An Ecological Study on Regional Disparity in the Provision of Rehabilitation Services Using Open NDB Data Japan

Yasuhiro Morii
National Institute of Public Health

Kagari Abiko
Sapporo Azabu Neurosurgical Hospital

Tomoki Ishikawa
Institute for Health Economics and Policy

Kensuke Fujiwara
Otaru University of Commerce

Keiko Konomura
National Institute of Public Health

Katsuhiko Ogasawara (oga@hs.hokudai.ac.jp)
Hokkaido University

Research Article

Keywords: rehabilitation, human resources, supply and distribution, ecological study, NDB Open Data Japan

Posted Date: August 30th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1999575/v1

License: ©  This work is licensed under a Creative Commons Attribution 4.0 International License.  Read Full License
Abstract

Background

Although medical resources related to rehabilitation services should be optimally allocated and utilized uniformly and efficiently, there is few reports on regional differences in the supply/demand balance and the provision of these services. This study analyzed the regional differences to help policymakers provide more uniform and efficient rehabilitation services and optimal allocation of related resources.

Methods

The subjects were 47 prefectures and nine regions in Japan in 2017. Primary indicators were “supply/utilization ratio”, which was calculated by dividing rehabilitation supply converted to service units, by rehabilitation utilized (utilization) and “utilization/needs ratio”, which was calculated by dividing utilization by needs. The needs were defined as utilization expected from the demographic in each area. The utilization/needs ratios were calculated for overall and individual rehabilitation services. Data required to calculate these indicators were collected from open sources such as NDB Open Data Japan.

Results

The supply/utilization ratios were higher in Shikoku, Kyusyu, Tohoku, and Hokuriku regions, and lower in Kanto and Tokai regions. The number of rehabilitation-related providers per population was larger mostly in the western parts of Japan and lower mostly in the eastern parts. The utilization/needs ratios were higher mostly in the western parts such as Shikoku and Kyusyu regions, and lower mostly in the eastern parts such as Tohoku, and Hokuriku regions. The same trend was seen for utilization/needs ratio of cerebrovascular disease and musculoskeletal disorders rehabilitation, which accounted for approximately 84% of rehabilitation services. For disuse syndrome rehabilitation, such a trend did not exist, and the utilization/needs ratio differed by prefectures.

Conclusions

The surplus in rehabilitation supply was attributed to the larger number of providers in the western parts and less amount of utilization in the eastern parts, indicating regional differences in the provision of rehabilitation services. Since cerebrovascular disease and musculoskeletal disorder rehabilitation accounted for a large part of services, priority should be given to them when considering an increase in uniform and efficient rehabilitation services.

Background

As the society is aging in Japan, medical demand is estimated to increase [1]. Since rehabilitation services are important for improving activities of daily living (ADL), and achieving physical independence, medical resources related to rehabilitation should be optimally allocated and utilized uniformly and efficiently.

There are several studies on the supply/demand of rehabilitation. Landry et al. predicted the supply/demand of physical therapists (PT) in the US and analyzed the extent to which attrition rates affected the supply/demand balance [2]. Zimbelman et al. evaluated the supply/demand balance of PTs in each state in the US and reported the possibility of future shortages in the southern and the western parts [3]. Jesus et al. compared the supply/demand balances of PTs in four countries and stated that uniform standards for optimal balances did not exist due to differences in factors such as medical systems. Therefore, those balances should be considered for individual countries or regions [4].

In Japan, the subcommittee on the supply/demand of physical therapists and occupational therapists in the Ministry of Health, Labour and Welfare (MHLW) reported in 2019 that the supply surpassed the demand and would be 1.5 times the demand in 2040, indicating the possibility of oversupply [5]. Morii et al. predicted the supply/demand of PTs in Japan and indicated that there could be oversupply in the future [6]. However, Morii et al. also stated that the relative disparity in PT supply such as regional disparity and that among rehabilitation services should be considered along with the absolute amount of supply in Japan. Although there are reports on PT supply [7], few studies considered regional differences in the supply/demand balance of rehabilitation services using data derived from national databases regardless of countries.

Medical services are provided at the universal prices in Japan, according to the national fee table [8]. Health insurance claims are made for each patient at each institution providing medical services every month. In recent years, those claims are administered by the government in a database called the National Database of Health Insurance Claims and Specific Health Checkups of Japan (NDB), which researchers can utilize with approval [9]. NDB Open Data Japan is open-sourced wherein the results of basic aggregation using NDB are shown [10]. Concerning rehabilitation, results of basic aggregation such as rehabilitation utilization by prefectures and age groups are available. Therefore, an analysis of regional differences in the provision of different rehabilitation services can be conducted using NDB Open Data Japan.

Therefore, in this research, we analyzed the regional differences regarding the provision and the supply/demand balances of rehabilitation services, to help provide more uniform and efficient rehabilitation services, and optimal allocation of the related resources.

Methods

Subjects and outcomes
Subjects were the 47 prefectures and the nine regions in Japan in 2017 where rehabilitation services were provided. The geographical locations and the population in each prefecture are shown in Additional file 1. The supply included PTs, occupational therapists (OT), and speech therapists (ST) who were the main rehabilitation providers in Japan.

The primary outcomes were "supply/utilization ratio", which was calculated by dividing rehabilitation supply converted to service units, by rehabilitation services utilized (utilization; see Equation), and "utilization/needs ratio", which is calculated by dividing utilization by needs. The needs were defined as utilization expected from the demographic in each area. These indicators' details are explained in the following sections.

\[
\text{supply/utilization ratio} = \frac{\text{Supply converted to rehabilitation service units}}{\text{Utilization}}
\]

**Supply of rehabilitation**

Data regarding the number of rehabilitation providers were collected from the Survey of Medical Institution by MHLW as the amount of supply [11]. The supply was converted to the number of rehabilitation services units under the assumption that one rehabilitation provider worked 251 days per year [12] and provided 15 or 18 units of rehabilitation per day (In Japan, one rehabilitation unit is 20 minutes, and one rehabilitation provider providing 18 units of services is considered as standard according to the national fee table) [8].

Moreover, the number of rehabilitation providers per population and the average number of rehabilitation units per provider per day were calculated.

**Utilization of/ Demand for rehabilitation**

"Utilization" and "needs" were defined and calculated. The former was defined as the number of rehabilitation service units utilized. The data on the utilization were collected from the NDB Open Data Japan [9].

Utilization of rehabilitation services included the inpatient and outpatient services listed in Additional file 2. Those services were insured for rehabilitation regardless of professionals such as PT, OT, and ST. For "I007 Psychiatry occupational therapy", two hours, six times the length of other rehabilitation services, were considered the standard time, and 25 patients were considered as the standard number treated at a time. Therefore, "I007 Psychiatry occupational therapy" was counted as a sixth of 25 rehabilitation units per utilization. "H008 Group communication therapy" was counted as one-third rehabilitation unit per utilization.

The needs indicated the number of rehabilitation services utilization expected from the demographics in each region or prefecture. They were calculated for each region and prefecture by multiplying the population by age groups [13] with the average amount of utilization per person by the corresponding age groups, which was calculated from the total utilization of rehabilitation services in Japan by age groups [8] and the total population [13].

The supply/utilization ratio and the utilization/needs ratio of the overall rehabilitation services were calculated for each region and prefecture. The utilization/needs ratio was also calculated for disease-specific rehabilitation services (for individual services) to understand which services caused regional differences in their provision. Disease-specific rehabilitation included the five major services numbered H000-H003 in Additional file 2.

Moreover, to clarify the amount and the time trend of the utilization, the amount of and the increased rates of utilization from the previous year were calculated using the 2014 to 2019 data of NDB Open Data Japan [8]. Before 2015, rehabilitation for disuse syndrome was part of cerebrovascular disease rehabilitation (i.e., rehabilitation for disuse syndrome was insured for cerebrovascular disease patients who had disuse syndrome before 2015). Therefore, for data from 2014 to 2015, utilization of part of cerebrovascular disease rehabilitation, which was conducted for disuse syndrome patients, was counted as disuse syndrome rehabilitation service.

**Results**

**Supply/utilization ratio**

The results of the supply/utilization ratio were shown in Fig. 1 and Tables 1 and 2. The supply/utilization ratios in overall Japan were 1.19 and 1.42 when one rehabilitation provider provided 15 units and 18 units of rehabilitation per day, respectively.

When one rehabilitation provider provided 15 units per day, the supply/utilization ratios were the lowest in Aichi (0.92), Gifu (1.02), and Chiba prefectures (1.03). By region, the ratios were the lowest in Tokai (0.99) and Kanto (1.11). The ratios were highest in Tottori (1.55), Akita (1.52), and Niigata prefectures (1.45). By region, the supply/utilization ratios were highest in Hokuriku (1.38), Chugoku and Tohoku (1.33 respectively), and Shikoku (1.29).

When one rehabilitation provider provided 18 units of rehabilitation per day, the supply/utilization ratios were lowest in Aichi prefecture (1.11), and highest in Tottori prefecture (1.86). By region, the ratio was higher in Hokuriku (1.66), Chugoku and Tohoku (1.59 respectively), and Shikoku (1.54).

**Utilization/needs ratio**

The results regarding the utilization/needs ratio were shown in Figure 2 and Tables 1 and 2. The ratio was highest in Kyusyu and Shikoku regions (1.37). However, it was lowest in Tohoku (0.68) and Hokuriku regions (0.79).

**The number of rehabilitation providers per population and the number of rehabilitation units per provider**

The results on the number of rehabilitation providers per population and that of rehabilitation units per provider were shown in Figure 3 and Tables 1 and 2.
The number of rehabilitation providers per 1,000 population in Japan was approximately 1.1. The number was highest in Shikoku (1.87) and Kyusyu regions (1.84). However, the number was lowest in Kanto (0.81), Tokai (0.87), and Hokuriku regions (0.87).

The overall number of rehabilitation units per provider per day in Japan was 12.6. The number was highest in Tokai (15.2), and Kanto regions (13.5). However, the number was lowest in Tohoku, Shikoku, and Chugoku regions.

Table 1 should be placed here.
Table 1
The supply/demand-related indicators by prefectures

<table>
<thead>
<tr>
<th>Prefecture</th>
<th>Supply/demand ratio by # of Rehabilitation units/personnel*day</th>
<th>Utilization/Needs ratio</th>
<th># of Personnel/1,000 population</th>
<th>Rehabilitation units/personnel*day</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hokkaido</td>
<td>1.22</td>
<td>1.13</td>
<td>1.37</td>
<td>12.3</td>
<td>Hokkaido</td>
</tr>
<tr>
<td>Aomori</td>
<td>1.31</td>
<td>0.71</td>
<td>0.97</td>
<td>11.4</td>
<td>Tohoku</td>
</tr>
<tr>
<td>Iwate</td>
<td>1.37</td>
<td>0.64</td>
<td>0.94</td>
<td>10.9</td>
<td>Tohoku</td>
</tr>
<tr>
<td>Miyagi</td>
<td>1.25</td>
<td>0.69</td>
<td>0.78</td>
<td>12.0</td>
<td>Tohoku</td>
</tr>
<tr>
<td>Akita</td>
<td>1.52</td>
<td>0.48</td>
<td>0.87</td>
<td>9.9</td>
<td>Tohoku</td>
</tr>
<tr>
<td>Yamagata</td>
<td>1.32</td>
<td>0.78</td>
<td>1.12</td>
<td>11.4</td>
<td>Tohoku</td>
</tr>
<tr>
<td>Fukushima</td>
<td>1.32</td>
<td>0.72</td>
<td>0.96</td>
<td>11.3</td>
<td>Tohoku</td>
</tr>
<tr>
<td>Ibaraki</td>
<td>1.28</td>
<td>0.77</td>
<td>0.90</td>
<td>11.8</td>
<td>Kanto</td>
</tr>
<tr>
<td>Tochigi</td>
<td>1.06</td>
<td>0.89</td>
<td>0.84</td>
<td>14.2</td>
<td>Kanto</td>
</tr>
<tr>
<td>Gumma</td>
<td>1.22</td>
<td>0.99</td>
<td>1.14</td>
<td>12.3</td>
<td>Kanto</td>
</tr>
<tr>
<td>Saitama</td>
<td>1.11</td>
<td>0.90</td>
<td>0.82</td>
<td>13.5</td>
<td>Kanto</td>
</tr>
<tr>
<td>Chiba</td>
<td>1.03</td>
<td>1.02</td>
<td>0.90</td>
<td>14.6</td>
<td>Kanto</td>
</tr>
<tr>
<td>Tokyo</td>
<td>1.10</td>
<td>0.91</td>
<td>0.79</td>
<td>13.7</td>
<td>Kanto</td>
</tr>
<tr>
<td>Kanagawa</td>
<td>1.11</td>
<td>0.73</td>
<td>0.67</td>
<td>13.5</td>
<td>Kanto</td>
</tr>
<tr>
<td>Niigata</td>
<td>1.45</td>
<td>0.56</td>
<td>0.85</td>
<td>10.4</td>
<td>Hokuriku</td>
</tr>
<tr>
<td>Toyama</td>
<td>1.44</td>
<td>0.71</td>
<td>1.06</td>
<td>10.4</td>
<td>Hokuriku</td>
</tr>
<tr>
<td>Ishikawa</td>
<td>1.32</td>
<td>0.93</td>
<td>1.17</td>
<td>11.4</td>
<td>Hokuriku</td>
</tr>
<tr>
<td>Fukui</td>
<td>1.30</td>
<td>0.97</td>
<td>1.26</td>
<td>11.6</td>
<td>Hokuriku</td>
</tr>
<tr>
<td>Yamanashi</td>
<td>1.16</td>
<td>1.28</td>
<td>1.49</td>
<td>12.9</td>
<td>Kanto</td>
</tr>
<tr>
<td>Nagano</td>
<td>1.38</td>
<td>0.93</td>
<td>1.35</td>
<td>10.9</td>
<td>Hokuriku</td>
</tr>
<tr>
<td>Gifu</td>
<td>1.02</td>
<td>0.82</td>
<td>0.81</td>
<td>14.7</td>
<td>Tokai</td>
</tr>
<tr>
<td>Shizuoka</td>
<td>1.06</td>
<td>0.96</td>
<td>0.97</td>
<td>14.1</td>
<td>Tokai</td>
</tr>
<tr>
<td>Aichi</td>
<td>0.92</td>
<td>1.14</td>
<td>0.85</td>
<td>16.2</td>
<td>Tokai</td>
</tr>
<tr>
<td>Mie</td>
<td>1.10</td>
<td>0.76</td>
<td>0.80</td>
<td>13.7</td>
<td>Tokai</td>
</tr>
<tr>
<td>Shiga</td>
<td>1.25</td>
<td>0.82</td>
<td>0.87</td>
<td>12.0</td>
<td>Kinki</td>
</tr>
<tr>
<td>Kyoto</td>
<td>1.25</td>
<td>1.01</td>
<td>1.16</td>
<td>12.0</td>
<td>Kinki</td>
</tr>
<tr>
<td>Osaka</td>
<td>1.16</td>
<td>1.05</td>
<td>1.06</td>
<td>12.9</td>
<td>Kinki</td>
</tr>
<tr>
<td>Hyogo</td>
<td>1.19</td>
<td>1.04</td>
<td>1.15</td>
<td>12.6</td>
<td>Kinki</td>
</tr>
<tr>
<td>Nara</td>
<td>1.21</td>
<td>1.00</td>
<td>1.16</td>
<td>12.4</td>
<td>Kinki</td>
</tr>
<tr>
<td>Wakayama</td>
<td>1.07</td>
<td>1.16</td>
<td>1.30</td>
<td>14.1</td>
<td>Kinki</td>
</tr>
<tr>
<td>Tottori</td>
<td>1.55</td>
<td>1.06</td>
<td>1.72</td>
<td>9.7</td>
<td>Chugoku</td>
</tr>
<tr>
<td>Shimane</td>
<td>1.50</td>
<td>0.78</td>
<td>1.32</td>
<td>10.0</td>
<td>Chugoku</td>
</tr>
<tr>
<td>Okayama</td>
<td>1.37</td>
<td>1.00</td>
<td>1.35</td>
<td>10.9</td>
<td>Chugoku</td>
</tr>
<tr>
<td>Hiroshima</td>
<td>1.16</td>
<td>1.13</td>
<td>1.23</td>
<td>12.9</td>
<td>Chugoku</td>
</tr>
<tr>
<td>Yamaguchi</td>
<td>1.44</td>
<td>1.02</td>
<td>1.59</td>
<td>10.4</td>
<td>Chugoku</td>
</tr>
<tr>
<td>Tokushima</td>
<td>1.39</td>
<td>1.37</td>
<td>2.02</td>
<td>10.8</td>
<td>Shikoku</td>
</tr>
<tr>
<td>Kagawa</td>
<td>1.21</td>
<td>1.17</td>
<td>1.45</td>
<td>12.4</td>
<td>Shikoku</td>
</tr>
<tr>
<td>Ehime</td>
<td>1.17</td>
<td>1.18</td>
<td>1.46</td>
<td>12.8</td>
<td>Shikoku</td>
</tr>
</tbody>
</table>

Table Legend: Table 1 shows the results regarding the supply/demand-related indicators by prefectures
Disease-specific rehabilitation
The results on the utilization/needs ratio of disease-specific rehabilitation services were shown in Figure 4 and Table 2. Specifically for cerebrovascular disease and musculoskeletal disorder rehabilitation, the utilization/needs ratio was the highest in Kyusyu and Shikoku regions, and lowest in Tohoku and Hokuriku regions. Kyusyu region had the highest utilization/needs ratios for all the disease-specific rehabilitation services other than disuse-syndrome.

For musculoskeletal-disorder rehabilitation, the utilization/needs ratio was the highest in Kyusyu and Shikoku regions (1.99 and 1.69, respectively), and the lowest in Tohoku and Hokuriku (0.62 and 0.80, respectively; Table 2, Fig 4-a).

For cerebrovascular-disease rehabilitation, the utilization/needs ratio was the highest in Hokkaido, Kyusyu, and Shikoku regions (1.26, 1.99, and 1.69, respectively; Table 2, Fig4-b), and was lowest in Tohoku and Hokuriku (0.78 and 0.80, respectively).

For disuse-syndrome rehabilitation, the utilization/needs ratio was highest in Hokkaido and Kinki regions (1.29 and 1.28, respectively), while lowest in Tokai and Chugoku regions (0.61 and 0.54, respectively; Table 2, Fig 4-c). By prefectures, the ratio was highest in Okinawa and Kochi (2.56) and Nara (1.62), while lowest in Okayama (0.34), Aichi (0.37), and Hiroshima (0.41).

For cardiac-disorder rehabilitation, the utilization/needs ratio was highest in Kyusyu and Hokkaido regions (1.53 and 1.30, respectively), and lowest in the Tohoku region (0.56; Table 2, Fig 4-d).

For respiratory-disorder rehabilitation, the utilization/needs ratio was highest in Kyusyu (1.76) and lowest in the Tohoku region (0.65).

Regarding the amount of utilization of disease-specific rehabilitation, musculoskeletal disorder rehabilitation accounted for 45.6% of the disease-specific rehabilitation services (H000-H003, H007-H008 in Table 1), cerebrovascular disease rehabilitation; 38.6%, disuse syndrome rehabilitation; 9.1%, respiratory disorder rehabilitation; 2.5%, cardiac disorder rehabilitation; 2.2%, cancer rehabilitation; 1.3%, and pediatrics rehabilitation; 0.8%. Cerebrovascular disease and musculoskeletal disorder rehabilitation accounted for 84% of the disease-specific rehabilitation services.

The results of the time trend are shown in Figure 5. Concerning the time trend, while the increase rate from the previous year was 1 to 3% for cerebrovascular disease, cerebrovascular disease, and respiratory disorder rehabilitation, the rate was more than 5% for disuse syndrome, cardiac disorder, and cancer rehabilitation.

Table 2 should be placed here.

Table 2 Results regarding the indicators by region

<table>
<thead>
<tr>
<th>prefecture</th>
<th>Supply/demand ratio by # of Rehabilitation units/personnel*day</th>
<th>Utilization/Needs ratio</th>
<th># of Personnel/1,000 population</th>
<th>Rehabilitation units/personnel*day</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15 units</td>
<td>18 units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kochi</td>
<td>1.40</td>
<td>1.68</td>
<td>1.96</td>
<td>3.10</td>
<td>10.7</td>
</tr>
<tr>
<td>Fukuoka</td>
<td>1.29</td>
<td>1.55</td>
<td>1.52</td>
<td>1.75</td>
<td>11.6</td>
</tr>
<tr>
<td>Saga</td>
<td>1.14</td>
<td>1.36</td>
<td>1.86</td>
<td>2.09</td>
<td>13.2</td>
</tr>
<tr>
<td>Nagasaki</td>
<td>1.23</td>
<td>1.48</td>
<td>1.47</td>
<td>1.89</td>
<td>12.2</td>
</tr>
<tr>
<td>Kumamoto</td>
<td>1.38</td>
<td>1.66</td>
<td>1.37</td>
<td>1.94</td>
<td>10.8</td>
</tr>
<tr>
<td>Oita</td>
<td>1.26</td>
<td>1.52</td>
<td>1.55</td>
<td>2.07</td>
<td>11.9</td>
</tr>
<tr>
<td>Miyazaki</td>
<td>1.40</td>
<td>1.68</td>
<td>0.91</td>
<td>1.33</td>
<td>10.7</td>
</tr>
<tr>
<td>Kagoshima</td>
<td>1.10</td>
<td>1.31</td>
<td>1.99</td>
<td>2.29</td>
<td>13.7</td>
</tr>
<tr>
<td>Okinawa</td>
<td>1.28</td>
<td>1.54</td>
<td>1.62</td>
<td>1.58</td>
<td>11.7</td>
</tr>
</tbody>
</table>

Table Legend: Table 1 shows the results regarding the supply/demand-related indicators by prefectures.
services. It could be because of the differences between prefectures in the root diseases from which disuse syndrome arose, the rate of population with disuse syndrome rehabilitation, the utilization/needs ratio was not different by region but by prefectures, unlike the trend for the overall rehabilitation services. Since these services contributed mostly to the trend of overall rehabilitation, these services should be prioritized when considering the provision of rehabilitation services. Therefore, further detailed analysis needs to be conducted on individual diseases, treatments, and treatment phases to clarify what exactly contributed to the regional differences.

For cardiac-disorder rehabilitation, although the utilization/needs ratio was highest in Kyusyu region, it was not too different in other regions. Nakanishi et al. conducted a survey of 597 hospitals in Japan and reported that even in hospitals providing advanced medical care, cardiac rehabilitation was not sufficiently common [15]. Goto et al. reported that the reasons for not providing it were a shortage of staff, requirements for institutions, and proficiency [16]. The result showed that in the Tohoku region, where the utilization/needs ratio of cardiac-disorder rehabilitation was lowest, the number of rehabilitation providers per population was lowest. The low amount of supply in the region could contribute to the low amount of utilization of cardiac-disorder rehabilitation.

The utilization/needs ratio was higher mostly in the western parts of Japan, and lower mostly in the eastern parts. Although the result was consistent with the trend of the medical services in general [14], it is unclear whether the result was attributed to the regional differences in the rate of the population receiving medical treatment or the number of rehabilitation services provided per patient. This result indicated that there was a regional disparity in their provision. To promote provision of more uniform rehabilitation services, the causes of the disparity need to be considered in detail using health-claim databases such as NDB.

Concerning disease-specific rehabilitation, for cerebrovascular disease and musculoskeletal disorder rehabilitation, which accounted for 84% of these services, the utilization/needs ratio was higher mostly in the western parts, and lower mostly in the eastern parts, presenting the same trend as the overall rehabilitation services. Since these services contributed mostly to the trend of overall rehabilitation, these services should be prioritized when considering the provision of more uniform and efficient rehabilitation services. As Additional file 2 shows, cerebrovascular disease and musculoskeletal disorder rehabilitation are provided for patients with various types of diseases. Therefore, further detailed analysis needs to be conducted on individual diseases, treatments, and treatment phases to clarify what exactly contributed to the regional differences.

For cardiac-disorder rehabilitation, although the utilization/needs ratio was highest in Kyusyu region, it was not too different in other regions. Nakanishi et al. conducted a survey of 597 hospitals in Japan and reported that even in hospitals providing advanced medical care, cardiac rehabilitation was not sufficiently common [15]. Goto et al. reported that the reasons for not providing it were a shortage of staff, requirements for institutions, and proficiency [16]. The result showed that in the Tohoku region, where the utilization/needs ratio of cardiac-disorder rehabilitation was lowest, the number of rehabilitation providers per population was lowest. The low amount of supply in the region could contribute to the low amount of utilization of cardiac-disorder rehabilitation.

The result also showed that the utilization of cardiac-disorder rehabilitation had increased from 2014 to 2019. Moreover, the convalescent rehabilitation ward fee has been insured for patients for whom cardiac-disorder rehabilitation is provided since April of 2022, meaning providing more intensive rehabilitation for those patients will be expected [8]. Therefore, there could be unmet needs for cardiac rehabilitation, and the result could change over time. Jesus et al. reported that not considering unmet needs could affect the amount of required rehabilitation services [4].

For disuse-syndrome rehabilitation, the utilization/needs ratio was not different by region but by prefectures, unlike the trend for the overall rehabilitation services. It could be because of the differences between prefectures in the root diseases from which disuse syndrome arose, the rate of population with disuse syndrome (prevalence), and the number of rehabilitation services per patient. Moreover, in the national fee table, when rehabilitation was provided for patients with disuse syndrome who can be subjects for another disease-specific rehabilitation service such as cerebrovascular disease rehabilitation, if the fee has been insured for patients for whom cardiac-disorder rehabilitation is provided since April of 2022, meaning providing more intensive rehabilitation for those patients will be expected [8]. Therefore, there could be unmet needs for cardiac rehabilitation, and the result could change over time. Jesus et al. reported that not considering unmet needs could affect the amount of required rehabilitation services [4].

The utilization/needs ratio was highest in the Kyusyu region, and lower mostly in other regions. Nakanishi et al. conducted a survey of 597 hospitals in Japan and reported that even in hospitals providing advanced medical care, cardiac rehabilitation was not sufficiently common [15]. Goto et al. reported that the reasons for not providing it were a shortage of staff, requirements for institutions, and proficiency [16]. The result showed that in the Tohoku region, where the utilization/needs ratio of cardiac-disorder rehabilitation was lowest, the number of rehabilitation providers per population was lowest. The low amount of supply in the region could contribute to the low amount of utilization of cardiac-disorder rehabilitation.
rehabilitation was for disuse syndrome, the patient is insured with disuse syndrome rehabilitation [8]. If the content of rehabilitation is not for disuse syndrome, the patient is insured with another disease-specific rehabilitation service. Therefore, the differences in the content of rehabilitation for patients with disuse syndrome could have contributed to the regional differences in the utilization/needs ratio. To consider providing more uniform and efficient rehabilitation services, the causes of the regional differences should be clarified by further analysis such as one for patients with individual conditions who have disuse syndrome, since disuse syndrome rehabilitation can be utilized by patients with a wide range of conditions.

This study analyzed regional differences in the supply/demand balance and the provision of rehabilitation services and the results are important to consider the provision of more uniform and efficient rehabilitation services. However, this study has several limitations. First, subject regional units are prefectures and regions due to a lack of data granularity. Analysis of the finer regional units needs to be conducted as needed. Next, since NDB does not include health insurance claims of publicly funded healthcare (e.g. healthcare for welfare recipients), the calculated utilization and the needs could underestimate the actual amount of utilization and needs by a few percent. Finally, as shown in Additional file 2, some rehabilitation services can be provided for patients with a wide range of conditions. Therefore, it is difficult to determine rehabilitation for which specific disease or condition contributed to the results. Further analysis targeting individual conditions should be conducted.

Conclusion
This study analyzed the regional differences in the supply/demand balance and the provision of rehabilitation services using NDB Open Data Japan to help consider provision of more uniform and efficient rehabilitation services.

The results showed that the supply/utilization ratio was highest in Shikoku and Kyusyu regions, and in Tohoku and Hokuriku regions, while it was lowest in Kanto and Tokai regions. Since the utilization/needs ratio was lowest in Tohoku and Hokuriku regions, the smaller amount of supply contributed to the surplus. In Kanto and Tokai regions, the smaller number of rehabilitation providers contributed to the smaller surplus.

Concerning disease-specific rehabilitation services, for cerebrovascular-disease rehabilitation and musculoskeletal, which accounted for 84% of the services, the utilization/needs ratio was higher mostly in the western parts of Japan, while lower mostly in the eastern parts, showing the same trend as overall rehabilitation services. Therefore, priority should be given to them when considering an increase in uniform and efficient rehabilitation services.

Abbreviations
NDB
National Database of Health Insurance Claims and Specific Health Checkups of Japan
PT
physical therapist
OT
occupational therapist
ST
speech therapist
MHLW
the Ministry of Health, Labour and Welfare

Declarations
Ethics approval and consent to participate: Not Applicable
Consent for publication: Not Applicable
Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request
Competing interests: The authors declare that they have no competing interests
Funding: Not Applicable

Authors' contributions: Y.M, K.A, T.I, K.K, K.O made substantial contributions to the conception and design of the work. Y.M and T.I made substantial contributions to the acquisition of data and the analysis. K.A made substantial contributions by providing advice from clinical perspective. T.I, K.F, K.K, K.O made substantial contributions by providing advice from the perspective of healthcare policy and system. Y.M drafted the work, and K.A, T.O, J.T, T.T, K.F, K.Y, K.A substantially revised it. All authors read and approved the final manuscript.

Acknowledgement: We would like to thank Editage (www.editage.jp) for English language editing.

References


Figures

**Figure 1**

The supply/utilization ratio by prefectures

Figure legend: Figure 1 shows the results of the supply/utilization ratio by prefectures when one rehabilitation provider provided (a) 15 units and (b) 18 units of rehabilitation per day.
Figure 2

The utilization/needs ratio by prefectures

Figure legend: Figure 2 shows the results of the utilization/needs ratio by prefectures.

Figure 3

The number of rehabilitation providers per population and the number of rehabilitation units per provider

Figure legend: Figure 3 shows (a) the number of rehabilitation providers per population and (b) the number of rehabilitation units per provider per day by prefectures.
Figure 4

The utilization/needs ratio of disease-specific rehabilitation by prefectures

Figure legend: Figure 4 shows the results of the utilization/needs ratio of (a) musculoskeletal disorders rehabilitation, (b) cerebrovascular disease rehabilitation, (c) disuse syndrome rehabilitation, and (d) cardiac disorders rehabilitation.
Figure 5

The time trend in the increase rate of utilization from the previous year

Figure legend: Figure 5 shows the time trend in the increased rate of utilization of disease-specific rehabilitation services from the previous years. Since the increase rates of cancer rehabilitation and respiratory rehabilitation were more than 100% from 2014 to 2015, the rates were not included to save space.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile1.png
- Additionalfile2.docx