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ORIGINAL ARTICLE

Publication Trends in Physical Medicine and Rehabilitation in Japan from 2001 to 2019

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Objectives: 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 (randomized controlled trials [RCTs], systematic reviews, meta-analyses) and those published in high impact factor journals. **Methods:** We searched the PubMed database to identify articles, RCTs, systematic reviews, and meta-analyses from Japan covering physical medicine and rehabilitation published between 2001 and 2019; we then calculated the proportion of articles from Japan. Additionally, using Journal Citation Reports, we selected the top ten highest impact factor journals on "Rehabilitation" each year between 2001 and 2019. For each year, we searched PubMed for the total number of articles in these top ten journals and for articles originating in Japan. The Cochran-Armitage test was used to evaluate the change in the proportion of publications from Japan over time. **Results:** The proportion of articles on physical medicine and rehabilitation originating in Japan increased from 2001 to 2019 ($P<0.0001$). An increase in the percentages of systematic reviews ($P=0.046$) and meta-analyses ($P=0.0013$) originating in Japan and a decrease in the percentage of original articles published in the top ten highest impact factor journals were demonstrated ($P=0.002$). However, there was no change in the percentage of RCTs from Japan over time ($P=0.055$). **Conclusions:** Our findings suggest 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

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.[1)] EBM comprises clinical judgment, scientific evidence, and patients' values and preferences.[2)] 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.[3–5)] Furthermore, the number of entries in the clinical trials registry in the field of rehabilitation medicine has an increasing trend in Japan.[6)] 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.[7)] It has been pointed out that the proportion of publications from Japan has been decreasing in various fields.[8, 9)] However, no previous study has shown the number of articles or the number of articles containing high-quality scientific evidence on physical medicine and

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rehabilitation originating in Japan.

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,

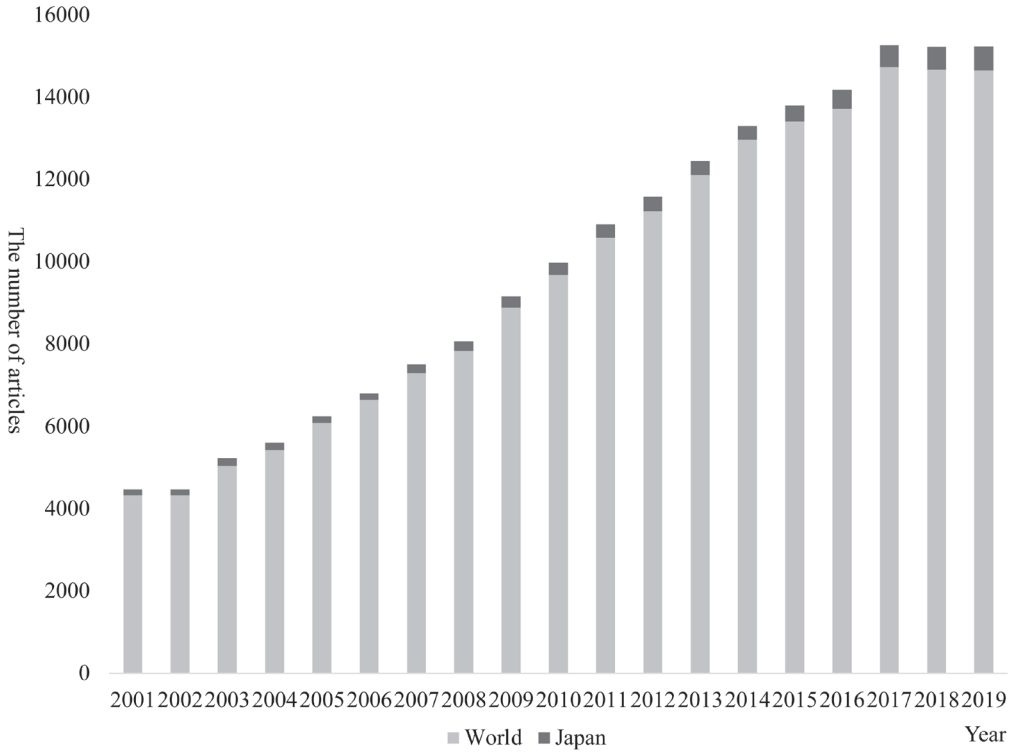

Fig. 1. The number of articles on physical medicine and rehabilitation originating in Japan (dark gray) and the rest of the world (light gray) between 2001 and 2019. The total number of relevant articles published in this period was 189,571, of which 5832 were from Japan.

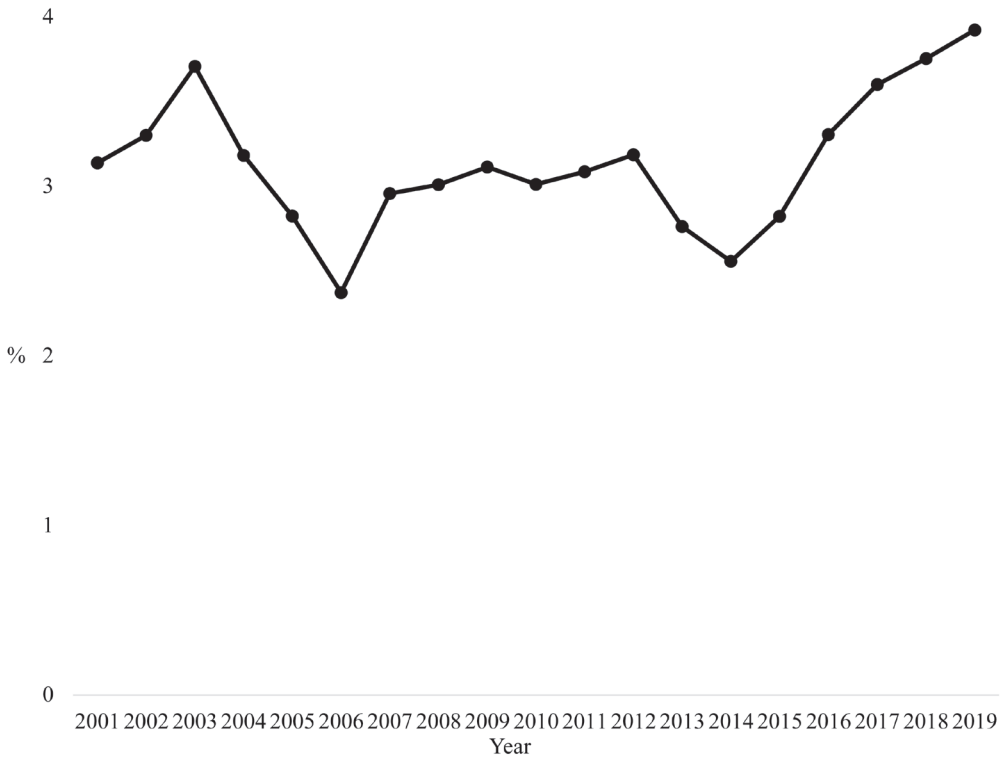

Fig. 2. The percentage of articles on physical medicine and rehabilitation originating in Japan.

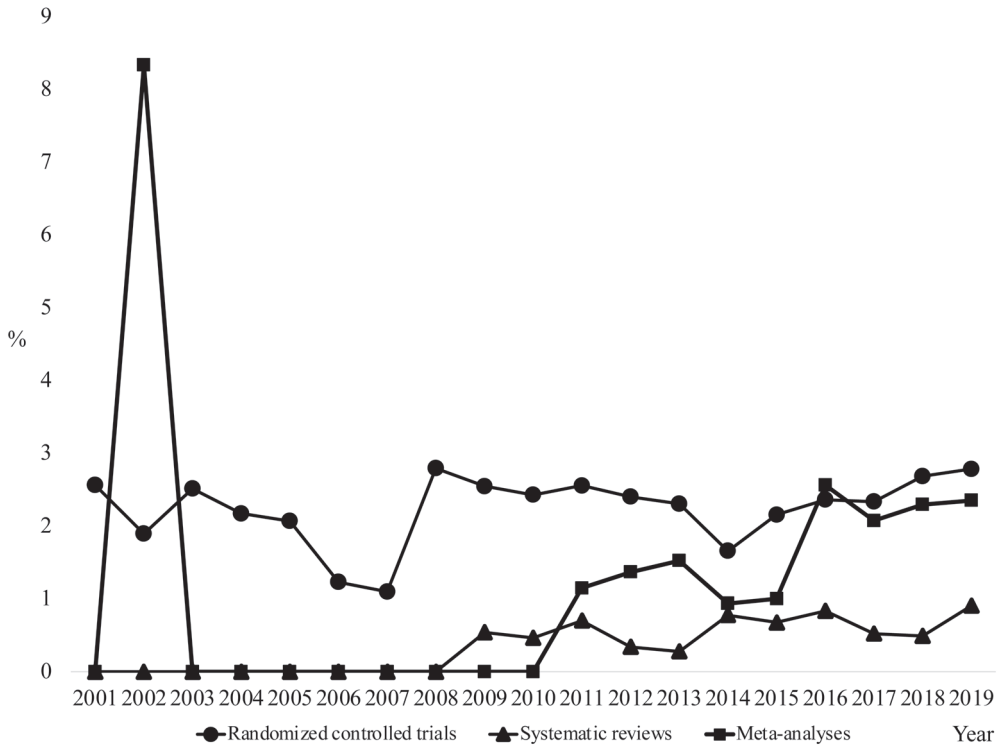

Fig. 3. The percentage of randomized controlled trials (circles), systematic reviews (triangles), and meta-analyses (squares) on physical medicine and rehabilitation originating in Japan.

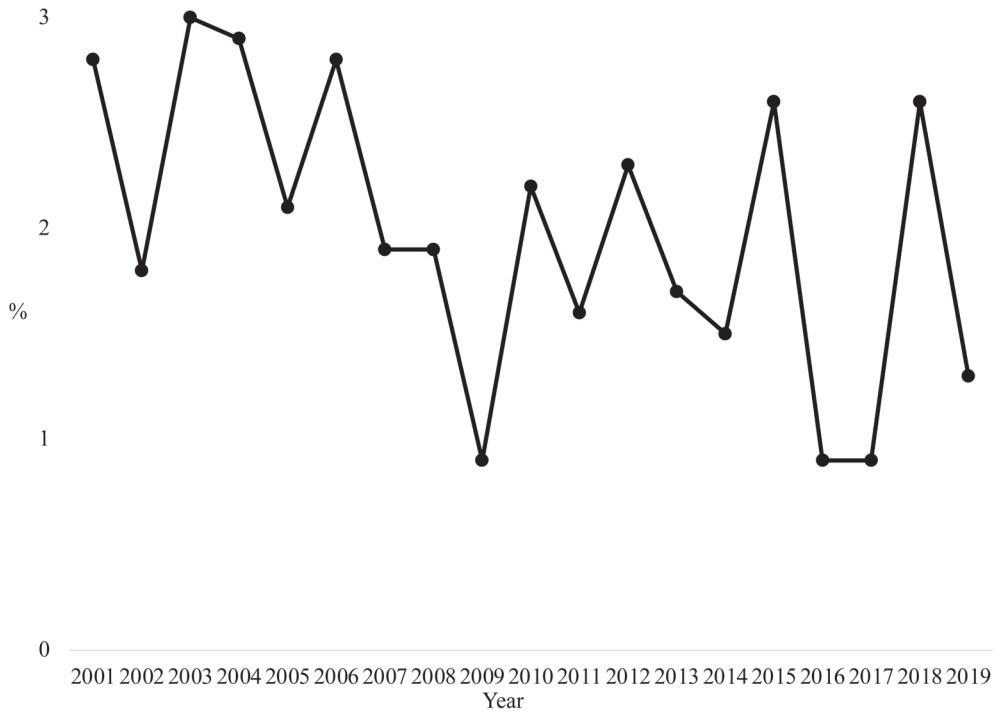

Fig. 4. The percentage of articles originating in Japan among all articles published in the top ten highest impact factor journals on physical medicine and rehabilitation. The top ten journals were determined annually.

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

	2001		2002		2003		2004		2005	
1	Except Child	*	J Intellect Disabil Res	0 (0/71)	Am J Ment Retard	0 (0/34)	J Electromyogr Kinesiol	4.3 (4/93)	J Electromyogr Kinesiol	5.9 (7/118)
2	J Speech Lang Hear Res	2.0 (2/99)	IEEE Trans Neural Syst Rehabil Eng	2.9 (1/34)	Phys Ther	0 (0/68)	Phys Ther	0 (0/66)	J Rehabil Med	3.4 (2/59)
3	Am J Ment Retard	0 (0/44)	Am J Ment Retard	0 (0/40)	J Speech Lang Hear Res	0 (0/106)	Neurorehabil Neural Repair	0 (0/29)	Man Ther	0 (0/51)
4	Assist Technol	0 (0/12)	Phys Ther	0 (0/82)	Am J Speech Lang Pathol	0 (0/41)	Arch Phys Med Rehabil	2.0 (7/346)	Arch Phys Med Rehabil	2.3 (9/398)
5	Arch Phys Med Rehabil	3.5 (10/289)	J Learn Disabil	0 (0/46)	Support Care Cancer	6.7 (9/135)	IEEE Trans Neural Syst Rehabil Eng	4.3 (2/47)	J Speech Lang Hear Res	0 (0/99)
6	Support Care Cancer	2.7 (3/110)	J Electromyogr Kinesiol	7.5 (4/53)	J Electromyogr Kinesiol	9.3 (5/54)	J Occup Rehabil	0 (0/23)	Except Child	*
7	J Learn Disabil	0 (0/48)	Scand J Rehabil Med	*	Arch Phys Med Rehabil	3.3 (10/307)	J Rehabil Med	6.6 (5/76)	IEEE Trans Neural Syst Rehabil Eng	3.0 (2/67)
8	J Assoc Pers Severe	*	Arch Phys Med Rehabil	2.0 (6/300)	IEEE Trans Neural Syst Rehabil Eng	2.9 (2/70)	Support Care Cancer	4.7 (8/170)	Phys Ther	0 (0/82)
9	J Electromyogr Kinesiol	11.4 (5/44)	Support Care Cancer	2.8 (3/107)	J Intellect Disabil Res	1.4 (1/70)	Rehabil Psychol	*	Am J Ment Retard	0 (0/42)
10	Phys Ther	0 (0/77)	Res Dev Disabil	0 (0/32)	Ann Dyslexia	0 (0/1)	Am J Ment Retard	0 (0/41)	J Fluency Disord	0 (0/16)

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) statement[12] for systematic reviews and meta-analyses and the Consolidated Standards of Reporting Trials (CONSORT) statement[13] 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. (*continued*)

	2006		2007		2008		2009		2010	
1	Except Child	*	Neurorehabil Neural Repair	2.4 (2/83)	Res Dev Disabil	2.6 (3/116)	Neurorehabil Neural Repair	0 (0/140)	Neurorehabil Neural Repair	0 (0/118)
2	Neurorehabil Neural Repair	0 (0/27)	J Head Trauma Rehabil	0 (0/45)	Res Autism Spectr Disord	0 (0/5)	Res Dev Disabil	1.5 (3/206)	Res Dev Disabil	1.5 (4/265)
3	J Rehabil Med	9.4 (6/64)	Except Child	*	Neurorehabil Neural Repair	1.9 (2/105)	Am J Ment Retard	*	J Head Trauma Rehabil	0 (0/50)
4	Man Ther	1.1 (1/94)	IEEE Trans Neural Syst Rehabil Eng	1.5 (1/68)	IEEE Trans Neural Syst Rehabil Eng	1.4 (1/69)	J Orthop Sports Phys Ther	0 (0/93)	Phys Ther	0 (0/180)
5	Support Care Cancer	3.2 (7/217)	J Burn Care Res	*	J Head Trauma Rehabil	0 (0/46)	IEEE Trans Neural Syst Rehabil Eng	0 (0/80)	J Neuroeng Rehabil	3.3 (2/60)
6	IEEE Trans Neural Syst Rehabil Eng	2.8 (2/72)	Phys Ther	0 (0/162)	Support Care Cancer	3.6 (9/249)	J Head Trauma Rehabil	0 (0/50)	J Orthop Sports Phys Ther	1.8 (2/110)
7	Arch Phys Med Rehabil	2.9 (8/272)	Support Care Cancer	3.5 (8/226)	Ann Dyslexia	0 (0/9)	Except Child	0 (0/1)	J Electromyogr Kinesiol	6.7 (14/208)
8	J Speech Lang Hear Res	0 (0/98)	J Occup Rehabil	0 (0/54)	Phys Ther	0.7 (1/145)	J Speech Lang Hear Res	0 (0/133)	Except Child	0 (0/1)
9	Ann Dyslexia	0 (0/12)	J Rehabil Med	3.7 (4/109)	Arch Phys Med Rehabil	1.4 (5/356)	Man Ther	3.6 (5/140)	Arch Phys Med Rehabil	2.4 (7/287)
10	Phys Med Rehab Kuror	*	Man Ther	0.9 (1/111)	J Neuroeng Rehabil	0 (0/36)	Res Autism Spectr Disord	0 (0/4)	Eur J Phys Rehabil Med	1.5 (1/68)

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.[9] 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*)

	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 Disord	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 Commun	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 Commun	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)

Table 1. (*continued*)

	2016		2017		2018		2019	
1	Neurorehabil Neural Repair	0.8 (1/125)	Neurorehabil Neural Repair	2.9 (3/104)	J Physiother	0 (0/98)	J Physiother	0 (0/94)
2	J Physiother	0 (0/90)	J Physiother	0 (0/98)	Ann Phys Rehabil Med	1.3 (1/76)	Neurorehabil Neural Repair	2.0 (2/99)
3	J Neuroeng Rehabil	3.1 (3/97)	IEEE Trans Neural Syst Rehabil Eng	0 (0/277)	Neurorehabil Neural Repair	0 (0/73)	J Orthop Sports Phys Ther	0 (0/153)
4	IEEE Trans Neural Syst Rehabil Eng	0 (0/279)	J Neuroeng Rehabil	4.7 (6/128)	J Neuroeng Rehabil	3.4 (4/119)	Ann Phys Rehabil Med	4.6 (5/110)
5	Arch Phys Med Rehabil	1.0 (4/420)	J Neurol Phys Ther	0 (0/49)	IEEE Trans Neural Syst Rehabil Eng	0 (0/274)	J Neuroeng Rehabil	1.3 (2/156)
6	J Head Trauma Rehabil	0 (0/84)	Ann Phys Rehabil Med	1.4 (1/73)	J Orthop Sports Phys Ther	0 (0/173)	J Geriatr Phys Ther	2.5 (2/81)
7	Physiotherapy	0.01 (1/101)	J Head Trauma Rehabil	0 (0/88)	Phys Ther	0 (0/103)	IEEE Trans Neural Syst Rehabil Eng	0 (0/297)
8	J Orthop Sports Phys Ther	0 (0/151)	Except Child	0 (0/4)	Except Child	0 (0/4)	Except Child	0 (0/4)
9	Clin Rehabil	2.4 (5/209)	Physiotherapy	0 (0/98)	Support Care Cancer	5.8 (43/746)	Phys Ther	1.3 (2/156)
10	Phys Ther	1.5 (3/204)	J Orthop Sports Phys Ther	0 (0/156)	Clin Rehabil	0.4 (1/228)	Arch Phys Med Rehabil	2.2 (8/356)

Data are percentages (Japan/Total).
*Not listed on PubMed.

CONFLICT OF INTEREST

None of the authors involved in the creation of this article have any competing interests. This project was not funded by any organization, and there is no financial incentive for any of the authors.

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