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Kashiko Fujii *, Mariko Nishikawa , Minoru Kadota

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Picture Sound Book with Ninja-Essence Targeting Older People Affected by the Fukushima Daiichi Nuclear Plant Accident: Development and Evaluation Before-after Pilot Clinical Trial

Kashiko Fujii [1,*], Mariko Nishikawa [2] and Minoru Kadota [3]

[1] Department of Nursing, Tokyo Kasei University, Saitama, Japan
[2] Department of Nursing, University of Human Environment, Aichi, Japan; m-nishikawa@uhe.ac.jp
[3] Department of Global Communication, Toyo Gakuen University, Tokyo, Japan; minoru.kadota@tyg.jp
* Correspondence: fujii-k@tokyo-kasei.ac.jp; Tel.: 04-2952-1621

Abstract: Health and well-being are a major concern for the elderly who experienced evacuation due to the 2011 Fukushima Daiichi Nuclear Power accident. This study examined the feasibility of a picture sound book with Ninja-essence to maintain or improve exercise habits and physical and mental conditions of the elderly affected by the Fukushima Daiichi Nuclear Power plant accident. We conducted a pre–post intervention study to evaluate a picture sound book with Ninja-essence for returnees and evacuees post lifting evacuation restrictions. In total, 29 people participated in this study. Residents in two groups, returnees and evacuees, were provided with the tool. Results of the pre–post changes were analyzed using descriptive statistics, i.e., Fisher's exact test and t-test, and a significant difference was observed in both groups of participants between their left and right hand-grip strength, the maximum phonation time in the participants of the group that regularly engaged in exercise, and in the questions regarding swallowing exercises and singing songs or practicing words ($p < 0.013$ and 0.033); 16 of 29 participants reportedly enjoyed the program. The results demonstrated the future possibility of determining the improved outcome of this program in larger samples.

Keywords: fukushima nuclear accident; aged; feasibility studies; hand strength; singing exercises

1. Introduction

Health and well-being have been challenging for the elderly who experienced evacuation due to the Fukushima Daiichi Nuclear Power plant accidents that occurred on 11 March 2011. Due to the explosions of units 1, 3, and 4 of the Fukushima Daiichi Nuclear Power Plant after the Great East Japan earthquakes [1], residents in the evacuation zones had to move because of the evacuation orders. Consequently, residents moved from the evacuation area to other temporary housing or relatives' homes and later to newly constructed houses, restored houses, rental apartments, or other housing in cities within or outside the Fukushima Prefecture. Although many thought that the evacuation would be temporary, they were not allowed to return to the area until the evacuation orders were gradually lifted, from 2013 to 2022 [2,3]. Because the evacuation duration was too long and many people had already settled in a new place, it became difficult for individuals to move back to their original residence. For example, according to 7471 household survey reports of Namie Town of Futaba Province in Fukushima, 54.9% of respondents stated no will return [4]. Of the 1400 residents, almost 1000 were returnees. [4] Overall, 21,500 people resided in this area before the accident; thus, <5% of the population returned.

Regardless of where they lived after the nuclear power plant accident, individuals who experienced an evacuation potentially experienced mental, physical, and social stress to some degree [5]. Previous literature has shown a high risk of stress, including posttraumatic stress disorder (PTSD), among residents experiencing traumatic stress [6]. Disasters are associated with a high occurrence of PTSD; however, disasters related to nuclear power plants worsen the risk of PTSD due

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to the fear of radiation exposure. [7] The evacuators in other areas and returnees have experienced fear, depression, stigma [8] of family separation, and unresolved fears of low levels of radiation exposure, loan payments, repeated moving, death of family members, and neighborhood. The majority of older returnees were healthy; however, they encountered the collapse of the original community, unpredictable support for future nursing care, and lost livelihoods, such as agriculture.

Moreover, they may face potential nursing and medical shortages. In some areas, mental care has been lacking because hospitals for mental care were closed due to the range of evacuations. The association between living in evacuation areas in Fukushima and alone and long-term care needs was reported [9]. A survey conducted in Namie Town showed 84.1% and 59.1% of the respondents sought to expand medical institutions and nursing care and welfare facilities [4]. Based on this situation, the main author developed a novel health-related tool, "Picture sound book with Ninja-essence" (hereafter, book), targeting the elderly who experienced evacuation from the Fukushima Nuclear Power accident. There are several reasons to include the Ninja-essence. First, the three diseases of the Ninja are fear, disregard for one's enemies, and spending time thinking [10]. Overcoming the three diseases of the Ninja can be understood by victims who experienced fear and anxiety in the nuclear accident. Second, Fukushima Prefecture is surrounded by magnificent mountains that seem to appear from an old Japanese folk tale. The nuclear power plant accident has taken a toll on its natural beauty. The elderly of Fukushima used to await going into the mountains and picking mushrooms and wild vegetables. However, after the nuclear accident, they can no longer do it. The images of the people of Fukushima and a Ninja going into the mountains overlapped; therefore, a Ninja spell was included in the picture book. Third, before exercising, we need to do some stretching and stimulation. Therefore, we introduced a method of stimulating the body that was used by the Ninja, starting with light tapping on the face, hands, and feet to move the muscles.

This study examined the feasibility of the book in maintaining or improving exercise habits and physical and mental conditions. It also explored the delivery method of the tools. The research questions are as follows:

1. Was it meaningful to introduce Ninja-essence into the book for evacuees?
2. Has the development of the book feasibility of effectiveness concerning exercise habits and physical and mental conditions for the target population been based on the data?
3. What is the suitable delivery of the book?

2. Materials and Methods

2.1. Study Design

This is a feasibility evaluation with an intervention study.
Before and after pilot clinical trial

2.2. Conceptual Framework

"Picture sound book with Ninja-essence" provided various exercises to maintain and improve health of the entire body. The program featured in this study was characterized by the underlying spirits and technique of protecting the mind and body like a Ninja [11].

The results of the outcomes were pre–post changes in the toe-grip forces, swallowing function, and arm force because toe and swallowing exercises are emphasized in the book. Changes in self-reported health condition and exercise habits were also compared. In this study, we checked the current condition of PTSD only at preintervention to understand the prevalence of the participant's situation.

Setting and Study Population

Study participants were home-based, older adults (elderly) who moved back to the area within the evacuation zone post lifting restrictions in Namie Town (returnees) or those who evacuated and lived in the disaster complex in Nihonmatu (evacuees). Those who returned to the area rebuilt or renovated their homes. Namie Town is located in Hamadori, Fukushima Prefecture, and belongs to

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Futaba County. After the Fukushima Nuclear Power Plant accident, citizens of the entire town of Namie were evacuated. The temporary town office was set up in Naomitsu, approximately 1.5 h away from Namie Town.

The study was conducted from July 2021 to March 2022. The main author visited the Council of Social Welfare, geriatric groups, day-service centers, local pension and guest houses, and disaster reconstruction complex for evacuees from nuclear disasters of the 12 evacuation zones or the nearest area outside the zones where evacuees lived after the accident. In Namie, the Council of Social Welfare introduced the study to a geriatric social group. The main author explained the contents of the study to several residents, including the head of the geriatric social group who informed other members about the study. In Nihonmatsu, the pension owner introduced the autonomous chairman of the disaster reconstruction complex. One of his roles was to help or manage the geriatric social group in the disaster reconstruction complex. The main author explained the contents of the study to the chairman and other staff members. The chairman helped circulate the notice within the disaster reconstruction complex for study recruitment.

Older adults were eligible to participate if they (1) experienced evacuation due to the Fukushima nuclear disaster regardless of whether they did or did not return to the area and (2) were living in an area where the evacuation order was lifted, or an area evaluated within Fukushima Prefecture. Individuals who had severe cognitive impairment, were at risk of engaging in risky behavior by reading the book, or failed to understand the study instructions were excluded.

Based on the power analysis using the G Power (test family: *t*-test, Statistical test: mean difference between two independent means [two groups], Effect size: 0.8, Power 0.8), sample size was 21 for each group. Initially, we planned to conduct a study including the day-service center and a parallel group with control and non-control groups. Because of various COVID-19 restrictions, all day-service centers rejected participation in the study. Midst, participants from the two geriatric groups of two areas and one person from the different area were willing to participate in the study. After the main author explained the study to the candidate participants, signed informed consent forms were obtained from 30 participants. We excluded a participant with a particular health concern and another who could not participate in the planned intervention. Therefore, 29 participants were finally included in the study.

2.3. Instruments and Study Procedure

Herein, the main tool was the author-developed picture sound book with Ninja-essence. The idea of the book was based on the previous research of author [12].

This book has several unique features. First, it contains colorful pictures with attractive exercise content. Second, it is easy to obtain exercise instruction by only pushing the bottom. At present, many researchers and companies have developed healthcare programs using information and communication technology, artificial intelligence, and robots that target people living at home. Nevertheless, only a limited number of people benefit from such devices because they are troublesome to use, and the hurdles are high. Third, it contains the Ninja-essence. NJ refers to "Ninja." Even after 10 years, survivors of the nuclear accident have complicated feelings that cannot be expressed in words. The essence of the term Ninja is considered to provide an encouraging message to them. In addition, participants can enjoy exercise by introducing the extraordinary existence of a Ninja.

The picture sound book with the Ninja consists of seven pages with seven colored pushbuttons. When the participant pressed the button shown on each page, a voice could be heard, providing instructions for the respective exercise. The sound is stopped by pressing the button again; when pressed again, the instruction for the exercise on the next page begins. In total, a single book contains 20 exercises and two songs.

The content of the exercises in the book went beyond the regular exercise, including stimulation via tapping, moving, or voicing. Stimulating the ends of the body, such as the tips of the hands, feet, and ears, enhances the internal organ functions. Swallowing exercises were also included.

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After creating the draft, the author discussed the tool at a professional meeting consisting of two university researchers with physical therapist qualifications, two with nurse qualifications, and one with social welfare qualifications. The main author also contacted an otorhinolaryngologist and plastic surgeon specializing in feet. The main author finally developed a picture sound book with Ninja-essence.

2.3.1. Supplement Materials

Ninja cipher text tracing and daily notes, as well as softball, were provided as supplemental tools. A softball was provided for swallowing exercises, used by the participant while doing Adam's apple squat, placing the ball between their neck and chin [13].

We introduced Ninja cipher text tracing notes, published by the Ueno Printing Company. Ninja used it to communicate among themselves. It motivates exercise by activating the brain by tracing complicated shapes and providing fun.

2.3.2. Demographic and PTSD Checklists

Basic characteristics and PTSD-related variables were used to obtain the characteristics and current situation. At the beginning of the intervention, the participants completed questionnaires related to baseline data, including sex, age, and existing diseases. The PTSD level was evaluated using the "Impact of event scale-revised (IES-R)" questionnaire, developed by Weiss et al. in the United States [14]. IES-R has been used in various studies [15]. In this study, PTSD was checked during preintervention to understand the overall mental and physical condition of participants.

2.3.3. Outcome Pre–Post Intervention

Before and after the study, scores of the toe-grip force, hand-grip strength, maximum phonation time, checklist on swallowing function, exercise status, and living status, were measured. Self-reported 20-item questionnaires were prepared for this study, including questions related to exercise habits and physical and mental conditions while answering the questions. The researcher will show the survey items to the collaborators and describe what they heard in an interview format. Questions including "are you doing throat exercises?" and "do you move your toes?" were asked to the participants from both the groups to verify whether there was a difference pre–post intervention.

2.3.4. Toe-grip Force, Hand-Grip Strength, and Maximum Phonation Time

The toe-grip force was measured using the toe muscle strength-measuring device (TKK) of Takei Scientific Instrument [16]. Hand-grip strength was used to measure the physical strength of the entire body. Maximum phonation time is the method used to measure cough reflex during aspiration. The participants were asked to utter the vowel "ahh," the time was recorded, and the strength of the voice was evaluated according to the participant's natural tone. The length of vocalization was measured using a stopwatch. The maximum vocalization time has been reported to be associated with swallowing function [17].

2.3.5. Program Satisfaction Sheet

Postintervention, self-reported questionnaires related to program satisfaction were answered by the participants.

2.3.6. Intervention for Program Evaluation

Participants of the control group (Group A) where returnees after the evacuation order was lifted, and participants of the intervention group (Group B) lived in a reconstruction complex in the closest city, Nihonmatsu City. The same tools were provided to both groups. Participants in the control group were instructed to use tools at home, while the intervention group regularly performed exercises at a geriatric club meeting. The autonomous chairman of the reconstruction complex made

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motion pictures based on the picture book and used them during regular meetings. The intervention period was 3 months.

2.4. Data Analysis

Data was recorded by two teams working with the same information at different times and locations. Descriptive analysis was used for basic characteristics, IES-R scores preintervention, and satisfaction postintervention.

For self-reported 20-item questionnaires, the chi-square test is often used to test cross tables; however, because the sample size in this study was small, Fisher's exact probability test was used to test null and alternative hypotheses. Null, "the responses to the questionnaire do not change pre- and post-intervention," and alternative hypotheses, "questionnaire responses change pre- and post-intervention," were tested at a 5% level of significance.

For the toe-grip force, maximum phonation time, and hand-grip strength, we used the *t*-test to analyze score changes in the study groups after the preintervention. Data were then categorized into two groups and subsequently analyzed using IBM SPSS version 24 (IBM Corp., Armonk, NY, USA). We used descriptive statistics (*t*-test).

2.5. Ethical Approval

The Ethical Committee of the Tokyo University of Information Sciences approved the study (2021-003). This study was conducted in accordance with the Declaration of Helsinki. Information related to the purpose of the study, privacy, and the right to discontinue has been included in the informed consent.

3. Results

Table 1 shows the characteristics of the subjects. The average age of the participants was 77 (SD 7.618) and 82 (SD = 7.014) years, with 6 males and 15 females in returnees and 2 males and 5 females in evacuees. Of 29 participants, participants answered self-reported diagnosed diseases. Back pain was the highest rate in both groups (24% and 50%, respectively).

The results of the IES-R scores are shown in Table 2. The study showed that 4 of 19 participants in the returnee group expressed sleeping concerns. A significant difference was observed between the groups in the items "I felt irritable and angry" and "I had trouble concentrating."

Table 3 shows the results of toe-grip force, hand-grip strength, and maximum phonation time. Because some participants were unable to participate in the toe and grip strength measurements, we analyzed data from 20 participants (14 from Namie and 6 from Nihonmatsu).

Regarding hand-grip strength, a significant difference was found between the right and left hands in both cities. In contrast, no significant difference in the toe-grip force was found in either city, but the mean value improved. In Nihonmatsu, a significant difference was observed in the maximum phonation time.

Table 1. Subject characteristics.

	Returnees (Namie Town)	%	Evacuees (Nihonmatu City)	%
Male	6	29	3	37.5%
Female	15	71	5	62.5%
Age	77		82	
High blood pressure	8	38	1	12.5
Diabetes	2	9.5	1	12.5
Heart disease	1	4.8	3	37.5
Cerebrovascular disease	1	4.8	0	0
Back pain	5	23.8	3	37.5

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Table 2. Impact of events scale-revised results.

	Not at all	A little bit	Moderately	Quite a bit	Extremely		Not at all	A little bit	Moderately	Quite a bit	Extremely		
	Returnee						Evacuee						
	0	1	2	3	4	Total	0	1	2	3	4	Total	P-value
Any reminder that brought back feelings about it	7	8	2	1	0	18	2	5	0	0	0	7	0.946
	38.9%	44.4%	11.1%	5.6%	0.0%	100.0%	28.6%	71.4%	0.0%	0.0%	0.0%	100.0%	
I had trouble staying asleep	4	8	3	4	0	19	0	3	3	1	0	7	0.361
	21.1%	42.1%	15.8%	21.1%	0.0%	100.0%	0.0%	42.9%	42.9%	14.3%	0.0%	100.0%	
Other things kept me thinking about it	9	8	2	1	0	20	3	2	2	0	0	7	0.743
	45.0%	40.0%	10.0%	5.0%	0.0%	100.0%	42.9%	28.6%	28.6%	0.0%	0.0%	100.0%	
I felt irritable and angry.	9	10	1	0	0	20	7	0	0	0	0	7	0.013 *
	45.0%	50.0%	5.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
I avoided letting myself get upset when I thought about it or was reminded of it.	7	9	4	0	0	20	5	1	1	0	0	7	0.169
	35.0%	45.0%	20.0%	0.0%	0.0%	100.0%	71.4%	14.3%	14.3%	0.0%	0.0%	100.0%	
I thought about it when I did not intend to.	5	12	2	0	0	19	2	2	2	0	0	6	0.669
	26.3%	63.2%	10.5%	0.0%	0.0%	100.0%	33.3%	33.3%	33.3%	0.0%	0.0%	100.0%	
I felt as if it was unreal.	10	8	1	0	0	19	4	1	1	0	0	6	0.746
	52.6%	42.1%	5.3%	0.0%	0.0%	100.0%	66.7%	16.7%	16.7%	0.0%	0.0%	100.0%	
I stayed away from reminders about it.	13	5	2	0	0	20	6	0	0	1	0	7	0.449
	65.0%	25.0%	10.0%	0.0%	0.0%	100.0%	85.7%	0.0%	0.0%	14.3%	0.0%	100.0%	
Pictures of it popped into my mind	8	10	2	0	0	20	1	3	3	0	0	7	0.071
	40.0%	50.0%	10.0%	0.0%	0.0%	100.0%	14.3%	42.9%	42.9%	0.0%	0.0%	100.0%	
I was jumpy and easily startled	7	11	1	0	1	20	2	3	1	1	0	7	0.465
	35.0%	55.0%	5.0%	0.0%	5.0%	100.0%	28.6%	42.9%	14.3%	14.3%	0.0%	100.0%	
I tried not to think about it.	8	8	2	1	0	19	4	0	0	1	1	6	0.810
	42.1%	42.1%	10.5%	5.3%	0.0%	100.0%	66.7%	0.0%	0.0%	16.7%	16.7%	100.0%	
I was aware that I still had many feelings about it, but I did	10	6	4	0	0	20	3	2	0	2	0	7	0.512
	50.0%	30.0%	20.0%	0.0%	0.0%	100.0%	42.9%	28.6%	0.0%	28.6%	0.0%	100.0%	

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not deal with them.														
My feelings about it were numb.	11	7	2	0	0	20	4	2	0	1	0	7	0.950	
	55.0%	35.0%	10.0%	0.0%	0.0%	100.0 %	57.1%	28.6%	0.0%	14.3%	0.0%	100.0 %		
I found myself acting or feeling like I was back in that time.	13	5	2	0	0	20	3	1	0	1	0	5	0.690	
	65.0%	25.0%	10.0%	0.0%	0.0%	100.0 %	60.0%	20.0%	0.0%	20.0%	0.0%	100.0 %		
I had trouble falling asleep.	11	7	0	2	0	20	4	1	0	1	0	6	0.756	
	55.0%	35.0%	0.0%	10.0%	0.0%	100.0 %	66.7%	16.7%	0.0%	16.7%	0.0%	100.0 %		
I had waves of strong feelings about it.	11	7	1	1	0	20	4	2	0	1	0	7	0.975	
	55.0%	35.0%	5.0%	5.0%	0.0%	100.0 %	57.1%	28.6%	0.0%	14.3%	0.0%	100.0 %		
I have tried forgetting about it.	11	7	1	1	0	20	3	1	2	0	0	6	0.590	
	55.0%	35.0%	5.0%	5.0%	0.0%	100.0 %	50.0%	16.7%	33.3%	0.0%	0.0%	100.0 %		
I had trouble concentrating.	14	5	1	0	0	20	1	2	2	2	0	7	0.003	*
	70.0%	25.0%	5.0%	0.0%	0.0%	100.0 %	14.3%	28.6%	28.6%	28.6%	0.0%	100.0 %		
Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart.	13	6	0	1	0	20	3	2	0	1	0	6	0.436	
	65.0%	30.0%	0.0%	5.0%	0.0%	100.0 %	50.0%	33.3%	0.0%	16.7%	0.0%	100.0 %		
I had dreams about it.	12	7	1	0	0	20	5	2	0	0	0	7	0.556	
	60.0%	35.0%	5.0%	0.0%	0.0%	100.0 %	71.4%	28.6%	0.0%	0.0%	0.0%	100.0 %		
I felt watchful or on guard.	9	9	1	1	0	20	2	2	1	2	0	7	0.162	
	45.0%	45.0%	5.0%	5.0%	0.0%	100.0 %	28.6%	28.6%	14.3%	28.6%	0.0%	100.0 %		
I tried not to talk about it.	9	9	2	0	0	20	3	1	1	1	1	7	0.340	
	45.0%	45.0%	10.0%	0.0%	0.0%	100.0 %	42.9%	14.3%	14.3%	14.3%	14.3%	100.0 %		

Format was downloaded from www.onlinecbtresources.co.uk. N = 29.

Table 3. Toe-grip force, hand-grip strength, and maximum phonation time.

	Returnees (Namie Town)			**Evacuees (Nihonmatu City)**		
	N	**Average ± SD (pre–post intervention difference)**	***p*-value**	**N**	**Average ± SD (pre–post**	***p*-value**

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					intervention difference)	
Toe-grip force (R)	14	0.2 ± 2.4	0.816	6	1.1 ± 1.2	0.058
Toe-grip force (L)	14	0.1 ± 1.5	0.838	6	0.9 ± 1.7	0.545
Hand-grip strength	14	4.5 ± 7.7	0.048*	6	1.4 ± 2.2	0.000*
Hand-grip strength	14	4.6 ± 6.7	0.023*	6	0.6 ± 0.8	0.000*
Maximum phonation time	13	0.8 ± 7.7	0.728	6	0.8 ± 3.6	0.033*

* $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$. N = 29.

Table 4 shows the results of the self-reported 20-item questionnaires. The p-value of the chi-square test was used to verify whether there was a difference in the subjects' condition and exercise behavior pre–post intervention. Participants answered the questions considering the current situation; 1. Applicable, 2. Somewhat applicable, 3, None of the above, 4. Slightly applicable, 5. Not at all. For returnees, there were significant differences in two questions: "Do you sing a song or practice that word?" and "Do you perform swallowing exercises?"

Table 4. Self-reported 20-item questionnaires.

	Returnees' (Namie Town)	**Evacuees' (Nihonmatu City)**
	***p*-value**	***p*-value**
Do you experience difficulty breathing or coughing while eating?	0.622	0.182
Do you cough while eating?	0.6	1
Does your saliva secretion increase during meals?	1	0.455
Do you experience difficulties while swallowing tablets?	0.792	1
Do you cough when you drink water?	0.711	1
Do you bend your neck forward when swallowing?	0.326	0.455
Does your phlegm accumulate in the throat?	0.067	0.455
Did you get a fever every time you ate?	1	1
Do you have a slight fever?	1	1
Do you feel food is tasty?	0.466	1
Do you sleep well at night?	0.232	1
Are you frustrated? (Answer is reverse scored)	0.273	1
Do you sing a song or practice a word?	0.013*	1
Do you perform swallowing exercises?	*0.033**	*0.212*
Do you stretch your posture?	0.732	1
Do you take deep breaths?	1	0.455
Do you move your fingers?	0.408	0.455
Do you exercise by raising and lowering your ankles?	0.24	1
Do you move your toes?	0.451	0.134
Do you move your shoulders using a towel?	0.067	1

* $p < 0.05$ Fisher's exact probability test. N = 29.

3.1. Satisfaction Survey

The satisfaction survey on experiencing the program is shown in Table 5. In total, 24 residents in both areas answered the questions; 16 respondents answered, "I enjoyed the program" and 6 "I relatively enjoyed it." For the question "was it easy to use for exercising at home?" 9 respondents answered "yes" and 10 "relatively yes." As one of supplement kit, Ninja cipher text letter tracing notes proved somewhat challenging according to 7 of 19 respondents, and 5 commented that it was difficult. Free responses are listed below.

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Table 5. Satisfaction survey about picture books.

What do you think should be improved about picture sound books?	- It is fine the way it is (1) - I enjoyed it (16) - I relatively enjoyed (7) - I cannot really judge (1) - I hope we can make a home video together (1) - It would be nice to be able to do it freely (1) - I would like the sound to be a little louder (2)
Any feedback on the Ninja cipher text letter tracing notes would be appreciated.	- Nothing in particular (1) - It was quite difficult (1) - I enjoyed understanding the flow of letters (1) - Difficult (3) - A little difficult (1)

N = 22.

4. Discussion

This study has several strengths. First, exercises included toe and throat exercises, which are usually not included in general exercises for the elderly. Second, the introduction of the program has led to regular exercise at geriatric club meetings. Keeping a picture sound book with Ninja-essence at home allows the participants to remember to use the book at home, which potentially leads to habitual exercises. Evacuees continued regular exercises in the group.

The limitation of the study was that there were only 8 people in the evacuees' group. In the recovery complex, the elderly participation in outside activities was limited and the trial was registered retrospectively. This is a challenging issue. It was difficult to increase the number of participants over a short time. Prior to the study, PTSD status was enquired to grasp the current mental conditions due to the accident, whereas poststudy PTSD status was not asked. We tried to avoid the increased fear of flashbacks among participants. Additionally, it was unclear whether short-term intervention could affect PTSD status. The PTSD prevalence rate may be lower than when it was reported in 2016, 11 years after the report. Minimum data showed that some participants still had sleep disturbances. Sleeping status changes due to the intervention with the book should be explored in the future.

Overall, the results showed that there were improvements in the hand-grip strength in two areas. A previous study reported that hand-grip strength correlates with physical function [18]. Regardless of whether the book exercises were conducted in a group or individually, positive effects on physical function were demonstrated.

In the case of swallowing exercise, group exercise may have potential effects on swallowing function. Swallowing exercises have not been well-introduced in Japan because of their complexity. The importance of oral care has been recognized with the increased elderly population. The shortage in otolaryngologists (n = 9831) compared with dentists (n = 107,443) [19] may be associated with the prevalence of exercise. In Japan, pneumonia and aspiration pneumonia are the fifth and sixth leading causes of death [20]. In total, pneumonia ranks fourth among the leading causes of death. Compared with international data, there is a high probability of death due to aspiration pneumonia. We believe that in the future, swallowing exercises can be instilled through the use of videos from this book and from group exercises.

A significant difference was found in the returnees' group for the questions on whether they practice speech and swallowing. When the elderly learn and recognize the importance of exercises such as swallowing and toe exercises, although they were initially not familiar with them, they engage in individual exercise behaviors. By encouraging people who exercise in groups to do so, a synergistic effect of exercise can be expected.

Herein, there were no significant changes in the toe-grip force pre–post intervention. Previous literature mentioned the importance of toes in the lower limb muscle strength and postural stability and prevention of all, etc [21]. By increasing the number of participants and sustaining the program over a long period, the effects of the exercise can be examined in detail.

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Exercises, including toe and swallowing exercises, which were not prevalent in geriatric society, were emphasized in the book. Although previous studies have reported an association between frailty and oral or swallowing function [22–24], studies on the association between frailty and integrated functions of the foot and oral swallowing were scarce. Otolaryngologist Koichiro Nishiyama stated that dysphagia is a systemic symptom and that there is a need to enhance whole-body strength through training [25]. Maintaining good foot conditions for walking helps maintain physical strength and prevent tracheal aspiration in patients with dysphagia. Thus, it is necessary to promote foot care, oral care, and pharyngeal care as frailty measures.

The satisfaction survey from participants showed that participants were satisfied with the program contents. Although participants felt that Ninja cipher text letter tracing notes that were used as a supplement kit were difficult to tackle, it may be explored as a potential tool potentially combined with physical exercises.

Introducing Ninja-essence into the book for participants who experienced the Fukushima Nuclear Power accident was meaningful. Although the initial purpose of introducing Ninja into the book was to encourage by letting them know the Ninja spirit, the residents paid attention to the word "Ninja" as a supernatural ability. The chairman of the recovery complex named the program "Ninja exercise" and participants continued the regular exercises in the group up to now. Basic exercises such as "tapping" used by ninjas or making poses have provided preparation before exercising using muscles. Although many concerns remain from the first trial, the study results showed that the development of the program is feasible for future use to improve the motor and exercise habits for evacuees.

5. Conclusions

We explored the feasibility of the picture sound book with Ninja-essence. The feature of the book allowed participants to perform several exercises with delight by introducing Ninja-essence.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of Ethics Committee of the Tokyo University of Information Sciences (NO 2021-003and Approved date 20210728).

Clinical Trial Registration: This study was retrospectively registered with the University Medical Information Network on the 12 February 2024 on the registration number UMIN000053603.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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