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ORIGINAL RESEARCH



Factors associated with successful publication of research abstracts presented at the Japanese Society of Anesthesiologists annual meetings 2015-2017: a bibliometric analysis

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Abstract

Background: Publication in a scientific journal is the desired outcome of the research cycle. However, previous anesthesiology research has not thoroughly examined factors predictive of subsequent publication after a meeting presentation. We aimed to assess the rate of peer-reviewed publication of abstracts presented at the Japanese Society of Anesthesiologists (JSA) annual meetings and identify factors associated with successful publication.

Methods: This study included all abstracts presented at JSA meetings from 2015 to 2017. The outcome of interest was subsequent publication of abstracts in journals included in the MEDLINE database within 36 months after presentation. Differences between published and non-published abstracts were evaluated.

Results: Among the 2,418 eligible abstracts, 487 were published within 3 years (publication rate, 20.1%). Multivariable logistic regression analysis showed that factors independently associated with subsequent publication were: presentation style (poster discussions: adjusted odds ratios (AOR) 1.70, 95% confidence interval [CI] 1.31-2.20; excellent abstracts: AOR 2.82, 95% CI 1.98-4.01); basic research (AOR 4.39, 95% CI 3.23-5.96), male first author (AOR 1.41, 95% CI 1.09-1.81); region (Kansai: AOR 2.16, 95% CI 1.57-2.99; abroad: AOR 4.57, 95% CI 2.58-8.09); facility characteristics (private university: AOR 3.97, 95% CI 2.60-6.08; public university: AOR 3.53, 95% CI 2.35-5.30; medical company: AOR 16.70, 95% CI 3.75-74.46); and number of collaborating facilities (two: AOR 1.50, 95% CI 1.15-1.97; three: AOR 1.83, 95% CI 1.23-2.73; four: AOR 2.40, 95% CI 1.27-4.54).

Conclusions: Approximately one-fifth of abstracts presented at JSA meetings are published in peer-reviewed journals within 3 years. Factors independently associated with subsequent full publication are presentation style, basic research, male gender, specific region, affiliation characteristics, and number of collaborating facilities. Our data should stimulate further studies that elucidate ways to assist the full publication process of meeting abstracts.

Keywords

Abstract publication rate; Academic conference; Bibliometric analysis; Gender gap; MEDLINE database

1. Introduction

Results of biomedical research are usually summarized in abstract form and presented at scientific meetings. Professional meetings offer a platform for exchanging scientific information from the latest research, building scientific networks, and developing new ideas for future studies. However, scientific meetings are insufficient to disseminate research findings. For example, although some scientific societies publish meeting abstracts on the Internet, these abstracts do not appear in

MEDLINE or other electronic databases. Furthermore, some journals limit the citation of abstracts as references to a specified time after publication of the abstract. Conference abstracts that never achieved full publication are referred to as lost information [1]. In general, scientific information contained in meeting abstracts is assumed to be subsequently published in a peer-reviewed journal in full manuscript form within a reasonable period. Therefore, the rate of publication of meeting abstracts is considered an indicator of the scientific

quality of a meeting [2, 3]. A recent meta-analysis of full publication following abstract presentations that included 425 studies found publication rates ranged from 2.6% to 90.7% (median rate 37.3%) [4].

In terms of anesthesiology as a specialty, abstract to publication rates for presentations at conferences held by associations such as the International Anesthesia Research Society, American Society of Anesthesiologists, and European Society of Anaesthesiologists have been reported to range from 0% to 53.6% [5–13]. Approximately 10,000 anesthesiologists from around the world attend the Japanese Society of Anesthesiologists (JSA) meeting each year and several hundred research abstracts are presented. This represents a unique opportunity to learn about novel research findings in anesthesiology. Although estimating the scientific level and output of such a large professional convention is important, there are no published data reporting the subsequent full publication rate of abstracts presented at JSA meetings. Serious concerns regarding the steep decline in anesthesia journal publications from Japan have recently been raised [14–18]. Therefore, we need to advance our understanding of current research output, especially from Japan. In addition, previous anesthesiology research [5–13] did not thoroughly examine factors predictive of subsequent publication after a meeting presentation. To promote the publication process of scientific meeting abstracts, factors associated with successful publication should be elucidated.

In this study, we sought to determine the fate of abstracts presented at JSA meetings from 2015 to 2017 by focusing on two objectives: assessing the publication rate in peer-reviewed journals and identifying factors associated with successful publication. We believe this study will provide information to facilitate the full publication process after scientific meeting presentations.

2. Methods

2.1 Study design, setting, subjects, and data source

This bibliometric analysis was conducted from January 2020 to August 2020 at a public university in Japan. All research abstracts accepted for presentation at JSA meetings from 2015 to 2017 were extracted from the official JSA members' website in May 2020. Abstracts from symposia, problem-based learning discussions, refresher course seminars, sponsored seminars, and other invited lectures were excluded from the analysis. Journal articles that were retracted after publication were also excluded.

2.2 Ethics approval and consent to participate

Current Japanese ethical guidelines do not mandate ethical review for studies analyzing publicly available data. This study was therefore exempt from ethical evaluation by the Institutional Review Board at the authors' facilities. Similarly, as this was a bibliometric analysis that did not involve human subjects, the need for informed consent was waived.

2.3 Outcome measures

The main outcome of interest was the subsequent publication of JSA meeting abstracts in the journals included in the MEDLINE database within 36 months after presentation. PubMed® was used to search the MEDLINE database. Other outcomes of interest were factors predictive of publication and the time-course of peer-reviewed publications after presentation. The journals in which JSA meeting abstracts were ultimately published and the impact factors of those journals were also recorded. Cumulative full publication was assessed using the Kaplan-Meier method. We considered 36 months as a reasonable time from presentation to publication because most articles derived from presentations at scientific meetings are known to be published within 36 months [4]. Time to publication was rounded to the nearest month, and articles published in peer-reviewed journals before the JSA annual meeting where they were presented were given a zero value for time of publication. Journal impact factors were obtained using InCites Journal Citation Reports™ (Clarivate Analytics, Philadelphia, PA, USA).

2.4 Assessment of subsequent publication

By referencing relevant studies [3–13, 19–24], the search strategy was determined a priori by the survey team, which comprised anesthesiologists, a librarian, a basic scientist, and emergency physicians. To assess whether the abstract had been published, the method previously described by Tyagi *et al.* [9] and Macmillan *et al.* [21] was used with minor modifications. In brief, the names of authors' facilities and first and last authors were used as search keywords. First authors were used as they were most likely to have written the final paper, and last authors were used as they were also most likely to be last author in the final paper. If no corresponding paper was found, second authors were used instead of first authors. Japanese authors' names are usually written in kanji characters and may sometimes be difficult to read. To address this problem, we referred to the 2020 lists of JSA board-certificated anesthesiologists available on the JSA official members' website (https://anesth.or.jp/users/member/certificate_information/doctors, accessed August 8, 2020). The 2020 lists cover 20,525 anesthesiologists and show how to read a member's name using katakana characters.

To evaluate the consistency between meeting abstracts and final publications, the methods previously reported by DeMola *et al.* [23] were employed with minor modifications. Briefly, we compared the similarity of the title, research hypothesis, study design, protocol, results, and conclusions between the original abstract and the final publication. Articles that contained all data presented in the abstract but also included additional data were regarded as a match, but publications that provided dissimilar data despite similar techniques or study designs were excluded.

With the aid of a professional librarian (author CS), all eligible JSA meeting abstracts were initially evaluated by the first author (YO) in June 2020. The second author (MS) then replicated the search using the same strategy to check for errors and increase the reliability of the search. All discrepancies were resolved by mutual agreement.

2.5 Statistical analysis

To determine factors associated with subsequent full publication of JSA meeting abstracts, differences in characteristics between published and non-published abstracts were evaluated. We examined associations between various factors and full publication of abstracts, including: JSA annual meeting year (2015, 2016, and 2017); presentation style (poster presentations, poster discussions, and excellent abstracts); presentation topics (cardiovascular medicine, respiratory medicine, neuroscience, pediatric anesthesia, obstetric anesthesia, pain medicine, intensive care unit [ICU] and emergency medicine, general topics in anesthesia, and anesthesia-related topics); research type (clinical or basic research); number of author(s) and authors' affiliation(s); gender of first author; first author's affiliation type (private community hospital, public community hospital, private university, public university, and medical company), and region of first author's affiliation (Kanto and Koshinetsu, Hokkaido and Tohoku, Tokai and Hokuriku, Kansai, Chugoku and Shikoku, Kyushu and Okinawa, and abroad).

We used the method previously reported by Demailly *et al.* [24] to identify the first author's gender. In short, the first author's gender was determined based on their first name. If the gender of the name was unclear, attempts were made to clarify the gender using search engines (e.g., Google Image®) and institutional website profiles. Presentation topics were defined based on the "sessions" scheduled in the JSA meeting program. JSA annual meetings include three presentation styles. Usually, JSA reviewers assign the top 10% of abstracts to excellent abstracts, the following 30% of abstracts to poster discussions, and remaining abstracts to poster presentations.

Differences in categorical variables were assessed by chi-square tests followed by residual analysis. Univariable and multivariable logistic regression models were then fitted to yield crude and adjusted odds ratios (AOR) for successful publication. Inconsistent characteristics between the published and non-published abstracts (variables with $P < 0.05$ in Table 1, see the Results section) were included as independent variables in the logistic regression models.

In all multivariable analyses, a variance inflation factor was used to detect multicollinearity. We confirmed the goodness of fit and discrimination ability of the models with the Hosmer-Lemeshow test and the c-statistic, respectively. All statistical analyses were performed with SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). The column scatter plot and Kaplan-Meier curve were generated using GraphPad Prism 8 (GraphPad Software, San Diego, CA, USA). A P -value < 0.05 was considered to indicate statistical significance.

2.6 Subgroup analysis

We were particularly interested in how different presentation styles affected our outcomes of interest. Therefore, differences in the cumulative publication rate and journal impact factors of peer-reviewed publication of JSA meeting abstracts were analyzed separately according to presentation style. In addition to the statistical analysis described above, event rates of publication among the three presentation styles were compared using a log-rank test for the time to the first event after presentations. The difference in journal impact factors among these three groups was analyzed using a Kruskal-Wallis test followed by Dunn's post hoc tests with Bonferroni correction.

3. Results

3.1 Publication rate

Fig. 1 shows the study flow. Of the 3,256 JSA annual meeting abstracts from 2015 to 2017, we excluded 836 abstracts that were presented at symposia, problem-based learning discussions, refresher course seminars, sponsored seminars, and other invited lectures. The remaining 2,420 abstracts underwent PubMed® searching. We found that 489 meeting abstracts were ultimately published. Of those, we excluded two abstracts from the analysis that were retracted after publication. Therefore, the publication rate of JSA meeting abstracts was 20.1% (487 of 2,418).

3.2 Time to publication

Fig. 2 shows the estimated cumulative publication rate for JSA meeting abstracts. The median time to full publication after JSA meeting presentation was 13 months (interquartile range, 3-22 months). We also found that 81 (3.3%) meeting abstracts were published in peer-reviewed journals before the JSA annual meeting in which they were presented.

3.3 Journal impact factor

Fig. 3 shows the distribution of the impact factors for journals in which JSA meeting abstracts were published. The median journal impact factor was 2.07 (inter quartile range 1.45-3.34), and the range was 0-15.9. The numbers of papers published in journals with an impact factor < 1 , between 1 and 3, and > 3 were 67 (13.8%), 266 (54.6%), and 154 (31.6%), respectively.

3.4 Differences in characteristics between published and non-published abstracts

Table 1 compares the demographic characteristics between published and non-published research abstracts presented at JSA annual meetings from 2015 to 2017. Research abstracts that were presented as poster discussions and excellent abstracts were more likely to be published than poster presentations. Abstracts on neuroscience and ICU and emergency medicine had higher publication rates than those on other topics. We also found that basic research had a higher possibility of publication than clinical research. Analysis of authors' characteristics showed the number of authors (four) and male gender were associated with successful publication. Similarly, in terms of affiliation characteristics, the number (two, three,

TABLE 1. Differences in characteristics between published and non-published research abstracts presented at the Japanese Society of Anesthesiologists annual meetings 2015-2017.

Research abstracts presented at JSA annual meetings 2015-2017			
	All Abstracts (N = 2,418)	Published abstracts ^a (N = 487)	Non-published abstracts (N = 1,931)
JSA annual meeting year			<i>P</i>
2015	854	173 (20.3)	681 (79.7)
2016	846	171 (20.2)	675 (79.8)
2017	718	143 (19.9)	575 (80.1)
Presentation style			< 0.001
Poster presentations	1,402	193 (13.8) *	1,209 (86.2) **
Poster discussions	759	173 (22.8) **	586 (77.2) *
Excellent abstracts	257	121 (47.1) **	136 (52.9) *
Presentation topics			< 0.001
Cardiovascular medicine	299	65 (21.7)	234 (78.3)
Respiratory medicine	183	42 (23.0)	141 (77.0)
Neuroscience	95	49 (51.6) **	46 (48.4) *
Pediatric anesthesia	91	11 (12.1) *	80 (87.9) **
Obstetric anesthesia	144	20 (13.9)	124 (86.1)
Pain medicine	431	81 (18.8)	350 (81.2)
ICU and emergency medicine	156	48 (30.8) **	108 (69.2) *
Anesthesia-related topics	766	146 (19.1)	620 (80.9)
General topics in anesthesia	253	25 (9.9) *	228 (90.1) **
Research type			< 0.001
Clinical research	2,089	301 (14.4) *	1,788 (85.6) **
Basic research	329	186 (56.5) **	143 (43.5) *
Number of the author(s)			< 0.001
One	70	7 (10.0) *	63 (90.0) **
Two	134	20 (14.9)	114 (85.1)
Three	259	51 (19.7)	208 (80.3)
Four	305	87 (28.5) **	218 (71.5) *
Five	383	91 (23.8)	292 (76.2)
Six	1,267	231 (18.2) *	1,036 (81.8) **
Gender of the first author			0.006
Male	1,545	337 (21.8) **	1,208 (78.2) *
Female	873	150 (17.2) *	723 (82.8) **
Number of the author affiliation(s)			< 0.001
One	1,519	234 (15.4) *	1,285 (84.6) **
Two	614	164 (26.7) **	450 (73.3) *
Three	208	62 (29.8) **	146 (70.2) *
Four	58	20 (34.5) **	38 (65.5) *
Five or more	19	7 (36.8)	12 (63.2)
First author's affiliation type			< 0.001
Private community hospital	548	38 (6.9) *	510 (93.1) **
Public community hospital	499	42 (8.4) *	457 (91.6) **
Private university	590	162 (27.5) **	428 (72.5) *
Public university	768	235 (30.6) **	533 (69.4) *
Medical company	13	10 (76.9) **	3 (23.1) *
First author's affiliation region			< 0.001
Kanto and Koshinetsu	884	164 (18.6)	720 (81.4)
Hokkaido and Tohoku	181	35 (19.3)	146 (80.7)
Tokai and Hokuriku	283	45 (15.9)	238 (84.1)
Kansai	484	120 (24.8) **	364 (75.2) *
Chugoku and Shikoku	245	50 (20.4)	195 (79.6)
Kyushu and Okinawa	264	30 (11.4) *	234 (88.6) **
Abroad	77	43 (55.8) **	34 (44.2) *

Data expressed as n (%). ^aDefined as JSA meeting abstracts that were successfully published in the international journals included in the PubMed® database within 36 months after presentation. **Adjusted standardized residual > 1.96, *adjusted standardized residual < -1.96. JSA, Japanese Society of Anesthesiologists.

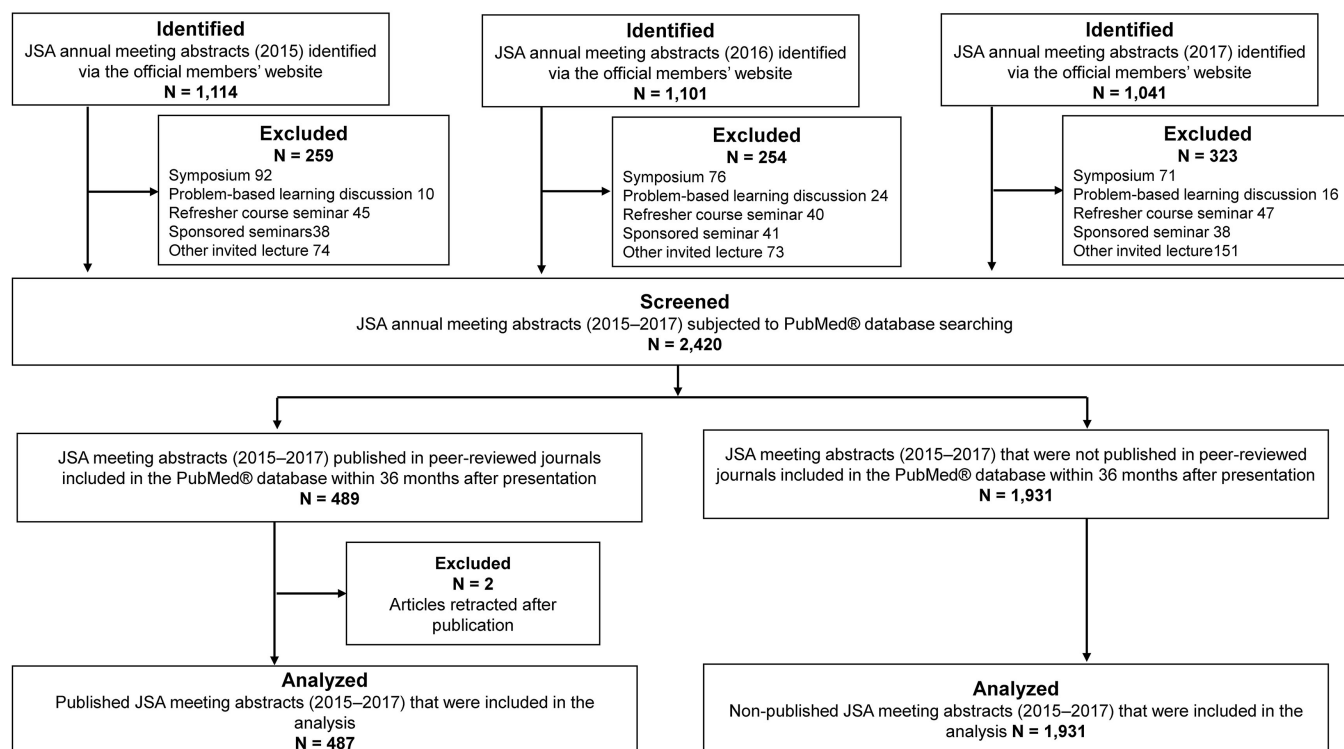


FIGURE 1. Study flow diagram. JSA, Japanese Society of Anesthesiologists.

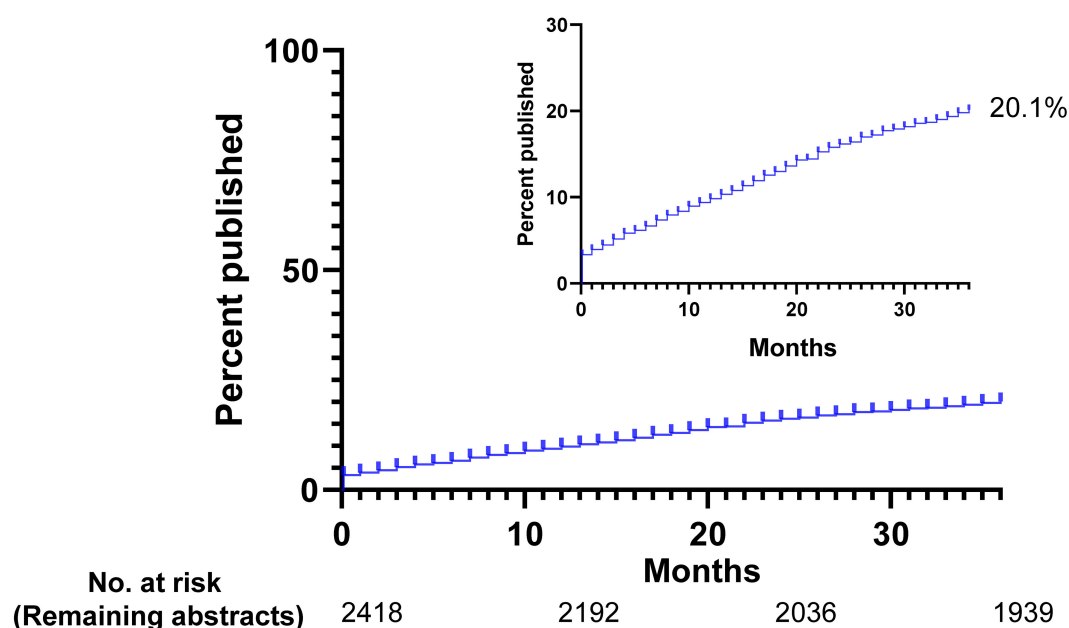


FIGURE 2. Cumulative full publication of research abstracts initially presented at the Japanese Society of Anesthesiologists annual meetings 2015-2017. Event rates shown are Kaplan-Meier estimates. The inset shows the same data on enlarged y axes. Among 2,418 research abstracts initially presented at JSA annual meetings 2015-2017, 487 (20.1%) abstracts resulted in full publication within 36 months. Median time to full publication after JSA meeting presentation was 13 months (interquartile range, 3-22 months), and 3.3% (81 of 2,418) abstracts were published before the relevant JSA annual meeting. JSA, Japanese Society of Anesthesiologists.

and four), type (private university, public university, and medical company), and region (Kansai and abroad) of facilities were positively associated with publication.

3.5 Factors associated with publication

The results of the univariable and multivariable analyses for subsequent publication of JSA meeting abstracts are shown in Table 2. After adjustment in the multivariable logistic

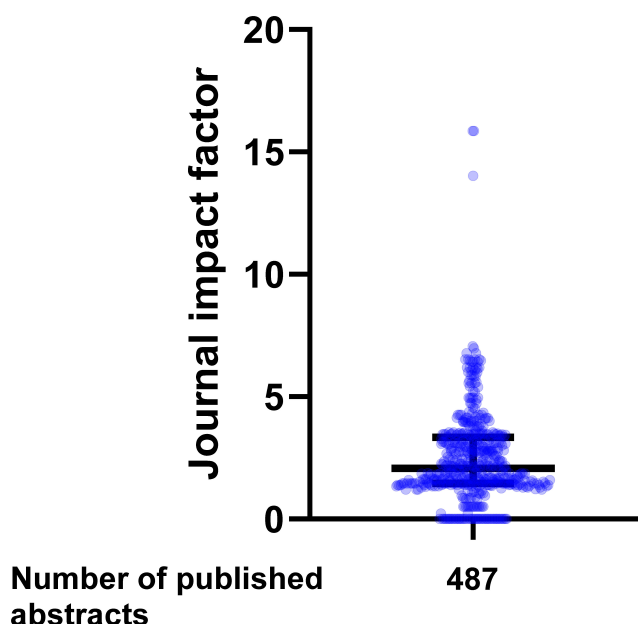


FIGURE 3. Journal impact factor of published research abstracts presented at the Japanese Society of Anesthesiologists annual meetings 2015-2017. Column scatter plots represent the data distribution (circles), median (horizontal bar), and interquartile range (vertical bar). The median journal impact factor was 2.07 (inter quartile range 1.45-3.34) and ranged from 0 to 15.9. The number of papers published in journals with an impact factor < 1, between 1 and 3, and > 3, were 67 (13.8%), 266 (54.6%), and 154 (31.6%), respectively.

regression model, factors independently associated with publication were: presentation style (poster discussions: AOR 1.70, 95% confidence interval [CI] 1.31-2.20; excellent abstracts: AOR 2.82, 95% CI 1.98-4.01), basic research (AOR 4.39, 95% CI 3.23-5.96), male gender (AOR 1.41, 95% CI 1.09-1.81), specific region (Kansai: AOR 2.16, 95% CI 1.57-2.99; abroad: AOR 4.57, 95% CI 2.58-8.09), affiliation characteristics (private university: AOR 3.97, 95% CI 2.60-6.08, public university: AOR 3.53, 95% CI 2.35-5.30; medical company: AOR 16.70, 95% CI 3.75-74.46), and number of collaborating facilities (two: AOR 1.50, 95% CI 1.15-1.97; three: AOR 1.83, 95% CI 1.23-2.73; four: AOR 2.40, 95% CI 1.27-4.54). Multicollinearity was not detected (variance inflation factor of < 10.0 for each explanatory variable). The Hosmer-Lemeshow test verified the good fit of this model ($P = 0.254$), and the c-statistic for this model was 0.826 (95% CI 0.806-0.846), suggesting acceptable discrimination.

3.6 Subgroup analysis

As shown in Fig. 4, the cumulative publication rate significantly differed by presentation style (poster presentation, 13.8%; poster discussions, 22.8%; excellent abstracts, 47.1%; $P < 0.001$). Similarly, the journal impact factor for final publication was significantly higher for excellent abstracts than other two presentation styles (vs. poster presentation, $P < 0.001$; and vs. poster discussions, P

< 0.01, Fig. 5).

4. Discussion

Our analysis of more than 2,000 abstracts presented at JSA meetings (2015-2017) showed that approximately one-fifth of these abstracts were ultimately published in peer-reviewed journals within 3 years after presentation. The publication rate differed significantly according to presentation style, research type, authors' gender, affiliation characteristics, and number of collaborating facilities.

In this study, the subsequent publication rate of JSA meeting abstracts was 20.1%. This abstract-publication rate was lower than that reported in other anesthesiology studies [5-13]. The reasons for those discrepancies may be multifactorial. Japan has fewer physicians per capita than most other OECD countries (<https://www.oecd-ilibrary.org/sites/b33ab4c1-en/index.html?itemId=/content/component/b33ab4c1-en>, accessed August 8, 2020). This means that many healthcare professionals (including anesthesiologists) in Japan are chronically exposed to a heavy workload. Most Japanese anesthesiologists also expected hold multifaceted roles encompassing clinical services, teaching residents, and ICU and operating room administration. Therefore, our study population may have difficulty finding time for research activity. This assumption was supported by the results that showed first the author's origin (abroad) and affiliation type (medical company) were both strong predictors of subsequent publication. In addition, the current JSA board certification system warrants mention. Anesthesiology residents entering specialty training programs need to make at least one presentation at a JSA annual meeting to apply for the board certification examination. Delivering a presentation at JSA annual meeting is also important for JSA board certified anesthesiologists to obtain points for retaining their license. Some JSA meeting presentations included in this study therefore might have been intended to obtain/maintain board certification, rather than subsequent publication in international journals. These differences in meeting focus along with differences in abstract selection processes, research culture, available funds/resources, data measurement, or a combination of these factors might have resulted in a relatively lower rate of anesthesiology publications in our study compared with previous studies. However, the fact that nearly 80% of JSA meeting abstracts did not achieve full publication warrants improvement.

This study also found that the first author being male was independently associated with full publication of the abstract. Japan lags behind other countries in gender equality. According to Global Gender Gap Report 2020 by World Economy Forum (http://www3.weforum.org/docs/WEF_GGGR_2020.pdf, accessed August 8, 2020), Japan ranks 121st out of 153 countries in gender equality. In Japan, women physicians still spend more time than their male counterparts engaged in domestic work (e.g., child rearing and housekeeping) [25, 26]. Because the publication cycle requires a lot of time, women researchers in the field under study may have difficulty balancing research activity and family responsibilities. Our

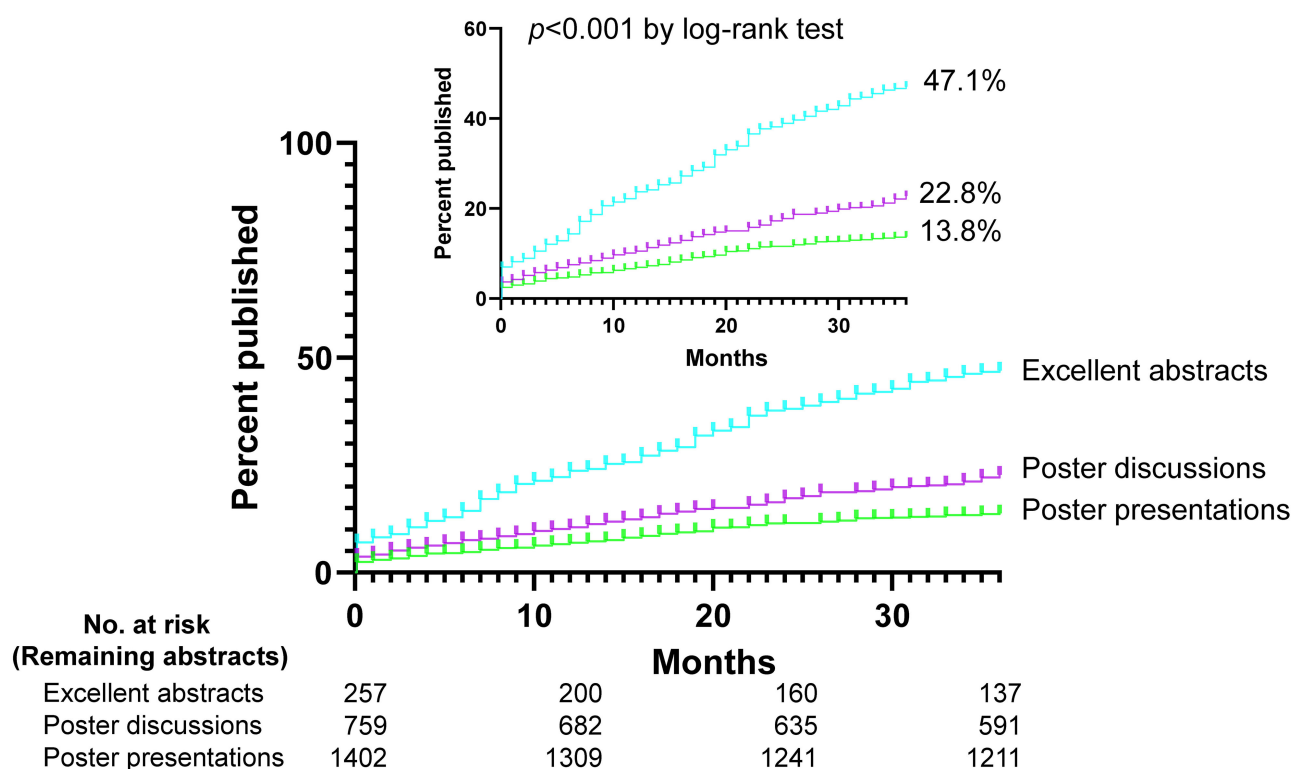


FIGURE 4. Cumulative full publication of research abstracts by presentation style. Event rates shown are Kaplan-Meier estimates. The P -value was calculated using means of the log-rank test based on all available follow-up data. The inset shows the same data on enlarged y axes. The number of research abstracts presented as poster presentations, poster discussions, and excellent abstracts at the Japanese Society of Anesthesiologists annual meetings 2015–2017 were 1402, 759, and 257, respectively. Of those abstracts, 193 (13.8%) poster presentations, 173 (22.8%) poster discussions, and 121 (47.1%) excellent abstracts resulted in full publication within 36 months.

finding was consistent with previous studies that reported a gender gap in academic achievement [27–30]. Increased institutional support and continuous, focused organizational efforts are needed to promote gender equality [27, 30].

This study also elucidated the relationship between facility characteristics and full publication. We observed that academic facilities had an improved chance of publication compared with community hospitals. In Japan, obtaining academic positions related to medicine is highly competitive [30, 31]. To obtain and remain in a tenured position in an academic facility, Japanese researchers are required to continuously publish their work in peer-reviewed journals. Our results may reflect this situation.

JSA annual meetings include three presentation styles. Usually, JSA reviewers assign the top 10% of abstracts to excellent abstracts, the following 30% of abstracts to poster discussions, and remaining abstracts to poster presentations. Our analysis also demonstrated that abstracts designated as excellent abstracts were more likely to be published than the other two presentation styles. Similarly, the journal impact factor of the final publications was significantly higher for excellent abstracts than other two presentation styles. Therefore, our results suggested that abstract reviewers discern the scientific value of abstracts well, and JSA meeting presentation designation may be used as a “test” to predict the fate of abstracts.

Consistent with prior studies [3, 6, 11], meeting abstracts

reporting on basic research were more likely to be published than clinical research. In most cases, experimental studies require careful forethought and planning, funding, a fully equipped laboratory, and protected research time. We assumed that such factors collectively lead to successful publication. Multi-institutional collaboration has increased and gained importance in the domain of scientific research over the last few decades [32, 33]. This study showed that the number of collaborating facilities was associated with an increased chance of publication. Our results were consistent with a previous report by Larivière *et al.* [34] that found an increased number of collaborating facilities led to increased research impact.

Our study had several limitations. First, the retrospective bibliometric design meant that we could not attribute causality from the associations between any exposures and publication. Second, as with any observational study, detected associations among publication and presentation style, research type, and first author and affiliation characteristics may be confounded by other factors. Although adjustments were made using a logistic regression model, there might have been other unmeasured confounders. For example, author’s age, clinical experience, workload, job title, academic degree, marital status, and number and age of children might have affected the publication rate. Further analyses including such in-depth personal information are required to further clarify factors

TABLE 2. Factors associated with subsequent full publication^a of research abstracts initially presented at the Japanese Society of Anesthesiologists annual meetings 2015-2017.

	Univariable analysis		Multivariable analysis ^b	
	OR (95% CI)	P	AOR (95% CI)	P
Presentation style				
Poster presentations	1 (Reference)		1 (Reference)	
Poster discussions	1.85 (1.47-2.32)	< 0.001	1.70 (1.31-2.20)	< 0.001
Excellent abstracts	5.57 (4.18-7.44)	< 0.001	2.82 (1.98-4.01)	< 0.001
Presentation topics				
Cardiovascular medicine	1 (Reference)		1 (Reference)	
Respiratory medicine	1.07 (0.69-1.67)	0.756	0.90 (0.54-1.51)	0.687
Neuroscience	3.83 (2.36-6.24)	< 0.001	1.72 (0.95-3.11)	0.073
Pediatric anesthesia	0.50 (0.25-0.98)	0.045	0.56 (0.27-1.20)	0.137
Obstetric anesthesia	0.58 (0.34-1.00)	0.051	0.74 (0.40-1.35)	0.327
Pain medicine	0.83 (0.58-1.20)	0.328	0.71 (0.46-1.08)	0.110
ICU and emergency medicine	1.60 (1.03-2.48)	0.035	1.00 (0.60-1.68)	0.996
Anesthesia-related topics	0.85 (0.61-1.18)	0.325	0.75 (0.51-1.10)	0.139
General topics in anesthesia	0.39 (0.24-0.65)	< 0.001	0.47 (0.27-0.81)	0.007
Research type				
Clinical research	1 (Reference)		1 (Reference)	
Basic research	7.73 (6.02-9.92)	< 0.001	4.39 (3.23-5.96)	< 0.001
Number of author(s)				
One	1 (Reference)		1 (Reference)	
Two	1.58 (0.63-3.94)	0.327	1.46 (0.49-4.29)	0.496
Three	2.21 (0.95-5.11)	0.064	1.38 (0.50-3.78)	0.536
Four	3.59 (1.58-8.15)	0.002	2.57 (0.99-6.67)	0.053
Five	2.80 (1.24-6.34)	0.013	2.05 (0.76-5.48)	0.155
Six	2.01 (0.91-4.44)	0.085	1.59 (0.60-4.16)	0.350
Gender of the first author				
Male	1.35 (1.09-1.66)	0.007	1.41 (1.09-1.81)	0.008
Female	1 (Reference)		1 (Reference)	
Number of author affiliation(s)				
One	1 (Reference)		1 (Reference)	
Two	2.00 (1.60-2.51)	< 0.001	1.50 (1.15-1.97)	0.003
Three	2.33 (1.68-3.24)	< 0.001	1.83 (1.23-2.73)	0.003
Four	2.89 (1.65-5.06)	< 0.001	2.40 (1.27-4.54)	0.007
Five or more	3.20 (1.25-8.22)	0.015	2.30 (0.74-7.15)	0.150
First author's affiliation type				
Private community hospital	1 (Reference)		1 (Reference)	
Public community hospital	1.23 (0.78-1.95)	0.368	1.17 (0.72-1.90)	0.520
Private university	5.08 (3.49-7.40)	< 0.001	3.97 (2.60-6.08)	< 0.001
Public university	5.92 (4.11-8.51)	< 0.001	3.53 (2.35-5.30)	< 0.001
Medical company	44.74 (11.81-169.43)	< 0.001	16.70 (3.75-74.46)	< 0.001
First author's affiliation region				
Kanto and Koshinetsu	1 (Reference)		1 (Reference)	
Hokkaido and Tohoku	1.05 (0.70-1.58)	0.805	1.12 (0.69-1.80)	0.655
Tokai and Hokuriku	0.83 (0.58-1.19)	0.312	0.71 (0.46-1.09)	0.115
Kansai	1.45 (1.11-1.89)	0.007	2.16 (1.57-2.99)	< 0.001
Chugoku and Shikoku	1.13 (0.79-1.60)	0.512	1.26 (0.81-1.97)	0.306
Kyushu and Okinawa	0.56 (0.37-0.85)	0.007	0.47 (0.29-0.76)	0.002
Abroad	5.55 (3.43-8.98)	< 0.001	4.57 (2.58-8.09)	< 0.001

^aDefinition of successful publication is the same as in Table 1. ^bAdjustment was made for all variables included in the table. Good fit was verified by the Hosmer-Lemeshow test ($P = 0.254$). The c-statistic for the model was 0.826 (95% CI, 0.806-0.846). AOR adjusted odds ratio, CI confidence interval, OR odds ratio.

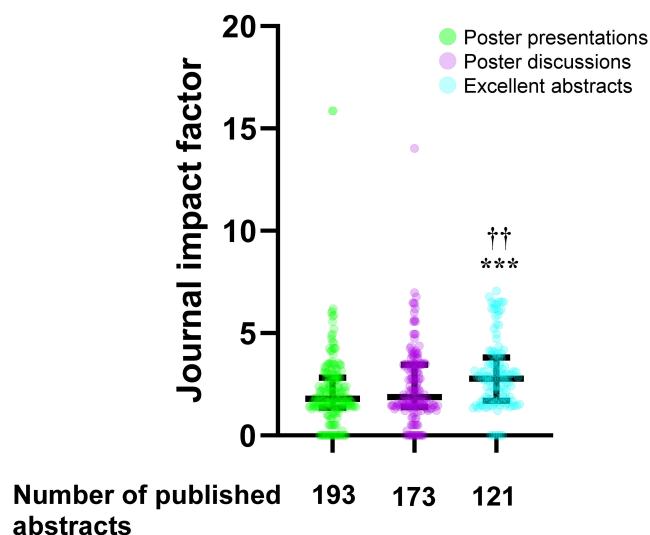


FIGURE 5. Journal impact factor for published research abstracts presented at the Japanese Society of Anesthesiologists annual meetings 2015-2017 by presentation style. Column scatter plots represent the data distribution (circles), median (horizontal bar), and interquartile range (vertical bar). *P*-values were derived from Kruskal-Wallis tests followed by Dunn's post hoc tests with Bonferroni correction. ****P* < 0.001 vs. poster presentations; ††*P* < 0.01 vs. poster discussions.

associated with successful publication. Finally, because we searched for published articles in a single database (MEDLINE) using a single search engine (PubMed®), some peer-reviewed manuscripts published after JSA annual meetings might have been overlooked. The publication rate detected by this study is therefore likely to be lower than the actual publication rate. However, we believe our search strategy was natural and clinically relevant because most researchers initially use MEDLINE as the most reliable source of medical knowledge. We also feel that it is unlikely that a significant difference would have been found even if other databases (e.g., Embase® and Google Scholar®) were included. For example, Berry *et al.* [35] found that 94% of target references were identified in their MEDLINE search for articles included in systematic review of medical imaging.

Despite these limitations, we believe our study provides an accurate depiction of the current anesthesia research activity in Japan. This study included enough abstracts to ensure model stability. Our logistic model was robust with high discrimination ability (*c*-statistic > 0.8), and successfully detected factors predictive of publication. Further research should seek to clarify barriers to the publication of findings presented at scientific meetings and identify objective ways to assist the publication process.

5. Conclusions

This bibliometric analysis found that approximately one-fifth of JSA meeting abstracts are subsequently published in MEDLINE-indexed journals within 3 years after the meeting. Factors independently associated with subsequent

full publication are presentation style, research type (basic research), male gender, specific region, affiliation characteristics (university and medical company), and increased number of collaborating facilities. We believe this study advances our understanding of current anesthesiology research output from Japan and provides important information to guide the successful publication of research abstracts. We believe that the implications of our results would be beneficial for both our study population and other settings. Our observations should stimulate further investigations that clarify objective ways to assist the full publication process of scientific meeting abstracts.

AUTHOR CONTRIBUTIONS

YO conceived the study design, collected the data, conducted the database search and the statistical analyses, drafted the initial manuscript, and takes primary responsibility for the whole paper. MS replicated the database searching after YO and checked the data validity and reproducibility. MS also participated in drafting the paper. As a professional librarian, CS provided critical advice and made substantial contributions to the construction of the database search strategy. CS also supervised the database searching and participated in drafting the paper. KS helped in conceptualizing the study design, critically reviewed the manuscript, and participated in reviewing various drafts. SI and JK supervised the study, and participated in discussing, revising, and editing the manuscript. All authors read and approved the final version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Current Japanese ethical guidelines do not mandate ethical review for studies analyzing publicly available data. This study was therefore exempt from ethical evaluation by the Institutional Review Board at the authors' facilities. Similarly, as this was a bibliometric analysis that did not involve human subjects, the need for informed consent was waived.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this article.

DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon request.

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