and the effects of sedentary behaviours on the body. Table 3 shows the demographic data and daily activity information.

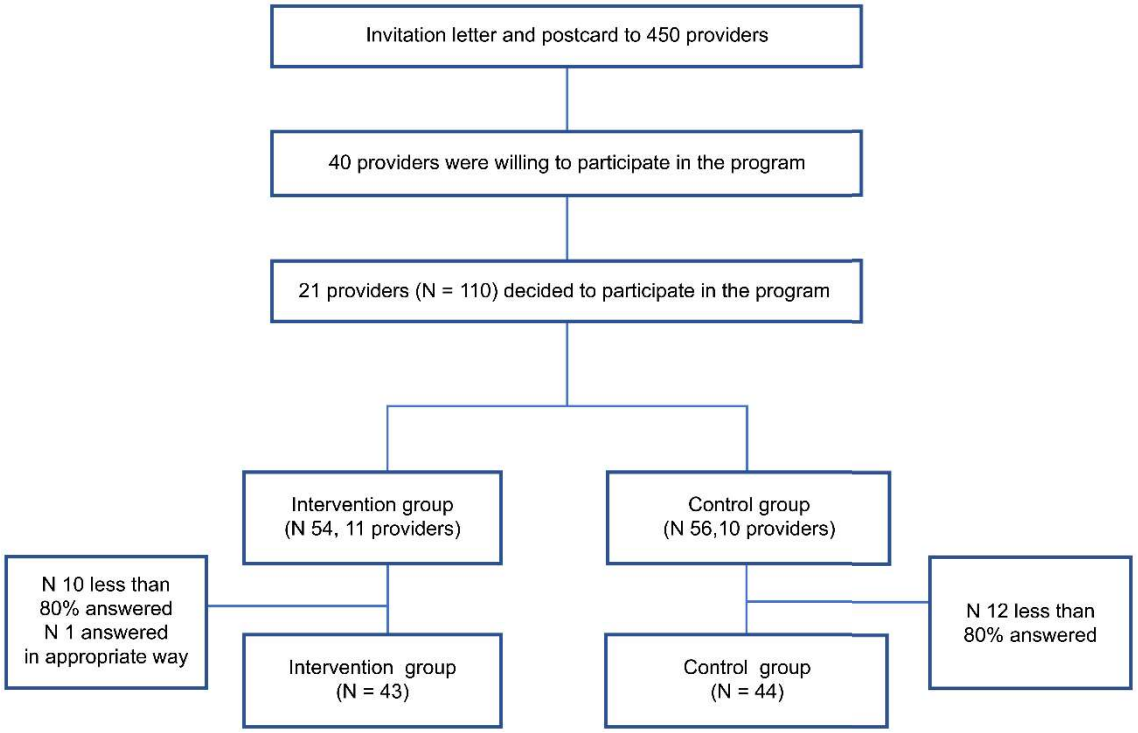

Figure 5-1: Consort of participants

Table 5-3: Demographic characteristics

		Intervention n 43 (100%)	Control group n 44 (100 %)	*p-value*
Sex	Mail	11(25.6)	2 (4.5)	0.007**
	Female	32(74.4)	42(95.5)	
Professio n	Nurse	10 (23.3)	18(40.9)	0.108
	Care workers	33(76.7)	26(59.1)	
working status	Part-time	13(30.2)	23(52.3)	0.050*
	Full-time	30(69.8)	21(47.7)	
		Mean (SD)	Mean (SD)	*p-value*
Age		47.0 (11.8)	50. (11.6)	0.189
Working experiences (year)		12.1 (10.2)	14.8 (11.6)	0.251

The number of clients cared for the day	3.1 (1.2)	2.4 (1.2)	0.017*

Note: Fisher's test: Sex, profession and working status Age, Student t-test: working experiences, the number of clients cared for the day *p<0.05, **p<0.01, *** p<0.001

Figure 5-2 shows the results of the exposure to the tools. Out of 43 participants, 42 were able to attend session 1 (power point presentation and motion pictures). Some providers were not able to set the time for session 2. Therefore, session 2 was replaced by session 3. Nighttime training session was conducted for home-visit providers or some day care service centres or day care centres because of work circumstances. For the training session, the main author assessed each client's feet with consent and shared the information and demonstrated the relevant part of care (e.g., arranging nail edges with a nail file). Then, the main researcher asked the participants to perform the rest of care (e.g., arranging nail edges with a nail file) in front of the author so that the author can explain how to properly use the file, thereby modifying participants' skills/practice. In the case of clients who were not available because of nighttime session, a dummy was used to explain the foot-care. To avoid confusion, the author repeatedly told participants that the study intervention is for nurses and care workers, not directly for the client.

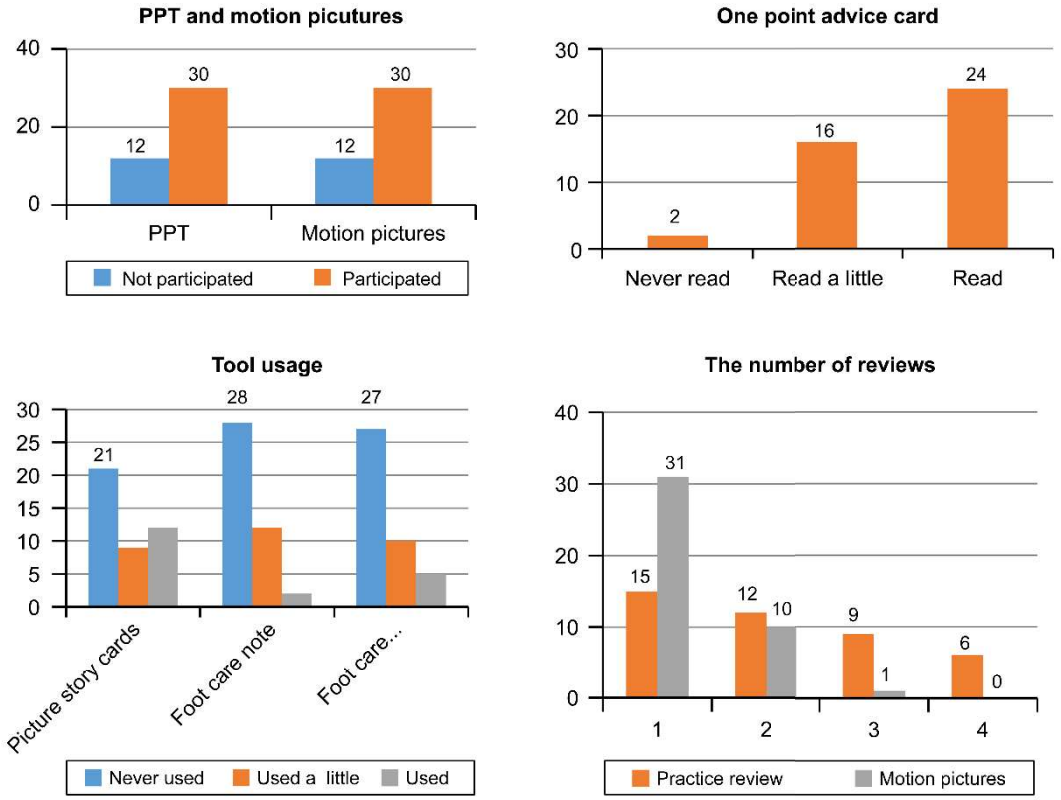

Figure5-2: Result of exposure to the tools (program participation) See Appendix for questionnaires

Before adjusting for demographic characteristics (Table 5-4), the significant differences of knowledge and practice was not recognized between the intervention and control groups. Scores of the subscales of nail, skin infection, shoes and sedentary behaviour in knowledge category and of the subscales of skin and consultation in practice category were significantly improved from the baseline in the intervention group. Score changes of these

subscales were higher compared to the control group.

After adjusting for the deflection of the demographic characteristics with logistic regression analysis (Table 5-5), significant differences were recognized in the subscale of skin and a consultation in the practice category with ANCOVA between the intervention and the control group (p-0.041, p-0.037). The changes in score of these subscales were higher in the intervention group compared with the control group (1.17, 1.08 vs -0.08, 0.20) (Table 5-4). The practice score of nail and movement and toe exercise were higher in the control group compared with the intervention group.

Figure 3 shows the perception of learning after the intervention. The instrument measured participants' perception of increasing knowledge on nail, skin, neurologic and vascular impediments, toe hygiene and exercise, early detection on foot as well as sedentary behaviour. It was also asked if they want to increased interest in foot and willingness to learn about foot in future. Overall, 95.3% (48.8% 'I think so', 48.5% 'I think so relatively') responded willing learn more about foot-care. 90.5% (53.5% 'I think so', 37.2% 'I think so relatively') became interested in foot-care. With regard to perception of increase of

knowledge (answers: ‘I think so’ and ‘I think so relatively’), the ratio of participants responded was 93% in toe exercise and hygiene, 88.4% in sedentary behaviour, 79% in early detection of foot, 69.8% in vascular, 65.1% in neurology, 81.4% in skin care and 88.4% in nail care.

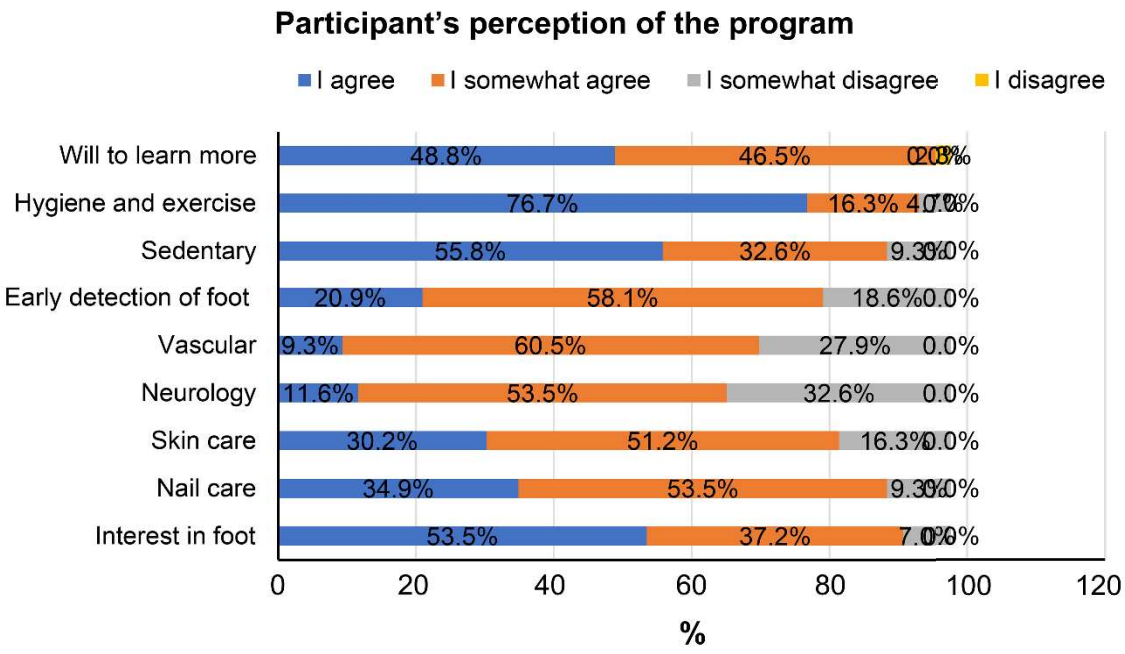
Participant's perception of the program
I agree
I somewhat agree
I somewhat disagree
I disagree
Will to learn more
Hygiene and exercise
Sedentary
Early detection of foot
Vascular
Neurology
Skin care
Nail care
Interest in foot
48.8%
46.5%
76.7%
16.3%
55.8%
32.6%
20.9%
58.1%
18.6%
9.3%
60.5%
27.9%
11.6%
53.5%
32.6%
30.2%
51.2%
16.3%
34.9%
53.5%
53.5%
37.2%
0
20
40
60
80
100
120
%

Figure 5-3: Learning perception after intervention

Note: 1) Would you like to learn more about foot care? 2) I thought hygiene and toe exercise are important, I increased knowledge of 3) Long-term sedentary behavior affects health 4) Early detection of foot problems, 5) Foot circulation, 6) Foot neuropathy, 7) Foot skin care, 8) Foot nail care 9) I became interested in foot care

Table 5-4: Analysis of knowledge and practice score before adjustment

Knowledge Subscales	Time	Intervention n 43 Mean	SD	Control group n 44 Mean	SD	*p-value*
Nail (5item) Score (0～5)	Before intervention	4.33	0.75	4.52	0.70	0. 207
	After intervention	4.74	0.58	4.82	0.39	0.487
	Changes (before and after)	0.42	0.70	0.30	0.67	0.403
	p-value	<0.001***		0.005**		
Skin (6 items) Score (0～6)	Before intervention	3.98	1.24	3.82	1.21	0.548
	After intervention	4.79	1.12	4.45	1.44	0.229
	Changes (before and after)	0.81	1.35	0.64	1.31	0.536
	p-value	<0.001***		0.002**		
Vascular and Neurologic (5 items) Score (0～5)	Before intervention	4.33	0.81	4.20	1.13	0.568
	After intervention	4.40	1.00	4.48	0.95	0.697
	Changes (before and after)	0.07	1.22	0.27	1.09	0.415
	p-value	0.710		0.103		
Toe and Arch (5 items) Score (0～5)	Before intervention	4.28	1.10	4.36	0.94	0.701
	After intervention	4.42	0.82	4.52	0.79	0.549
	Changes (before and after)	0.14	1.32	0.16	0.99	0.938
	p-value	0.492		0.291		
Infection (3 items) Score (0～3)	Before intervention	2.47	0.74	2.41	0.82	0.738
	After intervention	2.72	0.50	2.52	0.73	0.145
	Changes (before and after)	0.26	0.82	0.11	0.92	0.449
	p-value	0.047*		0.417		
Shoes and socks (4 items) Score (0～4)	Before intervention	2.44	1.01	2.61	0.97	0.420
	After intervention	3.07	0.94	2.95	0.96	0.573
	Changes (before and after)	0.63	1.13	0.34	1.06	0.225
	p-value	<0.001***		0.038*		
Sedentary behaviour (2 items) Score (0～2)	Before intervention	1.63	0.58	1.50	0.66	0.341
	After intervention	1.88	0.32	1.70	0.46	0.040*
	Changes (before and after)	0.26	0.66	0.20	0.55	0.695
	p-value	0.015*		0.018*		
Total Score (0～30)	Before intervention	23.44	3.00	23.43	4.12	0.990
	After intervention	26.02	3.18	25.45	3.68	0.443
	Changes (before and after)	2.58	3.39	2.02	3.30	0.438

	p-value	<0.001** *		<0.001** *		

Practice subscales	Time	Intervention n 43 Mean	SD	Control group n 44 Mean	SD	*p-value*
Skin assessment 3 items (3 to 15 points)	Before intervention	7.42	2.18	6.82	2.62	0.249
	After intervention	7.91	2.41	7.20	3.30	0.260
	Changes (before and after)	0.49	2.49	0.39	2.74	0.856
	p-value	0.206		0.355		
Nail 5 items (5～25)	Before intervention	14.12	3.90	11.89	4.46	0.015*
	After intervention	14.58	3.48	13.45	5.03	0.229
	Changes (before and after)	0.47	3.51	1.57	3.27	0.133
	p-value	0.389		0.003**		
Skin 4 items (4～20)	Before intervention	13.16	2.94	12.68	3.70	0.504
	After intervention	14.16	2.19	12.77	3.63	0.034*
	Changes (before and after)	1.00	2.65	0.09	3.23	0.155
	p-value	0.017*		0.853		
Hygrines 3 items (3～15)	Before intervention	10.77	2.38	10.66	2.33	0.831
	After intervention	11.21	2.26	11.00	2.43	0.679
	Changes (before and after)	0.44	2.44	0.34	2.57	0.852
	p-value	0.242		0.384		
Movement and toe exercises 3 items (3～15)	Before intervention	10.09	2.53	9.50	3.42	0.362*
	After intervention	10.09	2.27	9.80	3.16	0.616
	Changes (before and after)	0.00	2.98	0.30	2.79	0.635
	p-value	1.000		0.486		
Consultation 2 items (2～10)	Before intervention	4.88	2.08	4.61	2.23	0.562
	After intervention	5.84	1.93	4.93	2.27	0.048*
	Changes (before and after)	0.95	2.10	0.32	1.81	0.135
	p-value	0.005**		0.251		
Total Total scores (20～100)	Before intervention	60.44	11.78	56.16	14.28	0.131
	After intervention	63.79	9.29	59.16	15.47	0.095
	Changes (before and after)	3.35	10.80	3.00	11.75	0.886
	p-value	0.048*		0.097		

Note: Student t-test: before and after intervention of each subscale

Paired t-test: comparison between intervention and control group

*p<0.05, **p<0.01, *** p<0.001

Table 5-5: Analysis of knowledge and practice score after adjustment

	Intervention n=43			Control group n=44			
Knowledge subscale	Changes (before and after) Mean after adjustment	95% Cl Lower and upper limit		Changes (before and after) Mean after adjustment	95% Cl Lower and upper limit		*p-value*
Nail	0.33	0.18	0.47	0.38	0.24	0.53	0.616
Skin	0.79	0.42	1.17	0.66	0.29	1.02	0.621
Vascular and neurologic	0.07	−0.23	0.37	0.28	−0.02	0.57	0.353
Toe and arch	0.10	−0.16	0.35	0.20	−0.05	0.45	0.579
Infection	0.29	0.09	0.49	0.08	−0.12	0.27	0.148
Shoes and socks	0.59	0.30	0.88	0.38	0.09	0.67	0.339
Sedentary behaviour	0.30	0.18	0.43	0.16	0.04	0.28	0.106
Total	2.49	1.56	3.42	2.11	1.19	3.03	0.580
Practice subscales							
Skin assessment	0.68	−0.12	1.48	0.20	-0.59	0.99	0.422
Nail	0.95	−0.08	1.98	1.10	0.07	2.12	0.852
Skin	1.17	0.37	1.98	-0.08	−0.87	0.72	0.041*

Hygiene	0.61	−0.07	1.29	0.18	−0.50	0.85	0.395
Movement and toe exercise	0.13	−0.64	0.90	0.17	−0.60	0.93	0.952
Consultation	1.08	0.52	1.63	0.20	−0.35	0.75	0.037*
Total	4.61	1.34	7.88	1.77	−1.46	5.00	0.248

Note: *p<0.05

The multiple logistic regression analysis was used to calculate the propensity score to adjust background bias for intervention effect. To calculate the propensity score, the following variables were used; the dependent variable was intervention (intervention or control), the independent variables were gender (male or female), profession (nurse or caseworker), work status (part time or full time), age, year of work experiences in the current profession, the number of clients cared for per day.

The effects of intervention were verified by the score changes of each item of foot care knowledge and practice (after-before) as dependent variables. The independent variables were interventions (intervention /control), the propensity scores and the pre-intervention scores of each item of foot care knowledge and practice.

5.4. Discussion

This is first non-randomised interventional study to identify the efficacy of the foot-care programme for nurses and care workers at in-home service providers. Data were collected before and after the intervention and they show a significant improvement of practice in the intervention group. Participants' learning perception varies depending on the questions, but more than 50% perceived better learning in the intervention group.

The strength of the programme is its focus on nurses and care workers. Additionally, care workers were included in the study because of their countless roles in detecting signs and symptoms of health issues at home services (Haugstvedt, Aarflot, Igland, Landbakk, & Graue, 2016; Tingström et al., 2015). Many older people living in the community were not able to care for their feet due to the physical changes of aging. A variety of foot problems were reported (Muchna et al., 2018; Nguyen et al., 2010). Nurses and care workers play a key role to supplement the insufficiency of self-foot care of older people (Stolt et al., 2012). The results of this study echo that of a previous study on the efficacy of nursing educational sessions. Another strength of this study was a combination

of intervention tools as an integrated package. To account for learner variability in terms of foot-care education in Japan and work time constraints, the author developed several tools to provide more opportunities to expose foot-care learning. The method employed by such tools included combined listening, watching, reading and interactive exercising.

Our findings showed significant differences in skin, consultation in practice, total score of practice in the intervention group after adjusting for background data. Previous literature reported the effectiveness of practice sessions. Fan and colleagues (Fan et al., 2013) presented the effectiveness of the intervention by conducting 1-hour hands-on practice of strategies and two 10-miunte telephone contact booster sessions. Another study indicated that both individual and group training were effective (Seyyedrasooli et al., 2015). This study employed 10-to-20-minute practice sessions with a mix of a large and small group approach. Despite the short time, it showed that the intervention was effective in practice to some degree.

Skin checks and care of the feet were emphasised in a series of interventions. The scattered delivery of information of this area may lead to an

improvement of the scores. Skin problems were high because of aging (Laube, 2004). Questions about the foot file were not included in the questionnaire. However, since there were clients who have issues of keratotic lesions (corns and calluses) at the time of assessment, how to use the foot file was included in the training session. In a large-scale epidemiology study, Menz (2016) stated that keratotic lesions triggered by nail disorders and structural deformities commonly result in foot pain. This highlights why the use of the foot-care file should be included in future evaluations.

Sharing information with the participants by assessing the client's feet together led to a score improvement in consultation. During the training sessions, the main author suggested medical examinations and treatment by referral to a dermatologist based on foot assessment. The issue of referral to podiatrists is well reported in other countries where they play a role in foot-care (Boulton et al., 2005; Wylie et al., 2019; Spink et al., 2011). In Japan, licensed podiatrists and or podologists do not exist, though there are medical professionals or foot-care workers who have some form of training certificates. Factors such as lack of foot-care education for clients as well as for nurses and

care workers, transport access (Varela et al., 2019; Syed, Gerber, & Sharp, 2013), perception of foot-care (Chan et al., 2012; Persaud et al., 2018), and lack of physicians with foot specialty hinder referrals to doctors with extensive knowledge of foot and foot-care. The possibility of fungal infections occurring on the foot (Suzuki, Mano, Furuya, & Fujitani, 2017) suggests the need for not only nurses or care workers to properly examine the skin and nail of the foot when rendering in-home services but also doctors. Any subscale of knowledge did not show significant differences between the groups. This study contained a variety of topics with short time. Establishing solid knowledge may require restricting the knowledge parameters to a certain time span.

Before adjusting for background data, a total of the scores in subscales of knowledge and practice improved for both groups. This study was not able to execute randomise allocation. The number of providers was willing to join the foot-care programme; however, they requested to be in the control group due to the time schedule or difficulties with attending all the sessions. Therefore, the number of the allocations was almost even. There were more females, nurses,

participants with part-time statuses, age and those with extensive working experiences in the control group.

The score changes for the nail in knowledge category significantly improved in the intervention group at the before-after interventions, however, score changes for the nail in practice category improved higher in control group. Due to time constrains and insufficient nail cutting materials, interventions to enhance nail practice skills had some limitations. Uneven knowledge and skills of the nail of each participant at the time of intervention may reflect the results. The toenails of older people include thickened, elongated and ingrown nail. Confusion often exists concerning who should perform nail care (Malkin & Berridge, 2009). They also may not know where to consult with foot problem, however, not enough research on this issue have been reported in Japan.

The use of foot-care sessions opened the first door for nurses and care workers at in-home service providers to deal with the complexity of foot-care for older people This programme is best suited to the current Japanese society due to the predicted high prevalence of foot problems of the community-dwelling older people. Delivery of best foot-care for older people faces many hurdles.

Seeing the doctor due to foot problems is challenging for clients. Referral to the doctor with extensive knowledge and practice of foot is not customised in Japan. Therefore, wide basic knowledge and practice skills of foot and foot-care should be improved among nurses and care workers in the community.

Nurses and care worker require bending to see or care of feet, and concentration on look the site carefully while they have responsibility to carefully watch many older people going beyond frail status, in particular, one-day service providers. Foot-care time allocation in care schedule requires an understanding of the significance of the foot-care in-home visiting nurses or care providers. Like barrier to diabetic foot-care (Guell & Unwin, 2015), countless barrier to foot-care of the older people in the community. Foot-care is challenging, therefore, efficient and easy-to-understand foot-care programmes need to be further explored. Future large and in-depth studies are needed to confirm the validity of the programme developed in this study.

5.5. Limitations

There are some limitations associated with this study. Dropout rates are a

limitation of this study (n = 11 for intervention and n = 10 for control groups). Although the practice scores were significantly improved in the intervention group, it was only 20 questions. All areas of practice did not reflect in only 20 questions. Additionally, only 30 knowledge questions did not cover a variety of foot-care issues although essence of the problems was focused through extensive preparation. The instruments were newly developed and evidence of validity and reliability is limited. However, those measure important content. The exposure to all tools was difficult for participants due to time constraints. As far as practice, introduction of nail care requires time and equipment.

5.6. Conclusions

Nurses and care workers at in-home service providers have time constraints; however, improved scores of foot-care practices indicated that educational programmes as a package was effective. Studies in this area have been limited, and therefore, larger studies of a longer duration are needed to verify that such intervention enhances both the knowledge and practice of foot-care. In-depth strategies from different angles are needed to reach the target

patient population in order to reveal the improvements achieved.

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CHAPTER 5: Intervention study of a foot-care programme enhancing knowledge and practice among nurses and care workers and in-home service providers

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CHAPTER 6

Effects on older people's feet a foot care program for health professionals: Before-After Intervention study

Short title: The challenge for foot conditions of older people

CHATPER 6

Abstract

Background

Japan's increasing number of frail older people access daytime services, requiring foot care by nurses and care workers. This study explored the effects of nurses and care workers' foot care programs on foot conditions of older people attending daytime services.

Method

This was a before-after intervention study which was conducted at daycare service centers for older people. The foot care program was presented to nurses and care workers at daycare service centers over two months. The foot conditions of 23 clients (8 men, 15 women, mean age = 78.6, standard deviation = 9.2) were assessed before and after the program. Changes in foot condition and clients' perceptions after the study were analyzed by descriptive statistics and McNemar and paired t-tests.

Result

Although dramatic changes in foot conditions were not observed, some conditions were improved or maintained. Changes were observed in the mean of dry skin scores($p<0.01$; Right foot: 1.6→1.1, Left foot: 1.6→1.1), skin lesions and long nails(skin lesions R: 0.2 →0.1; long nail R: 1.4→1.0, L: 1.1→0.8), edema (R: 43.5%→39.1%, L: 52.2%→47.8%). Two participants say dermatologists. Further, clients started perceiving that foot health is important and discussed their feet with staff more often.

Conclusion

The nurses and care workers' foot care program were effective in maintaining and improve foot health in older people and positively affected their perception of foot care.

CHATPER 6

6.1. Introduction

Foot problems, including nail, skin, vascular, neurological, and bone changes, are a major concern amongst older populations. They increase due to systematic physical changes of aging, with foot pain, standing imbalance, impaired ambulation (Menz, Morris, & Lord, 2006), falling, and depression arising from foot problems, all being major concerns (Awale, Dufour, Katz, Menz, & Hannan, 2016; Menz & Lord, 2001).

Miikkola et al. (2019) reported that there is a high demand for foot care for older people at home. For frail older people, in particular, living in the community may exacerbate foot problems because of selecting inappropriate shoes, systematic physical changes, inability to self-care owing to poor vision, or lack of physical movement. Difficulty using transportation may leave them unable to access doctors, reducing daily living activities and participation in social activities (Eby, Molnar, Kostyniuk, Louis, & Zanier, 2017) and further worsening conditions. The interpretation of "frail" here uses the definition given by researchers (Cesari, Calvani, & Marzetti, 2017; Gobbens, Luijkx, Wijnen-Sponselee, & Schols, 2010) as individuals who are physically weak or need some care assistance.

In Japan, the ongoing demographic change poses serios challenges for the society. The population rate of people aged 65 and above has changed from 5.6% to 28% from 1960 to 2018 (World Bank, 2018). Hospital stays are decreasing and the focus of care is shifting from the hospital to the community. The growing number of older people in the community means the quality of their care, given the shortage of paid caregivers, is also a major concern in Japan.

As the number of older people increases, the number of people with foot problems is expected to increase, but there is limited research in Japan that captures the actual prevalence of the feet of the older people living in the community (Harada,K.,Oka, K.,Shibata, A.,Kaburagi, H., & Nakamura Y,2010; Mitsuishi, K.,Miyaji,F.,Tkahashi, K.,Yoda, N.,Tomomatsu,T,2013).

In Japan, all citizen have pubic medical insurance. In addition to that there is a system called "Long-term care insurance". Long-term care insurance includes 1) people aged 65 years or above (Category 1) and 2) people aged 40-64 years with at least one of the 16 specified conditions (Category 2). Care service applicants are categorized into two support levels and care levels 1 to 5 after screening (MHLW, 2016). All people over 65 years are eligible to apply for long-term care services, although not all of them are certified to use care services.

They are officially eligible to use services when municipalities judge their

requirements and the level of care required via the assessment process. Currently, approximately 18% individuals aged 65 or older years are people certified for the LTCI (MHLW, 2019). This percentage has changed and increased over the years. It was 11.2% in 2000 (MHLW,2000) and 16.9 % in 2010 (MHLW,2010).

The long-term insurance service is divided into home-based, community based or facility service. Daytime care services are included under community-based services category. Although services vary between facilities, they must adhere to fundamental regulations to provide daytime care services. Furthermore, service costs are higher in facilities offering rehabilitation programs by professionals.

Foot care is one area where the quality of nursing care in the community could be enhanced. Many frail older people attend daytime services and may seek foot care. Ideally, their foot health should be achieved by integrating the work of caregivers and clients. However, obstacles such as limited foot care education for nurses and care workers (NCWs), no podiatry system, low public and medical awareness of foot care, and shortages of paid caregivers impede the provision of foot care services. Therefore, the author introduces an NCW foot care program developed by the main author (Fujii & Stolt, 2020).

In this study, the foot conditions of older people in their facilities were assessed and measured to evaluate the ripple effect of the intervention.

The following were the study hypotheses:

1. The NCW foot care program will result in some improvement in clients' foot conditions, but not dramatic changes because of older people's physical characteristics.
2. Foot care perception of older people will be positively affected by the program.

6.2. Materials and methods

The design of the study was before-after intervention study. The study followed the TREND statement.

6.3. Study setting

From August to October 2019, a foot care program to enhance NCW's knowledge and practice was introduced to 21 in-home service providers such as home-visit nursing providers, daycare service centers, or daycare centers offering a rehabilitation program. Targeted providers were randomly selected from the Ministry of Health, Labor and Welfare's list of service providers. NCW, who had agreed to participate in a two-month-

long survey, participated in this study (Fujii & Stolt, 2020). The study focused clients of 10 of 11 providers in the intervention group and how their foot conditions and perception on foot were effected by foot care intervention for NCW,

All clients could be influenced by the changing NCW foot care knowledge and practice; however, two or four clients were recruited from each facility, and their foot care was monitored during practice sessions for the approximately two-month study period. These participants' foot conditions were followed during the study period.

The NCW foot care program consisted of 3 to 5 separate sessions conducted by the main author. The program comprised a PowerPoint presentation, motion pictures, and foot care practice sessions. It was developed based on a literature review, established guidelines, and a specialist's advice. Picture story cards, foot care booklets, assessment sheets, and foot files were provided for each facility, and each participant received a one-point advice card and nail file. (Fujii & Stolt, 2020). The care sections varied across the facilities; although, in most cases, a separate room or space was provided.

National research on foot care provision through daytime service centers is limited: the main author believes simple toenail care with a nail clipper is provided daily. There were no foot care professional visits for these facilities; clients with significant foot problems visited a doctor.

The facility managers agreed to select suitable clients for the study. All facilities were comfortable with selecting clients and explaining the study's purpose because they felt responsible for their care and had built trusting relationships with them. Usually, staff members are aware of their clients' characteristics and any issues that could be exacerbated by participation in the research. To my knowledge, staff members at each facility were aware of clients' foot conditions by observing them when assisting with bathing or changing socks. They listen to the clients daily and observe foot movement when walking and doing simple exercises.

The study's inclusion criteria were as follows: the client 1) attended a facility that has never offered any other foot care program and agreed to participate; 2) was identified as a candidate by the facility or the main author based on a foot assessment; 3) understood the study's contents or their family signed the agreement; 4) received foot care practice at least twice during the study period; and 5) had a high risk of foot problems, including feet with a) slight maceration or fissures between toes owing to overlapping; b) toenail problems because of potential fungal infection; c) thick keratin on the soles of toes; d) edema on the foot; e) skin lesions (e.g., callus, corn); and f) a risk of worsening owing to chronic diseases. Other conditions were also included.

Clients with normal foot conditions or an observed foot infection were excluded. The author emphasized that facility staff or managers should not pressure clients to participate.

Once the facility identified potential participants, a manager or staff member first explained the study, and verbally asked the client whether they would be interested in participating. When a client's cognitive state was such that it was felt agreement should be sought from a family member, or the facility manager or staff member considered agreement was necessary for all participating clients, a facility staff member—instead of the author—gave the invitation and agreement letters to the client's relevant family members. When the author visited the facility before the practice session, the details were reiterated to the client, and oral and written consent was obtained.

6.4. Instruments

6.4.1. Foot assessment sheets

Two kinds of foot assessment sheets (A and B) were developed for this study. Assessment Sheet A was provided to NCWs at the facility for daily use. Assessment sheet A contains some items in common with sheet B, and was simplified and easy to use for beginner learners.

The researcher used Assessment Sheet B to assess clients' feet before and after the foot care program. Items were rated as 1 for "exist" and 2 for "does not exist," or counted for some items. Assessment Sheet B items, along with definitions and measurement methods, are for analysis, presented in Table 6-1.

Table 6-1: Items of foot measurements

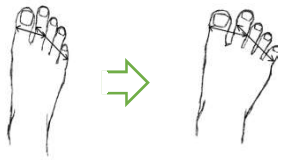
Item	Definition of measurement	Measurement	Scale definition for this study's analysis	related references
Arch deformities	Abnormal arch (e.g., high arch, flatfoot)	Examiner assessment based on Foot Look (machine) images	Exist/does not exist	flatfoot; (Japanese Society for Surgery of the Foot,2017, p33)
Ingrown toe nails	Corner edges of nails growing into the skin.	Examiner's assessment	Exist/does not exist	Ingrown toe nails (Japanese Society for Surgery of the Foot,2017, p44)
Sensitivity of toe (1st, 3rd, 5th)	Foot sensation Usually, if the subject feels numbness in two or more of the three toes, it is considered abnormal	Examiner touched the client's toes, asked whether she/he could feel it (Ipswich touch test)	Clients have feeling/do not have feeling (if he/she did not have feeling, there was a problem of sensitivity)	Ipswich touch test (Madanat et al.,2015; Sharma et al.,2014))
Foot circulation	Palpable posterior tibial arteries	Examiner palpated the pulse artery halfway between the medial malleolus posterior border and the Achilles tendon	An examiner was able to palpate the pulse or could not palpate it.	Posterior tibial arteries (Japanese Society for Surgery of the Foot, 2017, p75)

Edema	Pitting edema	Skin was pressed over the tibia, and the area pressed, +1 barely detectable, +2 slight indentation (15 seconds to rebound), +3 deeper indentation, +4 deeper indentation (above 30 seconds to rebound)	Above +2 was counted as edema in this study	(O'Sulllvian, S.B., & Schmitz, T.J, 2007)
Skin color	Skin color (red, white, purple, etc.)	Examiner's assessment	Normal skin color or abnormal skin color (red, purple, white)	(e.g., Sriyani, et al., 2013)
Toe deformities		Existence of mallet toes, hammer toes, claw toes, hallux valgus, lesser toes	Number of toes	(Dunn et al., 2004)
Skin lesions	Hyperkeratotic skin lesions (area of thickened skin caused by repeated friction, pressure). Corn usually hard and painful when pushed.	Examiner's assessment	Number of skin lesions	(Menz, et al., 2001)
Maceration between toes	Peeling and fissuring between the toes, lighter in color, sometimes white	Examiner's assessment	Number of instances	(Stolt et al., 2012; Bristow & Spruce, 2009)
Nail color change	Lack of nail color such as white or yellow	Examiner's assessment	Number of toenails	(e.g., Fawcett, et al., 2004

Long nails	Longer than fingertip	Examiner's assessment	Number of toenails	NA
Thickened nail	Nail has thickness	Examiner's assessment	Number of toenails more than 2mm above	(e.g., Dunn et al., 2004)
Skin dryness	Corneal layer water loss	Overall dry skin score [11] (ODS) EEMCO guideline Note: Specified symptom sum score (SRRC) excluded in this study	Exist or does not exist, then classified into a score of 0 to 4	(e.g., Kang BC et al., 2014; Serup J, 1995)
Suspected or existing nail fungal infection	Already diagnosed or suspected from nail color	Examiner's assessment	Number of toenails	(e.g., Eisman, 2014)
Walking speed	4-meter walking speed	Examiners or research assistants measured	Seconds	(e.g. Barbee et al., 2020)
Hallux valgus	Degree of hallux valgus	Examiners assessed based on Foot Look (machine) images The HVA was categorized into HVA $\leq$ 15°, 15 < HVA $\leq$ 20°, 20° < HVA $\leq$ 40°, and HVA > 40°	Degrees	(Coughlin MJ, & Jones CP, 2007)

[11] Overall dry skin score (ODS) A scoring scale combining all the major and minor signs of dry skin (xerosis) as follows: (citation from Kang et al.,2014)

0 Absent
1 Faint scaling, faint roughness, and dull appearance
2 Small scales in combination with a few larger scales, slight roughness, and whitish appearance
3 Small and larger scales uniformly distributed, definite roughness, possibly slight redness, and possibly a few superficial cracks
4 Dominated by large scales, advanced roughness, redness present, eczematous changes, and cracks

Widths of opening toes	Toe muscle weakness and declined range of motion	Examiners measured widths using a tape measure. Measure the length of the midpoint between the first toe and the second toe, between the second toe and the fifth toe, and then ask the subject to open the toe to the maximum, and then  calculate the difference. this research, the difference between the first toe and the second toe was measured	Cm	(Fujii K, 2018)
Toe grip strength	The toe strength seen on the screen of the machine when a client gripped the bar using the toes at maximal force for 3 seconds.	Examiners or research assistants measured with a toe-grip dynamometer (T.K.K. 3364 [12] , Takei Scientific Instruments Co. Ltd)	Kg	(e.g. Soma et al.,2016)
Floating toes	Toes which is not completely contact with the	Examiners assessed based on Foot Look[13] (machine) images	Number of toes which is not completely	(Tasaka. et al., 2016; Uritani et al.,2017)

[12] https://www.takei-si.co.jp/productinfo/detail/268.html
[13] https://footlook.co.jp/

	ground		contact with the ground.	

Dry skin was initially assessed as 1 for “exist” or 2 for “does not exist”, then was classified into based on overall dry skin scores (ODS) as outlined by the European Group on Efficacy Measurement and Evaluation of Cosmetics and Other Topical Products (EEMCO) guidelines’ clinical scoring systems (Kang et al., 2014; Lichterfeld, Lahmann, Blume-Peytavi, & Kottner, 2016; Serup, 1995). Foot sensitivity was assessed using the Ipswich Touch Test (Madanat, Sheshah, Badawy, Abbas, & Anas, 2015; Sharma, Kerry, Atkins, & Rayman, 2014), foot edema using pitting edema measurement (O’Sullivan & Schmitz, 2007), and hallux valgus using machine-based graphic assessment. If the client was not able to step on the machine for measurement, the degree of hallux valgus was measured later by observing a foot picture taken at the research site.

Both instruments were reviewed by a surgeon from the expert panel with significant knowledge of feet and foot care. Items on skin lesions were adapted from another instrument with permission from the developer, an internationally-recognized researcher.

6.4.2. Measurement equipment (For baseline data)

Foot Look (Foot Look, Inc, Japan) was used to measure floating toes and the degree of hallux valgus. Toe force measurement (T.K.K 3364 Takei Scientific Instruments, Japan) was used to measure toe-grip strength.

6.4.3. Other instruments

A demographic data sheet that included items on age, level of care under LTCI, and Barthel index was used to collect data. Data on illness history, walking time, skin temperature, degree of hallux valgus, and width between the first and second toes (when intentionally opening) were also collected. Previous studies indicated the Mini-Mental State Examination is overly long for frail, older adults; therefore, once a score of 10 points was reached, no further questions were asked. Initially, a short physical performance test battery was included; however, it was declined in this study. When the author conducted the study targeted for frail older people (submitted elsewhere), it was found that balancing and standing up from chairs caused instability or shortness of breath for frail older people, despite no previous heart problems.

Data of perception about the feet were collected from clients by asking verbal questions. Initially, internationally recognized anxiety scales were used; however, considering the complaints of some clients regarding the content.

Therefore, the questions developed for this study measured the client's perception. 1) I have started sleeping well, 2) saliva has begun emerging, 3) foot concerns have decreased, 4) I have started perceiving my feet as important, 5) I feel I can walk more easily, 6) I can move my foot more easily than before, 7) I feel I can open my toes better than before, 8) I have started consulting with staff about my foot more than before, and 9) my foot pain has reduced. I included questions related to sleeping and saliva because they may have been associated with foot conditions. Although there is not enough evidence, the main author predicted the association based on the remarks of health professionals in the field.

6.5. Outcome measurements and contents of the survey

The primary outcome was changes to clients' foot conditions after the NCW foot care program. Foot care assessment was conducted by only author before and after the intervention to avoid overburdening clients. Author is a registered nurse with an authorized foot care certificate (Japanese Society for Foot Care and Podiatric Medicine, and a foot care-related certificate (Japan Foot Care Fusspflege School; the Fusspflege Foot Care Association). The foot care program's sessions and data collection of secondary outcomes were conducted by the author. Opportunities to see doctors and to receive a diagnosis or treatment were also evaluated.

The demographic data (sex, nursing level medical condition) and baseline data of foot-related items (walking speed, skin temperature, right and left hallux valgus degree, toe-grip force, and number of floating toes) were partially obtained from other study (The study was approved by Nagoya University 2019-0150) supported by Grant-in aid for scientific research. (19K11111). Research assistants aided in the machine-measuring of foot morphology and obtaining demographic data. They attended training courses by the main author and an academic foot researcher, learned about foot anatomy and physiology, and acquired the skills to operate the Foot Look machine, toe force measurement, Mini-Mental State Examination, and Barthel index instrument.

The secondary outcome was gathering of perceptions scores from client scaled from 1 to 5 points.

6.6. Expected risks for frail older people's foot care

In general, the physical, emotional, and foot conditions of frail older people are unstable and complex. Providing foot care generally requires time and money to acquire the knowledge and skills because of the complexity and difficulty of older people's foot conditions. Fragile skin, toe deformities, and various nail problems require careful attention. Therefore, the author expected possible incidents and prepared responses for potential client risks such as pain, bleeding, stumbling, or raised blood pressure, which had been reported in past clinical experience and research by NCWs. During a series of foot care programs, the author briefly mentioned the following risks that could be expected during these programs.

1. Skin may be torn by washing the client's feet while assisting in bathing them.
2. When a staff member recommends the client perform toe exercises, extra pain may be generated.
3. When a staff member gain knowledge of the foot care, staff may get overly confident owing to gaining knowledge of cutting nails and may cut their flesh accidentally, leading to slight bleeding.
4. When a staff scrapes the client's nail edge, the nail file may touch the client's skin, which could result in slight bleeding.
5. When a staff member scales the sole of the foot using foot files, clients may express pain.
6. When a staff takes care of skin close to the nail edge, clients may start feeling foot pain.
7. Clients may start to complain that they have recently been told about their foot too much.
8. Client may complain of too much exercise when they are encouraged by the staff to exercise or stand, even though they already engage in such activities.
9. Clients may come close to stumbling when they stand up because the staff told them to stand up sometimes to protect their health.
10. When staff and clients start cleaning toes because they realize that toe hygiene and toe exercises are important, but the clients' blood pressure rises.

6.7. Analysis method

Since the author independently assessed each client's foot, a foot care professional was consulted to corroborate the rating scores for some cases based on pictures or digital foot views by providing anonymous data. Demographic data and foot perception were analyzed using descriptive statistics. The changes in clients' foot conditions, assessed

before and after the foot care program, were analyzed with McNemar (Table 6-4) or paired t-test (Table 6-5). *P*-value of <0.05 were considered statistically significant in all tests. SPSS Statistics 24 (IBM Corps) was used for all analyses.

6.8. Results

Figure 6-1 shows the TREND flowchart for the study. Table 6-2 presents demographic data and the results of participants' foot-related items. Of the 28 participating clients, data from 23 clients (8 men, 15 women, mean age=78.6, standard deviation=9.2) across ten facilities were analyzed. Four clients dropped out owing to sudden hospitalization, and they were excluded from the study. Another client was excluded due to excessive missing data. The results showed that 39.1% and 21.7% of clients were assigned to nursing care levels 2 and 3, respectively, and 56.5% and 43.5% were diagnosed with high blood pressure and brain-related problems, respectively. Clients under Category 2 or 3 tended to require more nursing care. Table 6-3 shows characteristics of foot related data at before-intervention. The right and left toe grip strength are 3.3 kg and 3.5 kg respectively.

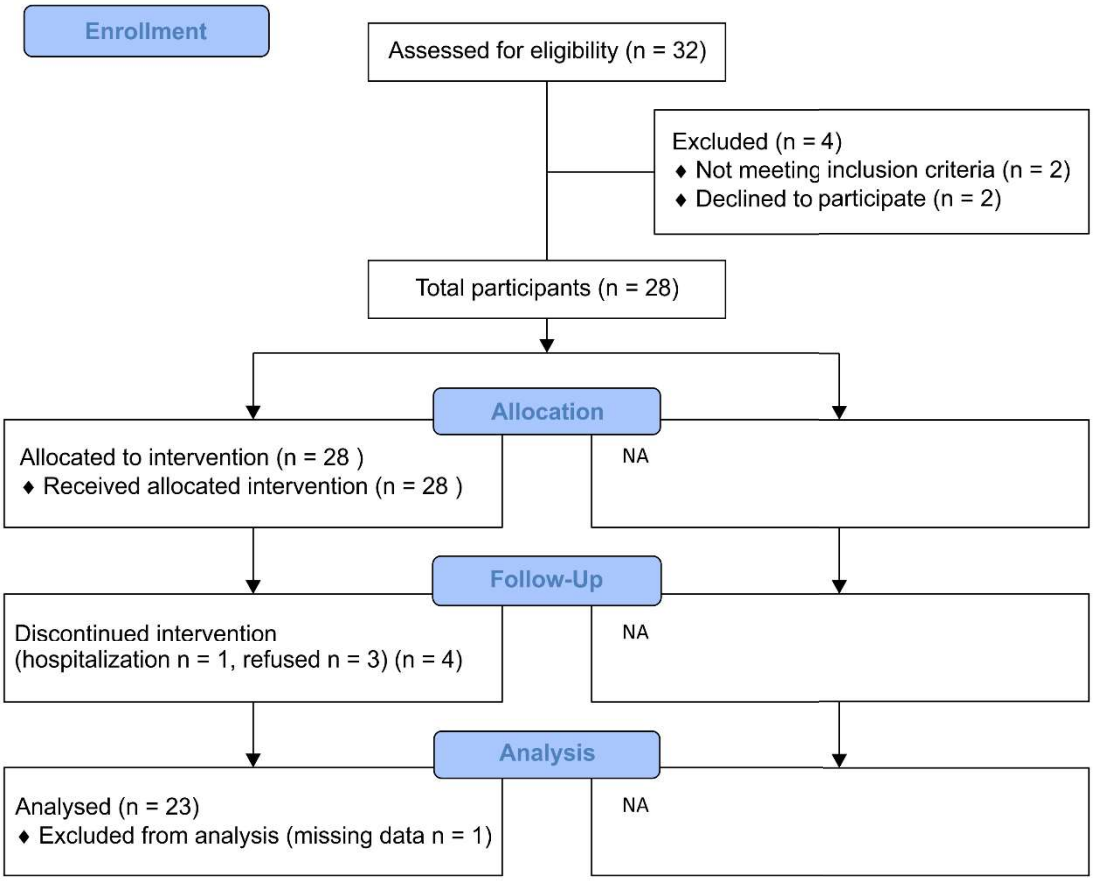


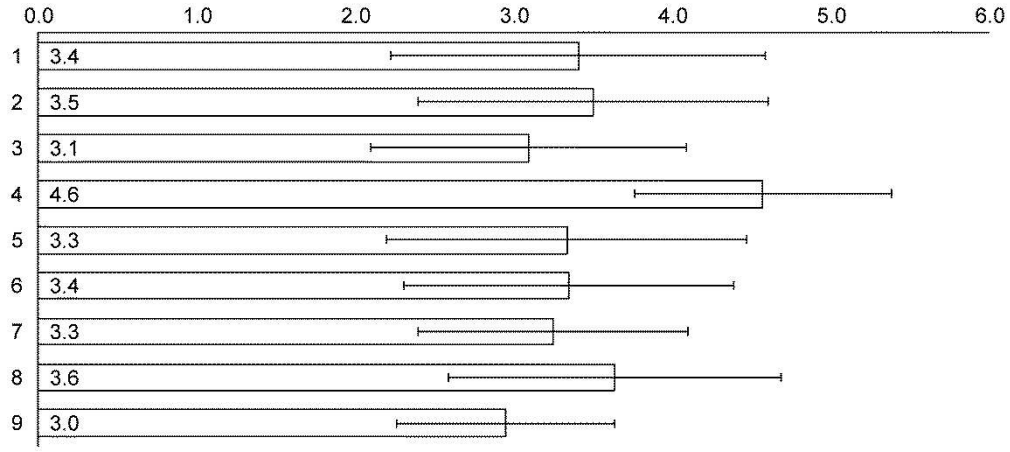
Figure 6-1: Flow diagram of study participants of day care centers and day care service centers offering a rehabilitation program
Note: finally, foot conditions of 23 participants of facilities were analyzed. The facilities included day care centers, daycare centers offering a rehabilitation program. Day care centers and day care centers offering a rehabilitation program are similar but different. The latter one offer rehabilitation program by professional staff of rehabilitation such as physical therapist or occupational therapist under doctor's order. Usage fee were higher. There are differences in operating standards and personnel standards from day service centers.

Tables 6-4 and 6-5 present participating clients' foot and ankle characteristics before and after the program. No significant difference was observed in arch deformity, ingrown nail, edema, skin color at before-after intervention. 91.3% of participants felt their toes to be touched. On the other hand, the examiner was not able to palpate the pulse on the posterior tibial arteries of majority of clients. The mean of dry skin scores of both right and left feet were significantly improved based on the foot assessment items ($p<0.01$; Right foot: 1.6→1.1, Left foot: 1.6→1.1). After the study, the mean numbers of skin lesions and long nails had reduced (skin lesions R: 0.2→0.1; long nail R: 1.4→1.0, L: 1.1→0.8), as reported by one client. The mean number of nails, with an existing or suspected fungal infection, before and after the program remained unchanged. However, two participants saw a dermatologist and obtained a fungal infection diagnosis during the

study. The number of clients with edema also decreased (R: 43.5%→39.1%, L: 52.2%→47.8%)

Before the study, three clients had long and untidy toenails. After the program, the assessment revealed that their toenails were cut correctly, and the nail edges were smooth and short.

Fig 6-2 illustrates the results of foot perception after the program, revealing that clients started perceiving their feet as important, and they could discuss their feet with staff more than before (means: 4.6 points, 3.6 points, SDs: 0.8, 1.0, respectively). The means of “other items” are 3.0 to 3.4 points (SD 0.7~1.0).



1) I have started sleeping well, 2) saliva has begun emerging, 3) foot concerns have decreased, 4) I have started perceiving my feet as important, 5) I feel I can walk easier, 6) I can move my foot easier than before 7), I feel I can open my toes better than before, 8) I have started consulting with staff about my foot more than before, and 9) my foot pain has reduced.

Figure 6-2: Foot perception of clients after the foot care program (mean and standard deviation)

Note: Examiner orally asked questions regarding perception on foot at one-point time. There are five scales to answer; 1) Yes, I do, 2) I think, I do, 3) I am not sure, 4) I do not think, I do, 5) No, I do not.

Table 6-2: Demographic characteristics

N=23

Item	Category	n	Rate
Sex	Men	8	34.8%
	Women	15	65.2%
Nursing level	Support-level 1	0	0.0%
	Support-level 2	5	21.7%
	Care-level 1	3	13.0%
	Care-level 2	9	39.1%
	Care-level 3	5	21.7%
	Care-level 4	1	4.3%
	Care-level 5	0	0.0%
Medical condition (Already diagnosed) *			
	Diabetes	6	26.1%
	High blood pressure	13	56.5%
	Kidney disease	2	8.7%
	Arteriosclerosis	0	0.0%
	Heart-related disease	6	26.1%
	Brain-related disease	10	43.5%
	Rheumatoid Arthritis	1	4.3%
	High lipid condition	8	34.8%
	Lung-related disease	0	0.0%
	Incontinent	3	13.0%

Note: Medical condition: multiple answers. Care service applicants for long -term care insurance are categorized into two support levels and care levels 1 to 5 after screening

Table 6-3: Characteristics of foot items at before-intervention N=23

Items	N	Mean	SD
4-meter walking speed	20	7.4 seconds	2.1
skin temperature	23	34.5 degree	2.0
R Degree of hallux valgus	23	11.6 degree	9.6
L Degree of hallux valgus	22	9.9 degree	7.1
R Widths of opening toes	20	0.2 cm	0.3
L Widths of opening toes	22	1.1 cm	2.1
R Toe grip strength	23	3.3 kg	2.2
L Toe grip strength	23	3.5kg	2.4
R Number of floating toes	23	1.3	1.4
L Number of floating toes	23	1.0	1.3

Note: Toe grip strength was measured with toe grip dynamometer (T.K.K. 3364 Takei Scientific Instrument). Hallux valgus, Number of floating toe was measured with Foot Look (Foot Look Inc). Skin temperature is measured with skin thermometer. Width of opening toes is measured by a tape measure.

Table 6-4-1: Foot and ankle characteristics at before-after intervention N=23

Items		Before-intervention		After-intervention		
		n	Rate	n	Rate	*p-value*
Right	Arch deformities	22	95.7%	22	95.7%	p>0.99
	Ingrown nail nails	5	21.7%	5	21.7%	p>0.99
	Edema	10	43.5%	9	39.1%	p>0.99
	Skin color	15	65.2%	15	65.2%	p>0.99
Left	Arch deformities	18	78.3%	18	78.3%	p>0.99
	Ingrown toe nails	4	17.4%	4	17.4%	p>0.99
	Edema	12	52.2%	11	47.8%	p>0.99
	Skin color	9	39.1%	9	39.1%	p>0.99

Items		Before-intervention		After-intervention		
		n	Rate	n	Rate	p-value
Right	Sensitivity of first toe	21	91.3%	21	91.3%	p>0.99
	Sensitivity of second toe	21	91.3%	21	91.3%	p>0.99
	Sensitivity of third toe	21	91.3%	21	91.3%	p>0.99
	Foot Circulation	2	8.7%	2	8.7%	p>0.99
Left	Sensitivity of first toe	21	91.3%	21	91.3%	p>0.99
	Sensitivity of second toe	21	91.3%	21	91.3%	p>0.99
	Sensitivity of third toe	21	91.3%	21	91.3%	p>0.99
	Foot Circulation	4	17.4%	4	17.4%	p>0.99

Note: McNemar test *$p< 0.05$, **$p< 0.01$, ***$p< 0.001$
Circulation: The rate represented percentage of client that an examiner was able to palpate on their pulse; Sensitivity of toes: The rate represented percentage of client who feel it when the examiner touch client's toes (1st, 3rd and 5th)

Table 6-4-2: Foot and ankle characteristics at before-after intervention N=23

	Items	Before intervention Mean	SD	After intervention Mean	SD	*p*-value
Right	No. of toe deformities	2.0	1.6	2.0	1.6	p>0.99
	No. of skin lesions (corn and callus)	0.2	0.5	0.1	0.3	0.162
	Maceration between toes	0.8	1.1	0.8	1.1	p>0.99
	No. of nail color change	1.2	1.1	1.2	1.1	>0.99
	No. of long nails	1.4	1.4	1.0	1.2	0.148
	No. of thickened nails	1.5	1.6	1.5	1.6	p>0.99
	Level of skin dryness	1.6	0.7	1.1	0.3	0.005**
	No. of nails with suspected or existing fungal infection	1.3	0.7	1.3	0.8	0.162
Left	No. of toe deformities	1.2	1.7	1.2	1.7	p>0.99
	No. of skin lesions (corn and callus)	0.2	0.4	0.2	0.4	0.328
	Maceration between toes	0.5	0.8	0.5	0.8	p>0.99
	No. of nail color change	1.0	1.5	1.0	1.5	p>0.99
	No. of long nails	1.1	1.0	0.8	1.0	0.110
	No. of thickened nails	1.4	1.8	1.4	1.8	p>0.99
	Level of skin dryness	1.6	0.7	1.1	0.3	0.005**
	No. of nails with suspected or existing fungal infection	1.0	0.8	1.0	0.8	p>0.99

Note: Paired t-test: *$p< 0.05$, **$p< 0.01$
Nail color: abnormal nail color
Thickened nail: more than 2mm

6.9. Discussion

This study is part of a larger study examining the enhancement of NCWs knowledge and practice skills. Here, the effects of a foot care program on the foot health of older clients were explored.

The study results indicated no dramatic changes, but items such as edema, number of skin lesions, long nails, and level of skin dryness, which are directly related to foot care practices, improved. In addition, foot conditions and foot health were either improved or maintained without deterioration. As expected, the first hypothesis was supported. The second hypothesis was also supported. The mean value of perception items revealed that an NCW foot care program did not result in immediate improvements in foot movement. However, the higher means for consultation with others or the perception that one's feet are important indicate that this study positively affected perceptions by reducing older people's tendency to ignore foot care or their difficulties in discussing the issue (Miikkola, Lantta, Suhonen, & Stolt, 2019)

Foot skin dryness was found in all clients. Stolt et al. (2012) reported that 44%–45% of older people in home care had dry skin. Furthermore, prior research has reported that 89.5%–100% of frail older people using home-visit services had dry skin on their feet (Fujii, 2018). The foot care program in this study included recommendations that clients see a dermatologist and use moisturizing cream/ointments. The mean dry skin score showed significant improvement, indicating the program's effectiveness in changing behaviors to reduce instances of dry skin experienced by older people. Dry skin can be prevented through the efforts of both the client and caregiver. Older clients may able to reach their lower limbs but may struggle to reach their toes. Clients and caregivers must be aware of the importance of regular moisturizing to protect the skin barrier.

In the program, the author demonstrated how to scale corns and calluses using a foot file. After the study, the mean for skin lesions on the right foot was reduced. Clients who received skin lesion care stated that their walking improved after their corns were reduced with the foot file. Although corns or calluses are common foot problems, the disparity in correlations between clinical and histopathological findings have previously been reported (Mohan, Bal, & Aulakh,2008). Even in a country where podiatry services exist, evidence of the long-term effect of the treatment is limited. Randomized control trials have reported scalpel debridement leading to pain reduction in older people (Farndon et al.,2013; Landorf et al., 2013). However, the studies of corns and callus are limited in general.

Among various foot problems, the suspicion, or presence of nails with fungal infection was a concern for clients; this has also been observed in other studies(Gupta, 2000; Suzuki, Mano, Furuya, & Fujitani, 2017). A large study in Japan revealed that the majority of older people over 60 years have the highest ranking of skin and nail fungal infections (Furue et al., 2011). Yellowish and crumbling nails suggest the possible

existence of a fungal infection. During this study, two clients saw a doctor and were diagnosed and treated for nail and skin fungal infections. Nails with fungal infection are often overlooked or ignored; however, this may cause cellulitis (Bristow & Spruce, 2009), or the nail may fall off. The ability to identify fungal infection symptoms could contribute to protecting not only foot health but also systemic health. Defining what constitutes a fungal nail infection, identifying factors that trigger these infections, and then intervening are important (Abdullah & Abbas, 2011).

In previous research and field experience, the author had observed many older people complaining of previous deep tissue cuts from others including caregivers such as family member, nurses or care workers. Thus, fearing receiving nail cuts from others. Complaints also included the clients' nail edges getting caught in their socks, which could be resolved by receiving foot care or tidying nails.

Obtaining basic knowledge and practice to take care of nail, corn and callus among nurses and care workers would contribute to the prevention of the worsening of foot problems to maintain the foot health of older people. Therefore, the nurse and care workers were taught how to use a nail file and foot file in this study although this study did not include training staff to use a grinder machine that podiatrists around the world regularly use. The introduction of foot and nail files into daily practice seems to be cost-effective, and the required skills require less training compared to learning how to use a machine such as a grinder. As a starter kit, delivering these methods and awareness points to NCWs to prevent accidents at the time of practice would be beneficial in providing foot care for older clients.

The examiner was not able to detect the pulsation of the posterior tibial artery in the majority of participants. In the aging group, an absent pulse may be related to the very process of aging or be a sign of atherosclerosis (Ludbrook J et al. 1962) . Additionally, the methods of the examiner could also be a reason. The palpation depends on the strength and weakness of the person who presses on the skin, and an abundant experience of foot examination is required to palate the pulse of older population. In this study, pulse palpation was used instead of doppler examination though doppler ultrasonography is accepted as it has greater accuracy than palpation (Pandry.,2020 et al). However, another study in 1988 reported the reliability of palpation of the pulses for diabetic patients (Durarte, Young, & Clarke, et al., 1988) Since then, the studies related to topics are limited. Therefore, a study with a larger sample is needed for ensuring the reliability of both methods

Future studies may need to utilize machines such as a doppler to detect pulse for

this population. The reliability of pulse examination of older people who live in the community as a tool for early detection of vascular problems will also need to be explored.

Compared to the baseline, edema on both feet had decreased. Leg edema is a common problem in older people (Ciocon, Fernandez, & Ciocon, 1993), along with dorsum edema. Foot edema is caused by various factors, including drug use (Thaler, Wirnsberger, Pienaar, & Roller, 2010). During this study, a method of lymph massage, the distinction between lymph massage and connective tissue massage, and the importance of foot exercise were introduced to some staff members. The majority of clients with edema did not have routine exercises aside from short-term group exercise in their facility, tending to sit in chairs for extended periods except for when using the bathroom or engaging in other activities. Previous studies have reported the negative effects of overly sedentary behavior on physical health (Dunstan et al., 2012; Keevil et al., 2015). Despite the complex ways an edema on the foot can be generated, knowledge of edema and its prevention may contribute to preventing worsening of the condition or promote early detection and consultation with other professionals. Massage education is limited to the NCW curriculum in Japan. Knowing how to distinguish lymph massage and connective tissue massage (Ekici, Bakar, Akbayrak, & Yuksel, 2009) or the side effects of compression stockings may allow NCWs to protect foot health.

Conducting foot care research on mildly-to-severely frail clients and NCWs who oversee the foot health of this population in the community was challenging. Moreover, international research into nurses' knowledge and practices on foot care (Stolt et al., 2015) and studies of frail people or those with dementia are limited (López-López et al., 2018; Muchna et al., 2018) Moreover, the foot care instruments or methods used in previous studies of older people in the community with diabetes were not well suited to this population.

Initially, a short physical performance test battery was included; however, it was also found in another study (submitted elsewhere) that balancing and standing up from chairs caused instability or shortness of breath for older people, despite no previous heart problems. Additionally, questions about anxiety made older clients feel uncomfortable; new methods for measuring daily living activity, physical ability, cognitive function, and anxiety need to be developed for the frail population, regardless of foot care research.

To the knowledge of the main author, the majority of one-day care centers are introducing exercise programs for older frail people. However, foot and toe issues are not well incorporated in the exercise framework. Exercise programs for older people with advanced frailty have not been included sufficiently in Japan's care policy.

Researches regarding frail older people are lacking as well. Given the major concern of the high number of bedridden people in Japan, the incorporation of foot care into exercise programs for a wide range of the older population may lead to stability of posture and walking, and prevent clients from becoming increasingly bedridden. Therefore, foot care education for nurses and care workers in this area is challenging but significant to address some of the problems faced by an aging society in Japan.

This study was conducted by considering NCWs' limited knowledge and practice level of foot care in different randomly selected facilities. Overall, each facility's staff operate under significant time constraints because they have to carefully watch clients when they perform movements or activities to prevent falls or injury. They know foot-care issues exist and are concerned and willing to learn, but they do not have enough available time for foot care. However, the foot-care program presented in this study may have some effect on foot conditions and older people's perceptions of them. Therefore, many participating facilities expressed a willingness to participate in such a program again. Considering the growing number of older people and the decreasing number of younger people, simple and highly effective foot-care methods must be delivered and developed for the future.

6.10. Limitations

Client medical history was obtained based on the facilities' records. A complete medical history might be missing because some clients do not regularly visit a doctor. Some medical information may be missing because these facilities were not directly connected with hospitals. Staff shortages and time constraints meant only one or two staff members from each facility were able to participate in each practice session. The time allotted to each client's foot care session had to be shortened (about 20 minutes to reduce the physical and emotional burden, both for the clients and the staff). This study's duration was almost two months; therefore, the long-term effects of foot care were not observed. In Japan, foot care education in the curriculum in nursing or care workers' schools is limited. Thus, acquiring foot care skills requires more time and equipment. A range of foot problems was observed in this study; however, the presentation of particular foot problems across the whole population was limited. The small sample size for each foot problem meant that quantitative data were difficult to collect. It was challenging to insist that clients conduct foot self-care at home, owing to their frailty. Aggressive interventions, such as telephone follow-ups (Jayakody et al., 2016) and home visits (Estey, Tan, & Mann, 1990), were not conducted. Consistency of foot exercise was taxing because of each

facility's daily schedules. Owing to schedules and limited prior foot care knowledge, it was difficult to promote consistent foot exercise encouragement or incorporation of family involvement in foot care.

6.11. Conclusions

The nurses and care workers' foot care program were effective in maintaining and improve foot health in older people and positively affected their perception of foot care. This finding contributes to future strategies for foot health of frail older people in the community.

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CHAPTER 6: Effects on older people's feet a foot care program for health professionals: A non-randomized clinical trial study

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CHAPTER 7

Conclusions

CHAPTER 7

7.1. Summary

This study aims to identify the prevalence of foot care knowledge and practice and intervention effects to enhance knowledge and practice for both nurses and care workers at IHSPs[1]. The target research questions were evaluated based on two stages of empirical research. In a series of studies, many instruments were developed to accomplish the entire study. All ideas, including newly established concept and instruments consisting of several questionnaires and intervention tools, were generated based on an abundant literature review and advice and evaluation from experts, nurses and care workers in the field.

As shown in Figure 7-1 shown, visible foot problems derive from the roots and spill over to different problems.

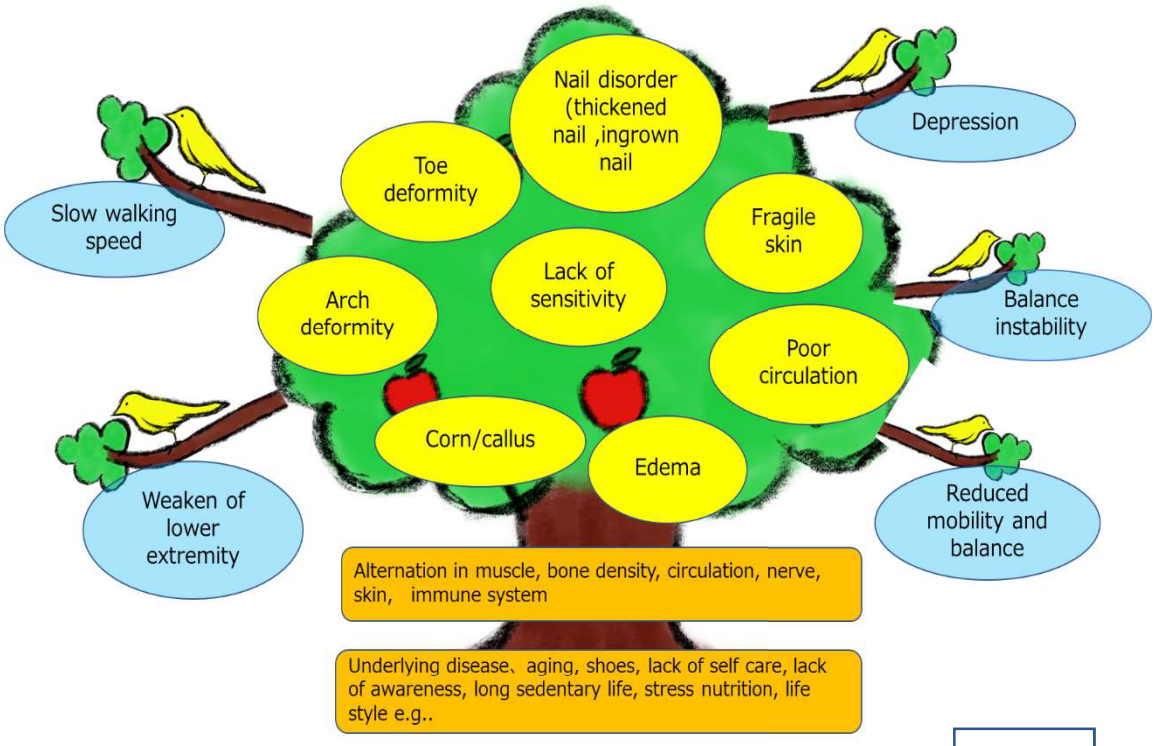

Figure 7-1: Tree of foot problem

[1] IHSPs including home visit nursing provider, home care service provider or one-day care services center or one-day care center emphasizing rehabilitation for seniors.

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In the first stage of study, the author conducted a cross-sectional study using random cluster sampling. The results showed a significant association between foot care knowledge and practice among both nurses and care workers. They were interested in learning about foot care and observing clients' foot problems despite having low confidence, insufficient time and limited foot care education. In contrast to the hypothesis, a significant correlation between working experience and practice scores was observed, with full-time participants having higher mean scores. Significant differences in knowledge items related to early detection of foot problems and skin tears on lower limbs were observed between nurses and care workers. In spite of the differences, both groups had low accuracy rates on the shoes and socks subscale. For practice, both groups had low mean scores for checking client's shoes, methods for reducing ingrown nail pain, and opportunities for discussing foot care with others.

In this study, the author identified the weak and strong areas of nurses and care workers were identified. Despite the presence of serval barriers to enhancing care delivery to clients most in need, nurses and care workers understood the importance of foot care. More participants were expected, some facilities were not able to take part in this study. The reasons for the lack of participation in this study should be further explored.

In the second stage of the study, a descriptive mixed method study of quantitative and qualitative data, a nonrandomized controlled study with random cluster sampling study and a controlled before-after intervention study were conducted. A foot care program with tools was created. The tools consisted of 68 PowerPoint slides, 10 minutes of motion picture materials, 19 pages of picture story cards, 78 pages of a foot care booklet, a 1-page foot care assessment sheet, and a one-point advice card and foot care kits, including nail files and foot files. The content of the tools was evaluated from different perspectives at different stages for validity.

The effects of the foot care program were evaluated in two ways. First, the changes in foot-care knowledge and practice scores of nurses and care workers were analyzed. Second, the changes in the foot conditions of the clients were examined at the facilities where the nurses and care workers worked.

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Foot care programs with tools as a package or standard care over 2 months were provided to nurses and care workers working at in-home service providers. The total scores of the knowledge and practice categories were higher than the baseline in the intervention group compared with the control group before background adjustment. After statistically adjustment of the non-randomized setting, significant differences between groups were observed in the mean scores and changes in skin and consultation subscales of the practice category.

Intervention Group consisted of 11 facilities, but home visit nursing provider was excluded, therefore, each of 10 facilities selected 2 to 4 clients to follow during the study. A total of 23 clients were followed and analyzed in the pre-and post- intervention period. As the results, client's foot and ankle characteristics did not change dramatically, however, they were either improved or maintained without deterioration. Some clients started to perceive the significance of foot health and could talk more about their feet than before.

According to the author's observation at the field sites, the most notable finding throughout the study was that nurses and care workers at in-home service providers always look carefully at the client's movement to prevent injury or falls. Although there are tremendous time constraints, nurses and care workers expressed their concerns about the foot problems of their clients and were willing to learn more about foot care. Some facilities expressed willingness to participate in this type of study again. The use of foot care programs opened the door to introduce basic knowledge and skills of foot care to nurses, care workers and clients of IHSPs. Because the study time was limited, more extensive research is needed.

By addressing the foot health as a key component of quality of life and as a part of the combined efforts of older people and care givers, the author realized the need for further strategies. The foot problems of older people living in the community who need particular nursing or medical care may be exacerbated due to a lack of foot self-care, the selection of shoes, and difficulty of access to doctors. Systematic physical changes and a lack of physical movement and lower vision may be a sign of lacking self-care. The research to accumulate data is needed.

7.2. Future suggestions

Figure 7-2-1,7-2-2 shows flow chart of suggestions for the future.

First, evidentiary data for foot research should be built to raise the awareness of both the public and health care personals. Government-related research organizations as well as universities, hospitals, and local facilities have to deepen their understanding and recognize the issues related to feet and foot care. They should conduct more researches to accumulate data, so that they can plan efficient and effective foot care programs.

Although the necessity of foot exercise has been well known to people, the incorporation of key elements, such as foot and toe care, hygiene, exercise, the prevention of long-term sedentary behavior, and the selection and checking of shoes and socks, in regular practice is currently not considered important. There is an urgent need to allocate funding to enhance research, promotion, education, and the creation of programs and tools in this field of the study.

Education on feet and foot care is needed for people in all age groups. A lifetime of foot care that starts from childhood provide basic of physical and mental health. Education is needed not only for elderly individuals who use services under long-term care insurance but also for those who are not certified or do not use such services. Formal and informal education on feet and foot care should be provided to medical and nursing personnel especially to those caring for older people.

Because older people are difficult to care for their feet at a certain age, foot care and early detection of foot problems of older people by nurses and care workers is needed to protect foot health. However, this is not something that can be done just by calling for people to do it. A new health care system or change the existing health care system is necessary. Systematic changes of the system is the foundation to face the root causes of the problems. However, it requires overcoming many challenges and conducting simulations based on abundant and reliable data. Subjective data, constituting the voices of people is also valuable.

Before presenting suggestions to change the system, a concrete foot care plan and the rationale are presented as follows. This care plan is for nurses and care workers

working with older people in the community, however, can be used by anyone.

Table 7-1: Foot care plan and rational

Care	**Rationale**
Touching feet (when showering feet while assisting with bathing, gently stroking feet to reduce edema, applying ointment, etc.)	Increased exposure to foot contact increases human conversation between clients and those caring people and releases oxytocin, which helps to arrange the autonomic nerves in the body and protect heart function.
Listening to how people has feel / has felt about their feet.	By listening to past and present thoughts about feet, we can understand a person's past and present condition Conversation between clients and those caring for older people can activate the brain and prevent dementia
Practicing basic foot care	Basic foot care will help people move their feet and prevent further worsening of foot problem
Stretching the plantar fascia (using bamboo stomping exercises, or golf balls or equipment)	Stretching the plantar fascia reduces pain when exercising feet; the stretching prevents further worsening of the arch function
Cleaning and providing care to toe nails, the skin between toes, soles, and the heel and promoting foot and toe exercise	Protecting toes is effective in balancing posture; it stabilizes the core of the body and activates the central nervous system, including the brain and spinal cord, which control the human body;

	improving posture will improve oral function by adjusting the temporomandibular joint
Preventing prolonged periods of sitting	Avoiding sitting for long periods of time has a positive effect on blood flow throughout the body, not just in the legs
If there is a foot problem, detect it early and consult a specialist	Early detection can prevent the deterioration of the general condition of the body
Making people aware of their fingertips, spine and gravity when they walk	Power of concentration can prevent falling People can find meaning in life by having the feeling that their feet are on the surface of the earth and are being pulled by gravity

To incorporate ideal care into regular practice, many barriers has to be overcome in both of public and private sectors. Mass media, and members of the government related organization[1] and private organizations which relate to making policies and national and local budget need to realize how feet and toes work and how they greatly affect the lives of people and society.

The following change is recommended.

1) The government and other public or private organizations should generate more programs on feet and foot care.

2) The government and other public or private organizations should allocate more financial resources to research, programs, and formal and informal education on feet and foot care. For example, a mandatory number of hours studying feet and foot care should be allocated as part of formal education in nursing or care worker schools. Training courses for doctors and medical and nursing workers should be offered to learn

[1] In particular, 1) the Ministry of Health, Labor and Welfare and 2) the Ministry of Education, Culture, Sports, Sciences and Technology in Japan

more about feet and foot care. More doctors, nurses, and care workers should obtain knowledge and practice skills on feet and foot care and national licensing programs for feet and foot care should be established.

3) The government or other public or private organizations should develop tools, equipment or methods using informatics and AI technology to assist with foot care and assistance programs for other care tasks, such as meal delivery, so that nurses and care workers have more time to spend on foot care.

4) The government or other public organizations should consider revising medical or nursing extra funds to promote foot care. For example, improvements in foot and toe conditions can lead to additional funds to facilities. The outcome can be measured by a toe force machine or other objective and subjective data.

5) The government or other public organizations should strive to create better working conditions for nurses and care workers at community-based facilities, so they have more time for foot care. There are many topics to deal with, such as financial benefits, motivation, and anti-harassment among staff and from clients.

6) Foot care outpatient clinics have to hold the ability to accept more patients with other diseases due to system changes instead of accepting only patients with diabetes, as the current system does. The current regulation should be changed.

As Figure 7-2-2 shows, protecting foot health fundamentally leads to increase of activities of daily living (ADL) and quality of life. Foot health relates to falls, posture, cognition, sarcopenia, and spirituality, e.g. The number of hospitalizations, the number of falls, the number of bedridden individuals, and the number of people with dementia will decrease. Fundamentally, protecting foot health is cost-effective in terms of medical and nursing budgets.

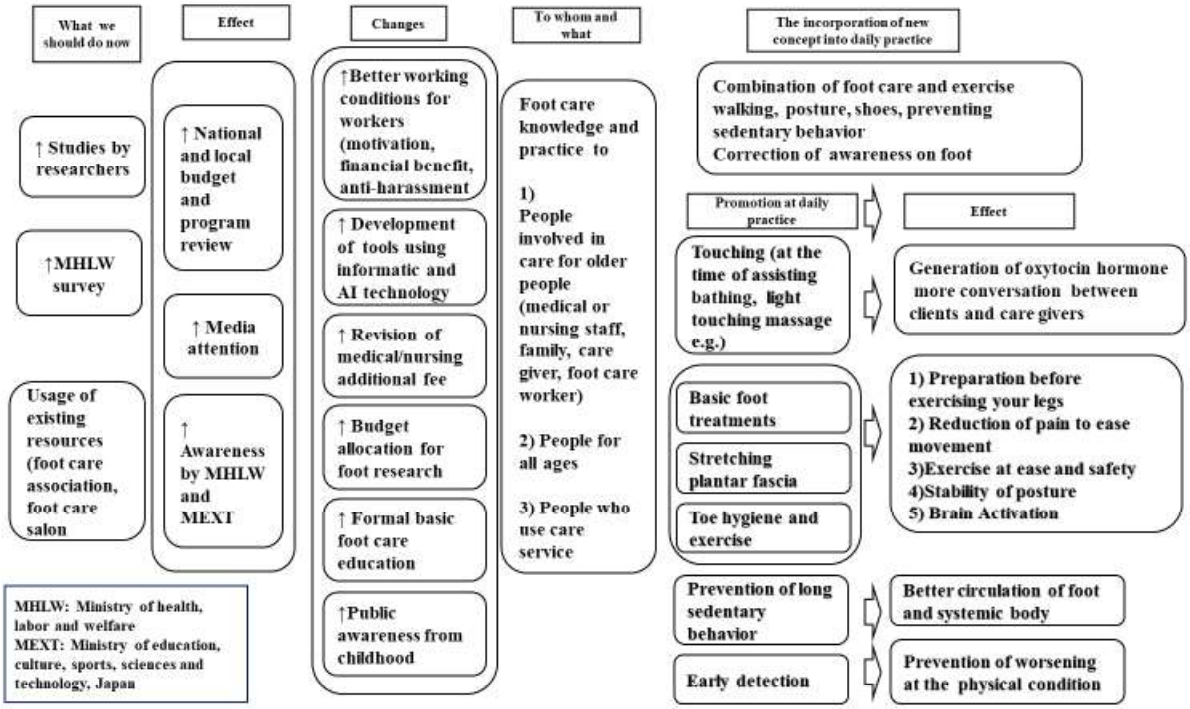

Figure 7-2-1: Flow chart for future foot care plan

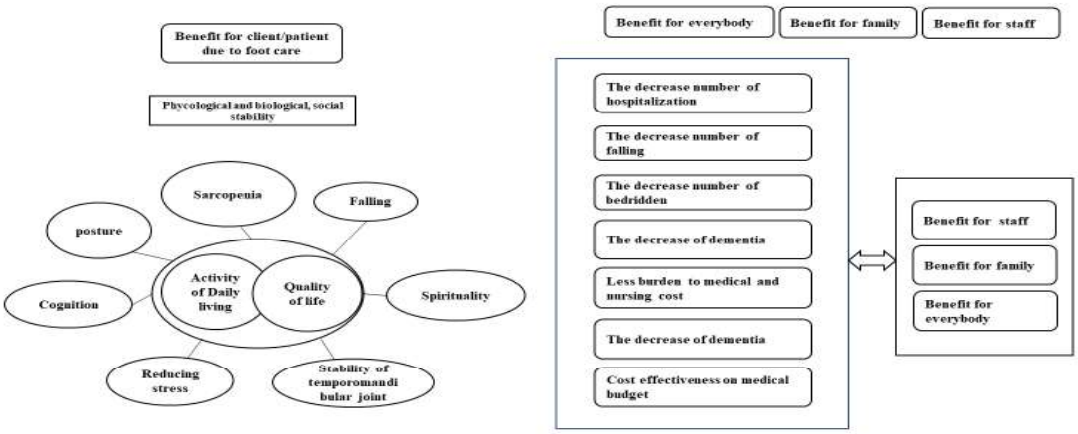

Figure 7-2-2: Flow chart for future foot

7.3. Outlook

The Ministry of Health, Labor and Welfare has predicted that if the current situation continues, there would be a shortage of approximately 336,606 caregivers those caring older people in 2025 (MHLW, 2018, Appendix I). Ministry of Economy, Trade and Industry estimated the shortage of 790,000 caregivers those caring older people in 2035 (METI, 2018, Appendix I). According to the Cabinet Secretariat/Cabinet Office/Ministry of Finance/Ministry of Health, Labor and Welfare, the ratio of social security benefits to Gross Domestic Product (GDP) will increase year by year. From 2025 to 2040, the ratio will raise by 2.1-2.2% by 2040 and would reach to 188.2 to 190 trillion yen.

(Cabinet Secretariat, Cabinet Office, Ministry of Finance, MHLW, 2018).

Due to financial strain, the transition from hospitals to homes is accelerating; however, it is far from safe for all people to live at home. In Japan, there is a gap between healthy life expectancy and average life expectancy, and the number of people who support older people will decrease drastically. A very large challenge of how older people can live with peace of mind in a familiar area is facing us. Even if people have diseases or have to keep costs down, the most important issue to be addressed is finding social value in one's existence.

In Japan, there is a shortage of research and foot care program for people in the community. The study identified current knowledge, practice, perceptions, and effects of foot care interventions, but the sample size was limited. Nurses and care workers encounter the foot conditions of older people on a daily basis and would like to learn more about foot care; however, constraints of time and a lack of confidence exist. They carefully observe older people to prevent injury in practice and communicate and provide necessary care in daily practice. To introduce foot care practice into the field, profound strategies are needed based on abundant research on current working conditions and foot care education for nurses and care workers.

Empirical analysis results based on statistical data provided new insight for future strategies and important suggestions for constructing new approaches for foot

health given the various current limitations. Along with the aforementioned issues, the improvement of working conditions of nurses and care workers in the community. A delivery of practical and hands on information of foot and foot care are needed for older people and nurses, and care workers. The enhancement of social awareness of foot health is a combined effort of caregivers and clients, which lead to the protection of quality of life of older people.

In the future, the author will further refine and package the program created in this study. By implementing the foot care program both domestically and internationally, the author will be able to verify its effectiveness and develop a study that aims to replicate the program. The study is expected to lead to the enhancement of the activity of daily living and the quality of life for the older people living in the community.

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CHAPTER 2: Foot health for older people living in the communiyt: A Scoping review

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CHAPTER 3: Foot care knowledge and practice among Japanese nurses and care workers in-home service providers: A cross-sectional study

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CHAPTER 6: Effects on older people's feet a foot care program for health professionals: A non-randomized clinical trial study

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CHAPTER 7: Conclusion

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Menz, H. B., Auhl, M., Ristevski, S., Frescos, N., & Munteanu, S. E. (2014). Comparison of the responsiveness of the Foot Health Status Questionnaire and the Manchester Foot Pain and Disability Index in older people. *Health and Quality of Life Outcomes, 12*(1), 158.

Menz, H. B., Gill, T. K., Taylor, A. W., & Hill, C. L. (2008). Predictors of podiatry utilisation in Australia: the north West Adelaide health study. *Journal of foot and ankle research, 1*(1), 8.

Menz, H. B., & Morris, M. E. (2006). Clinical determinants of plantar forces and pressures during walking in older people. *Gait & posture, 24*(2), 229-236.

Ministry of Economy, Trade and Industy (2018). Study group on elderly care system for future long-term care demand. Retrieved Aug 21,2020 from https://www.meti.go.jp/press/2018/04/20180409004/20180409004-1.pdf

Ministry of Economy, Trade and Industry (2018 April 9) Summary of the Report by the Study Group for Future Supply and Demand of Elderly Nursing Care Systems (2018) https://www.meti.go.jp/english/press/2018/pdf/0409_004a.pdf

Patel, K. V., Phelan, E. A., Leveille, S. G., Lamb, S. E., Missikpode, C., Wallace, R. B., . . . Turk, D. C. (2014). High prevalence of falls, fear of falling, and impaired balance in older adults with pain in the United States: findings from the 2011 National Health and Aging Trends Study. *Journal of the American Geriatrics Society, 62*(10), 1844-1852.

Rönnemaa, T., Hämäläinen, H., Toikka, T., & Liukkonen, I. (1997). Evaluation of the impact of podiatrist care in the primary prevention of foot problems in diabetic subjects. *Diabetes care, 20*(12), 1833-1837.

Redmond, A., Waxman, R., & Helliwell, P. (2006). Provision of foot health services in rheumatology in the UK. *Rheumatology, 45*(5), 571-576.

Vernon, W., Borthwick, A., & Walker, J. (2011). The management of foot problems in the older person through podiatry services. *Reviews in Clinical Gerontology, 21*(4), 331.

Appendix A: The Japanese Healthcare system

Japan has two types of insurances for older individuals in terms of access to care, medical insurance, and long-term care insurance.

1. Medical insurance

In Japan, all people are supposed to have health insurance which is known as universal health insurance (TableA-1). People use medical insurance to pay for medical treatment and examination due to illness or injury. All people regardless of age enroll into public medical insurance. The cardholder is responsible for 10%–30% of the treatment cost (typically 30%); however, the rate of burden varies depending on age and income.

Medical insurance is categorized into three types. When the burden of medical cost becomes high due to the long duration of hospitalization or treatment, payment is fixed at a certain amount. It is known as "high cost medical expense benefit"[16][17][18]

Table A-1: Medical insurance in Japan

Type of medical insurance	Used by
National health insurance	Self-employed or for the unemployed or others.
Employee's health insurance for employed people	For those with health insurance from their employer such as health insurance association, mutual aid association, or association/union administrated health insurance
Medical care system for the elderly aged ≥75 years	Aged ≥75 years

NOTE: People who have trouble making a living are excluded from national health insurance. The medical cost of these individuals is covered as medical assistance in the frame of public assistant system.

2. Long-term care insurance[19][20]

The second insurance type is the long-term care insurance (LTCI) that is a mandatory public program run by the municipal government or specified district in

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[16] Organizations FoNHI. 2019.Guide to Japan's National Health Insurance (NHI) system. Retrieved Sept 9, 2019 from http://yoshida.com/forms/nationalins.pdf.

[17] Ministry of Health Labor and Welfare. Overview of Medical Service Regime in Japan. Retrived July 15, 2020 from https://www.mhlw.go.jp/bunya/iryouhoken/iryouhoken01/dl/01_eng.pdf

[18] Ministry of Health Labor and Welfare. 2010.Public assistant system. Retrieved July 10, 2020 from https://www.mhlw.go.jp/english/topics/social_welfare/dl/outline_of_the_public_assistance_system_20101004.pdf

[19] Shinjuku City Long-term care insurance division. (2018). Guidebook for long-term care insurance. Retrieved March 1, 2019 from http://www.foreign.city.shinjuku.lg.jp/en/wp-content/uploads/sites/4/2018/10/kaigo2018_e.pdf#search=%27longterm+insurance+system+category+1+category+2%27.

[20] Ministry of Health, Labor and Welfare. (2013). Health and welfare services for the elderly. Retrieved Jan 25, 2020 from https://www.mhlw.go.jp/english/wp/wp-hw8/dl/10e.pdf

Tokyo. It is paid extra by all Japanese citizen aged ≥ 40 years. LTCI can be claimed starting at the age of 65 or over years (category 1) or at the age of 40-64 years for those with specific diseases such as amyotrophic lateral sclerosis, cerebrovascular diseases, e.g. (category 2), and applicants for care services must be screened. Those who are eligible to use the LTCI system are categorized into one of the seven care need levels: two support levels (1 and 2) and care level 1 through 5[21].

The cardholder will be responsible for 10%–30% of the nursing service cost. There is a payment limit depending on the category, and the nursing care services are selected to not exceed the limit.

According to current calculations based on statistics from the MHLW as of March 2019, approximately 18% individuals aged ≥ 65 years are people certified for the LTCI[22]. Some reasons are considered regarding why approximately 82% of the population aged ≥ 65 years have not reached to the services of LTCI. It is assumed that there are some reasons as follows. The actual number of individuals in need of home-based care remains unknown.

1. Those aged ≥ 65 years may have been denied to receive the application due to a nonqualifying condition.
2. Those aged ≥ 65 years and whose family may not have sufficient knowledge or information about the LTCI system.
3. Those aged ≥ 65 years and whose family are only willing to receive hospital care
4. Those aged ≥ 65 years and whose family are not willing to accept care besides the family members or acquaintances.
5. Those ages ≥ 65 years may not reach to the place to get application due to the difficulties of transportation or physical conditions.

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[21] Ministry of Health Labor and Welfare. 2016. Long-term care insurance sytem of Japan.Retrived July 7, 2020 from https://www.mhlw.go.jp/english/policy/care-welfare/care-welfare-elderly/dl/ltcisj_e.pdf

[22] Ministry of Health Labor and Welfare. 2019.Care insurance business status report (provisional). Retrieved Aug 30, 2019 from https://www.mhlw.go.jp/topics/kaigo/osirase/jigyo/m19/1903.html. (In Japanese only).Author translated some contexts and incorporated into Appendix.

Appendix B: Current status of additional fees for adult service centers in Japan[23][24]

After the commencement of the Long-Term Insurance System, the Ministry of Health, Labor and Welfare establsihed new prevention benefit system associated with the shift to prevention-oriented sytem as part of the revision of medical service fees in 2006. The fees were revised on the grounds that the number of persons certified as being in need of support level 1 and 2 or long-term care level 1 was soaring and that prevention benefits in place then could not prevent the detrioraton of conditions of less severe cases. There are new care prevention services for those in need of support levles 1 and 2 and long-term care level 1, but no program has yet been established for those in need of long-term care level 2 or higher.

Addtional fees for day-care services are charged for extension hour, bathing assistance, implementation of care system for people with moderate to severe intensity, individual fuction training, dementia treatment, accepting early-onset dementia patients, nutrition improvement, oral function improvement and maintenance of the service system. As for day-care services with rehabilitation, addtional fees are calculated for rehabilitation managment, implementation of short-term intensive rehabilitation, implementation of short-term personal rehabilitation for people with dementia, rehabilitation for improving activities of daily life, bathing assistance, early-onset demetia user acceptance, nutrition improvement, oral function improvement, additions to severe care management, implementation of care sytem for people with moderate to severe intensity, social participation support, and fee deduction for transportation support. However, foot care is not considered part of functional improvement of locomotrorium.

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[23] Outpatient day care and therapeutic outpatient day care (Reference) Social Security Council - Subcommittee for Long-Term Care Benefit Expenses 141th (June 21,2017) Retrieved July 1, 2020 from https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshitsu_Shakaihoshoutantou/0000168705.pdf (In Japanese only). Author translated some contexts and incorporated into Appendix.

[24] Outpatient rehabilitation (Reference) Social Security Council - Subcommittee for Long-Term Care Benefit Expenses 141th (June 21,2017) Retrieved July 1,2020 from https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshitsu_Shakaihoshoutantou/0000168706.pdf (In Japanese only). Author translated some contexts and incorporated into Appendix.

Appendix C: Awareness of foot and foot care by the government in Japan

In Japan, A research committee on foot care was organized as part of the health and health promotion program of the Ministry of Health, Labor and Welfare in 2000 when the long-term care insurance was introduced. The long-term care prevention/regional support program has been started since 2000. The program is to promote the support projects for local government's long- term care prevention measure. Although the projects concerning the feet and nails have been gradually introduced as preventive care and a community support project since 2003, they are not well-spread. The data indicated that 35 municipalities out of 2319 municipalities were engaged in the toe and nail program[25]. Instead, they made unique projects in each municipality[26]

In 2009, there was one description in the "Manual for functional improvement of locomorium" by the research team of Shuichi Obuchi et al[27], which mentioned that "since frail older people (who belongs to precare or support level under long-term care insurance) tend to decrease their activities, they are at risk of having foot problems such as deformation and/or thickening of toes and nails. Therefore, the toes and nails should be assessed, when necessary, cared in implementing the program" (Author's translation based on content interpretation and the translation was checked by professional interpreter).

However, it seems the recognition of the importance of toes and nails in general exercise manuals ins on a stand still. The Ministry of Health, Labor and Welfare released an interim report on April 19, 2017, as a model project for municipalities to prevent long-term care. The item of foot care was included,[28]but the report concerning the results seems to be insufficient.

In 2019, one woman's call for high heels and other items in the workplace online led to a call for opposition to the mandate of wearing high heels. In some private sectors, they force women to wear high heels and pumps, which are hard on the feet. Approximately 18,800 signatures were submitted to the Ministry of Health, Labor and Welfare on June 03, 2019. On June 5, at the House of Representatives Committee on

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[25] Ministry of Health Labor and Welfare.(2013). The long-term care prevention /regional support buisess. Retrieved June 24, 2020 from https://www.mhlw.go.jp/shingi/2003/12/s1222-4d9.html (In Japanese only).Author translated some contexts and incorporated into Appendix.

[26] Nishiwaki U. (2015). Current status and issues of foot care in home care nursing. Health Science Universty Library, 11(1), 163-170（in Japanese only）.

[27] Shuichi Obuchi et al.(2009). "Manual for functional improvement of locomorium" Retrieved July 07,2019 from https://www.mhlw.go.jp/topics/2009/05/dl/tp0501-1d.pdf In Japanese only). Author translated some contexts and incorporated into Appendix.

[28] Ministry of Health Labor and Welfare.(2017). Long-term care prevention municipality model business interim report. Retrieved June 24, 2020 from https://www.mhlw.go.jp/shingi/2005/04/s0419-7.html (In Japanese only). Author translated some contexts and incorporatedd into Appendix.

Health, Labor and Welfare, the Minister of Health, Labor and Welfare said wearing high hell is necessary for certain work operation (Koichi Murakami, June 05, 2019, Asahi Shimbun Digital)[29]. Some researchers from other countries presented the relationship between wearing of high heels and the occurrence of hallux valgus. In Japan, it is considered that data presenting this issue is lacking and the awareness of foot issue is low.

[29] Murakami K. 2019 (2019, June 5). Forced high heels at work "If necessary for business Permission from the Ministry of Health, Labor and Welfare" Asahi Simbun. Retreived from July 1, 2000 from https://www.asahi.com/articles/ASM6566MNM65ULFA04B.html (In Japanese only).Author translated some contexts and incorporated into Appendix.

Appendix D: Foot care practice overseas

In Europe, the United States, and Australia, the professional national qualification for the foot is called a podologist or a podiatrist. In Finland, he/she is called a podiatrist. Doctor-qualified foot specialists are called orthopedists. If the patient's foot problem is less severe, an orthopedist will likely refer the patient to a podiatrist for foot treatment. According to Minna Stolt, a podiatrist-qualified researcher, the term "podiatrist" has the following interpretation.

"In Finland, podiatrist is not a doctor. Podiatrist is a bachelor of health care in degree program of podiatry. The education is 3.5 years and 210 European credits. The title is protected and all podiatrists are approved by the states. Internationally there is great variety of podiatry education. In the US, the podiatrist is a doctor focusing on ankle and foot. But for example, in the UK, podiatrist is not a doctor" (Minna Stolt, personal communication, March 06, 2019).

"In Finland, we have orthopedist who have specialized to foot and ankle. Usually they have patients with foot/ankle problems. Orthopedist make the foot/ankle assessments and decide if the problems can be cared with surgical procedures and if the problems are not that severe yet, they refer the patients to a podiatrist or a physiotherapist" (Minna Stolt, personal communication, March 06, 2019).

A podiatrist is a qualified individual who is allowed to conduct professional foot care and has basic knowledge in foot medical care and necessary specialized knowledge about the bones, skin, and keratin and practical treatment. The interpretation of the job title podiatrist varies from country to country, and in some countries, a foot specialist with a doctor's license is sometimes called a podiatrist. In Germany, it is described as a podologist instead of a podiatrist in the literature. Podologists have described that unlike podiatrists, they do not perform surgery but can conduct medical treatment (Kröger K et al. 2016)[30]. In Germany, a podiatrist is a qualified professional. In the case of Japan, there are no specialized national qualifications for either podiatrist or podologist.

The following is Minna Stolt's interpretation:

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[30] Kröger, K., Moysidis, T., Feghaly, M., Schäfer, E., Bufe, A., & Initiative Chronische Wunden e.V., Germany. (2016). Association of diabetic foot care and amputation rates in Germany. International Wound Journal, 13(5), 686-691. https://doi.org/10.1111/iwj.12347

"International Federation of Podatrists (FIP-IFP) has countries with professional podiatry associations as members. This Federation has done a definition for podiatry. Podiatry is that profession of health sciences concerned with the research, prevention, diagnosis and treatment of deformities, pathologies and injuries of the foot, and associated structures-in relation with the body as well as the manifestations of systemic diseases-by all appropriate systems and technologies using scientific and professional specialized knowledge" (Minna Stolt, personal communication, March 05, 2019).

The FIP-IFP comprises countries with specialized podiatrist associations. Podiatry is a health science profession focused on the study, prevention, diagnosis, and use of science and specialized knowledge and all appropriate systems and techniques to investigate the relationship between the state of the body and physical symptoms of possible foot disease. It is a nationally qualified occupation for deformation, pathology, and foot injury. There are websites regarding podiatry in Australia, USA, UK, Netherlands[31]

Fusspflege in German means foot care and is a preventative foot care procedure; however, it is conducted slightly differently from a medical viewpoint. Fusspflege courses are available in the curriculum of the national qualification for an orthopedic shoe-meister (shoemaker), and the certification can be obtained through the provided training in the course (Izumi Yamamichi, personal communication, March 23, 2019).

[31] Stolt Mina introduced following web sites to the author.
Podiatry. (2017). Retrieved Aug 12, 2020 from Allied Health Professions Australia: https://ahpa.com.au/allied-health-professions/podiatry/ About
Podiatry. (USA). (2020). Retrieved Aug 1 2,2020 from STEP INTO PODIATRY: https://www.stepintopodiatry.com/about-podiatry/about-podiatry/
What is podiatry. (UK). (2020). Retrieved Aug 12,2020 from The college of podiatry: https://cop.org.uk/
What is a podiatrist. (Netherlands). (2020). Retrieved Aug 12,2020 from INNO FEET: https://www.innofeet.nl/en/podiatry/what-is-a-podiatrist/

Appendix E: Scope of foot care by laws and regulation

The foot conditions of older people are individualized, and it can be difficult to define the extent to which nurse and care worker can provide foot care. Currently, there are the following laws and regulations that should be known.

1) Article 17 of the Medical Practitioners Act, Article 17 of the Dental Practitioners Act, and Article 31 of the Act on Public Health Nurses, Midwives and Nurses and other related laws and regulations[32].[33]

2) Ministry of Health, Labor and Welfare "Interpretation of Article 17 of the Medical Practitioners Act, Article 17 of the Dental Practitioners Act, and Article 31 of the Act on Public Health Nurses, Midwives and Nurses." This interpretation was notified from the Health and Welfare Bureau for the Elderly of the Ministry of Health, Labor and Welfare to the prefectural long-term care insurance representatives[34] .

3) The Ministry of Economy, Trade and Industry (METI) has a system whereby employers can inquire as to whether the regulations apply to their business. METI Website presents the answer to what kind of foot care is allowed for workers without medical license in elderly care facilities accordance with the Medical Practitioners Act. It is based on the utilization of the "gray zone elimination system" of the Act on Strengthening Industrial Competitiveness[35].

Medical services (including dentistry; the same applies below) by those who are not licensed as, as doctors, dentists, nurses, or other specialists are prohibited in Article 17 of the Medical Practitioners Act, Article 17 of the Dental Practitioners Act, Article 31 of the Act on Public Health Nurses, Midwives and Nurses and other relevant laws and regulations. "Medical practice" is "an act unless the doctors' medical judgment and skills are utilized, the act may cause harm to the human body, or the repeated act

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[32] Ministry of Health, Labor and Welfare. 1948.About medical practice; search date. Retrieved Sep 02, 2019 from https://www.mhlw.go.jp/shingi/2003/02/s0203-2g.html (In Japanese only). Author translated some contexts and incorporated into Appendix.

18 The author previously translated "Article 17 of the Doctor's Law, Article 17 of the Dentist's Law, and Article 31 of the Public Health Nurse and Midwife Nurse's Law and other related laws and regulations". After obtaining opinions from international interpreter, the author retranslated as "Article 17 of the Medical Practitioners Act, Article 17 of the Dental Practitioners Act, and Article 31 of the Act on Public Health Nurses, Midwives and Nurses and other related laws and regulations although the content meaning is same.

[34] Ministry of Health, Labor and Welfare. 2019. Interpretation of Article 17 of the Medical Practioners Act, Article 17 of the Dental Practioners Act , and Article 31 of theAct on Public Health Nurses, Midwives and Nurses; search date Retrieved Aug 01, 2019 from . https://www.mhlw.go.jp/web/t_doc?dataId=00tb2895&dataType=1&pageNo=1 (In Japanese only). Author translated some contexts and incorporated into Appendix.

[35] Ministry of Economy, Trade and Industry. 2017. Clarification of the handling of the Medical Practioners Act concerning the implementation of foot care services in nursing homes for the elderly; use of the "gray zone elimination system" of the Act on Strengthening Industrial Competitiveness. Retrieved Sep 02, 2019 from https://www.meti.go.jp/press/2017/11/20171120002/20171120002.html (In Japanese only). Author translated some contexts and incorporated into Appendix.

(medical activity) by the doctor, unless conducted, may cause harm to the human body."[36] On July 28, 2005, the Health and Welfare Bureau of the Ministry of Health, Labor and Welfare sent out a notification to each prefecture's long-term care insurance representative the interpretation of the Ministry of Health, Labor and Welfare "Article 17 of the Medical Practitioners Act, Article 17 of the Dental Practitioners Act, and Article 31 of the Act on Public Nurses, Midwives and Nurses and other relevant laws and regulations." Because of this notification, 11 items were excluded from medical treatment in principle. Among them were items related to foot care "treatment for conditions such as minor cuts, abrasions, burns, etc. (which do not require specialized judgment or skill)", "If the condition is stable, applying medicine, eye drops, poultice, or ointment which do not require specialized judgment or skill", "Nail clipping or filing with nail file when the nails have no abnormalities, and the skin around the nails is neither with pus nor inflammation". Also, nail clipping or filing with nail file with nail in case where specialized management associated with diseases such as diabetes is not required."

[36] Ministry of Health, Labor and Welfare. 1948.About medical practice; search date. Retrieved Aug 01, 2019 from https://www.mhlw.go.jp/shingi/2003/02/s0203-2g.html (In Japanese only).Author translated some contexts and incorporated into Appendix.

Appendix F: Act of Certified Care Workers[37,38,39,40] and Licensed Practical Nurse

The Japan Association of Certified Care Workers provided the explanation of certified care workers. A Certified Care Worker is defined under the Certified Social Worker and Certified Care Worker Act which was enacted on May 25, 1987 and revised on December 5, 2007. The Ministry of Health, Labor and Welfare presented the overviews of certified social workers and cerified care workers.

The defintion of Nurse and Assistant Nurse is defined under Act on Public Health Nurses, Midwives and Nurses. Artcile 5 defined nurse as... a person under licensures from the Minister of Health, Labor and Welfare to provide medical treatment or assist in medical care for injured and ill persons or puerperal women, as a profession. Article 6 defined Assistant Nurse as ... a person under licensure from the prefectural governor to do as set forth in the preceding Articles under the direction of a physician, dentist, or Nurse as a profession. In this thesis, the term of " Licensed Practical Nurse (LPN) " is used that is "Assistant nurses " in accorance to the Japanese law translation because the term "LPN" is widely used abroad.

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[37] The Japan Association of Certified Care Workers. Retrived July 15 2020 from http://www.jaccw.or.jp/home/index_en.php

[38] Ministry of Justice.2020. Certified Social Worker and Certified Care Worker Act Japansese law Tranlation. Retrived July 15 2020 from http://www.japaneselawtranslation.go.jp/law/detail_main?re=&vm=&id=2693 (In Japanese only). Author translated some contexts and incorporated into Appendix.

[39] Ministry of Health Labor and Welfare. (2009). Certified Social Workers and Certified Care Workers. Retrieved June 24, 2020 from https://www.mhlw.go.jp/english/wp/wp-hw3/dl/8-11.pdf

[40] Ministry of Justice.(2020). Japanses law Translation. Act on Public Health Nurses, Midwives, and Nurses. Retrieved from July 15, 2020 from http://www.japaneselawtranslation.go.jp/law/detail/?id=2075&vm=04&re=01

Appendix G: Exclusion criteria of participants for foot care research

The Author excluded people with wounds or ulcers, marked maceration, skin fragility, or skin problems from the study. “Foot research sometimes require client to do extra movement. The manual for functional improvement for locomorium” (revised March 2009)[41]can be used as reference to decide exclusion criteria for participants. because foot care research may require clients to do extra movement.

Those with;

- Myocardial infarction or stroke within the last 6 months
- Angina/heart failure/severe arrhythmia
- High blood pressure with a systolic blood pressure of ≥ 180mmHg or a diastolic blood pressure of ≥ 110mmHg
- Chronic obstructive pulmonary disease with shortness of breath and dyspnea
- Diabetes and with serious complications
- Acute joint pain, arthritis, back pain, and neurological symptoms
- Inflammation such as pneumonia and hepatitis and is in the acute phase
- The risk of sudden change or deterioration of their health conditions because of the implementation of other services.

Criteria that should be considered relative to exclusion and exercise restrictions based on the judgment of the attending physician

Those with;

- Controlled heart disease/arrhythmia
- High blood pressure with a systolic blood pressure of < 180mmHg
- Chronic obstructive pulmonary disease with mild symptoms
- Chronic joint pain, arthritis, back pain, and neurological symptoms
- Osteoporosis with spinal compression fracture
- Difficulty in participating due to the deterioration of cognitive function
- Exclude or restrict for exercise accordance with doctors’ instruction.

Criteria to be considered for the adaptation of the functional improvement of locomorium

- Patients with chronic knee and back pain who have not been restricted to exercise by their doctors

[41] Shuichi Obuchi (March 2009). “Manual for functional improvement of locomorium” Retrieved July 1, 2020 from https://www.mhlw.go.jp/topics/2009/05/dl/tp0501-1d.pdf (In Japanese only). Author translated some contexts and incorporated into Appendix.

Appendix H: The number of employees at in home-service providers in Japan and Aichi Prefecture[42]

Type of services in Japan	Total of Registered Nurses (Including LPN)	Registered Nurses	LPNs	Care workers (including Certified Care Workers)	Certified Care Workers
Day service (more than 19 users)	52,063	28,139	23,924	175,665	69,149
Day service (less than 18 users)	22,617	13,044	9,573	81,711	23,270
Day care (medical facilities)	5,742	3,742	2,000	22,433	11,550
Day care (welfare facilities for the elderly)	5,640	3,230	2,410	31,338	19,163
Home visiting helper station	0	0	0	436,223	170,032
Home visiting nursing stations	61,765	55,261	6,504	0	0
Total	147,827	103,416	44,411	747,370	293,164

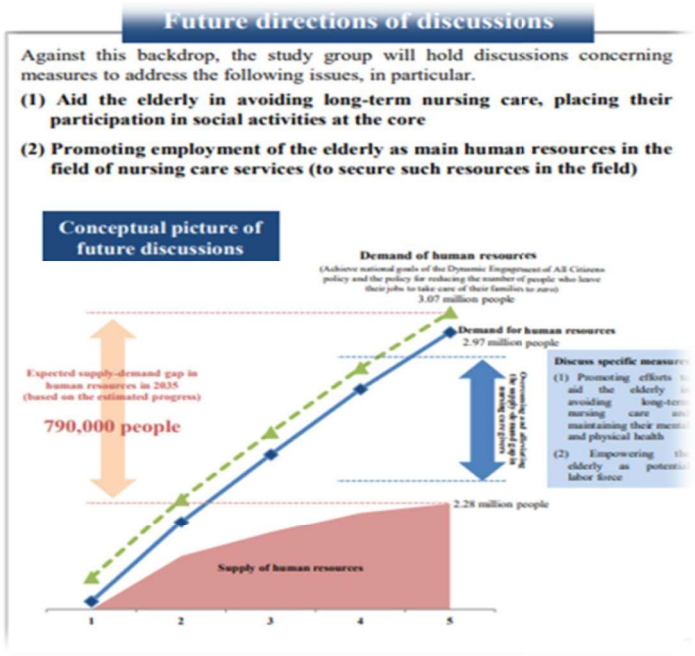
Aichi prefecture	Total of registered nurse (Including LPN)	Registered nurse	LPN	Care workers (including with national license)	Care workers with national license
Day service (more than 19 users)	2,880	1,775	1,105	10,114	3,670
Day service (less than 18 users)	1,054	662	392	4,557	1,305
Day care (medical facilities)	405	274	131	1,465	703
Day care (welfare facilities for the elderly)	279	184	95	1,557	884
Home visiting helper station	0	0	0	24,203	9,380
Home visiting nursing stations	3,965	3,467	498	0	0
Total	8,583	6,362	2,221	41,896	15,942

[42] Ministry of Health Labor and Welfare. 2018 e-Stat is a portal site for Japanese Government Statistics. Retrived Sep 5, 2019 from https://www.e-stat.go.jp/stat-search/files?page=1&layout=datalist&toukei=00450042&tstat=000001029805&cycle=7&tclass1=000001118808&tclass2=000001118810&tclass3=000001118819&tclass4=000001118826&second2=1 (In Japanese only). Author translated some contexts and incorporated into Appendix.

Appendix I: Demand and supply forecast of care workers in all Japan as of 2016[43]and 2018[44]

2016 The number of care workers in all Japan	2020		2025	
	Demand forecast	Supply forecast based on current situation scenario	Demand forecast	Supply forecast based on current situation scenario
1,898,760	2,160,494	2,034,133	2,446,562	2,109,956

MHLW, 2016
The simple calculation (the number of demands minus supply) demonstrated that expected shortage number of care workers would be 336606 in 2025 (In Japanese only).



METI. Economic and Industrial Policy Bureau (April 9, 2018)

[43] Ministry of Health Labor and Welfare. About the necessary number of nursing care personnel based on the 7th long-term care insurance business plan. Retrieved Sep 5, 2019 from https://www.mhlw.go.jp/stf/houdou/0000207323.html

[44] METI. Economic and Industrial Policy Bureau (April 9, 2018). Summary of the Report by the Study Group for Future Supply and Demand of Elderly Nursing Care Systems Industrial Structure Policy Division. https://www.meti.go.jp/english/press/2018/pdf/0409_004a.pdf