INTRODUCTION

In recent years, the importance of evidence-based medicine (EBM) and evidence-based practice (EBP) has been recognized in the field of physical medicine and rehabilitation. EBM comprises clinical judgment, scientific evidence, and patients’ values and preferences. Conducting clinical research with a high level of evidence plays an important role in the development of both EBM and EBP.

In physical medicine and rehabilitation, an increase in the number of international publications has been observed. Furthermore, the number of entries in the clinical trials registry in the field of rehabilitation medicine has an increasing trend in Japan. However, Nakashima et al. surveyed the number of articles published in 136 Web of Science journals in the field of rehabilitation and in the top ten Eigenfactor journals by country between 2010 and 2015 and reported a significantly lower percentage of papers published in the field of rehabilitation in Japan than in other fields, both overall and in the top ten journals. It has been pointed out that the proportion of articles from Japan containing high-quality scientific evidence is increasing. However, there is a need to expand the support system for research while considering the quality of research.

Key Words: Japan; medical research; meta-analyses; randomized controlled trial; systematic review
The aim of this study was to examine, using PubMed, the number of articles in the field of physical medicine and rehabilitation medicine originating in Japan, especially those containing high-quality scientific evidence (i.e., randomized controlled trials [RCTs], systematic reviews, and meta-analyses), and those published in high impact factor journals.

MATERIALS AND METHODS

The primary outcome of this study was the change in the total number of articles from Japan on physical medicine and rehabilitation between 2001 and 2019. The secondary outcomes were the changes in the percentages of RCTs, systematic reviews, and meta-analyses and the changes in the percentage of articles on Japanese physical medicine and rehabilitation published in the top ten highest impact factor journals. We performed searches in PubMed (http://www.ncbi.nlm.nih.gov/pubmed) on March 13, April 23, and May 18, 2021. Medical Subject Headings (MeSH) was used for the search. Because there is a time lag in the registration of PubMed indexes, the period covered was from 2001 to 2019. Only articles written in English were included, and the filter “English” was used. We used Journal Citation Reports to select the top ten highest impact factor journals on “Rehabilitation” for each year. Journal impact factors calculate the number of times an article in a journal published in the 2 years before the target year was cited in an article published in the target year. We searched PubMed for the number of articles in the top ten highest impact factor journals of each year and for such articles originating in Japan. The search formula for articles in rehabilitation medicine was “rehabilitation”[MeSH Terms] AND “journal article”[ptyp] AND (2001:2019[pdat]), and the search by journal included “journal name”[jour] AND “journal article”[ptyp] AND (2001:2019[pdat]). For articles on physical medicine and rehabilitation originating in Japan, the criterion was that the authors must belong to Japanese institutions: the articles originating in Japan were identified using Japan[ad]. For the identification of RCTs, systematic reviews, and meta-analyses, the filters “randomized controlled trial,” “systematic reviews,” and “meta-analysis” were used. The distinction between systematic reviews and meta-analyses was made using the Boolean operator NOT, the number of each article type was determined.

The Cochran-Armitage test was used to evaluate the change in the percentage of such articles over time. The statistical software used was JMP 15 (SAS Institute Inc., Cary, NC, USA). The significance level was set at P<0.05 for two-sided tests.

RESULTS

Changes in the Proportion of Articles Originating in Japan

From 2001 to 2019, the percentage of articles on physical medicine and rehabilitation originating in Japan was 3.1% (Japan: 5832, Total: 189,571) (Fig. 1). The change in the percentage of articles from Japan in this period was statistically significant (P<0.0001), with an increase from 3.0% in 2001 (Japan: 136, Total: 4469) to 3.8% in 2019 (Japan: 575, Total: 15,235) (Fig. 2).

Changes in the Percentages of RCTs, Systematic Reviews, and Meta-analyses

The mean percentage of RCTs from Japan on physical medicine and rehabilitation from 2001 to 2019 was 2.3% (Japan: 728, Total: 31,557), that of systematic reviews was 0.5% (Japan: 28, Total: 5145), and that of meta-analyses was 1.6% (Japan: 70, Total: 4285). The percentage of RCTs changed from 2.6% in 2001 (Japan: 12, Total: 468) to 2.8% in 2019 (Japan: 75, Total: 2,694), that of systematic reviews changed from 0% in 2001 (Japan: 0, Total: 38) to 0.9% in 2019 (Japan: 6, Total: 662), and that of meta-analyses changed from 0% in 2001 (Japan: 0, Total: 30) to 2.4% in 2019 (Japan: 15, Total: 637) (Fig. 3). There was no significant change in the percentage of RCTs over time (P=0.055), whereas systematic reviews (P=0.046) and meta-analyses (P=0.0013) showed a significant upward trend.

Changes in the Percentage of Articles Published in the Top Ten Highest Impact Factor Journals

The percentage of articles from Japan in the top ten highest impact factor journals on physical medicine and rehabilitation between 2001 and 2019 was 2.0% (Japan: 473, Total: 24,101). Between 2001 and 2019, the percentage of such articles decreased from 2.8% in 2001 (Japan: 20, Total: 723) to 1.3% in 2019 (Japan: 19, Total: 1506), and the difference was statistically significant (P=0.002), (Table 1, Fig. 4).

DISCUSSION

Our findings suggest that the proportion of articles originating in Japan containing high-quality scientific evidence is on the increase. In this study, the percentages of articles,
**Fig. 1.** The number of articles on physical medicine and rehabilitation originating in Japan (dark gray) and the rest of the world (light gray) between 2001 and 2019. The total number of relevant articles published in this period was 189,571, of which 5832 were from Japan.

**Fig. 2.** The percentage of articles on physical medicine and rehabilitation originating in Japan.
**Fig. 3.** The percentage of randomized controlled trials (circles), systematic reviews (triangles), and meta-analyses (squares) on physical medicine and rehabilitation originating in Japan.

**Fig. 4.** The percentage of articles originating in Japan among all articles published in the top ten highest impact factor journals on physical medicine and rehabilitation. The top ten journals were determined annually.
systematic reviews, and meta-analyses from Japan on physical medicine and rehabilitation showed an increasing trend, and the percentage of articles from Japan in the top ten highest impact factor journals on physical medicine and rehabilitation showed a decreasing trend. This is the first study to show the trends in the proportions of articles from Japan containing high-quality scientific evidence on physical medicine and rehabilitation.

The percentages of articles, systematic reviews, and meta-analyses from Japan on physical medicine and rehabilitation showed an increasing trend between 2001 and 2019. Although the change in the percentage of RCTs was not significant, Negrini et al. reported that the numbers of RCTs, systematic reviews, and meta-analyses in the field of rehabilitation medicine and physical therapy present in PubMed showed a higher increasing trend than those of drug therapy.3) One contributing factor may be the increase in the number of professions involved in rehabilitation medicine in Japan. In Japan, the number of physical therapists, occupational therapists, and physiatrists is increasing,10,11) and the number of publications is expected to increase in the future. However, the reporting quality of each study was unclear. Notably, adherence to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement12) for systematic reviews and meta-analyses and the Consolidated Standards of Reporting Trials (CONSORT) statement13) for RCTs is still low in the field of physical therapy and rehabilitation medicine.14,15) We consider these facts to be topics for future research.

The percentage of articles from Japan published in high impact factor journals on physical medicine and rehabilitation has been decreasing. However, the impact factor has been criticized as a metric of excellence,16) with claims that it does not represent the quality of the articles published in

Table 1. The number of articles originating in Japan published in the top ten highest impact factor journals in physical medicine and rehabilitation

| Rank | Journal                                      | Year | Articles from Japan |
|------|----------------------------------------------|------|---------------------|
| 1    | Except Child                                  | 2001 | 0                   |
| 2    | J Speech Lang Hear Res                       | 2002 | 2.0 (2/99)          |
| 3    | Am J Ment Retard                             | 2003 | 0                   |
| 4    | Assist Technol                               | 2004 | 0                   |
| 5    | Arch Phys Med Rehabil                        | 2005 | 3.5 (10/289)        |
| 6    | Support Care Cancer                          | 2006 | 2.7 (3/110)         |
| 7    | J Learn Disabil                              | 2007 | 0                   |
| 8    | J Assoc Pers Severe                          | 2008 | 0                   |
| 9    | J Electromyogr Kinesiol                      | 2009 | 11.4 (5/44)         |
| 10   | Phys Ther                                   | 2010 | 0                   |

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Although the impact factor does not necessarily indicate the quality of the articles published in a journal, it is certain that a high impact factor journal possesses a certain level of influence in the field. Our findings are consistent with those of previous studies showing a decrease in the percentage of articles in high impact factor journals in respiratory medicine originating in Japan. This study shows changes over time of the number/proportion of articles originating in Japan but does not compare Japan with the rest of the world. However, the results may suggest a relative decline in Japan’s research capability in rehabilitation medicine.

Our study has several limitations. First, a detailed examination of each study, such as classification of the study design (e.g., basic science research or intervention studies), target population, and occupation of the first author, was not conducted. Second, we did not investigate the existence and quality of peer review or open access status of each journal. In recent years, open access has been subdivided into hybrid open-access journals and delayed open-access journals, among others, and it is difficult to make a general evaluation. Third, because we did not make comparisons by country, it is not clear how Japan’s ranking in the world has changed. Our findings suggest that the number of articles originating in Japan containing high-quality scientific evidence is on the increase. To conduct high-quality research, it is important to establish research systems such as multicenter studies, to establish multidisciplinary research facilities, and to construct large-scale databases. There is a need to expand the support system for research while emphasizing the quality of the research. In the future, we plan to conduct a detailed survey of research in physical medicine and rehabilitation in Japan, including the levels of adherence to the PRISMA and the CONSORT statements and evaluation of the risk of bias.

| Table 1. (continued) | 2006 | 2007 | 2008 | 2009 | 2010 |
|----------------------|------|------|------|------|------|
| 1 Except Child *     |      |      | 2.4  | 2.6  | 0    |
| Neurorehabil Neural Repair | 2.4  | Res Dev Disabil | 2.6  | Neurorehabil Neural Repair | 0    |
| J Head Trauma Rehabil | 0    | 0    | 0    | Res Dev Disabil | 1.5  |
| Res Autism Spectr Disorder | 0    | 0    | 0    | Res Dev Disabil | 1.5  |
| J Rehabil Med        | 9.4  | 1.9  | Am J Ment Retard | *    | J Head Trauma Rehabil | 0    |
| Phys Ther            | 1.1  | 1.5  | 1.4  | J Orthop Sports Phys Ther | 0    |
| IEEE Trans Neural Syst Rehabil Eng | 2.8  | 3.6  | J Head Trauma Rehabil | 0    |
| J Burn Care Res *    | 3.2  | 0    | 0    | IEEE Trans Neural Syst Rehabil Eng | 0    |
| Support Care Cancer  | 2.9  | 3.5  | Ann Dyslexia | 0    | J Orthop Sports Phys Ther | 1.8  |
| Phys Ther            | 0    | 0    | 0    | Phys Ther | 0    |
| IEEE Trans Neural Syst Rehabil Eng | 0    | 0    | 0    | J Speech Lang Hear Res | 0    |
| J Speech Lang Hear Res | 0    | 0    | 0    | J Speech Lang Hear Res | 0    |
| Arch Phys Med Rehabil | 0    | 0    | 3.6  | Arch Phys Med Rehabil | 1.4  |
| J Head Med            | 0    | 3.7  | 1.4  | Man Ther | 3.6  |
| Ann Dyslexia         | 0    | 3.7  | Arch Phys Med Rehabil | 1.4  |
| Phys Ther            | 0    | 0    | 4.5  | Arch Phys Med Rehabil | 1.8  |
| J Speech Lang Hear Res | 0    | 0    | Res Autism Spectr Disorder | 0    |
| Man Ther             | 0    | 0    | 4.5  | Eur J Phys Rehabil Med | 0    |
| Eur J Phys Rehabil Med | 0    | 0    | 4.5  | Eur J Phys Rehabil Med | 1.5  |

a journal. Although the impact factor does not necessarily indicate the quality of the articles published in a journal, it is certain that a high impact factor journal possesses a certain level of influence in the field. Our findings are consistent with those of previous studies showing a decrease in the percentage of articles in high impact factor journals in respiratory medicine originating in Japan. This study shows changes over time of the number/proportion of articles originating in Japan but does not compare Japan with the rest of the world. However, the results may suggest a relative decline in Japan’s research capability in rehabilitation medicine.

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|    | 2011  | 2012  | 2013  | 2014  | 2015  |
|----|-------|-------|-------|-------|-------|
| 1  | Neurorehabil Neural Repair | 4.3 (6/139) | J Head Trauma Rehabil | 0 (0/61) | Neurorehabil Neural Repair | 3.1 (4/127) | Neurorehabil Neural Repair | 1.9 (3/160) | Neurorehabil Neural Repair | 2.4 (4/166) |
| 2  | J Fluency Disorder | 2.5 (1/40) | Neurorehabil Neural Repair | 3.1 (4/127) | Phys Ther | 0.5 (1/198) | J Physiother | 1.3 (1/77) | J Physiother | 1.12 (1/89) |
| 3  | Aust J Physiother * | IEEE Trans Neural Syst Rehabil Eng | 0 (0/139) | J Head Trauma Rehabil | 0 (0/67) | IEEE Trans Neural Syst Rehabil Eng | 0 (0/199) | J Head Trauma Rehabil | 0 (0/87) |
| 4  | IEEE Trans Neural Syst Rehabil Eng | 2.0 (2/98) | J Orthop Sports Phys Ther | 1.5 (2/134) | J Physiother | 0 (0/52) | J Orthop Sports Phys Ther | 0.9 (1/113) | Arch Phys Med Rehabil | 1.2 (5/421) |
| 5  | Res Dev Disabil | 1.4 (6/444) | Res Autism Spectr Disord | 0 (0/16) | J Neurol Phys Ther | 0 (0/28) | J Head Trauma Rehabil | 0 (0/83) | Augment Altern Comm | 0 (0/30) |
| 6  | J Head Trauma Rehabil | 0 (0/47) | Phys Ther | 0.6 (1/179) | IEEE Trans Neural Syst Rehabil Eng | 0 (0/139) | Except Child | 0 (0/1) | Phys Ther | 1.7 (4/236) |
| 7  | J Neuroeng Rehabil | 3.3 (2/60) | Support Care Cancer | 4.5 (25/554) | Res Dev Disabil | 1.3 (7/543) | J Neuroeng Rehabil | 4.7 (8/170) | Except Child | 0 (0/2) |
| 8  | Phys Ther | 0 (0/198) | J Neuroeng Rehabil | 3.6 (3/83) | J Neuroeng Rehabil | 4.3 (5/117) | Augment Altern Comm | 0 (0/30) | IEEE Trans Neural Syst Rehabil Eng | 0 (0/209) |
| 9  | J Orthop Sports Phys Ther | 1.4 (2/139) | Am J Intellect Dev Disabil | 0 (0/36) | Support Care Cancer | 2.9 (15/522) | Arch Phys Med Rehabil | 2.0 (9/459) | J Orthop Sports Phys Ther | 0 (0/116) |
| 10 | Res Autism Spectr Disord | 0 (0/4) | Res Dev Disabil | 0.9 (3/350) | Arch Phys Med Rehabil | 1.6 (7/451) | Phys Ther | 0.5 (1/221) | Support Care Cancer | 5.8 (39/674) |
CONFLICT OF INTEREST

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