Original Article

Thirty-Year Pediatric Residency Research and Publication Productivity: Association with Research Funding

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Background: The Department of Pediatrics, Faculty of Medicine, Ramathibodi Hospital, Mahidol University has developed a residency research program and continuously improved the curriculum. The main source of funds for resident's research projects comes from the Faculty of Medicine. This fund was once limited, but it has been gradually increased.

Objective: To assessed publication productivity during the past 30 years and its association with research funding.

Materials and Methods: The present study was a retrospective cohort study, using the database containing detailed information on scholarly projects of the Ramathibodi's pediatric residents between 1983 and 2012. Univariate and multivariate analyses of factors that could be associated with publication productivity and types of study design were performed.

Results: Three hundred forty-nine projects were included. These projects were categorized into three groups based upon research funding, no fund (F0) (n=255), funded at 50,000 THB or less (F1) (n=67), and funded at more than 50,000 THB (F2) (n=27). The demographic data of residents and mentors among the three groups were not significantly different. A significant increase in the number of publications was positively associated with more funds. The percentage of publications rose with increasing funds (16.5%, 28.4%, and 33.3% in F0, F1, and F2, respectively) (p=0.019). The percentages of the prospective study were also increased with increasing funds (31.4% to 46.3%, and 48.1% in F0, F1, and F2, respectively) (p=0.022). Multivariate analysis demonstrated that funds was the only factor associated with percentage of publications (odds ratio [OR] 2.54, 95% confidence interval [CI] 1.07 to 6.03) and with percentage of prospective study design (OR 7.16, 95% CI 3.50 to 14.66). Funds was an independent factor associated with journal impact factor (adjusted OR 4.09, 95% CI 1.41 to 11.87).

Conclusion: An increase in pediatric residency research funding was a major factor associated with an increase in publication productivity.

Keywords: Education, Pediatrics, Medical, Resident, Grant

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The Faculty of Medicine Ramathibodi Hospital has a mission of research excellence. To fulfill this mission, the Department of Pediatrics at Ramathibodi Hospital has established a 3-year residency training program in 1969 and has continuously developed the research curriculum to enhance academic productivity, especially in the last 10 years. Now the curriculum consists of 1) providing faculty staff as mentors, 2) biostatistics and research methodology course, 3) monthly journal club, 4) mandatory annual residency research presentations, 5) residency research contest, and 6) sponsoring the selected projects for presentations in the Annual National Pediatric Academic Conference. This curriculum corresponds with the American Academy of Pediatrics (AAP) recommendation to enhance quality child health research in the Twenty-first century[1].

A recent study has shown that the factors associated with successful publication included having received funding and the nature of the research project[2]. For Ramathibodi Hospital, the main source of funds for resident's research project comes from the Faculty of Medicine. This fund was once limited but has been gradually increased from time to time. The Faculty started budgeting the grant for residency research projects from a maximum of 50,000 Thai Baht (THB) per project (approximately 33 THB=1 US$) in 1997 to 100,000 THB per project (approximately 3,000 US$ per project) in 2006 and afterwards. This grant was primarily for covering the expense of chemicals, imaging, and biochemical tests, not for stipend. To the authors' knowledge, there

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is no study in Thailand looking at the association of the amount of funds with publication productivity. Whether an increase in research funding improves the publication productivity of pediatric residency research is not clear. The authors hypothesized that an increase in residency research funding would improve publication productivity. The objective of the present study was to assess publication productivity during the past 30 years and its association with research funding.

Materials and Methods

Ethical approval

The study was approved by the Ethics Committee of the Faculty of Medicine, Ramathibodi Hospital (MURA 2013/153). Informed consent was not applicable for the present study.

Sample

After ethical approval, the scholarly projects of pediatric residents between 1983 and 2012 were collected.

Study design

A retrospective review was performed. The projects were categorized by the amount of funds into three groups, no fund (F0), 50,000 THB or less (F1), and more than 50,000 THB (F2). To compare the productivity outcomes, the authors chose the primary outcomes as the quantity and quality of publications. The quantity of publications was defined by the number of publications presenting as the percentage of the residency projects that were published in both national and international peer-reviewed journals versus the total number of residency projects in each group. The international publication was defined by which publication presented in Pubmed and/or SCOPUS databases. The national publication was defined by which journal presented in the list of approved national journals by the Office of the Higher Education Commission but did not meet the criteria of international publication. The quality was determined by journal impact factor (JIF) of the published articles, using the data from the Journal Citation Reports® (JCR®) database. In addition, the authors chose the secondary outcome as the number of prospective studies.

Data collection

The authors retrieved the data from the Department of Pediatrics' roster of the graduates to find their contact information and their residency scholarly projects. In addition, the authors also contacted both the residents themselves and their mentors. The records of funding were obtained from the Division of Research of the Faculty of Medicine. The data were collected in four categories, 1) demographics of researchers including age, gender, previous degree (MD only or Masters/PhD degree), previous research experiences, and demographics of their mentors including the number of mentors, their subspecialty, and academic position; 2) characteristics of projects including title, journals, list of authors, and study design; 3) funds including amount and sources; and 4) publication productivity including number of publications and journal impact factor. After verifying all these data with the databases stated above, each outcome was analyzed in two aspects, 1) timely basis (each five years of study) and 2) amount of funds.

Statistical analysis

Statistical comparisons were made by using chi-square and Fisher's exact tests for the differences of the frequency in categorical parameters and ANOVA for the differences of the means in continuous data. Univariate and multivariate analyses of factors that might be associated with publication productivity and types of study design were performed. Univariate analysis was done by using Pearson's chi-square and Fisher's exact test. Multivariate logistic regression analysis was used to identify independent factors associated with the above outcomes.

Results

Sample characteristics

Between 1983 and 2012, 393 pediatric residents graduated from the Department of Pediatrics, Faculty of Medicine Ramathibodi Hospital. Forty-four (11%) of them could not be contacted or retrieved the complete data, so they and their residency scholarly projects were excluded from the present study. Furthermore, the publications of these 44 residents were not found. The final residency research projects included in the present study were 349 (89%) projects.

The number of projects increased with time due to the increasing number of residents in the training program. The authors categorized these projects by each 5-year period of the study. The numbers of the projects were 35, 49, 54, 66, 70, and 75 projects in the year 1983 to 1987, 1988 to 1992, 1993 to 1997, 1998 to 2002, 2003 to 2007, and 2008 to 2012, respectively.

From the hypothesis that there would be a positive association between the amount of funds and the publication productivity, another method of

categorization was performed by using the amount of funds as stated above. There were 255, 67, and 27 projects in F0, F1, and F2, respectively. Most projects in F0 were retrospective studies from medical records.

The average age of the residents performing the projects was 29 years. The approximate male: female ratio was 3:7. Only nine (2.6%) and three (0.9%) residents had previous degree (Masters or PhD degree) and previous research experiences, respectively. Sixty three percent (n=218) of the residents collaborated with mentors in only a single pediatric subspecialty. Percentages of academic positions of the major mentors were 32.1%, 39.3%, and 21.2% in professor, associate professor, and assistant professor, respectively. The demographic data were not significantly different in the three groups of funds.

Publications

A thesis is a part of the requirements for the Diploma of Thai Board of Pediatrics. An option for a thesis is a published article in a peer-reviewed journal. However, the latter requires unpredicted time for getting published. Therefore, almost all pediatric residents submitted their thesis for the Diploma. Most of the publications were published after finishing their residency training. Within the 30-year period of the present study, there were 70 publications (20.1% of projects), which consisted of 60 international and 10 national publications (17.2% and 2.9% of projects, respectively). For the international publications, the residents were mainly the second author (resident:mentor ratio of being the first author=9:51). Due to the fact that most residents could not finish up the English manuscript for the international publication, they submitted their thesis written in Thai language for completion of the Diploma. Therefore, the publication was finally written by the major advisor. On the other hand, the residents were mainly the first author for the national publication written in Thai language (resident:mentor ratio of being the first author=7:3).

The publications increased with time, especially in the last 5-year period (2008 to 2012), in which they rose from 14.8% to 18.6% range in all the previous 5-year periods to 29.4%. The percentages of publications were increased in both international and national, which were up to 22.7% and 6.7%, respectively (Figure 1).

A significant increase in the number of publications was positively associated with more funds for both national and international publications.

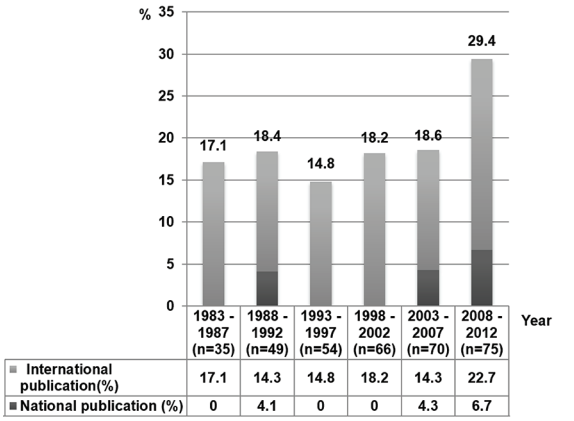

Figure 1. Percentages of publications categorized by the year of residency training period.

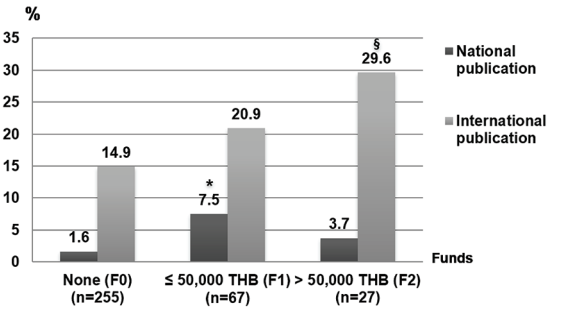

Figure 2. Percentages of publications categorized by amount of funds.

* Significant increase in number of national publications (no fund vs. fund ≤50,000 THB, p=0.006); § Significant increase in number of international publications (no fund vs. fund >50,000 THB, p=0.041)

The percentages of publications rose with increasing funds (16.5%, 28.4%, and 33.3% in F0, F1, and F2, respectively) (p=0.019). In subgroup analysis, the authors found a significant increase in percentages of national publications from F0 to F1 groups (p=0.006). In addition, the percentages of international publications were significantly increased from F0 to F2 groups (p=0.041). However, those from F1 and F2 groups were not significantly different (Figure 2).

In the present study, out of the 26 international publications found in the JCR databases, there were 17 articles published in the journals with JIF of 2 or less and the remaining nine articles published in those with JIF greater than 2. The articles with JIF of 2 or less and greater than 2 increased with time, especially during the last 5-year period. From 2008 to 2012, the publications with JIF of 2 or less and greater than 2 were 12% and 8%, respectively. This number significantly rose from the previous 5-year

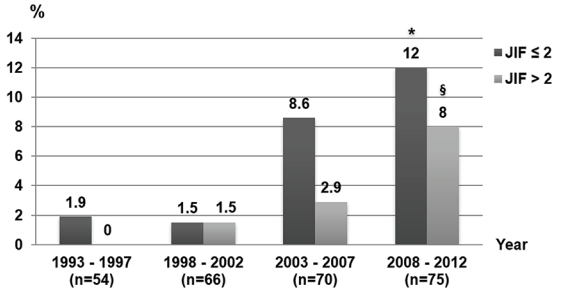

Figure 3. Percentages of publications with journal impact factor (JIF) of ≤2 and >2 categorized by the year of residency training period.

* Significant increase in number of publications in JIF ≤2 (1993 to 1997 vs. 2008 to 2012, p=0.042; 1998 to 2002 vs. 2008 to 2012, p=0.018); § Significant increase in number of publications in JIF >2 (1993 to 1997 vs. 2008 to 2012, p=0.033)

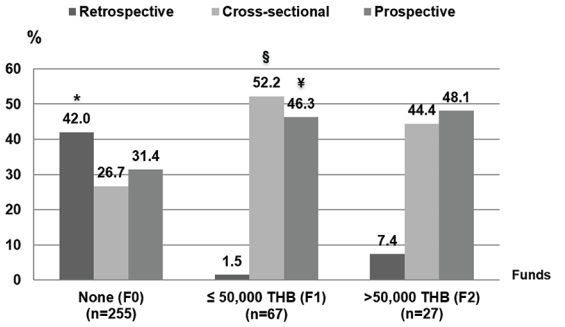

Figure 4. Percentages of type of study design categorized by amount of funds.

* With more funds there were significant decrease in number of retrospective studies (no fund vs. fund ≤50,000 THB, p<0.001; no fund vs. fund >50,000 THB, p<0.001); § Significant increase in number of cross-sectional studies (no fund vs. fund ≤50,000 THB, p<0.001); ¥ significant increase in number of prospective studies (no fund vs. fund ≤50,000 THB, p=0.022)

periods, both in JIF of 2 or less (1993 to 1997 versus 2008 to 2012, p=0.042; 1998 to 2002 versus 2008 to 2012, p=0.018) and in JIF greater than 2 (1993 to 1997 versus 2008 to 2012, p=0.033) as shown in Figure 3.

Regarding the types of study design of the scholarly projects, there were 110 retrospective studies (31.5%), 115 cross-sectional studies (33%), and 124 prospective studies (35.5%). Concerning the relationship among amount of funds and types of study design, the prospective studies in F0, F1, and F2 were 31.4%, 46.3%, and 48.1% of projects, respectively. When the funds were increased, the authors found an increase of prospective study, but a decrease of retrospective study (Figure 4).

Multivariate analysis was performed for all interesting outcome parameters. For timely basis aspect, the authors re-categorized years of residency training periods as Y0 (reference period or before developing the research curriculum): 1983 to 2002, Y1 (period of developing the curriculum): 2003 to 2007, and Y2 (period of using the developed curriculum): 2008 to 2012. While continue to use F0, F1, and F2 in the amount of funds aspect, the authors found that funds was the only factor associated with 1) number (percentage) of publications (odds ratio [OR] 2.01, 95% confidence interval [CI] 1.07 to 3.75 in F1 and OR 2.54, 95% CI 1.07 to 6.03 in F2), and with 2) number (percentage) of prospective study design (OR 7.16, 95% CI 3.50 to 14.66 in F1; OR 5.53, 95% CI 2.03 to 15.06 in F2). Whereas, both time periods and funds were independent factors associated with journal impact factor (adjusted OR 3.94, 95% CI 0.89 to 17.49 in Y1, and adjusted OR 8.32, 95% CI 2.72 to 33.40 in Y2; adjusted OR 3.90, 95% CI 1.09 to 14.00 in F1, and adjusted OR 4.09, 95% CI 1.41 to 11.87 in F2) (Table 1).

Discussion

Publication productivity of pediatric residency research in Ramathibodi Hospital has increased with time, especially in the last 5-year period (2008 to 2012). In addition, the publication in relatively higher-impact journals tended to be increased. This improvement coincided with many strategies developed to enhance the publication productivity of resident's projects initialized at that time. This improvement occurred after the implementation of many strategies initialized around 15 years ago (2003) to enhance the publication productivity of resident's projects.

The Ramathibodi's pediatric research training program comprised of various evidence-based medical education strategies. First, the department has provided faculty staff to be mentors of resident's projects. This is a priori key factor for resident's research productivity. As demonstrated in previous studies, medical students, residents, and fellows to junior faculty who had mentors were more productive in research in terms of number of publications and grants[3-8]. A systematic review in 2006 about mentoring in academic medicine disclosed the impact of mentorship on research development and productivity[9].

Secondly, the curriculum provided a course of biostatistics and research methodology at the beginning of each academic year as the requirement for the first-year residents and the refresher course for the second- and third-year residents as well as young faculty staffs. Recently, Farrokhyar et al

Table 1. Multivariate analysis for factors affecting number of publications, journal impact factor of publications, and type of study designs

Factors[a]	Outcomes; n (%)		OR_{crude} (95% CI)	OR_{adj} (95% CI)
	No	Yes		
Number of publications[b]				
Funds[c]				
• F0*	213 (76.3)	42 (60.0)		
• F1	48 (17.2)	19 (27.1)	2.01 (1.07 to 3.75)	
• F2	18 (6.5)	9 (12.9)	2.54 (1.07 to 6.03)	
Journal impact factor[d]				
Funds[c]				
• F0*	248 (76.8)	7 (26.9)		
• F1	54 (16.7)	13 (50.0)	8.53 (3.25 to 22.38)	4.09 (1.41 to 11.87)
• F2	21 (6.5)	6 (23.1)	10.12 (3.12 to 32.87)	3.90 (1.09 to 14.00)
Year[e]				
• Y0*	201 (62.2)	3 (11.5)		
• Y1	62 (19.2)	8 (30.8)	8.65 (2.23 to 33.59)	3.94 (0.89 to 17.49)
• Y2	60 (18.6)	15 (57.7)	16.75 (4.69 to 59.80)	8.32 (2.07 to 33.40)
Types of study design	Retrospective	Prospective		
Funds[c]				
• F0*	142 (90.4)	113 (58.9)		
• F1	10 (6.4)	17 (29.7)	7.16 (3.50 to 14.66)	
• F2	5 (3.2)	22 (11.5)	5.53 (2.03 to 15.06)	

OR_{crude}=crude odds ratio; OR_{adj}=adjusted odds ratio; CI=confidence interval

[a] Shows only factors significantly associated with each outcome; [b] Number of publications, no: not published, yes: published in Thai or international journal; [c] Funds, F0: no fund, F1: ≤50,000 Thai baht (THB), F2: >50,000 THB, 33 THB≈1 US$); [d] Journal impact factor (JIF), No: published in journal without IF, yes: published in journal with IF; [e] Years of residency training period, Y0: 1983 to 2002, Y1: 2003 to 2007, Y2: 2008 to 2012; * Reference value

found an association between the formal teaching sessions on the principles of clinical epidemiology and biostatistics and the publication productivity[10]. In addition, the residents who completed the formal methodology sessions before conduction of the research also produced significantly more projects of higher levels of evidence, with systematic reviews or meta-analyses, randomized controlled trials, and prospective cohorts[10].

The next strategy was the mandatory residency research presentation in the departmental research meeting, including proposal presentation in the first year, project progression in the second year, and completion of project presentation in the third year of training. This strategy was effective for improving research proposal, monitoring project progression, and improving research result expression as well as presentation skill. A previous study demonstrated that participation in an annual research day was significantly and strongly associated with future publications among resident trainees[11].

The increase in amount of funds was the other factor newly introduced in the authors' faculty to the residency research curriculum around the year 2006. The present study noted that the significant increases in percentage of publications as well as percentage of prospective studies were positively associated only with the increase of research funds. The present study findings were in agreement with the recent studies that demonstrated the association between amount of funds and publication productivity from various departments including neurosurgery, ophthalmology, and otolaryngology[12-14]. However, the amount of fund in the authors' pediatric residency projects was relatively small with a maximum of up to 3,000 US$ per project. Therefore, large projects with high expense for the resident trainees are less likely and consequently may compromise publication quality and productivity.

In the present study, the primary investigators were the pediatric residents. Nearly all of them did not have previous research experience. The fact that

research publication is not compulsory for pediatric board certification and their overwhelmed clinical workloads, most of them could not publish their work, especially in an international journal. Therefore, the percentage of publications was relatively low and most published articles were written and completed by their major advisors as the first author. Nevertheless, the authors found that both the amount of funds and period of training before, during, or after development of the research curriculum, were independently associated with journal impact factor.

For the aspect of financial resource, the present study funds came mainly from the Faculty of Medicine, which was relatively limited. This situation is inevitable in Thailand, a limited-resource country. Despite limited funding, an association of funding with publication productivity was found.

There are several limitations in the present study including the variable time periods and the change to the curriculum over the 30 years of the study. Due to the retrospective nature of the long-term study and small number of publications, improvement of publication productivity could not be explained by increasing research funds only. As the research curriculum was strengthened and had evolved over time, it may have had some impacts on publication productivity. In fact, most large and high-quality projects require high expense and usually resulting in publication in high impact factor journals. This might explain the relatively low impact factor publication in the present study.

Because of the characteristics of the present study residency research program and the limited funding policy, the result from the study might be applicable to other residency research programs in limited-resource countries. Further studies in other residency research training programs should be encouraged. The findings might lead to improve their strategic plan for increasing residency research publication productivity.

Conclusion

An increase in residency research funding was a major factor significantly associated with an increase in publication productivity. The development of the research curriculum might also contribute to the improvement of publication productivity.

What is already known on this topic?

Factors associated with successful publication included having received funding and the nature of the research project. To the authors knowledge, there is no study in pediatric residency in Thailand about the factors associated with publication productivity.

What this study adds?

An increase in residency research funding was a major factor significantly associated with an increase in publication productivity. The development of the research curriculum might also contribute to the improvement of publication productivity.

Acknowledgement

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Potential conflicts of interest

None of the authors has any conflict of interests.

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