

# Research Trends and Impact Factor on PubMed Among General Medicine Physicians in Japan: A Cross-Sectional Bibliometric Analysis

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**Background:** Japan created a specialty system for general medicine in 2018. However, Japanese academic generalists' contribution to research remains unclear. This study examines the popularity of Japanese general medicine research, the characteristics of journal publications, annual trends, and the characteristics/differences among publications in journals with an impact factor (IF).

**Methods:** This bibliometric analysis extracted international, English-language, journal articles published on PubMed between January 1, 2015, and December 31, 2020. Analysis included articles with either the first, second, or last author in general medicine. We classified articles according to publication or article type and field of research. We obtained standard descriptive statistics for each publication type. Chi-squared test or Fisher's exact test was used to compare nominal variables. For continuous variables, *t*-tests or Wilcoxon rank-sum tests were used, as appropriate.

**Results:** Of the 2372 articles analyzed, original articles were most common (56.3%), followed by case reports (30.1%), reviews (7.63%), and letters/others (5.9%). Publication volume increased 2.64-fold annually over 5 years. Clinical research (60.5%) was most common among original articles, followed by basic experimental research (17.5%) and public health/epidemiology (12.7%). Medical quality and safety (4.1%), medical and clinical education (3.1%), and health services (1.42%) received comparatively little attention. Eighty percent of articles were published in journals with IF; however, these journals rarely published case reports. Among original articles, the likelihood of publishing in journals with IF was high for basic laboratory medicine articles with higher IF (median IF 3.83, OR 1.71, 95% CI 2.20–5.95,  $p=0.044$ ) and lower for clinical education research with the lowest IF (median IF 1.83, OR 0.56, 95% CI 0.18–0.75,  $p<0.001$ ).

**Discussion:** General medicine physicians' international research output is increasing in Japan; however, research achievements have not been generalized, but rather much influenced by clinical subspecialty backgrounds. This will likely continue unless an academic generalist discipline is established.

**Keywords:** general medicine, academic generalist, research productivity, research trend, impact factor

## Introduction

Research forms the heart of medical contributions that advance the practice of general medicine.<sup>1-5</sup> In the US, where general medicine research is well-established and vibrant, scholarship in family and hospital medicine has led to scientific validation and advancement in fields such as patient safety,<sup>6,7</sup> healthcare economics and cost-effectiveness,<sup>8,9</sup> medical education,<sup>10,11</sup> patient satisfaction and patient-centered care,<sup>12</sup> and high-quality medical services.<sup>7,12-14</sup> The publication of such literature has led to the recognition of generalists by their peers as clinicians and scientists.<sup>4,15-18</sup>

In Japan, however, it was not until 2018 that general medicine was established as an official program—its 19th specialty accreditation.<sup>17,19</sup> Thus, Japanese general medicine is in its formative years, and there is no precise segregation

of this discipline thus far. At this stage, there are several types of general medicine physicians: those that do not have a hospital role, but rather have a role equivalent to a family medicine physician or primary care physician versus those that care for patients with acute diseases in hospitals, such as hospital medicine and general internal medicine. Many general medicine physicians can choose their own clinical style depending on the clinical setting, which is a unique system in the world. Consequently, its corresponding field of research remains nascent.<sup>19,20</sup> With this background, Japan's international contribution to general medicine research remains unclear, and there is little knowledge of trends in Japanese research grants or funding and research practice.<sup>19,21</sup> Furthermore, the international impact of papers published by Japanese general medicine physicians, and trends in journal impact factor (IF), are unknown.<sup>22,23</sup> Consequently, establishing evaluation criteria for the academic achievements of Japanese generalists remains difficult.<sup>15,17,22</sup>

To understand the current state of international scholarship by Japanese generalists, we clarified the characteristics (eg, number, contents, thematic categories, and IFs) of articles published in English by Japanese general medicine physicians in English-language journals included in PubMed.

## Methods

In this cross-sectional bibliometric analysis, we extracted English-language articles published in international journals on PubMed between January 1, 2015 and December 31, 2020 using a search formula combining several keywords. The search formula was based on the most common English names of affiliations customarily used in Japan:

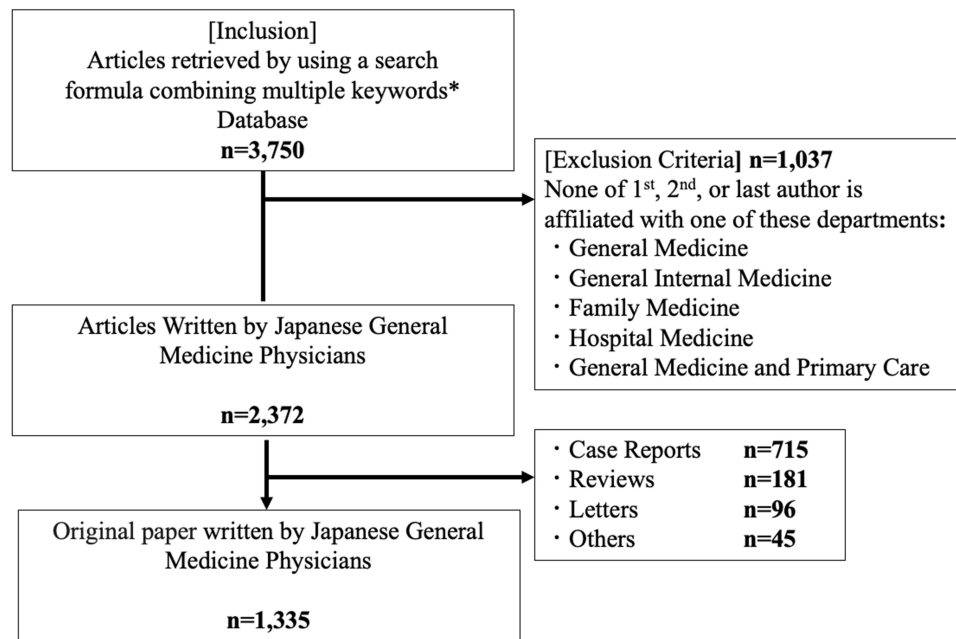
\*Search formula (Japan[ad] AND "General medicine"[ad]) OR (Japan[ad] AND "Family medicine"[ad]) OR (Japan[ad] AND "general internal medicine"[ad]) OR (Japan[ad] AND "hospital medicine"[ad])OR (Japan[ad] AND "General Medicine and Primary Care"[ad])

Inclusion criteria were as follows: 1) The paper needed to include at least one author who belonged to a department of general practice in Japan. Articles were considered authored by a general medicine physician if the first, second, or last author's primary affiliation was general medicine.<sup>19,20</sup> Exclusion criteria were: 1) the first, second, or last authors did not belong to a department of general practice and 2) papers that fulfilled the first inclusion criterion, but the authors' first affiliation were not in general medicine. As a result, manuscripts were excluded if they included general medicine physicians as other co-authors; if authors had a group as their affiliation; or if authors were affiliated with health care quality, safety, or medical education (Figure 1).

Next, the three co-authors read the titles and abstracts of all cases. We then followed the methodology to characterize the published articles and divided the articles into four categories (ie, original articles; case reports including brief reports, communications to the editor, clinical pictures, clinical images, images, and clinical quizzes; reviews; letters; and others, such as activity reports, opinions, and advertisements).<sup>13,17</sup> Then, original articles were extracted and further classified into seven sub-categories (ie, clinical research; medical and clinical education; public health and epidemiology; health services; quality and safety; experimental basic medicine; and others, which included opinion articles and editorials, among others). The IF of each journal was calculated using the 2021 update to the annual Journal Citation Reports (JCR) published by Clarivate.<sup>24</sup> The journals appearing within the JCR were defined as having an IF and those not listed there were defined as journals without an IF. We then assessed whether an IF was available and calculated the median IF, IQR, and odds ratio for each type of article published by general practitioners for the categories of original articles, case reports, reviews, and letters/others. The same analysis was also performed for each research field within the original articles only. The IF was considered to be a representative surrogate for the quality of medical journals. Before data cleaning, if the classification was initially unclear, the three co-authors discussed and decided on the classification, which was re-reviewed by Y.N., M.K., and A.T., with the final classification determined by the first author (T.W.). Consequently, there were fewer than 10 unclassified items, which were included in others. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline for cross-sectional studies.

## Statistical Analysis

We used standard descriptive statistics to calculate the number, percentage, median, and interquartile range (IQR) for each category of publication type. The chi-squared test or the Fisher's exact test was used to compare nominal variables. For continuous variables, *t*-tests or Wilcoxon rank-sum tests were used, as appropriate. Confidence intervals are



**Figure 1** Search flow for articles written by Japanese general medicine physicians. \*Search formula (Japan[ad] AND “General medicine”[ad]) OR (Japan[ad] AND “Family medicine”[ad]) OR (Japan[ad] AND “general internal medicine”[ad]) OR (Japan[ad] AND “hospital medicine”[ad]) OR (Japan[ad] AND “General Medicine and Primary Care”[ad]).

presented in the format 95% CI [LL, UL], where LL is the lower limit and UL is the upper limit of the confidence interval. All analyses were performed using Stata statistical software (14.0, StataCorp LLC, College Station, TX). All tests were two-tailed, with p-value lower than 0.05 indicating statistical significance.

## Ethics Statement

This study was conducted in accordance with the Declaration of Helsinki. Approval from the institutional review board of the Shimane University was not necessary as this was a completely bibliometric study, and informed consent was not applicable.

## Results

Of the 3750 articles published in PubMed during the study period, 1378 were excluded as none of the first, second, or last authors were affiliated with an appropriate department (Figure 1). A total of 2372 articles by Japanese general medicine physicians were included in the analysis.

Of the publication types, original articles were the most common (1335; 56.3%), followed by case reports (715; 30.1%), reviews (181; 7.63%), and letters/others (141; 5.9%).

From 2015 to 2020, there was a 2.64-fold increase in the total number of articles published (from 251 to 663). There was a 1.96-fold increase in original papers (from 143 to 280), a 2.64-fold increase in case reports (from 78 to 206), a 2.5-fold increase in review articles (from 22 to 55), and a 3.7-fold increase in letters/others (from 10 to 37). The classification of research topics and publishing trends among original papers (n=1335) is demonstrated in Figure 2.

The most common research theme was clinical research (n=807), accounting for 60.5% of the original papers, followed by experimental basic research (n=234) and public health and epidemiology (n=169), at 17.5% and 12.7%, respectively (Figure 3). The number of articles on health care quality and safety, medical and clinical education, and health services (online eg, medical care, artificial intelligence, and medical assistance) were 55 (4.1%), 41 (3.1%), and 19 (1.4%), respectively (Figure 3). Most general medicine physicians who published original articles were affiliated with university hospitals (1056; 79.1%) or general city hospitals (227; 17.0%), and fewer authors were affiliated with clinics or government

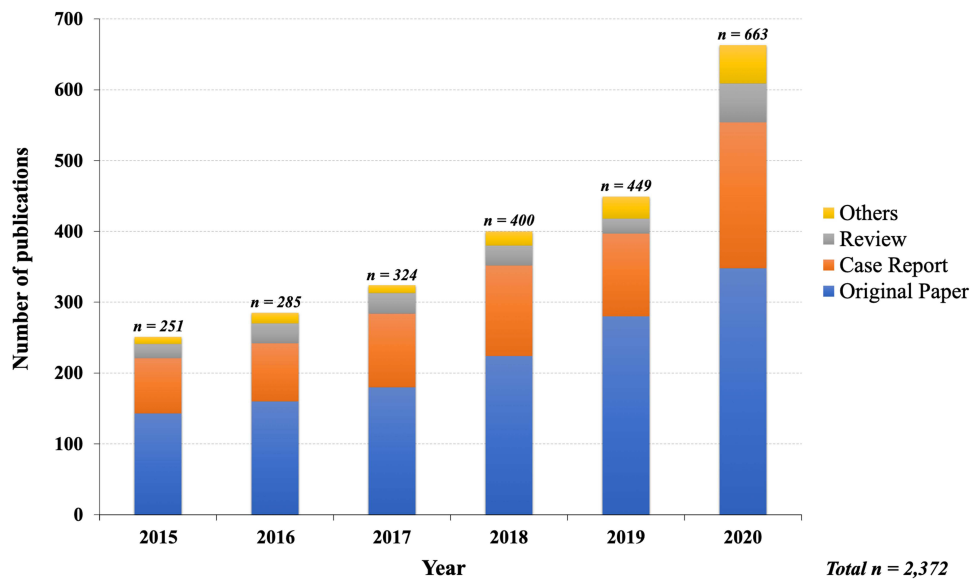


Figure 2 Trend of types of articles by year (n=2372).

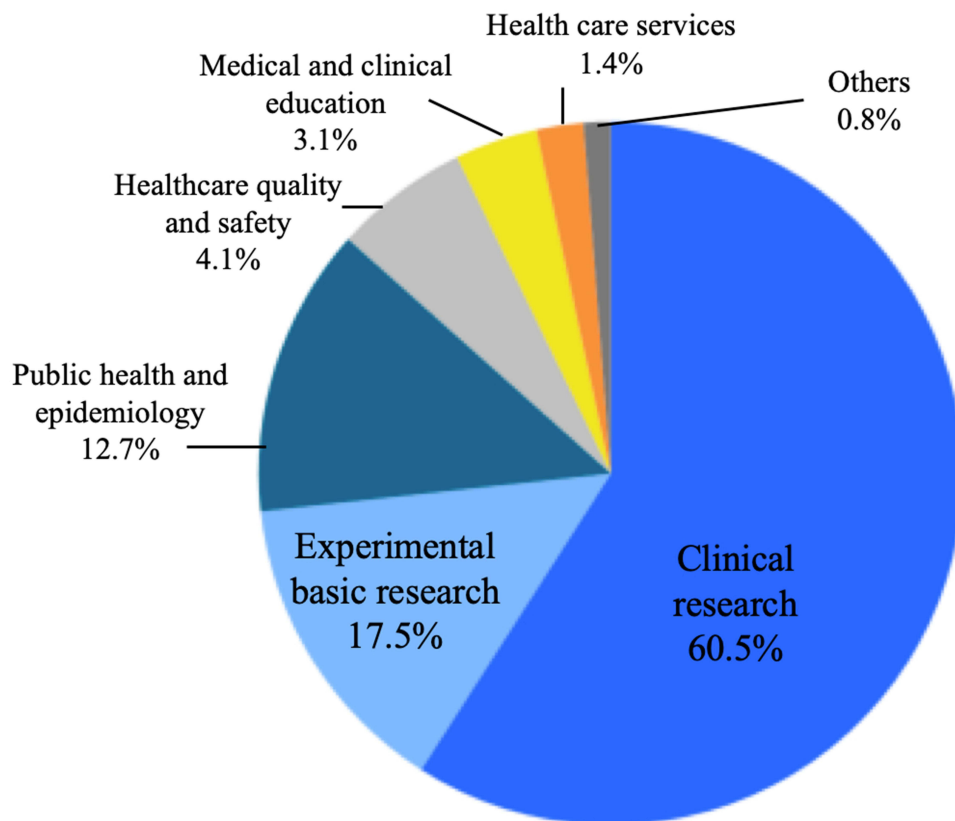


Figure 3 Breakdown of the original articles by the general medicine field during 2015–2020 (n=1335).

facilities. Among original articles, 750 (56.2%) were domestic multicenter studies coauthored by two or more different institutions, and 331 (24.8%) were international collaborations with the participation of one or more foreign researchers.

Table 1 shows the characteristics of IFs for each type of article written by general medicine physicians in Japan. Of the 2372 articles published, approximately 80% were in journals with an IF (JIF) as of January 2022. Of the JIF, there

**Table 1** Characteristics of Impact Factors for Each Type of Article Written by Japanese General Medicine Physicians

	Total Number (n)	JIF		Impact Factor		OR	95% CI	p-value
		n	%	Median	IQR			
Original articles	1335	1188	89.0	2.99	2.09–4.23	3.61	2.90–4.48	<0.001
Case reports	715	438	61.3	1.88	1.01–3.17	0.20	0.16–0.25	<0.001
Reviews	181	163	90.1	3.67	2.57–6.13	2.33	1.42–3.82	<0.001
Letters/others	141	116	82.3	3.74	1.91–5.13	1.15	0.74–1.78	0.5467

**Abbreviations:** JIF, Journals with impact factors; IQR, interquartile range.

**Table 2** Characteristics of Impact Factors for Original Article Categories Written by Japanese General Medicine Physicians

	Total Number	JIF		Impact Factor		OR	95% CI	p-value
		n	%	Median	IQR			
Clinical research and practice	807	721	89.3	2.74	1.83–4.09	1.10	0.77–1.55	0.609
Experimental basic research	234	217	92.7	3.83	2.74–5.87	1.71	2.20–5.95	0.044
Public health and epidemiology	169	150	88.8	2.71	1.73–3.07	0.97	0.59–1.62	0.918
Health care quality and safety	55	45	81.8	2.05	1.01–2.74	0.54	0.27–1.08	0.083
Medical and clinical education	41	31	75.6	1.83	0.76–2.34	0.56	0.18–0.75	<0.001
Health care services	19	15	78.9	2.05	1.72–2.74	0.46	0.16–1.33	0.159
Others	10	9	90.0	2.27	2.02–2.74	1.11	-	0.918

**Abbreviations:** JIF, Journals with impact factors; IQR, interquartile range.

were 1188 original papers (median IF 2.985), 438 case reports (median IF 1.877), 163 review papers (median IF 3.665), and 116 letters/others (median IF 3.738). The probability of a particular type of article being published in a JIF was highest for original articles (OR 3.6; 95% CI 2.91–4.48) and lowest for case reports (OR 0.2; 95% CI 0.16–0.25), when other types of articles were used as reference numerators.

Table 2 shows the differences in IF among categories of original research by general medicine physicians in Japan. The odds of publication in a journal with IF were highest for experimental basic research (OR 1.71; 95% CI; 2.20–5.95,  $p < 0.044$ ). Medical and clinical education research was less likely to be published in journals with IF (OR 0.56; 95% CI; 0.18–0.75). Similarly, the IF for experimental basic research was highest at 3.83 (95% CI; 2.74–5.87), followed by clinical research and practice at 2.74 (95% CI; 1.83–4.09) and public health and epidemiology at 2.71 (95% CI; 1.73–3.07). The IF of medical and clinical education (1.83) was the lowest among original articles.

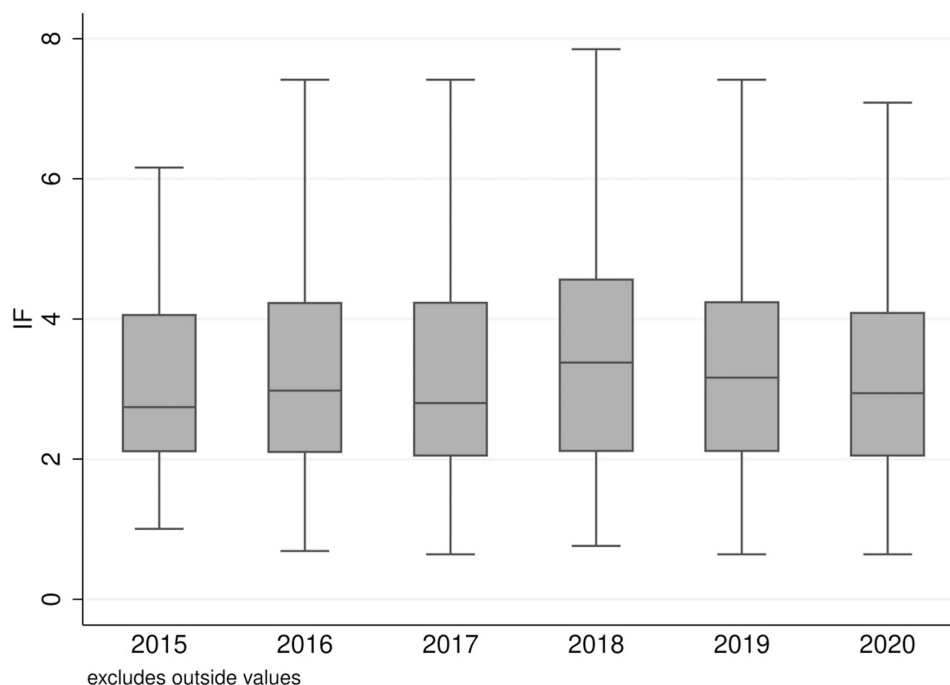
Figure 4 shows a box plot of the IF trends. IFs published by Japanese general medicine physicians did not change significantly from 2015 (median 2.74; IQR 2.11–4.06) to 2020 (median 2.94; IQR 2.05–4.09). In the 5 years assessed, the number of papers with IF greater than 10 was: 10 in experimental basic research; 7 in clinical research and practice; 4 in health care quality and safety; 4 in health care services; 1 in medical and clinical education; and 0 in public health and epidemiology.

## Discussion

This study is the first cross-sectional, observational study to comprehensively summarize the research performance of Japanese general medicine physicians from the perspectives of annual changes, types of articles preferred by Japanese general medicine physicians and research areas, and IFs.

### Yearly Change in the Trend

The number of research articles by Japanese general medicine physicians—both original articles and case reports—increased steadily in 5 years. Although there are at least 12,000 active general medicine physicians in Japan, the overall research contribution by Japanese general medicine physicians (in terms of number of publications) remains low, and the increase in published papers may still be minimal. How physician research performance should be assessed broadly is



**Figure 4** Annual trend of the impact factor (IF) of articles archived in PubMed by general medicine physicians in Japan.

only briefly discussed in the literature, and the appropriate relative contribution to international research by Japanese physicians, given the size of the specialty, is difficult to quantify.<sup>13,25</sup> Moreover, such standards may not uniformly apply to different countries with varied health care systems.<sup>22,23,25,26</sup>

## Types of Papers and Research Areas

Japanese general medicine research focuses on experimental laboratory and subspecialty clinical research, with insufficient focus on patient-centered care, common problems encountered in daily general practice, and public and community health. A possible reason for this is, as mentioned previously, that the Japanese general medicine program was recently introduced as the 19th specialty and modeled after the educational systems in Western countries.<sup>27,28</sup> General medicine in Japan encompasses various generalist specialties, such as family medicine, general internal medicine, and hospital medicine.<sup>19–21,29</sup> As these are new subspecialty programs, the names of the affiliations of each hospital vary and their definition and clinical work style are not currently fixed;<sup>19</sup> furthermore, fewer than 300 senior general medicine residents per year (2018: 184; 2019: 180; 2020: 222) register as future general medicine specialists nationwide.<sup>20,30</sup> The number of trainees electing to pursue a position as a general medicine specialist has not increased significantly in the last 4 years.<sup>28</sup> Consequently, most articles by Japanese physicians indexed by PubMed are by attending physicians who are affiliated with university hospitals.<sup>22</sup> Some of these physicians are trained as general medicine physicians, whereas others are cardiologists, gastroenterologists, and pulmonologists.<sup>5,22,31,32</sup>

Furthermore, it is important to note that the research areas preferred by Japanese general medicine physicians included clinical and basic experimental research.<sup>17</sup> This may be because physicians who concurrently practice both subspecialties and general medicine often continue as general medicine physicians in the field of experimental basic research under their previous specialty areas.<sup>17,23,31,32</sup> Prior studies have shown that academic generalists are suitable for the academic fields of quality and safety in health care, medical education, and health care services, but our results show that Japanese generalists published very few papers in these areas.<sup>2,7,17,18,27,33–38</sup> We thus suggest promoting these aforementioned research topics, instead of organ-specific research topics, suited to generalists who provide comprehensive medical care based on patient-centeredness.<sup>5,17,22,23,31,32</sup> To encourage scholarship among academic generalists in Japan, research could focus on the settings and patients in which generalists serve.<sup>39</sup> For example, in the US, academic hospital medicine has been extensively

developed by presenting evidence of its high quality, safety, efficacy, and cost-effectiveness, with a special focus on quality improvement and safety and medical education.<sup>4,27,40–43</sup> In the primary care field, competencies include assessment of lifelong biological and psychosocial needs and patient-centered care planning, including collaborative decision-making and patient self-management; thus, these purely non-biomedical research areas are highly relevant to Japanese general practitioners. Future development could be achieved by improving training systems for conducting such research and promoting collaboration with researchers in the fields of quality improvement, patient safety, and medical education.<sup>40–43</sup>

IFs represent the average number of times an article published in a journal is cited per year.<sup>44</sup> In general, journals with higher IF values are more likely to be considered critical and have intrinsic prestige than journals with lower values. By extension, the IF is often used in the evaluation of university faculty members and researchers in some countries (including Japan). However, caution must be exercised in its use.<sup>44–46</sup> Within the field of general practice as well, basic research is favored for promotion and personnel evaluation, as basic and experimental science publications have the greatest odds of publication in journals with an IF.<sup>23</sup> Areas of specialty that have a high affinity with general medicine physicians, such as comprehensive patient-centered medicine, community medicine, clinical education, and medical quality and safety activities, are not evaluated as highly as basic research,<sup>17,22,23</sup> and thus, general medicine physicians with research interests in these areas are often undervalued in Japan.<sup>21,31</sup>

To the best of our knowledge, this study is the first to identify the characteristics and IFs of articles published in PubMed by Japanese general medicine physicians. We thus provide essential information for future general medicine research and confirm the direction of training academic generalists.

## Limitations

Several limitations of this study must be acknowledged. First, although this study revealed an increase in the total number of papers by Japanese general medicine physicians, it is not clear whether this is because of an increase in the productivity of doctors or an increase in the number of physicians involved in the general medicine research area. However, the rapid increase in the number of papers cannot be explained by an increase in the number of physicians, since official data do not indicate that the number of general practitioners in Japan has rapidly increased over the previous five years. Therefore, we suppose that there has been an increase in the number of people who have started to prioritize research work.

Second, we only used PubMed to collect data. Other search engines such as Google Scholar were not used because these contain many non-peer-reviewed international works of literature with English abstracts attached to Japanese-language articles. This presents a methodological difficulty; thus, they were not considered for data collection. As non-English papers were excluded, many papers in Japanese, which Japanese general medicine physicians often publish in, were also excluded. This could lead to systematic selection bias, resulting in an incorrect perception of the type and volume of research activities performed by Japanese general medicine physicians.

Third, even if the authors are classified as general practitioners using the study-presented definition, it is unclear whether their clinical setting belongs to the field of hospital medicine, general internal medicine, family medicine, or a combination.<sup>19</sup> The information provided by PubMed did not clearly indicate whether the primary clinical setting was outpatient or inpatient. While almost all general practitioners working in Japanese hospitals practice in both outpatient and inpatient settings, the number of physicians who specialize in primary care, such as newly qualified family physicians, is gradually increasing. Unfortunately, we do not know the main clinical contributions of each.

As mentioned, general medicine has a short history as an academic discipline in Japan, and its strict classification remains difficult.<sup>5,22</sup> Consequently, we conducted this study to obtain an accurate picture of the status of general academic medicine. In the future, as distinct fields within general medicine grow, it will be necessary to further distinguish the areas that tend to overlap, such as general internal medicine, hospital medicine, and family medicine, by considering researchers' affiliations and then investigating the contents and characteristics of the themes.

Finally, publication in journals with IF was used as surrogate data for research achievements. The IF—one of the most widely used figures among researchers—tends to reflect the number of citations of the entire journal rather than the number of citations of individual papers. Hence, it may be inappropriate to use a case report or letter having a low number of citations for comparison with a review or other article having a high number of citations.<sup>45,46</sup>

## Conclusion

The international research output of general medicine physicians increased approximately 2.6-fold from 2015 to 2020 in Japan. Although clinical research has expanded significantly, the popularity of basic and experimental primary medicine research with high IF has also persisted. The proportion of publications within areas considered to have high affinity and importance for generalists, such as quality and safety of health care and medical education, is still considerably small. Based on our results, this study can serve as a landmark for creating indicators and policies for the research performance of academic generalists in Japan. Further research is needed on developing the research field of general medicine and on ways to promote and foster academic generalist scholarship.

## Data Sharing Statement

The data that support the findings of this study are available from the corresponding author, T.W., upon reasonable request.

## Acknowledgments

We thank the team members, Dr. Yoshihiko Shiraishi, Dr. Ichiro Kato, Dr. Seiji Odagawa, Dr. Takeshi Endo, Dr. Nobuyuki Ueno, and Mrs. Kazumi Iwatani from Shimane University Hospital, General Medicine Center, for sharing their wisdom with us during this research. In addition, we also thank Dr. Sanjay Saint for his remarkable guidance, Mr. Jason Engle for his professional English advice, and Dr. Takuya Aoki for advice on the classification of research articles in Japan.

## Funding

T.W. was supported by grants from the National Academic Research Grant Funds (JSPS KAKENHI: 20H03913). The sponsor of the study had no role in the study design, data collection, analysis, or preparation of the manuscript.

## Disclosure

The authors have no conflicts of interest to declare in this work.

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