



## Home-visit rehabilitation in a repopulated village after the Fukushima nuclear disaster

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### Abstract

Following the evacuation of areas affected by Japan's 2011 Fukushima Daiichi Nuclear Power Plant (FDNPP) accident, Kawauchi Village was one of the first municipalities repopulated. Although rehabilitation resources were limited, a healthcare facility near the municipality initiated home-visit rehabilitation in 2016. To the best of our knowledge, reports of home-visit rehabilitation in repopulated villages that were evacuated following a nuclear accident are lacking.

This article describes a case study of home-visit rehabilitation in Kawauchi Village. The purpose of this study was to explore how users of home-visit rehabilitation services in Kawauchi Village perceive home-visit rehabilitation, and whether it had a positive impact on their daily life. A questionnaire survey was conducted, and their ability to perform activities of daily living was assessed, to understand the living conditions of the visiting-rehabilitation service users.

We studied 10 rehabilitation-service users, with a mean age of 86.8 years, who had used the services for an average of 591.4 days. Themes that emerged from the open-ended questionnaire were "established exercise habits and improved physical functions," "the joy of returning to the village," "challenges in the mountainous areas" and "changes in relationships due to the earthquake or evacuation."

In conclusion, home-visit rehabilitation was successfully implemented in the repopulated village, and helped maintain the users' physical functions. This may thus be a viable choice for rehabilitation care in repopulated areas after disasters.

**Key words :** Fukushima Nuclear Disaster, home-visit rehabilitation, community healthcare, community dwelling, older adults, case study

### Introduction

Home-visit rehabilitation is an important form of home-based rehabilitation that supports the lives of, and provides care for, individuals who are unable to visit rehabilitation facilities. Home-visit rehabil-

itation enables elderly people to receive care at home, which helps them maintain their dignity and live independently<sup>1)</sup>. Additionally, rehabilitation plays an important role in enabling independent living in many countries around the world<sup>2-5)</sup>. In rural and remote areas, there is a lack of sufficient medi-

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cal resources, and access to healthcare is affected by cost, distance to facilities, and information barriers, in addition to the limited availability of therapists<sup>6,7)</sup>. Disaster evacuation and repopulation are known to be complex situations that affect access to various healthcare services, such as emergency medical services<sup>8)</sup>. However, there is a lack of information regarding the provision of rehabilitation in limited-resource areas, the distance to the patient's home, the number of staff available, and the frequency of rehabilitation activities. It is important that recovery areas provide rehabilitative care to community members returning to their homeland after a disaster evacuation.

In Fukushima Prefecture, Japan, residents of 12 municipalities within a 20 km radius were forced to evacuate due to the Fukushima Daiichi Nuclear Power Plant (FDNPP) accident caused by the Great East Japan Earthquake of March 11, 2011<sup>9)</sup>. The FDNPP accident had a significant impact on the medical system in Hamadori, the coastal region of Fukushima Prefecture. Before the nuclear accident, there were 80 operational medical institutions in Hamadori's Futaba County; however, by August 1, 2016, only 15, i.e., 18.75% of these institutions, were operational<sup>10)</sup>.

Kawauchi Village, located 10–30 km from the FDNPP (Figure 1), was one of the first municipalities to be repopulated after the evacuation in April 2012. Before the disaster, Kawauchi Village had

only one medical facility, the National Health Insurance Clinic<sup>11)</sup>. Rehabilitation resources were limited by the closure of medical facilities in neighboring municipalities after the disaster.

In March 2016, the Healthcare Corporation Seireikai was started as a home-visit rehabilitation service in Kawauchi Village to provide access to rehabilitation care. However, contemporary reports on home-visit rehabilitation in repopulated villages after an evacuation following a nuclear accident have been scarce. Kawauchi Village is an important area to understand the feasibility of home-visit rehabilitation in the repopulated areas, and how rehabilitation care was conducted in a real-life situation.

Hence, this report describes a case study of home-visit rehabilitation in Kawauchi Village. The purpose of this study was to explore how the users of home-visit rehabilitation services in Kawauchi Village perceive home-visit rehabilitation and whether it has a positive impact on their daily life.

## Methods

### Setting

Kawauchi Village is a hilly and mountainous area with an elevation of 400–600 m. In the 2010 census, before the disaster, its population was 2,820, with the elderly (> 65 years old) comprising 35.2%. In 2015, after the earthquake, the population was 2,021 with the elderly comprising 37.9% of the total.

Home-visit rehabilitation was widespread in Japan before the earthquake, but Kawauchi Village did not have such services. In March 2012, after the earthquake, Healthcare Corporation Seireikai signed a medical welfare agreement with Kawauchi Village to provide visiting rehabilitation services, but without any financial support. Since October 2020, we have been the only institution providing visiting rehabilitation services in Kawauchi Village. There was no relationship between Kawauchi Village and Healthcare Corporation Seireikai before the disaster. Furthermore, there are only a limited number of facilities in neighboring cities, towns, and villages that provide visiting rehabilitation services in the former evacuation zone.

The institute is located approximately 33 km away from Kawauchi Village in Hirata Village, Fukushima Prefecture (Figure 1). The Japanese government has been promoting the establishment of a comprehensive regional support and service provision system within a 6 km radius by 2025. However, since the FDNPP disaster, it has been difficult to

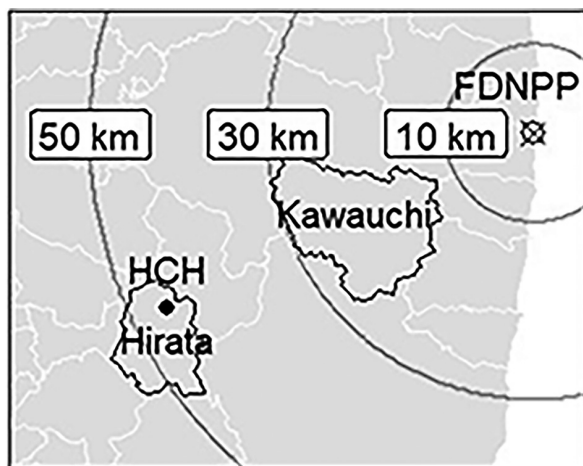


Fig. 1. Location of Kawauchi Village, Hirata Village, Hirata Central Hospital (HCH), and Fukushima Daiichi Nuclear Power Plant (FDNPP). This map was created using R version 3.5.0 (<http://www.r-project.org>) and R Package “jpnndistrict” (<https://cran.r-project.org/web/packages/jpnndistrict/index.html>), which derives its geographical plotting data from National Land Numerical Information (<http://nlftp.mlit.go.jp/ksj-e/index.html>).

provide home-visit rehabilitation services to the affected areas within this radius.

#### *Case of Seireikai Home Nursing Station Hirata*

Seireikai Home Nursing Station Hirata, Healthcare Corporation Seireikai, is currently operated by three nurses (including one part-time nurse), four physical therapists (including one part-time therapist), and one part-time speech therapist. The percentage of home-care users in Kawauchi Village is approximately 20%. Due to the limited availability of rehabilitation resources, the nursing home station covers an approximate area of 30 km<sup>2</sup>, including Ishikawa County, a part of Futaba County, and a part of Iwaki City.

Three physical therapists were dispatched to Kawauchi village thrice a week. The average number of visits per week was five, and the average number of visits per patient was 1.3 per week. The average travel distance from the office to the first site was  $31.2 \pm 2.6$  km, and the average travel time was  $39.3 \pm 2.7$  minutes. As a reference, nationally aggregated data showed an average travel distance to the farthest user's home of  $23.6 \pm 11.5$  km, with a travel time of  $30.9 \pm 9.5$  minutes, according to Japan's Ministry of Health, Labour and Welfare<sup>12)</sup>. The average total distance traveled, which included a round trip to and from Kawauchi Village and between the residences, was 86.0 km, and the average travel time was 124.0 minutes.

#### *Participants and design*

This case study was an observational study of home-visit rehabilitation users who lived in Kawauchi Village during the study period. We conducted a review of the medical records and a questionnaire survey of the home-visit rehabilitation users. The participants of this study were all users of the home-visit rehabilitation service of the visiting nursing station Hirata in February 2019. The users' data was reviewed in retrospect from the time they began using the home-visit rehabilitation service. A questionnaire survey was conducted by home-visit rehabilitation staff from February to March 2019, to explore users' opinions on home-visit rehabilitation and the repopulated village itself.

#### *Analytical methods*

To clarify the actual conditions of home rehabilitation users, the following items were extracted from their medical records: gender, age, nursing care level, number of days, daily life independence level, degree of independence in daily living for el-

derly with dementia, and Barthel Index (BI). To evaluate the daily life activities of the users, the mean and standard deviation of BI were calculated from the first day of use to February 2019, the most recent date of the rehabilitation service. A thematic analysis was conducted based on the responses to the open-ended questionnaire<sup>13)</sup>. The authors assigned the first coding based on the written comments. The coding framework, developed by the two present authors, combined the codes into categories and themes to interpret the underlying factors related to home-visit rehabilitation and life in the repopulated village. The themes were refined through discussion, commented on by each participant, and checked against the entire dataset. All co-authors reviewed the coding, categories, and themes, discussed them, and resolved any disagreements through discussion.

Data management and coding of the descriptive statistics and thematic analyses were performed using Excel for Windows 2016.

#### *Ethical Considerations*

The study was approved by the Ethics Committee of Hirata Central Hospital (approval no. 2017-0321-1) as well as the Fukushima Medical University Ethics Committee (reference number: General 2019-064). Accordingly, written explanations were provided and informed consents were obtained from the study participants.

## **Results**

As of February 2019, there were 15 home-visit rehabilitation users. From this sample, five users did not provide consent, and were, therefore, excluded. The ten consenting study participants included three men and seven women. Table 1 shows the users' backgrounds. Their mean age was 86.8 years (standard deviation (SD) 4.57). The mean usage period was 591.4 days (SD 413.60). The BI (mean) was 82/100 points (SD 11.66) at the beginning of each user's rehabilitation, and 82/100 points (SD 10.54) at the end of February 2019. Within the sample, two had improved physical activity, six maintained their physical activity, whereas two had decreased physical activity.

Table 2 shows the themes, subthemes, and categories identified through the thematic analysis of the questionnaire survey. Four main themes were identified:

(1) Establishment of exercise habits and improvement of physical functions:

Table 1. Background of home-visit rehabilitation users

No.	Gender	Age	Nursing care level	Number of days	Level of independence in daily life	Independence degree in daily living for elderly with dementia	Barthel Index (at the start)	Barthel Index (as of February 2019)
1	Female	79	Nursing care level 3	1094	A2	I	80	80
2	Female	88	Nursing care level 4	966	B1	IIb	50	55
3	Male	84	Nursing care level 5	261	J2	I	90	90
4	Female	87	Nursing care level 2	512	A1	IIa	80	75
5	Male	88	Nursing care level 2	512	A1	IIIa	90	85
6	Female	89	Nursing care level 2	966	A2	IIIb	85	85
7	Female	91	Nursing care level 2	1094	B1	I	85	85
8	Female	85	Nursing care level 1	169	J2	I	85	90
9	Male	80	Nursing care level 2	28	A1	IIb	80	80
10	Female	88	Requiring help 2	30	J2	I	95	95

Table 2. Coding tables with the opinions on home-visit rehabilitation in the repopulated village

Themes	Category
Establishment of exercise habits and improving physical functions	Establishment of exercise and activity habits
	Improvement in physical function
The joy of returning to the village	The goodness of life in our home
	The goodness of hometown
	Resumption of interactions with local residents
Challenges in the mountainous areas	Lack of living infrastructure
Changes in relationships due to the earthquake or evacuation	Changes in the family environment after the earthquake
	Farewell to acquaintances at the evacuation site

The users stated that they established exercise habits, and their physical functions had improved.

“I am able to play ground golf.” (P3, a man in his 80s).

“My body movement is getting better.” (P1, female in her 80s).

(2) Joy of returning to the village :

The users expressed a sense of security in their homes and the joy of reconnecting with their neighbors.

“This is good because it is my hometown. I do not think there is a better place than here.” (P4, female in her 80s).

“I can have tea with my acquaintances. They come

here, and I go there by myself.” (P10, female in her 80s).

(3) Issues in the mountainous areas

Some users mentioned the lack of medical and commercial facilities.

“It is difficult to go to the hospital.” (P10, female in her 80s)

“I have to travel far for shopping.” (P3, male in his 80s).

(4) Changes in human relationships due to the earthquakes or evacuation :

Some users mentioned meeting and parting with family members and people they had become friends with at the evacuation site.

“To be honest, I did not want to leave because I became friends with volunteers.” (P7, female in her 80s).

“I was separated from my grandchildren.” (P1, female in her 80s).

## Discussion

To the best of our knowledge, there have been no reports on home-visit rehabilitation in the setting of repopulated villages after an evacuation. In this study, we found that users of home-visit rehabilitation were able to maintain their daily lives, social interactions, and activities. These results suggest that the use of home-visit rehabilitation and living in a familiar home may contribute to the maintenance of users' physical functions and participation in activities in the community. Home-visit rehabilitation, even from 30 km away, may help improve access to rehabilitation services in a post-evacuation area.

Our results suggested that the provision of home visit rehabilitation in the repopulated village area contributed to the maintenance of users' physical functions. According to a previous study, living in temporary housing is associated with a high risk of disease due to chronic pain and a decrease in the amount of social activity and going out, due to the weakening of ties among local residents<sup>14,15</sup>. In the present study, the questionnaire survey showed an improvement in individuals' physical function and maintenance of BI, which can be attributed to the exercise habits established. These results suggest that home-visit rehabilitation may be effective in maintaining individual physical function after returning to the village.

There were opinions that indicated an increase in social activities in the repopulated village, such as playing ground golf and having tea with neighbors. Elderly people living in rural areas have been reported to be less socially active than those living in urban areas<sup>16</sup>. Rehabilitation has been reported to lead to improvements in social participation<sup>17</sup>. Additionally, while some users regretted the change in human relationships due to the return from evacuation, some said that they were able to reunite with old friends and live in a familiar environment after returning to the village. Therefore, receiving home-visit rehabilitation in a repopulated village may lead to improvements in users' social lives, such as going out and interacting with others.

For home-visit rehabilitation, we showed that it was possible to conduct home-visit rehabilitation

from outside the living area. Hence, we suggest it is feasible to provide home-visit rehabilitation, even from areas distant (about 30 km from the main facility) compared with the mean distance based on Japan's Ministry of Health, Labour and Welfare statistics (mean  $23.6 \pm 11.5$  km). Home-visit rehabilitation users stated that medical and commercial facilities were scarce in the village. Rehabilitative care was provided through home-visits. However, due to the transportation burden on the service provider, the frequency of service was limited to 1.2 times per week on average for each user. Even with such infrequent visits, there was no deterioration in physical function, and the users were able to participate in the community.

Our study had a few limitations. First, this study was conducted under limited circumstances in the areas affected by the FDNPP accident. The area was already depopulated to a degree, with few medical resources, and the earthquake accelerated the decline in medical resources. Family support decreased due to the decrease in the number of family members living together after evacuation. Furthermore, there might be a decrease in activity level due to evacuation or avoiding radiation exposure after the disaster. For these reasons, it was not possible to generalize the study to other municipalities. Second, there were some themes with small samples in the thematic analysis. However, this study included all consenting home-visit users and used all the available information. Third, as this was a descriptive observational study, a clear causal relationship could not be established. Because the questionnaire survey was conducted by the therapist, there may have been observer bias leading to the collection of more positive opinions than negative ones. Fourth, in clinical practice, we did not assess daily life activities at every visit. The evaluation of the daily activities may not be sufficient for rigorous data analysis. However, the results of this study suggest that home-visit rehabilitation may be effective as a means to cope with the depletion of rehabilitation resources that would follow a disaster. Provision of visiting-rehabilitation services from nearby facilities may lead to the expansion of rehabilitation services in rural and remote areas. Healthcare Corporation Seireikai continues to provide medical care, amenable to further investigation. To the best of our knowledge, this study, limitations notwithstanding, is a useful first report about home rehabilitation services provided in an area repopulated after the FDNPP accident in Japan.

## Conclusion

In a village repopulated after the FDNPP accident, home-visit rehabilitation has been successfully conducted and may contribute to the establishment of exercise habits and the maintenance of physical functions for the elderly. Home-visit rehabilitation may be useful for rehabilitation in day-to-day environments for enhancing social activities, such as going out and interacting with others. Thus, it may be a viable option for providing rehabilitation care in repopulated villages in disaster-affected areas.

## Conflicts of interest

Masaharu Tsubokura received grants from the Ministry of Environment, Japan, and Nuclear Regulation Authority, Japan.

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## References

1. Community-based care system (in Japanese) [Internet]. Ministry of Health, Labor and Welfare : 2020 [cited 2020 Nov 7]. Available from : [https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/huku shi\\_kaigo/kaigo\\_koureisha/chiiki-houkatsu](https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/huku shi_kaigo/kaigo_koureisha/chiiki-houkatsu).
2. Nakai T, Suzumoto S, Kawai E, Suzuki F, Sakai J, Okada F, *et al.* Chuu sankanbu deno houmon rehabilitation no zittai [The reality of home rehabilitation in mountainous areas]. (in Japanese) The 55th Annual Meeting of the Japanese Society of Rural Medicine. Aichi [Internet]. 10, 2006. <https://doi.org/10.14879/nnigss.55.0.132.0>
3. Bateman C. "One size fits all" health policies crippling rural rehab-therapists. *S Afr Med J*, **102** : 200-208, 2012. <http://www.samj.org.za/index.php/samj/article/view/5806>
4. Wegner L, Rhoda A. The influence of cultural beliefs on the utilisation of rehabilitation services in a rural South African context : therapist's perspective. *Afr J Disabil*, **4** : 1-8, 2015. <https://doi.org/10.4102/ajod.v4i1.128>
5. Nualnetr N. Physical therapy roles in community-based rehabilitation : A case study in rural areas of north eastern Thailand. *Asia Pac Disabil Rehabil J*, **20** : 73-82, 2009.
6. Strasser R. Rural health around the world : Challenges and solutions. *eFam Pract*, **20** : 457-463, 2003. <https://doi.org/10.1093/fampra/cm422>
7. Takahashi T, Eguchi N, Ishikawa M. Current status of local medical care provision systems : Data collection by municipality (related to regional comprehensive care) (April 2020, 5) (in Japanese) [Internet]. Japan Medical Association Research Institute. Available from : <https://www.jmari.med.or.jp/download/WP444/WP444-07.pdf>
8. Nishikawa Y, Tsubokura M, Takahashi Y, Nomura S, Ozaki A, Kimura Y, *et al.* Change of access to emergency care in a repopulated village after the 2011 Fukushima nuclear disaster : A retrospective observational study. *BMJ Open*, **9** : 1-8, 2019. <https://doi.org/10.1136/bmjopen-2018-023836>
9. Naito W, Uesaka M, Kurosawa T, Kuroda Y. Measuring and assessing individual external doses during the rehabilitation phase in Iitate village after the Fukushima Daiichi nuclear power plant accident. *J Radiol Prot*, **37** : 606-622, 2017. <https://doi.org/10.1088/1361-6498/aa7359>
10. Tanigawa K. Fukushima ken hamadori no genpat-su ziko go no tiiki iryou taisai no hensen to nokosareta kadai [Changes in the regional medical system in Hamadori, Fukushima Prefecture, following the nuclear accident and remaining issues]. (in Japanese) *Kousyu eisei gaku [Public Health]*, **84** : 308-314, 2017. <https://doi.org/10.11477/mf.1401208645>
11. Nishikawa Y, Tsubokura M, Yamazaki S. Healthcare delivery to a repopulated village after the Fukushima nuclear disaster : A case of Kawauchi village, Fukushima, Japan. *Japan Med Assoc J*, **59** : 159-161, 2016. Available from : <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5476993/>
12. Japan Ministry of Health, Labor and Welfare. Survey and research project on the way of service provision in mountainous areas. (in Japanese) [Internet]. Tokyo : Ministry of Health, Labor and Welfare (2016 Mar 30) [cited 2020 Oct 21]. Available from : [https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshit su\\_Shakaihoshoutantou/0000119059.pdf](https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshit su_Shakaihoshoutantou/0000119059.pdf)
13. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*, **3** : 77-101, 2006. <https://doi.org/10.1191/1478088706qp0630a>
14. Moriyama N, Urabe Y, Onoda S, Maeda N, Oikawa T. Effect of residence in temporary housing after the Great East Japan Earthquake on the physical activity and quality of life of older survivors. *Disaster Med Public Health Prep*, **11** : 701-710, 2017. <https://doi.org/10.1017/dmp.2017.19>
15. Yabuki S, Ouchi K, Kikuchi S, Konno S. Pain, quality of life and activity in aged evacuees living in temporary housing after the Great East Japan

- earthquake of 11 March 2011 : A cross-sectional study in Minamisoma City, Fukushima prefecture. *BMC Musculoskelet Disord*, **16** : 1-6, 2015. <https://doi.org/10.1186/s12891-015-0711-2>
16. Vogelsang EM. Older adult social participation and its relationship with health : Rural-urban differences. *Health Place*, **42** : 111-119, 2016. <https://pubmed.ncbi.nlm.nih.gov/27755999>
17. Hirabayashi I, Murayama Y, Shitakura H. A case of rehabilitation focusing on activities of daily living improves the sense of motivation and increases the range of activities. *Medical Journal of Aizawa Hospital*, **14** : 67-71, 2016.