Combinations of long-term care insurance services and associated factors in Japan: a classification tree model

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Abstract

Background: To develop a quality community-based care management system, it is important to identify the actual use of long-term care insurance (LTCI) services and the most frequent combinations of services. It is also important to determine the factors associated with the use of such combinations.

Methods: This study was conducted in 10 care management agencies in the urban area around Tokyo, Japan. The assessment and services data of 983 clients using the Minimum Data Set for Home Care were collected from the agencies. We categorized combination patterns of services from descriptive data analysis of service use and conducted chi-squared automatic interaction detection (CHAID) analysis to identify the primary variables determining the combinations of the services used.

Results: We identified nine patterns of service use: day care only (16.5%); day care and assistive devices (14.4%); day care, home helper, and assistive devices (13.2%); home helper and assistive devices (11.8%); assistive devices only (10.9%); home helper only (8.7%); day care and home helper (7.7%); home helper, visiting nurse, and assistive devices (5.4%); and others (11.3%). The CHAID dendrogram illustrated the relative importance of significant independent variables in determining combination use; the most important variables in predicting combination use were certified care need level, living arrangements, cognitive function, and need for medical procedures. The characteristics of care managers and agencies were not associated with the combinations.

Conclusion: This study clarified patterns of community-based service use in the LTCI system in Japan. The combinations of services were more related to the physical and psychosocial status of older adults than to the characteristics of agencies and care managers. Although we found no association between service use and the characteristics of agencies and care managers, further examination of possible bias in the use of services should be included in future studies. Researchers and policymakers can use these combinations identified in this study to categorize the use of community-based care service and measure the outcomes of care interventions.

Keywords: Service utilization, Care management, Home care, Older adult, Chi-squared automatic interaction detection
Under the LTCI, the necessary services for each older adult are determined by a comprehensive assessment by a care manager (CM), a new profession introduced by the LTCI. CMs come from a variety of professional backgrounds, including care workers, social workers, and nurses. CMs work in care management agencies that are operated by several types of organizations, such as for-profit, social welfare, and non-profit organizations as well as healthcare corporations. Many of these organizations operate more than one agency and provide other care services (e.g., home helper, visiting nurse, day care, and assistive devices). Developing a high-quality care management system in the LTCI requires knowledge of how services are provided under the management of CMs.

To identify how the long-term care services are used, it is necessary to determine the factors associated with the use of services. Many studies have examined factors associated with the use of the following services: home helper [6-11], day care [12], and visiting nurse [2,9,10,13], nutrition/meals-on-wheels services [8,10], and any combination of two or more long-term care services [8,14]. In other studies, researchers have examined the rate of utilization for each service [15] and the cost of services [10,16]. In most of these studies, the independent variables associated with the use of services were selected based on the Anderson-Newman model of predisposing, enabling, and need factors [17]. Predisposing factors associated with long-term care service use included age [8,11] and gender [8], while enabling factors associated with use of services included living arrangement [8,10,11,16], social support [8], informal care [10], and caregiver’s burden [7,18]. Among these factors, the familial relationship of the primary caregiver was also identified as an important determinant of service use. Spousal caregivers were more likely to receive outside assistance than adult children caregivers [19]. Need factors associated with the use of services included functional disability [7-9,11]; cognitive decline or disability [18]; specific diseases like stroke, heart, and respiratory diseases [8,16]; and the perceived need for services [9,10].

In addition, it has been suggested that service selections are affected by the management skills of the CMs; the variety of professional backgrounds and the potential conflict of interest in recommending services that are offered by the service agency that employs the CM may affect combinations of services [20]. Although Kashiwagi et al. [2] demonstrated an effect of the type of care management corporation on the use of visiting nurses—the service was provided more frequently for clients managed by a medical care management agency than clients served by a non-medical care management agency—no study has confirmed the effect of other characteristics of care management agencies (e.g., whether they provide other services, such as home helper and day care services, operated by the same organization). CMs, and the effect of these characteristics on the use of other types of services.

It is also important to consider the combinations of services used in addition to the factors related to service use. Although the Japanese government reports usage statistics of each care service in the LTCI system every month on its website [21], how the services are combined to meet the needs of individuals is not reported. To analyze the combinations of services, some studies have used pre-determined “service packages”; that is, set combinations of services. Such combinations have consisted of in-home (visiting), out-of-home (ambulatory), and mixed services [22,23] or visiting, ambulatory, short-stay respite care (including in a hospital or a long-term care facility), and institutional services [24]. These studies, however, decided service combinations in an arbitrary manner without consideration of actual use.

In contrast, researchers in other countries have categorized patterns of long-term care service use in empirical analyses [25-27]. For example, Kendig et al. classified home/community care service use into nine patterns using cluster analysis and enumerated the characteristics of each pattern [26]. These previous studies, however, classified tendencies of service combinations into patterns; various combinations of services were involved in each pattern, and unified or fixed combinations were not determined.

We found only one study that identified the combinations of services based on actual combinations and examined factors associated with the service use [28]. However, in that study, the combinations did not include the use of assistive devices and day care, both of which are commonly used LTCI services in Japan. Further, in the analysis, multinomial logistic regression was used with visiting nurse service as a reference; the differences between types of the combinations of services other than the nursing service could not be examined.

For a more complete evaluation of services and the development of strategies to improve the quality of care management, it is important to identify the actual use of LTCI services, including combinations of services, and to examine factors associated with these combinations, which are likely to include the characteristics of older adult clients, care management agencies, and CMs. Thus, this study sought to identify the patterns of combined community-based LTCI services used by older adults in need of care and the factors related to the selection of these service combinations.

**Methods**

**Study design and participants**

This study was part of a quality evaluation and improvement project in community-based care management using...
Home Care Quality Indicators based on the Minimum Data Set-Home Care (MDS-HC) [29]. The MDS-HC is a comprehensive assessment tool [30] for older adults who have been officially designated for assessment and care planning by CMs in the Japanese LTCI system. For the quality evaluation and improvement project, we recruited care management corporations that used the MDS-HC in 2010. Four corporations with 10 care management agencies, all located in the Greater Tokyo Area, agreed to participate in the project. One corporation was a healthcare facility and the other three were for-profit; all corporations had agencies for assistive devices. At the agency level, all agencies supplied home helper services; two agencies (the healthcare facility and one of the for-profit corporations) supplied visiting nurse services; one agency supplied day care services; and one agency had bathing services. The participating corporations introduced a cloud-based assessment system customized for this study, which enabled us to download assessment and services data.

Although the participating agencies conducted care management for older adults at all care need and support levels, we decided to include only clients assigned a care need level in this study for two reasons: there were very few clients in the levels of support in the assessment databases and, in most cases, individuals in these levels used just one service because of their limited benefits [31]. We retrieved assessment data for all clients with a care need level who had been assessed between November 2010 and October 2011, along with their care plan data, and identified the use of LTCI services three months after the assessment. When there was more than one assessment per client during this period, we selected the most recent assessment. This resulted in assessment data for 1160 individuals. We then matched the assessment and care plan data for each client. If the LTCI-certified care need level changed during the three months following the assessment, we excluded the client data from analyses; we eventually included the data of 983 clients in the analyses. To investigate CM characteristics, we conducted a self-reported questionnaire survey targeting CMs in May 2012. The data of each CM was then matched to the client data.

To maintain client and CM anonymity, a data download system was developed that automatically changed the client and CM identification numbers. Although the identification numbers were linked, the researchers were not allowed to connect the data. The Ethics Committee of the Dia Foundation for Research on Ageing Societies approved this study.

**Measures**

The data used in this study included the use of LTCI services and the characteristics of older adults, care management agencies, and care managers.

**Services utilized in long-term care insurance**

We investigated the use of LTCI services by each client according to their care plan. The community-based services in the LTCI system consist of home helper, day care, day care with rehabilitation, visiting nurse, assistive devices, bathing, home rehabilitation, short-stay respite care, and management guidance for in-home care [1,4,32]. In this study, we combined the use of day care and day care with rehabilitation as “day care” because they play a similar role of respite care for families during the day and rehabilitation in the LTCI, and the rate of the use of day care with rehabilitation was relatively low. Further, we excluded the utilization of management guidance for in-home care from the analyses because it was not available from the care plan data in the care management agencies.

**Characteristics of clients, care management agencies, and care managers**

The Andersen-Newman model [17] was used to select independent variables regarding the characteristics of clients, care management agencies, and CMs that could be associated with the service use. We defined gender and age of clients as predisposing factors; socioeconomic status of clients such as living arrangement, caregiver's situation and economic status, the characteristics of agencies, and CMs as enabling factors; care need level, diagnoses, and physical and psychological status of clients as need factors.

The characteristics of clients were assessed using MDS-HC assessment, including demographics and physical, psychological, and socioeconomic status. The demographics included age, gender, LTCI-certified care need level (ranging from levels 1 to 5), and diagnoses (cerebrovascular disease, dementia, diabetes, arthritis, fracture, cardiac disease, and cancer). The client's living arrangement (living with family or alone) and relationship to the primary caregiver were also included, as well as the economic status of the client.

The physical status of clients was assessed on activities of daily living (ADL), the presence or absence of pain, difficulty swallowing, urinary incontinence, fecal incontinence, a fall in the past 90 days, pressure ulcers, and the need for any medical procedures (oxygen administration, vascular infusion, and catheter or fistula). ADL were measured using the ADL Hierarchy Scale, which uses information on self-performance of ADL, such as bathing and eating, to assign scores from 0 (no impairment) to 6 (total dependence on caregiver); this scale has adequate validity [33]. Pain was measured on a four-point Pain Scale that also has adequate validity [34]; pain scores ranged from 0 (no pain) to 3 (severe pain). Dichotomous scores (0, 1) were used to assess whether clients had difficulty swallowing, urinary incontinence, fecal incontinence, falls, and pressure ulcers.
Measures of cognitive function and depression were used to assess clients’ psychological status. Cognitive function was measured with the Cognitive Performance Scale (CPS), which uses the MDS-HC data on memory and communication skills to assign clients a score from 1 to 7; scores ≥3 are indicative of moderate to severe cognitive impairment, and this scale has adequate validity [35]. Depression was measured with the Depression Rating Scale (DRS), which consists of seven items to create a 14-point scale in which scores ≥3 serve as a marker for depressive symptoms; this scale has adequate reliability and validity [36]. All scale scores were available from the MDS-HC data.

Agency characteristics included the agency’s code (identification number), and the corporation code and type (such as for-profit or healthcare facility) of the organization that manages the care management agency and affiliated service agencies providing care (visiting nurse, day care, bathing, and healthcare facilities).

The characteristics of CMs that were obtained from the questionnaire completed by the CMs in charge of the clients included age, gender, professional background (health care professional, such as nurse; or non-healthcare professional, such as a care worker or social worker), and years of experience, both in the background profession and working as a CM.

Statistical analyses
First, we conducted descriptive analyses of the characteristics of the CMs, clients, and services (Table 1). Second, we classified the combinations of services into categories from the descriptive data of each service. We focused on several types of services and examined the associations between the identified service combinations and remaining minor services (Table 2).

Finally, to identify the significant variables that affected the combinations of services used, we conducted chi-squared automatic interaction detection (CHAID) analysis [37], commonly used in the field of data mining. The CHAID technique determines the relative importance of each of the independent (predictor) variables in explaining group membership in a categorical dependent (outcome) variable with $\chi^2$ significance level. We used the combinations of services as the dependent variable and the characteristics of clients, agencies, and care managers as independent variables.

According to a previous study using the technique [38,39], we selected the following criteria to prevent inappropriate splitting of nodes: the tree depth was limited to three levels, no group smaller than 40 was split (parent node), and no group smaller than 20 was formed (child node). To confirm the validity of the prediction accuracy (i.e., the correct classifications) of the models developed using the CHAID algorithm, we ran a “cross-validation command”: the sample was divided randomly into 10 groups (a default of the program), and a dendrogram was created using nine subsamples. Next, the dendrogram was applied to the remaining one subsample for the test and the proportion of correct classifications was calculated. This examination was repeated nine more times with the subsample for the test changed each time. The average proportion across the 10 test subsamples is discussed in the following section. We used the dendrogram that was drawn using the full sample as the final model.

Further, to deal with the possibility of differences in the use of day care and day care with rehabilitation, we conducted analyses with these as separate categories.

SPSS, version 21, and Decision Tree, version 21 (IBM, Chicago, IL, USA), were used for the analyses. The significance level was set at less than 0.05 (two-tailed).

Results
Characteristics of care managers, clients, and services
Table 1 shows the characteristics of CMs, clients, and services used by clients. The questionnaire was not completed by the CMs of one corporation because those CMs had a high amount of daily routine work.

Ninety percent of the 48 CMs were female and 15% had a professional healthcare background (e.g., nurse); their years of experience in their profession and as CMs were 12.0 and 4.9, respectively. The mean age ± standard deviation (SD) of the clients was 80.0 ± 9.9; 64% were female. The distribution of care need level in this study was comparable with that of the population in Tokyo, with only a slightly larger rate of higher care need levels [40]. About 40% of the clients were ADL independent and cognitively intact.

The proportion of the service utilizations were as follows: assistive devices, 64.1%; day care, 58.0%; home helper, 52.1%; visiting nurse, 16.3%; short-stay respite care, 15.9%; bathing, 11.6%; and home rehabilitation, 2.4%. These rates were also comparable to population data in Tokyo, despite the relatively higher use of assistive devices, short-stay respite care, and bathing, and the lower use of day care [40].

Patterns of home services used in long-term care
Based on the descriptive data of each service used by each client, we identified frequently occurring combinations. We focused on assistive devices, day care, home helper, and visiting nurse, which were the most commonly used, and created nine combinations: day care only (n = 162, 16.5%); day care and assistive devices (n = 142, 14.4%); day care, home helper, and assistive devices (n = 130, 13.2%); home helper and assistive devices (n = 116, 11.8%); assistive devices only (n = 107, 10.9%); home helper only (n = 86, 8.7%); day care and home helper
We also examined the distribution of the remaining minor services (i.e., short-stay respite care, bathing, and home rehabilitation) in each pattern (Table 2). This descriptive analysis revealed that short-stay respite care services were commonly combined with day care, while

Table 1 Characteristics of care managers, clients, and services

| Characteristics of care managers (n = 48) | n | %  | Tokyo % |
|-----------------------------------------|---|----|---------|
| Age (years)                             |   |    |         |
| 20–29                                   |   | 1  | 2.1     |
| 30–39                                   | 13| 27.7|
| 40–49                                   | 10| 21.3|
| 50–59                                   | 19| 40.4|
| 60 and over                             | 4 | 8.5 |
| Gender                                  |   |    |         |
| Female                                  | 37| 90.2|
| Long-term care work experience facility/hospital |   |    |         |
| None                                    | 17| 37.8|
| Facility                                | 13| 28.9|
| Hospital                                | 15| 33.3|
| Professional background                 |   |    |         |
| Healthcare                              | 7 | 15.2|
| Non-healthcare                          | 39| 84.8|
| Years of experience in profession, mean ± SD |   |    |         |
|                                        | 120±4.9 |       |
| Years of working as care manager, mean ± SD |   |    |         |
|                                        | 4.9±3.0 |       |

Table 1 Characteristics of Clients (n = 983)

| Characteristics of Clients (n = 983) |   |    |         |
|-------------------------------------|---|----|---------|
| Age (years), mean ± SD              | 80.0±9.9 |       |
| Gender                              | 622| 64.1|
| Care need level                     |   |    |         |
| 1                                   | 280| 28.5|
| 2                                   | 278| 28.3|
| 3                                   | 163| 16.6|
| 4                                   | 137| 13.9|
| 5                                   | 125| 12.7|
| Diagnosis                           |   |    |         |
| Cerebrovascular disease             | 298| 30.3|
| Dementia                            | 271| 27.6|
| Diabetes                            | 159| 16.2|
| Arthritis                           | 118| 12.0|
| Fracture                            | 133| 13.5|
| Cardiac disease                     | 131| 13.3|
| Cancer                              | 71 | 7.2 |
| Living with family                  | 700| 79.5|
| Relationship with caregiver         |   |    |         |
| Child or his/her spouse             | 538| 58.8|
| Spouse                              | 308| 33.7|
| Other                               | 69 | 7.5 |
| Economic status                     |   |    |         |
| Poverty                             | 34 | 3.7 |
| Physical status                     |   |    |         |
| ADL<sup>a</sup> mean ± SD           | 1.6±1.8 |       |
| Independent                         | 430| 43.7|
| Supervision                         | 166| 16.9|
| Limited                             | 111| 11.3|

SD: standard deviation.
<sup>a</sup>ADL was measured on the ADL Hierarchy Scale.
<sup>b</sup>Pain was measured on a pain scale.
<sup>c</sup>Cognitive function was measured on Cognitive Performance Scale (CPS).
<sup>d</sup>Depression was measured on Depression Rating Scale (DRS).

Service use in home care

- Assistive devices: 630 (64.1)
- Day care: 570 (58.0)
- Home helper: 512 (52.1)
- Visiting nurse: 160 (16.3)
- Short-stay respite care: 156 (15.9)
- Bathing: 114 (11.6)
- Home rehabilitation: 24 (2.4)

(n = 76, 7.7%); home helper, visiting nurse, and assistive devices (n = 53, 5.4%); and others (n = 111, 11.3%).

We also examined the distribution of the remaining minor services (i.e., short-stay respite care, bathing, and home rehabilitation) in each pattern (Table 2). This descriptive analysis revealed that short-stay respite care services were commonly combined with day care, while
bathing were commonly combined with home helper services and assistive devices, but not with day care.

Factors related to service use combinations: CHAID
To clarify the factors related to the combinations of services, which we identified from the descriptive data, we conducted the CHAID analysis. We used only eight combinations of services (the “others” category was excluded) in the analysis. The CHAID dendrogram illustrated the relative importance of significant independent variables in determining the combinations of services. The independent variables in the model were the care need level, living arrangement, cognitive function, and need for medical procedures. The characteristics of agencies or CMs were not associated with any of the eight combinations of LTCI services (Figure 1).

On the first branch of the dendrogram, the certified care need levels were divided into 3 nodes (levels 1, 2–4, and 5); the node of care need levels 2–4 and 5 included assistive devices more frequently than level 1, and the node of care need level 5 included the use of visiting nurse services more frequently than levels 1 and 2–4. On the second branch, the use of home help and day care were divided by the living arrangement; clients who lived alone used home help services more frequently, while those who lived with family used day care services more frequently. On the third branch, the use of day care and other services were divided by cognitive function; clients with cognitive decline used only day care more frequently, while cognitively intact clients also used other services, such as assistive devices.

Finally, the dendrogram divided the clients into eight nodes: (1) care need level 1 and living alone (n = 82); (2) care need level 1, living with family, and cognitively intact (n = 134); (3) care need level 1, living with family, and cognitive decline (n = 54); (4) care need level 2–4 and living alone (n = 81); (5) care need level 2–4, living with family, and cognitively intact (n = 281); (6) care need level 2–4, living with family, and cognitive decline (n = 147); (7) care need level 5 and no need for medical procedures (n = 58); and (8) care need level 5 and need for medical procedure (n = 35) (Figure 1).

Each bar in nodes 1–8 shows the proportion of clients using the corresponding combination of services (Figure 1). The gray bar shows the most likely combination expected for each node. When we classified the clients to the most expected category represented by the gray bar, the proportion of correctly classified clients was 30.2% with a standard error of 1.6%. The cross-validated proportion of correct classification that accounted for over-fitting in the algorithm was 26.9% with 1.5% standard error. This proportion was slightly decreased from the 30.2% found using the full sample, but much higher than the 12.5% probability associated with selecting one of the eight categories at random. This suggests that the rule used in the development of the model in this study had good predictive ability.

We obtained the same groups from the additional analysis with separate categories of day care and day care with rehabilitation; therefore, in the final model, we combined “day care” and “day care with rehabilitation”.

We observed tendencies in the services used in each node. First, assistive devices were utilized by clients with a relatively severe care need level (levels 2–5; nodes 4–8) rather than the lightest care need level (level 1; nodes 1–3).

Second, differences in service utilizations were observed by living arrangements. Most clients who lived alone in both care levels 1 (node 1) and 2–4 (node 4) used home helpers, and in some cases, day care as well. On the other hand, most clients who lived with their family (nodes 2, 3, 5, and 6) used day care. Among the clients living with family, however, cognitively intact clients (nodes 2 and 5) were more likely to rent an assistive device in addition to using day care, while almost all clients with cognitive decline (nodes 3 and 6) did not utilize the rental service.

Third, among clients with the most severe care need level (level 5), most clients who needed a medical procedure (node 8) utilized a home helper and rented an assistive device, and half of them also used visiting nurse services. On the other hand, clients who did not require medical procedures (node 7) had a different trend from those needing a procedure; some utilized day care in addition to home helper services and assistive devices.

Table 2 Patterns of service use (n = 983)

| D & H & A | H & A | A | H | D & H | H, N, & A | Other |
|----------|-------|---|----|------|---------|-------|
| D & A | n = 162 | n = 142 | n = 130 | n = 116 | n = 107 | n = 86 | n = 76 | n = 53 | n = 111 |
| % | % | % | % | % | % | % | % | % | % |
| 30 | 18.5 | 41 | 28.9 | 26 | 20.0 | 10 | 8.6 | 4 | 3.7 | 2 | 2.3 | 8 | 10.5 | 7 | 13.2 | 28 | 25.2 |

D: day care, H: home helper, A: assistive devices, N: visiting nurse.
Bold numbers represent frequent patterns of minor services used.
In this study, we examined the use of combinations of Japanese LTCI community-based services and identified some factors associated with these combinations. To the best of our knowledge, this is the first study to report actual combinations of community-based services in Japan. Nine combinations of services were found; the CHAID techniques divided clients into eight groups by trends in the use of services.

The first important finding of this study was the identification of combined community-based services. The rates of renting assistive devices and home helper services were high (64.1% and 52.1%, respectively), and they were usually used in combination with other services (in many cases, day care) rather than alone. On the other hand, day care, which was also one of the most common services, was sometimes the only service accessed; however, in other instances, it was also used with assistive devices or home helper services. Furthermore, the results revealed that short-stay respite care was often combined with day care for the common purpose of respite for the caregiver [41]. Bathing at home was combined...
with home helper or visiting nurse services, but not with
day care; this is logical because day care also provides
bathing in the day care facility [42].

Our second finding was that clients who used community-
based LTCI services were represented by eight different
groups identified by care need level, cognitive function,
living arrangements, and need for medical procedures.
The findings that service use was associated with care
need level reflecting physical disability [7-9,11], cognitive
function [18], and living arrangement [8,10,11,16] were
consistent with previous studies. On the other hand, we
did not find associations of diagnoses and symptoms with
service use, perhaps because they had smaller impacts
than physical and psychological conditions that also
reflected diagnoses and symptoms.

Clients with higher levels of care need were more
likely to rent assistive devices. National statistics indicate
that beds, bed supplements, and wheelchairs are a sig-
ificant portion of assistive devices used by clients with
higher care need levels [21]; most of those with lower
care need levels do not need these devices; other ser-
cices, such as day care, are a higher priority. Addition-
ally, among older adults living with their family and who
had either a lower care level (nodes 2 and 3) or higher
care level (nodes 5 and 6), clients with cognitive decline
were less likely to use assistive devices than cognitively
intact clients. This result suggests that clients with cog-
nitive decline used respite services (day care and short-
stay respite care) to the limit of the family budget or the
maximum benefit of the LTCI to reduce the caregiver's
burden; therefore, they could not afford to use additional
services. Furthermore, this suggests a difference in ser-
cices needed by clients with dementia: for instance, they
might not need assistive devices because their care need
levels were determined mainly based on cognitive de-
cline and behavior associated with the decline rather
than physical disability. We should take into account of
the amount and types of services necessary for clients
with dementia and their families in the future.

Combinations of services were related to living ar-
rangements: older adults living alone had a home helper
and those living with family used day care as the base of
their care. This difference suggests that living arrange-
ments impact service use, despite the government policy
of providing appropriate services irrespective of family
conditions [4].

Visiting nurse services were utilized by the most se-
vere care need level (level 5), consistent with a previous
study [2], regardless of whether medical procedures were
required. In Japan, visiting nurses manage the chronic
conditions of older adults and conduct necessary med-
ical procedures [13]. Furthermore, at this care need level,
implementation of medical procedures determined the
use of day care: older adults who required medical
procedures did not use day care, while those not requir-
ing medical procedures used day care. This is representa-
tive of the current issue that older adults with medical
procedures are not able to attend day care because the ser-
vice usually has few medical professionals (only one nurse
is required for day care programs). Thus, older people
who require medical procedures might have limited access
to respite services despite the high burden on the family.
It is necessary to further investigate and offer respite ser-
cices for families of clients with high medical needs.

Our third important finding was that the difference in
utilization of services was not associated with the char-
acteristics of agencies or CMs for the participants in this
study; the CHAID techniques did not identify any char-
acteristics of agencies or CMs associated with service
use. Although previous studies [2,20] pointed out the
potential for bias in the selection of services or the pat-
terns of services based on the characteristics of agencies
or CMs, the effect of these factors seemed to be less
than those related to the physical, psychological, and so-
cial characteristics of clients.

This study has several limitations. First, this study was
conducted in only 10 agencies of the four corporations
that agreed to participate in the quality evaluation and
improvement project, and these agencies are located in
areas around Tokyo; the selection bias might affect the
results of service use and related factors. For example,
there was no corporation operated by a social welfare
organization (which consists of about 25% of care man-
gagement agencies [43]) in this study. Further, there are
some differences in the rate of use of services compared
to that in the population data of Tokyo; this might indi-
cate bias in the distribution of service agencies in the
area. In addition, the agencies participating in this study
used the MDS-HC as a client assessment tool; they
could be highly motivated to improve their care quality.
This might account for the lack of association between
the patterns of services and the characteristics of agen-
cies and CMs. In addition, the characteristics of the
population and available services in Tokyo, the major
metropolitan area in Japan, are different from those on a
national scale.

A second limitation is that we did not investigate the
amount of services or the characteristics of care service
agencies selected by the CMs (e.g., if the service agencies
were operated by same corporation as the care manage-
ment agency). These variables might be affected by the
characteristics of agencies and CMs. Future studies
should examine in more detail whether the patterns of
services found in this study can be applied nationwide,
and re-examine the effects of characteristics of agencies
and CMs on these patterns.

Despite these limitations, this study is the first to
characterize combinations of community-based services.
use in the Japanese LTCI. The categories identified in this study can be used in care interventions in future research, which involves evaluating client outcomes (e.g., their physical or cognitive decline, hospitalization, and burden of family care givers). The possible imbalances in service use due to cognitive function, family condition, and medical procedures can be used in the continuing development of a quality care system. Finally, researchers in other countries can use the methods and results of this study to analyze how long-term care services are used and to identify the current issues in long-term care systems in each country.

Conclusions
This study clarified combinations of community-based services and factors associated with each combination in the Japanese LTCI system. Nine categories of service use were found: (1) day care; (2) day care and assistive devices; (3) day care, home helper, and assistive devices; (4) home helper and assistive devices; (5) assistive devices; (6) home helper; (7) day care and home helper; (8) home helper, visiting nurse, and assistive devices; and (9) others. The use of services was determined by care need level, cognitive function, living arrangements, and medical procedures rather than characteristics of care management agencies and CMs. Researchers and policymakers can use these results to review the use of community-based care services and to measure outcomes of care interventions.

Abbreviations
ADL: Activities of daily living; CHAID: Chi-squared automatic interaction detection; CMS: Care manager; CPS: Cognitive performance scale; DRS: Depression rating scale; LTCI: Long-term care insurance; MDS-HC: Minimum data set-home care; SD: Standard deviation.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
IA had a primary role in conceiving and conducting the study and drafting the manuscript. IT and YMN also participated in the conception of the study and supervised the data analysis and manuscript development. ST supervised the statistical analysis and critically reviewed the manuscript. All authors read and approved the final manuscript.

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