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4 1 Title:
5 2 **Research in Pediatric Residency: The Experience of Pediatric Chief Residents Nationally**

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1 **Objective:** To determine factors associated with increased research productivity, satisfaction,
2 and perceived barriers to research within residency from the experience of pediatric chief
3 residents.

4 **Methods:** An online cross-sectional survey was administered to 2014-2015 chief residents.
5 Topics assessed included program demographics, career intentions, research productivity,
6 satisfaction with research training and opportunities, and research barriers. Chi-square and
7 Fisher’s Exact Tests were used for descriptive statistics. Multivariable logistic regression
8 analysis determined factors associated with productivity and research satisfaction.

9 **Results:** The response rate was 63% (165/261). Half (82/165) were productive in research. Most
10 were satisfied with their quality of research training (55%; 90/165) and research opportunities
11 (69%; 114/165). Chiefs reporting interest in research were five times more likely to be
12 productive than those who did not (OR 5.2; 95% CI:2.3-11.8). Productive chiefs were more
13 likely to report including research time in future careers (p=0.003). Most (83%; 137/165) thought
14 their programs were supportive of resident research, but lack of time was frequently cited as a
15 major barrier. Those satisfied with research opportunities were less likely to find lack of training
16 (OR 0.3; 95% CI:0.1-0.7) or faculty mentorship (OR 0.2; 95% CI:0.0-0.9) as a major barrier.

17 **Conclusions:** Pediatric chief resident interest in research is strongly associated with research
18 productivity during residency, and research productivity is strongly associated with career plans
19 including research time. By cultivating research interest through faculty mentorship, research
20 training, and dedicated time, pediatric residency programs may help foster early research success
21 and, potentially lead to continued engagement with research in trainees’ future careers.

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1 **What's New:** Pediatric chief residents who were interested in research were five times more
2 likely to be productive. Productivity was associated with incorporating research into career plans.
3 Research training, faculty mentorship, and scholarly activity requirements were associated with
4 satisfaction with research opportunities.

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1 Child health research is critical for the advancement of pediatric medicine.^{1,2} We are facing a
2 shortage of clinician-researchers.³ To bridge this gap, we need to find ways to encourage early
3 physicians to incorporate research in their future careers. Prior studies have shown that research
4 experiences not only improve the ability to do research, but also positively influence decisions to
5 be involved in research careers.⁴⁻⁶ Pediatric residency is an ideal setting for exposure to
6 research experiences. Scholarly activity during residency is an Accreditation Council for
7 Graduate Medical Education (ACGME) requirement for all residents and residency programs are
8 required to allocate adequate resources to facilitate resident involvement in scholarly activity.⁷
9 There is limited literature looking at the implementation of research curriculums, tracks, and
10 rotations to help support trainees with research. However, few data exist exploring the resident
11 experience of research nationally.⁸⁻¹¹

12 We performed a national survey of pediatric chief residents (CR) to understand their experiences
13 with research during their residencies. Our specific aims were (1) to determine factors associated
14 with increased research productivity (2) to determine factors associated with increased
15 satisfaction with the quality of research training and research opportunities, and (3) to determine
16 barriers to research faced during residency.

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18 Methods:

19 **Survey Administration**

20 We performed a national cross-sectional web-based survey of pediatric CR. CR in ACGME-
21 accredited pediatric residency programs were emailed an online survey link and recruitment

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1 letter in February 2015, followed by two reminders. Three gift cards were randomly raffled off
2 as incentives. The institutional review board at Indiana University approved this study.

3 **Survey Content**

4 The survey was adapted from a national assessment of pediatric residency program directors.¹²
5 Both terms, “scholarly activity” and “research” were used in this survey. When asked if there
6 was a scholarly activity requirement in their programs, respondents were asked to define what
7 qualified as scholarly activity. In all other instances, the words were interchangeable, and thus
8 we only use the term “research” throughout the remainder of the manuscript. Topics assessed
9 included program size (small (≤ 30), medium (31-60), large (>60)), program location (Northeast,
10 Midwest, South, West), career intentions, research participation, productivity (publication or
11 presentation at national meeting), satisfaction with research training and opportunities, and
12 barriers to research. We confirmed program-related characteristics, such as size and location,
13 using FREIDA (the American Medical Association’s online residency and fellowship database).

14 **Measures**

15 Research productivity was defined as manuscript publication or abstract presentation at a
16 national conference, including those accepted but not yet published or presented. We used a 7-
17 point Likert scale to evaluate satisfaction and interest, with “1” indicating not at all
18 satisfied/interested, “4” indicating somewhat satisfied/interested, and “7” indicating completely
19 satisfied/interested. We defined “satisfied” and “interested” as a 5, 6, or 7 on the scale.

20 **Analysis**

21 We analyzed program demographics using standard summary statistics. Only one respondent per
22 program was included in the program demographics analysis. We used chi-square testing and

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1 Fisher’s Exact Test to evaluate association between categorical variables. We used multivariable
2 logistic regression adjusting for program size and region to determine factors associated with
3 productivity and satisfaction with research opportunities and training. Factors that were
4 evaluated and controlled for in the model included research time in residency (<8 weeks and ≥8
5 weeks), research interest, scholarly activities requirement, perceived barriers related to lack of
6 research training, mentorship, and funding to conduct research. We summarized results using
7 odds ratios (OR) and 95% confidence intervals (CI). Analyses were performed using IBM SPSS
8 Version 23.0.

9
10 **Results:**

11 ***Response Rate:***

12 A total of 165 CR completed the survey, representing 70% (139/199) of all ACGME-accredited
13 pediatric programs. Three programs did not have CR and eight did not have accurate contact
14 information publically available. Twenty-two programs had two CR complete the survey and
15 two had three CR complete the survey. Some CR had a group email. The response rate per
16 email address contacted was 63% (165/261).

17
18 **Participant and Program Demographics**

19 Respondents were representative of all CR in terms of program size and location (Table 1). The
20 vast majority (98%, n=162) completed their residency training at the same program where they
21 were currently CR. Nearly a third (31%, n=51) believed they were equally interested in research

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1 compared to their co-residents, while just over a third (39%, n=65) felt they were more
2 interested. Eight percent (n=13) were part of a special research track during residency. Most
3 (84%, n=140) reported that scholarly activity was a program requirement.

4 Half (51%, n=84) intended on pursuing a fellowship, and 61% (n=101) intended on pursuing an
5 academic medicine career. Eighty-five percent (n=140) expected to devote some time to
6 research, and nearly a third (32.9%, n=54) expected to devote 25% or more time to research.

7
8 ***Research Productivity***

9 Half (50%, n=82) of CR reported productivity in research activities. Table 2 shows that
10 productive CR were more likely to be interested in research (OR 5.19 (95% CI: 2.29-11.75)).
11 Multivariate logistic regression found no other significant differences between productive and
12 non-productive CR. Productive CR were significantly more likely to report career plans to
13 commit 25% or more time towards research (p=0.003)

14
15 ***Satisfaction with Research Opportunities and Training***

16 Over half (55%, n=90) of CR were satisfied with the quality of research training in their
17 residency. Our multivariable logistic regression found no significant differences between those
18 who were satisfied compared to those who were not (data not shown).

19 Two-thirds (69%, n=113) of CR were satisfied with the research opportunities provided by their
20 programs. Table 3 shows that CR who were satisfied with their research opportunities were
21 more likely to have a scholarly activity requirement (OR 3.71 (95% CI:1.32-10.42)) and less

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1 likely to identify lack of research training (OR 0.28 (95% CI: 0.11-0.70) and lack of faculty
2 mentorship (OR 0.17 (95% CI:0.03-0.98) as major barriers.

3 The majority (83%, n=137) of CR thought their programs were more than somewhat supportive
4 of resident research, with 38% (n=63) saying their programs were extremely supportive.

6 ***Barriers***

7 Approximately half (47%, n=77) of all CR reported that lack of time was a major barrier to
8 research. Of those who reported time as a major barrier, there was no difference between those
9 who spent more or less than 8 weeks doing research during residency (p=0.085). A quarter
10 (27%, n=44) stated that lack of research training was a major barrier. Table 4 shows that
11 regardless of program size, lack of time and lack of training to conduct research were identified
12 as the top two major barriers. Additionally, lack of funding to conduct research was more likely
13 to be seen as a major barrier in medium-sized programs.

15 Discussion

16 We found half of pediatric CR published or presented their research nationally. CR productivity
17 was strongly associated with CR interest in research. CR interest in devoting $\geq 25\%$ of their
18 future academic career in research was strongly associated with research productivity during
19 residency. In addition, CR satisfaction with research opportunities was associated with faculty
20 research mentorship and research training during residency, as well as having a scholarly activity

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1 requirement. CR felt that the largest barrier to research was lack of time, even in those with >8
2 weeks protected time.

3 We found that CR research productivity was strongly associated with CR interest in research and
4 interest in devoting $\geq 25\%$ of future career in research. These findings are consistent with prior
5 literature that found medical students who were strongly interested in research at the time of their
6 graduation were more likely to pursue a career as clinician-scientists.¹³ These findings suggest
7 that supporting resident research interests such that they are more likely to be productive in
8 research may improve the chances that they would incorporate research into their future careers.

9 Our findings that CR satisfaction with research opportunities was associated with faculty
10 research mentorship and research training during residency suggest that pediatric programs that
11 are able to provide research mentorship and training experiences will better support residents
12 interested in research. These findings are supported by a recent study which found that residents
13 who completed a clinical outcomes research pathway were more productive in their scholarly
14 activity than non-participants.⁶ With the advent of individualized curricula in pediatric residency,
15 programs have the opportunity to help residents tailor their experiences to their individual
16 interests. We strongly recommend this should include providing faculty mentorship and research
17 training for those residents interested in research, which allows these trainees opportunities and
18 support to develop careers as clinician-scientists.

19 Our finding that 69% of CR were satisfied with research opportunities in their program is similar
20 to that reported in the 2015 ACGME Resident Survey.¹⁴ While this is an overall positive
21 finding, it is clear that barriers to research impact satisfaction with research opportunities. In our
22 study, lack of time and research training were consistently cited as major barriers, and lack of
23 faculty mentorship and research training were the only barriers associated with satisfaction. This

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1 is consistent with findings from other studies.^{12, 15, 16} As pediatric departments consider ways to
2 increase research productivity within their residency programs, attention should be given to
3 cultivating and recruiting faculty that can mentor and educate residents in various aspects of
4 research. Having a core curriculum and carving out protected time, such as through use of
5 individualized curriculum, are also likely to foster interest in and satisfaction with the research
6 experience during residency. This may, in turn, lead to productivity and set the stage for greater
7 interest in pursuing research in the future, as productive CRs in our study were more likely to
8 report wanting $\geq 25\%$ research time in their career plans.

9 While lack of funding was another identified barrier, it did not impact productivity or
10 satisfaction. However, we were surprised to find that it was identified as a major barrier
11 significantly more in medium-sized programs (31-60 residents) than small or large programs.
12 Differences between pediatric program sizes have been seen with research training and career
13 intentions, but little is known about how funding may differ between programs.¹⁷ However, it
14 could be postulated that small programs have fewer residents, thus they may more easily support
15 those interested in research. Alternatively, large programs may have access to more resources
16 and funding due to the institutional size, which helps to support their programs. Further
17 evaluation of this finding should be considered.

18 Our study has several limitations. Despite our high response rate and program representation, we
19 did not have a complete and accurate resource to determine the total number of pediatric CR
20 across accredited program. We also did not collect more in-depth information regarding
21 programs, such as the number of faculty and external grant funding that may have influenced
22 research quality or productivity. Ten of the 11 programs for which we were unable to get CR
23 contact information were small in size and may have reported different barriers and facilitators of

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1 research productivity. However, regardless of program size, CR identified similar barriers to
2 research. Because this is a research-focused survey, it is possible that the estimates of research
3 interest and productivity may be overestimated as a result of response bias. Additionally, we
4 may not have had sufficient power to delineate differences among the CR, as suggested by our
5 large confidence intervals. With our focus on pediatric CR, our findings may not be
6 generalizable to all pediatric residents or residents from other specialty programs. In general, CR
7 may be more motivated to publish and participate in research than their peers. However, our
8 study had similar proportions of CR interested in fellowships and academic medicine as other
9 pediatric residents in the recent literature.¹⁷ As this was a survey study, we cannot infer
10 causation, merely associations.

11

12

13 **Conclusions:**

14 Interest in research was the only variable found to be associated with productivity, and having
15 adequate faculty mentorship, research training, and a scholarly activity requirement were the
16 variables associated with satisfaction with research opportunities. In addition, productive CR
17 were more likely to want to include research in >25% of their future career plans. In light of
18 these findings, when considering ways of increasing resident research productivity, pediatric
19 departments should consider supporting their faculty in research and research education of
20 residents, to create curriculum and environments that enable interested residents to have
21 increased chance of being productive in their research pursuits and encourage their development
22 as clinician-scientists.

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Table 1: Program demographics of respondents

Variable	Total Respondents*	All ACGME-accredited pediatric residency programs	P value
	N (%)	N (%)	
	N = 137	N = 199	
Program Size			0.49
Small (≤ 30 residents)	41 (29.9)	72 (36.2)	
Medium (31-60 residents)	60 (43.7)	80 (40.2)	
Large (>60 residents)	36 (26.3)	47 (23.6)	
Program Location			0.89
Northeast (ME, NH, MA, CT, VT, RI, PA, NY, NJ)	38 (27.7)	58 (29.1)	
Midwest (WI, MI, IL, IN, OH, MO, ND, SD, NE, MN, IA)	36 (26.3)	45 (22.6)	
South (TX, OK, LA, AR, MS, AL, TN, KY, WV, VA, NC, SC, GA, FL MD, DE, DC, PR)	46 (33.6)	69 (34.7)	
West (ID, MT, UT, AZ, WY, CO, NM, CA, NV, OR, WA, HI, AK)	17 (12.4)	27 (13.6)	

*- Only one respondent per program was included in program demographics analysis.

Table 2: Factors Associated with Chief Resident Research Productivity

Variable	Odds Ratio (95% Confidence Interval)
PROGRAM SIZE	
Small (≤ 30 residents)	Referent
Medium (31-60 residents)	1.12 (0.45-2.80)
Large (>60 residents)	0.73 (0.27-2.03)
PROGRAM REGION	
Northeast	Referent
South	0.72 (0.28-1.87)
West	0.75 (0.21-2.65)
Midwest	0.52 (0.19-1.43)
VARIABLES	
Requirement to do scholarly activity	1.26 (0.47-3.38)
Identifies as being interested in research	5.19 (2.29-11.75)
Identifies lack of training as a major barrier	1.31 (0.55-3.13)
Identifies lack of faculty mentorship as a major barrier	0.57 (0.11-2.94)
Identifies lack of funding to conduct research as a major barrier	0.88 (0.25-3.15)
Spent 8 weeks or more doing research in residency	1.69 (0.78-3.62)

Table 3: Factors Associated with Chief Resident Satisfaction with Research Opportunities

Variable	Odds Ratio (95% CI)
PROGRAM SIZE	
Small (≤ 30 residents)	Referent
Medium (31-60 residents)	2.23 (0.79-6.26)
Large (>60 residents)	1.78 (0.59-5.43)
PROGRAM REGION	
Northeast	Referent
South	1.70 (0.60-4.86)
West	0.65 (0.17-2.40)
Midwest	3.15 (0.96-10.32)
VARIABLES	
Requirement to do scholarly activity	3.71 (1.32-10.42)
Identifies as being interested in research	0.97 (0.40-2.35)
Identifies lack of training as a major barrier	0.28 (0.11-0.70)
Identifies lack of faculty mentorship as a major barrier	0.17 (0.03-0.98)
Identifies lack of funding to conduct research as a major barrier	1.97 (0.49-7.94)
Spent 8 weeks or more doing research in residency	0.45 (0.19-1.03)

Table 4: Major Barriers to Research for Chief Residents by Program Size

Areas Identified as Major Barriers	Small N (%) N =49	Medium N (%) N =69	Large N (%) N =47	P value
Time to participate in research	24 (49.0)	32 (46.4)	21 (44.7)	0.28
Training to conduct a research	15 (30.6)	19 (27.5)	10 (21.3)	0.25
Research curriculum	12(24.5)	14 (20.3)	7 (14.9)	0.31
Statistical support	5 (10.2)	10 (14.5)	5 (10.6)	0.29
Funding to conduct research	4 (8.2)	15 (21.7)	4 (8.5)	0.005
Faculty mentorship to conduct research	4 (8.2)	6 (8.7)	1 (2.1)	0.18
Funding to present research	1 (2.0)	5 (7.3)	3 (6.4)	0.26
Program director/chair support	4 (8.2)	3 (4.4)	0 (0)	0.71