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Resident and facility characteristics associated with care-need level deterioration in long-term care welfare facilities in Japan

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Aim: To determine the resident and facility characteristics associated with residents' care-need level deterioration in long-term care welfare facilities in Japan.

Methods: A nationally representative sample of 358 886 residents who lived in 3774 long-term care welfare facilities for at least 1 year from October 2012 was obtained from long-term care insurance claims data. Facility characteristics were linked with a survey of institutions and establishments for long-term care in 2012. We used a multilevel logistic regression according to the inclusion and exclusion of lost to follow-up to define the resident and facility characteristics associated with resident care-need level deteriorations (lost to follow-up: the majority were hospitalized residents or had died; were treated as deterioration in the including loss to follow-up model).

Results: Adjusting for the covariates, at the resident level, older age and lower care-need level at baseline were more likely to show deterioration in the care-need level. At the facility level, metropolitan facilities, unit model (all private room settings) and mixed-model facilities (partly private room settings) were less likely to experience care-need level deterioration. A higher proportion of registered nurses among all nurses was negatively related to care-need level deterioration only in the model including lost to follow-up. A higher proportion of registered dietitians among all dietitians and the facilities in business for fewer years were negatively associated with care-need level deterioration only in the model excluding lost to follow-up.

Conclusions: The present study could help identify residents who are at risk of care-need level deterioration, and could contribute to improvements in provider quality performance and enhance competence in the market. **Geriatr Gerontol Int 2018; 18: 758–766.**

Keywords: care-needs, functional decline, multilevel analysis, nursing homes, quality of care.

Introduction

Older populations have a higher rate of disabilities and increased requirements for healthcare needs. Japan has been particularly affected by increased healthcare needs, because it has the highest proportion of older adults worldwide. To solve this problem, the Japanese government introduced a long-term care insurance (LTCI) system in April of 2000.[1]

Since the implementation of the LTCI system, there has been a dramatic increase in the number of long-term care facilities.[2] Because older adults or their families can freely choose the types of services and facilities, the competition among the facilities has increased. Therefore, the necessity to improve the quality of care has become a critical issue in Japan. In 2015, the Ministry of Health, Labor and Welfare (MHLW) made recommendations for the implementation of assessment indicators to measure the quality of care. One of the key quality indicators as an assessment measure is the change of health status.[3] The care-need level could be a possible indicator of functional status, because activities of daily living (ADL) is an important factor in qualifying the care-need level. In addition, a previous study

has shown that the care-need level strongly reflected the ADL.[4]

To date, studies have attempted to investigate the factors that are related to deteriorations in the care-need level,[5–8] but most studies focused on community-based services or home care services.[5–7] However, previous studies have shown that facility service users were more likely to experience a deterioration in the care-need level than community-based service and home care service users.[8] To the best of our knowledge, only one study has analyzed the facility characteristics that are associated with the outcome indicators, but no study has investigated the facility characteristics that are associated with care-need level deterioration.[9]

In the USA, investigations of nursing home characteristics using the quality indicator of ADL change have been well documented.[10–15] According to a previous review, we found that both resident- and facility-level characteristics affect physical status decline;[12,13] however, some research studies failed to find facility-level-related variables.[14] This result implies that there might be other facility characteristics that affect functional status.

The present study applied both Donabedian's structure-process-outcome (SPO) model,[16] and Unruh and Wan's structure-process-outcome system model of nursing care quality in nursing homes.[17] Donabedian mentioned that structural indicators were associated with process and outcomes.[16] In addition, Unruh and Wan mentioned that outcomes were also influenced by resident characteristics, especially when nursing homes are not captured in the case mix.[17]

Furthermore, multilevel framework of assessing facility effect of quality of care posit that both resident and facility level should be examined and relation that residents are nested within facilities should be considered.[14,18,19]

In Japan, there are three types of long-term care facilities for older adults as follows: long-term care welfare facilities (LTCWF), long-term care health facilities and long-term care medical facilities. In the present study, we focused on LTCWF because among the three types of facilities, LTCWF have the highest number of users and the longest mean length of stay.[20]

The aim of the present study was to investigate both resident- and facility-level characteristics associated with care-need level deteriorations by using multilevel analysis in LTCWF for older adults in Japan.

Methods

Data source

The present study combined resident-level national LTCI claims data from October 2012 to October 2013, and facility-level data from a survey of institutions and establishments of long-term care in 2012. The LTCI claims data contain information regarding user sex, age, care-need level and types of service received. The long-term care facility characteristics were obtained from the facility survey, which is carried out by MHLW every year. In Japan, the LTCI claims data are not available to all researchers, and only researchers who receive permission from the MHLW are allowed to use these data. This research project received an official ethical approval to use the secondary data from the Statistics and Information Department of the MHLW under Article 33, Statistics Act. This study was also approved by the ethical committee of the University of Tsukuba (1431-2).

Measurements

Eligibility for the LTCI is strictly determined by municipalities according to the extent of the physical and mental disability. Seven levels of long-term care-need certificates were established beginning with support levels 1 or 2, which are intended to provide preventive services; care-need level 1 comprises users who are less disabled, and care-need level 5 comprises users who are most disabled.[5–8] The certificate is available for a maximum of 2 years (1 year in principle) for persons who renew the certificates, and a maximum of 1 year (6 months in principle) for new LTCI users. However, users are allowed to reapply for the care-need level certificate whenever they experienced functional changes, even in a short period, such as 1 month. Only users with care-need levels 1–5 are eligible to use facility services under the LTCI system.[21]

Participants

Inclusion criteria required that residents be aged ≥65 years and have been discharged multiple times from a facility during the follow-up period. Approximately 24.4% of all residents were lost to follow-up because they left the facilities. According to MHLW, the main reasons for leaving a facility were death, which accounted for 63.7%, and hospitalization, which accounted for 28.9%.[20] For residents who were hospitalized for several weeks including those who have died in hospitals, LTCWF register them as residents. Therefore, we first analyzed all residents and defined lost to follow-up residents as the "deterioration group" because of the consideration that 92.6% of the residents might be hospitalized or dead. Then, an analysis was carried out after excluding the lost to follow-up group. The residents who were care-need level 5 at baseline could not deteriorate further; thus, these residents were excluded to prevent a ceiling effect (Fig. 1).
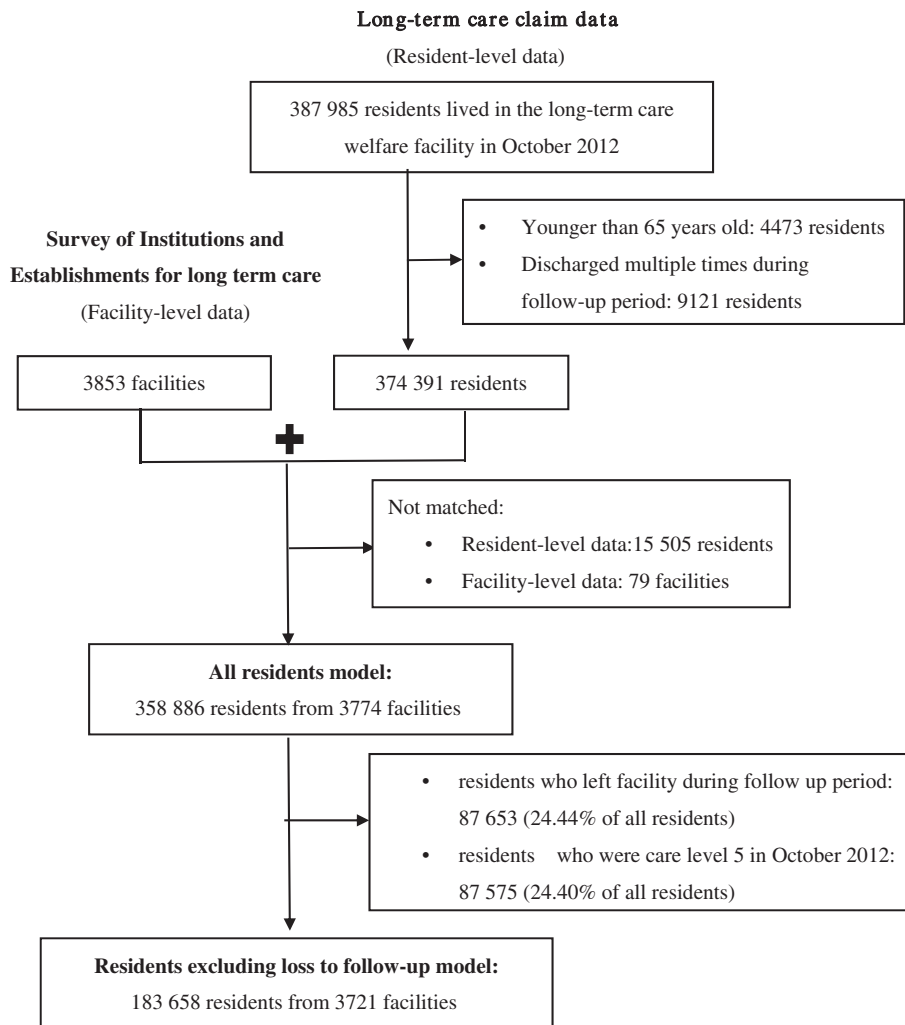
Long-term care claim data
(Resident-level data)

387 985 residents lived in the long-term care welfare facility in October 2012

- Younger than 65 years old: 4473 residents
- Discharged multiple times during follow-up period: 9121 residents

Survey of Institutions and Establishments for long term care
(Facility-level data)

3853 facilities

374 391 residents

+

Not matched:
- Resident-level data:15 505 residents
- Facility-level data: 79 facilities

All residents model:
358 886 residents from 3774 facilities

- residents who left facility during follow up period: 87 653 (24.44% of all residents)
- residents who were care level 5 in October 2012: 87 575 (24.40% of all residents)

Residents excluding loss to follow-up model:
183 658 residents from 3721 facilities

Figure 1 Participant flow chart diagram (graph of participant selection).

Dependent variable

The care-need level deterioration is the dependent variable in the present study. First, we calculated the change in the care-need level by subtracting the care-need level in October 2012 from the care-need level in October 2013. If the residents' care-need level changes were ≤0, they were defined as "not deteriorated." If the residents' care-need level changes were >0, they were defined as "deteriorated."

Independent variables

Resident-level characteristics

The age (65–74, 75–84, 85–94, >95 years) at baseline and sex were collected.[10,11] This study used the care-need level at baseline to adjust the residents' health status.[5–8]

Facility-level characteristics

We included years in business, facility size (<100 beds, 100 beds or >100 beds), location (metropolitan, non-metropolitan), the availability of 24-h nursing staff and the number of staff in different specialties allocated per 100 users, the proportion of registered nurses (RN) among nurses, and the proportion of registered dietitians among all dietitians.[9,13,14,22] We also included an independent variable that indicated the types of care facilities provide in terms of traditional, unit or mixed. Traditional care is mainly provided in facilities with a shared room setting. In contrast, unit care refers to person-centered care and care for a small number of residents (<10) as one living unit, and provided care mainly in all private room setting facilities. Mixed care facilities are those where both unit care and traditional care exist.[23]

Statistical analysis

The descriptive analysis was carried out first to review the distribution of the dependent variable and the independent variables. Then, a univariate logistic regression was carried out to identify the variables that are significantly associated with the outcome for inclusion in the

Table 1 Descriptive analysis of the resident and facility characteristics at baseline, and the care-need level deterioration in the 1 year follow-up

	All residents		Residents excluding lost to follow-up	
	% or mean ± SD	Deterioration rate (%)	% or mean ± SD	Deterioration rate (%)
Dependent variables				
	n = 358 886		n = 183 658	
Care-need level deterioration	36.58	36.58	23.75	23.75
Independent variables				
Resident level	n = 358 886		n = 183 658	
Age	86.66 ± 7.44	—	86.22 ± 7.36	—
Age group (years)				
65–74	6.43	26.63	7	19.29
75–84	29.65	31.55	31.06	22.6
85–94	49.52	37.95	49.44	24.44
≥95	14.4	46.71	12.49	26.32
Sex				
Male	19.71	42.33	19.42	21.69
Female	80.29	35.16	80.58	24.24
Care-need level				
Care-need level 1	2.95	43.13	5.08	35.39
Care-need level 2	8.41	40.43	14.08	30.53
Care-need level 3	20.17	40.13	32.4	27.15
Care-need level 4	32.82	38.28	48.44	18.27
Care-need level 5	35.65	31.55	-	-
Facility level	n = 3774		n = 3721	
Care type				
Traditional	65.13	36.84	65.14	24.07
Mixed (traditional + unit)	5.67	35.7	5.72	23.07
Unit	29.2	36.09	29.13	23.02
Facility size				
<100 beds	58.16	36.62	57.86	23.91
>100 beds	41.84	36.55	42.14	23.66
Years in business	18.42 ± 12.55		18.46 ± 12.56	
Location				
Non-metropolitan	82.25	36.77	82.75	24.01
Metropolitan	17.75	35.67	17.25	22.57
Staffing level				
Doctors per 100 users	0.32 ± 0.37	—	0.32 ± 0.36	—
Dentists per 100 users	0.02 ± 0.15	—	0.02 ± 0.15	—
RN per 100 users	3.15 ± 5.01	—	3.16 ± 4.97	—
LPN per 100 users	2.94 ± 2.39	—	2.95 ± 2.43	—
RN/nurse	0.51 ± 0.25		0.52 ± 0.26	—
Care workers per 100 users	47.80 ± 54.51	—	47.71 ± 53.97	—
Registered dietitians per 100 users	1.33 ± 1.48	—	1.33 ± 1.47	—
Non-registered dietitians per 100 users	0.45 ± 0.84	—	0.45 ± 0.84	—
Registered dietitians/dietitians	0.79 ± 0.33	—	0.79 ± 0.33	—
PT per 100 users	0.14 ± 0.66	—	0.14 ± 0.65	—
OT per 100 users	0.09 ± 0.31	—	0.10 ± 0.32	—

(*Continues*)

Table 1 Continued

	All residents		Residents excluding lost to follow-up	
	% or mean ± SD	Deterioration rate (%)	% or mean ± SD	Deterioration rate (%)
ST per 100 users	0.01 ± 0.10	—	0.01 ± 0.11	—
Care managers per 100 users	1.85 ± 1.72	—	1.85 ± 1.72	
24-h nursing care				
Yes	2.41	36.81	2.5	24.5
No	97.59	36.58	97.5	23.73

Residents excluding the lost to follow-up group includes residents who stayed at the facility, excluding the cases lost to follow-up due to death or hospitalization in the majority. LPN, licensed practical nurse ; OR, odds ratio; OT, occupational therapist; PT, physical therapist; ref., reference; RN, registered nurse; ST, speech therapist.

multivariate model. A Pearson correlation coefficient analysis was carried out between all independent variables, and we excluded variables that were highly correlated (>0.7) to avoid multicollinearity.

We used a multilevel logistic regression because of the nested nature of our dataset (residents nested within facilities). Additionally, the multilevel model accounts for the hierarchical structure to produce better inferences.[24] The STATA (StataCorp, College Station, TX, USA) procedure "melogit" was used to fit this multilevel model.[25]

Results

Descriptive analysis and unadjusted logistic regression

Table 1 presents the descriptive analysis of the final study participants. The deterioration rate is the proportion of cases that experienced a deterioration in the care-need level among all cases within a specific subgroup in 1 year. Based on the descriptive analysis, we carried out a univariate logistic regression to identify the variables that were significantly associated with the care-need level deterioration (Table 2).

Adjusted multilevel logistic regression

Table 3 presents the results of the multivariate models predicting care-need level deteriorations. At the resident level, residents who were in the higher age group, male and at a lower care-need level at baseline were significantly more deteriorated in the care-need level in the all residents model. However, after excluding the lost to follow-up group, females were more likely to experience care-need level deterioration.

Several facility variables were consistently associated with care-need level deterioration regardless of whether the lost to follow-up group was excluded. Compared with facilities with traditional care, facilities that provided unit care and mixed care were less likely to experience care-need level deterioration. In addition, facilities that were located in metropolitan areas were less likely to experience a deterioration in the care-need level.

The results showed that a lower proportion of registered nurses among all nurses were associated with care-need level deterioration only in the all residents model. After excluding those who were lost to follow-up, a re-analysis of the data showed that a lower proportion of registered dietitians among all dietitians and facilities with longer years in business were associated with care-need level deterioration.

Discussion

The present study is the first to analyze nationally representative data to identify the characteristics that are associated with care-need level deterioration in LTCWF in Japan. The results showed that at the resident level, age, the care-need level at baseline and sex were significant predictors of deterioration. At the facility level, the types of care, location, years in business, the proportion of RN and the proportion of registered dietitians among all dietitians were significant predictors of care-need level deterioration.

At the resident level, older age and a lower care-need level at baseline were significantly associated with care-need level deterioration, as documented in earlier studies.[8,10]

However, we found contradictory associations with sex in terms of care-need level deterioration when including and excluding those residents who were lost to follow-up. The results show that male residents contribute more to hospitalization or death than female residents. In contrast, women have a higher risk of care-need level deterioration only when excluding the lost to follow-up group. Previous studies have shown that women have a higher risk of surviving with deteriorating trajectories in health limitations.[26]

Table 2 Unadjusted logistic regression of the care-need level deterioration for the resident and facility characteristics

Independent variables	All residents (n = 358 886)			Residents excluding lost to follow-up (n = 183 658)		
	OR	95% CI	P-value	OR	95% CI	P-value
Resident Level						
Age group, years (reference: <75)						
75–84	1.27	1.23–1.31	<0.001	1.22	1.16–1.28	<0.001
85–94	1.68	1.63–1.74	<0.001	1.35	1.29–1.42	<0.001
≥95	2.41	2.33–2.50	<0.001	1.49	1.42–1.58	<0.001
Female	0.74	0.73–0.75	<0.001	1.16	1.12–1.19	<0.001
Care-need level (ref.: care-need level 1)						
Care-need level 2	0.89	0.86–0.94	<0.001	0.80	0.76–0.84	<0.001
Care-need level 3	0.88	0.85–0.92	<0.001	0.68	0.65–0.71	<0.001
Care-need level 4	0.82	0.79–0.85	<0.001	0.41	0.39–0.43	<0.001
Care-need level 5	0.61	0.58–0.63	<0.001			
Facility Level						
Care type (ref.: traditional)						
Mixed (traditional + unit)	0.95	0.93–0.97	<0.001	0.95	0.91–0.98	<0.001
Unit	0.97	0.95–0.99	<0.001	0.94	0.92–0.97	<0.001
Years in business	1.00[†]	1.00–1.00[‡]	<0.001	1.00[§]	1.00–1.00[¶]	<0.001
Bed size (ref.: >100 beds)	1.00	0.98–1.01	0.715	0.99	0.96–1.01	0.24
Metropolitan (ref.: non-metropolitan)	0.95	0.94–0.97	<0.001	0.92	0.90–0.95	<0.001
Staffing level						
Doctors per 100 users	1.01	0.99–1.04	0.237	1.03	0.99–1.06	0.12
Dentists per 100 users	1.00	0.95–1.06	0.866	0.97	0.89–1.08	0.67
RN per 100 users	1.00	1.00–1.00	0.119	1.00	1.00–1.00	0.82
LPN per 100 users	1.01	1.00–1.01	<0.001	1.01	1.00–1.01	0.03
RN/(RN + LPN)	0.90	0.87–0.93	<0.001	0.92	0.87–0.96	<0.001
Care workers per 100 users	1.00	1.00–1.00	0.658	1.00	1.00–1.00	0.98
Registered dietitians per 100 users	1.00	0.99–1.00	0.436	1.00	0.99–1.01	0.77
Non-registered dietitians per 100 users	1.01	1.00–1.02	0.05	1.02	1.01–1.04	<0.001
Registered dietitians/dietitians	0.96	0.93–0.98	<0.001	0.92	0.88–0.95	<0.001
PT per 100 users	0.99	0.98–1.01	0.376	0.98	0.96–1.00	0.13
OT per 100 users	0.97	0.95–1.00	0.034	0.99	0.95–1.02	0.45
ST per 100 users	1.06	0.98–1.14	0.146	1.03	0.92–1.16	0.63
Care managers per 100 users	1.00	1.00–1.01	0.715	1.00	1.00–1.01	0.34
24 h nursing care	0.99	0.94–1.04	0.671	0.96	0.89–1.03	0.26

[†]1.001. [‡]1.001–1.002. [§]1.002. [¶]1.002–1.003. Residents excluding the lost to follow-up group includes residents who stayed at the facility, excluding the cases lost to follow-up due to death or hospitalization in the majority. LPN, licensed practical nurse ; OR, odds ratio; OT, occupational therapist; PT, physical therapist; ref., reference; RN, registered nurse; ST, speech therapist.

The most important objective of this work was to investigate the facility characteristics that are related to care-need level deterioration. First, this study found two variables that are consistently associated with our outcomes.

Facilities that provide unit care and mixed care were less likely to deteriorate in care-need level than facilities providing traditional care. To date, although many facilities that provide unit care have been established, doubts regarding their performance remain. The present study was the first to investigate whether there are different effects on the care-need level deterioration based on the types of care facility provides. One reason for this difference could be the personal background of the users in private rooms, because unit care provides a private room that requires additional payments, and the residents might have higher income levels. We carried out a subanalysis to include a resident-level binary independent variable to show whether the resident used a private room service or a shared room service in traditional facilities. Consequently, a significantly negative relationship between a private room service and care-need level deterioration was found in both the all residents model and the residents excluding lost to

Table 3 Facility and resident characteristics associated with the care-need level deterioration: results of the multilevel logistic regression analysis

	All residents (*n* = 358 886)			Residents excluding loss to follow-up (*n* = 183 658)		
	OR	95% CI	*P*-value	OR	95% CI	*P*-value
Resident level						
Age group, years (ref. <75)						
75–84	1.39	1.35–1.44	<0.001	1.21	1.15–1.27	<0.001
85–94	1.99	1.93–2.06	<0.001	1.33	1.27–1.40	<0.001
≥95	2.99	2.88–3.95	<0.001	1.50	1.42–1.58	<0.001
Sex (Male)	0.64	0.63–0.65	<0.001	1.12	1.09–1.16	<0.001
Care-need level (ref.: care-need level 1)						
Care-need level 2	0.88	0.84–0.92	<0.001	0.79	0.75–0.83	<0.001
Care-need level 3	0.85	0.82–0.89	<0.001	0.66	0.63–0.69	<0.001
Care-need level 4	0.78	0.75–0.81	<0.001	0.39	0.37–0.41	<0.001
Care-need level 5	0.59	0.58–0.62	<0.001	-	-	-
Facility level						
Care type (ref.: traditional)						
Mixed (traditional + unit)	0.94	0.90–0.97	0.001	0.93	0.88–0.98	0.01
Unit	0.97	0.94–0.99	0.042	0.95	0.91–0.99	0.024
Metropolitan (ref.: nonmetropolitan)	0.97	0.94–0.99	0.011	0.92	0.89–0.96	<0.001
Years in business	1.00[†]	1.00–1.00[‡]	0.051	1.00[§]	1.00–1.00[¶]	0.016
RN/(RN + LPN)	0.93	0.89–0.97	0.001	0.98	0.92–1.05	0.581
Registered dietitians/dietitians	0.99	0.95–1.02	0.376	0.94	0.90–0.99	0.02

[†]1.001. [‡]0.999–1.002. [§]1.002. [¶]1.000–1.003. Residents excluding the lost to follow-up group includes residents who stayed at the facility, excluding the cases lost to follow-up due to death or hospitalization in the majority. LPN, licensed practical nurse; OR, odds ratio; ref., reference; RN, registered nurse.

follow-up model (results not shown.). This result might be caused by the residents' income level, which could be a possible confounder, because a higher socioeconomic status is well known to be correlated with better health outcomes.[27] Future studies need to be carried out to clarify the reason for the differences in performance in terms of care-need level deterioration among the different types of care facility provides.

Second, facilities located in metropolitan areas performed better. A previous study argued that rural facilities were less likely to provide mental health services and lacked accreditations or special care programs.[19]

Fewer years in business contributed to a reduced care-need deterioration only in the model of residents excluding lost to follow-up. However, a non-significant relationship between ADL change and facility age was shown in a previous study.[12,13] In Japan, the proportion of unit facilities increased dramatically from 1.5% to 31.7% between 2003 and 2014.[28] The increase in new facilities with unit care might have influenced the effect of the business years variable on the outcome.

In addition to the three facility variables, two staffing level variables were associated with our outcomes. A lower proportion of RN on the nursing staff was significantly associated with care-need level deterioration only in the all residents model. Earlier studies have shown

that RN serve as leaders and role models in the supervision of licensed practical nurses,[29] and might improve resident outcomes.[15]

The present research study also provided new information in the analysis by excluding the lost to follow-up group. A higher proportion of registered dietitians among all dietitians contributed to a better performance. In Japan, registered dietitians are required to have a high level of professional knowledge and technique to address the residents' physical and nutritional conditions and food service management. In contrast, non-registered dietitians are nutrition experts that mainly engage in nutrition education.[30] A higher proportion of registered dietitians among all dietitians might affect the physical status of residents, because registered dietitians play an important role in providing appropriate instructions according to the health condition.

The present study had some limitations. First, even though we included a wide range of variables related to the facility, we still could not control for possible confounding variables, such as staffing turnover and the policies of the facilities, that could affect the care-need level deterioration.[13] In addition, at the resident level, the clinical diagnosis and cognitive functioning were not considered because of the limited information in

our dataset.[14,17] Second, we based our findings on five functional status levels, and the very limited information might be different from previous studies, such as that carried out by Phillips *et al.*, who based their study on ADL measures.[10] Additionally, some research, including the present study, used care-need level as an outcome, because the evaluation process of care-need level is strictly carried out by the government, and a strong correlation between care-need level and ADL was found in a previous study.[5–8] However, the validation of the care-need level measurement has yet to be investigated. Third, we defined the lost to follow-up residents as the deterioration group, because most of these residents might be hospitalized or dead. However, among those lost to follow-up, 7.4% might have been lost due to other reasons, such as returning home or discharge to other types of facilities. Fourth, the cross-sectional approach for the independent variables showed correlations, but not causation.

Despite these limitations, the present study had several strengths. First, Japan is a unique country with national-level claims data as a result of its national health insurance system and a well established payment computer system. This advantage will likely result in good generalizability of the results. Second, this study used multilevel models to account for resident and facility predictors, and to overcome the weaknesses of previous studies. Additionally, this study controlled for several facility variables that might affect the resident outcomes.

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Disclosure statement

The authors declare no conflict of interest.

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