

Article

Impact of Program Region and Prestige on Industry Supplemental Earnings for Pediatric Orthopedic Surgery Fellowships in the United States: A Retrospective Analysis

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Abstract: *Introduction:* With the passage of the Physician Payment Sunshine Act, there has been increased transparency regarding the industrial financial relations that physicians have. Orthopedic surgeons have been highly studied in this domain with approximately 50% of all orthopedic surgeons engaging in industrial financial relationships. Furthermore, an increasing number of orthopedic surgeons are seeking fellowship training with pediatric fellowship programs gaining popularity in recent years. The purpose of this study is to evaluate the impact various pediatric orthopedic fellowship programs have on industry earnings and academic productivity. *Methods:* Pediatric orthopedic fellowship programs were identified via the Orthopedic Society of North America (POSNA) website. Information on individual fellowship programs was obtained from their respective websites. Academic productivity was measured via an aggregate of all employed physicians' H-index at a specific fellowship as found on the Scopus website. The Open Payments Database (OPD) website was used to assess lifetime industry earnings. Other variables such as *Newsweek* or Doximity ranking were taken directly from relevant websites. Statistical analysis was performed using a Kruskal–Wallis test with Bonferroni correction and Mann–Whitney U-test. *Results:* A total of 43 pediatric orthopedic surgery fellowships in the United States were identified with a total of 392 physicians as fellowship faculty. Complete OPD and H-index information were available for 336 of those physicians (85.7%). On average, there were 7.81 ± 5.18 physicians and 1.56 ± 0.93 fellows per program. The mean combined physician H-index was 117.23 ± 122.51 , and the mean combined physician lifetime supplemental earnings in dollars was $\$646,684.37 \pm \$1,159,507.17$. There was no significant relationship between region of pediatric orthopedic fellowship, *Newsweek* ranking of affiliated hospital, Doximity ranking of affiliated hospital, presence of MBA program, type of program (public, private, mixed), and the lifetime industry earnings or academic productivity of program graduates. *Conclusions:* Despite the observed lack of statistical significance, there were clear trends observed with fellowship programs in the northeast and west coast regions being the highest earning and fellowship programs with top 10 *Newsweek* ranking of affiliated hospital having by far the greatest industry earnings. Sample size limitations likely prevented the detection of statistical significance. Future studies should examine if any relation exists when accounting for type of industry payment received and case volume per fellowship program.

Keywords: pediatric orthopedic; fellowship; open payments database; H-index; ranking; industry



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1. Introduction

The passage of the Physician Payment Sunshine Act (PPSA) as part of the Affordable Care Act (ACA) in 2010 mandated the creation of an Open Payment Database (OPD) overseen by the Centers for Medicare and Medicaid Services (CMS) [1]. Starting 1 August 2013, all meaningful payments, defined as individual gifts greater than USD 10 and yearly payments greater than USD 100 made by drug or device manufacturers to teaching hospitals and physicians, must be publicly available through the OPD and classified as either “general payments”, “ownership interests”, or “research payments” [1–3]. Between 2014 and 2020, the total value of general payments alone to physicians was USD 14.78 billion with the annual total dollar value of all payments increasing from USD 8.61 billion in 2014 to USD 10.03 billion in 2019 [4].

Although comprising less than 3% of all physicians, orthopedic surgeons receive almost 25% of all industry payments with approximately 50% of all orthopedic surgeons engaging in a financial relationship with the industry [5]. Since the inception of the OPD, both the number and value of payments to orthopedic surgeons have grown from 313,194 separate payments totaling USD 883.8 million in 2014 to 335,815 separate payments totaling USD 958.6 million in 2018 with royalties accounting for approximately 70% of all payments to orthopedic surgeons [6,7]. This increase has occurred at a significantly faster rate for orthopedic surgeons when compared to other non-orthopedic surgeons [8]. Furthermore, there has been shown to be a positive correlation between academic productivity and industry payments received amongst orthopedic surgeons [9]. This correlation has been shown to hold true with both research specific and non-research industry payments [9,10].

There has been growing interest in identifying trends in OPD payments based on orthopedic subspecialty with foot and ankle, orthopedic sports medicine, and orthopedic trauma among the most studied [11–16]. With over 90% of graduating orthopedic residents now pursuing fellowship training, these studies are part of a larger body of literature interested in analyzing compensation based on fellowship training [17,18].

Pediatric orthopedic surgery is a historically overlooked fellowship that has seen increased interest in recent years with a growing number of fellowship programs and applicants [19,20]. Over the past decade, there has been a significant increase in the amount of pediatric orthopedic cases performed by pediatric orthopedic surgeons [21–23]. Simultaneously, there has been an increase in the number of pediatric orthopedic subspecialists and an increase in the proportion of pediatric subspecialty cases performed by pediatric orthopedic subspecialists [24]. Despite this trend, orthopedic residents continue to report hesitancy to pursue pediatric fellowships due to concerns for decreased procedural volume and corresponding fears of decreased financial return on investment [18,25].

The purpose of this study is to address this historically nebulous topic by providing a comprehensive financial understanding of pediatric orthopedics through the unique lens of the OPD, which is a key performance indicator of overall financial productivity. In addition to providing financial transparency regarding pediatric orthopedics, this study seeks to go a step further by evaluating the effect of various fellowship characteristics such as fellowship H-index, region, *Newsweek* ranking of affiliated hospital, and Dximity ranking of affiliated residency program on OPD payments. To date, no study has evaluated the various characteristics of pediatric orthopedic fellowships and correlated them to industry performance. In doing so, this article provides much needed transparency regarding pediatric orthopedic fellowship programs, which is an essential component of effective orthopedic care across all institutions.

2. Methods

2.1. Study Creation

This study is a retrospective analysis of variables associated with academic and industry productivity of all of the pediatric orthopedic fellowships in the US as of June 2023 in order to better understand potential areas of bias affecting the highest level of orthopedic education. The exhaustive list of pediatric orthopedic fellowships in the US used for this

study was found on the Pediatric Orthopedic Society of North America (POSNA) website (<https://posna.org/resources/fellowship-match/peds-ortho-fellowships>, accessed on 1 June 2023). Fellowships found on the POSNA website were then individually searched on the internet for more specific information.

2.2. Study Variables

Academic productivity was measured via fellowship H-index, which was an aggregate of all the employed physicians' H-index of that specific fellowship as found on the Scopus website (<https://www.scopus.com/freelookup/form/author.uri>). Industry productivity was measured via lifetime supplemental earnings per fellowship, which was also an aggregate of all employed physicians' lifetime supplemental earnings of that specific fellowship as found on the Open Payments Database (OPD) website (<https://openpaymentsdata.cms.gov/search>) created by the Center for Medicare and Medicaid Services (CMS). Variables investigated for association with the academic and industry productivity of pediatric orthopedic surgery fellowships included region of the United States, Doximity ranking of directly affiliated orthopedic residency programs, *Newsweek* ranking of directly affiliated hospitals, presence of a directly affiliated Master of Business Administration (MBA) program, and type of program.

Information regarding directly affiliated Doximity rankings was found on the Doximity website sorted by reputation (<https://www.doximity.com/residency/match-data-step-complex-scores?specialtyKey=bd2342386960426094751fa18f58f092orthopaedicsurgery&sortByKey=reputation&trainingEnvironmentKey=&intendedFellowshipKey=>, accessed on 1 June 2023). Information regarding directly affiliated *Newsweek* hospital rankings were found on the *Newsweek* website (<https://www.newsweek.com/rankings/worlds-best-hospitals-2023/united-states>, accessed on 1 June 2023). Finally, the presence of an MBA program was determined via searching Wikipedia (https://en.wikipedia.org/wiki/List_of_business_schools_in_the_United_States, accessed on 1 June 2023).

2.3. Inclusion and Exclusion Criteria

The inclusion criterion was being a pediatric orthopedic fellowship listed on the POSNA website. Individual physicians that had complete information in regard to H-index and lifetime supplemental earnings data were included in the data. Exclusion criteria for individual physicians was the lack of either the H-index or the supplemental earnings data.

2.4. Study Definitions

For the purpose of this study, the Doximity ranking of affiliated orthopedic residency programs was considered to be affiliated with the pediatric orthopedic surgery fellowships by direct affiliation when they shared the same name (For example, Cleveland Clinic Orthopedic Surgery Residency and Cleveland Clinic Pediatric Orthopedic Surgery Fellowship). The total lifetime supplemental earnings by physicians did not include research payments and only included money directly received by the physician as seen in the category of "General Payments" on the OPD website. Research funding is not included in the total lifetime supplemental earnings per fellowship. Lifetime supplemental earnings represented all data recorded on the OPD website, which was from 2015 to 2021 as of June 2023 and the completion of this study.

2.5. Data Collection

Data collection was completed by a single author. Data collected in this study included the number of physicians per fellowship, number of fellows per fellowship, total lifetime supplemental earnings per fellowship (dollars), total H-index per fellowship, combined total supplemental income payments per fellowship, average total lifetime supplemental earnings per faculty physician per fellowship (dollars), type of program (university, mixed, private), Doximity rank of affiliated orthopedic residency programs (top 10, top 11–30, top 31+, and unranked), region of the fellowship program (northeast, Midwest, southeast,

southwest, and west coast), *Newsweek* rank of affiliated hospital (top 10, top 11–30, and top 31+ and unranked), and presence of MBA program affiliated with fellowship (yes or no).

2.6. Statistical Analysis

Statistical analysis was completed using the Statistical Package for the Social Sciences (SPSS) version 29.0 (Armonk, NY, USA; IBM Corp.). Descriptive statistics were used for fellowship demographics. The normality of the study data was first determined using the Shapiro–Wilk test due to the small sample size. Means between three or more groups were compared using the Kruskal–Wallis test with Bonferroni correction, whereas the means between two groups were compared using the Mann–Whitney U test due to the non-parametric nature of the data. Statistical significance was set at 0.05 prior to the statistical analysis.

Linear regression analysis was performed using Microsoft Excel. The data were entered into a spreadsheet, and the “Data Analysis” toolpak was utilized to execute the regression function, which provided coefficients, R-squared values, and significance levels for the predictor variables.

3. Results

3.1. Fellowship Demographics

There are a total of 43 pediatric orthopedic surgery fellowships in the United States as of June 2023 with a combined total of 392 physicians as fellowship faculty at those fellowship programs. Only physicians with complete OPD supplemental earnings and payment data as well as H-index on Scopus ($n = 336$ physicians, 85.71%) were included in the current study. Fifty-six physicians (14.29%) were missing supplemental income and payment information on the OPD website and were subsequently excluded from the study. This resulted in a total of 336 physicians (85.71% of physicians) who are faculty at 43 pediatric orthopedic fellowships (100% of fellowships) being included in the data analysis.

3.2. Fellowship Academic and Industry Productivity

The mean number of physicians per fellowship was 7.81 ± 5.18 physicians (median: 7.00 physicians; range: 1.00–26.00 physicians) and the mean number of fellows per fellowship was 1.56 ± 0.93 fellows (median: 1.00 fellows; range: 1.00–5.00 fellows) at the 43 pediatric orthopedic surgery fellowships in the US on the POSNA website as of June 2023. The mean combined physician H-index per pediatric orthopedic surgery fellowship ($n = 43$ fellowships) was 117.23 ± 122.51 (median: 81.00; range: 3.00–689.00), and the mean combined physician lifetime supplemental earnings in dollars was $\$646,684.37 \pm \$1,159,507.17$ (median: $\$172,713.14$; range: $\$200.49$ – $\$5,861,272.48$). The mean combined physician number of payments per fellowship was 412.70 ± 377.56 (median: 330.00; range: 3.00–1716.00). The mean combined physician lifetime supplemental earnings per H-index per fellowship was $\$5818.11 \pm \8285.34 (median: 2383.10; range: $\$14.32$ – $\$37,508.27$).

3.3. Fellowship Academic and Industry Productivity by Region

There was no significant association between fellowship total lifetime supplemental earnings and region of the US for pediatric orthopedic surgery fellowships in the US ($H = 5.077$, $p = 0.280$). Refer to Table 1 and Figure 1 for the total lifetime supplemental earnings for fellowships per region of the US.

Furthermore, there was no significant association between fellowship H-index and total OPD payments for pediatric orthopedic surgery fellowships in the US ($R^2 = 0.078$; $p = 0.07$). Refer to Figure 2 for visualization of the linear regression analysis of fellowship industry earnings and H-index.

Table 1. Information regarding total lifetime supplemental earnings per fellowship by region of the United States (US) for pediatric orthopedic surgery fellowships. Data are recorded in mean $\pm$ standard deviation as well as median for completion.

Region	Total Life-Time Supplemental Earnings	
	Mean $\pm$ Standard Deviation	Median
Northeast (n = 14)	\$671,119.44 $\pm$ 972,567.47	\$375,519.06
Southeast (n = 13)	\$423,247.46 $\pm$ 801,552.85	\$91,981.00
Midwest (n = 5)	\$126,410.42 $\pm$ 129,702.71	\$70,397.82
Southwest (n = 2)	\$201,751.87 $\pm$ 267,631.64	\$201,751.87
West Coast (n = 9)	\$1,319,331.45 $\pm$ 1,931,420.35	\$307,327.96

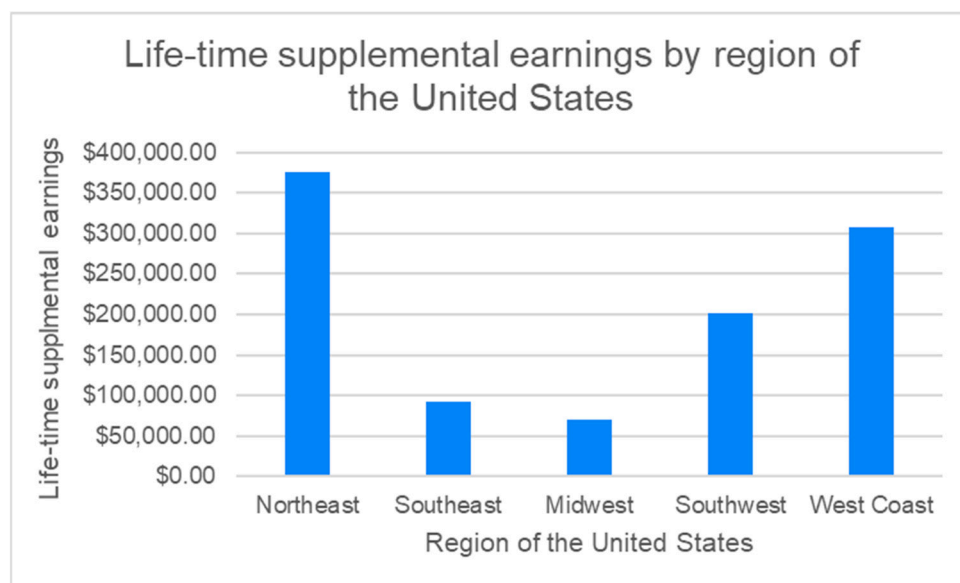


Figure 1. Bar graph depicting the median lifetime supplemental earnings per fellowship by region of the United States. Regions included northeast, southeast, Midwest, southwest, and west coast.

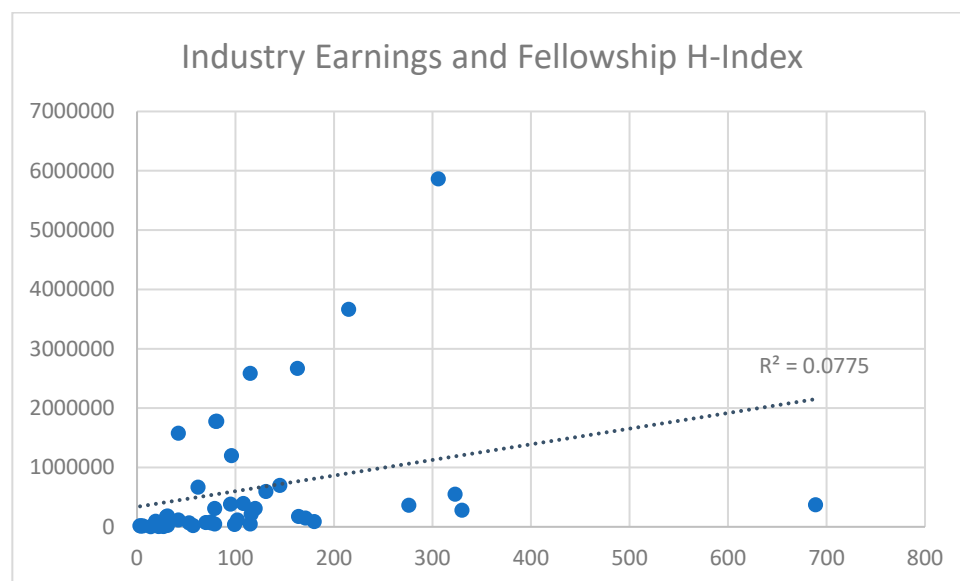


Figure 2. Linear regression analysis of fellowship H-index and total OPD compensation for fellowship.

3.4. Other Associations for Fellowship Academic and Industry Productivity

There was no significant association between total lifetime supplemental earnings and Doximity ranking of the affiliated orthopedic residency program (Top 10, Top 11–30, Top 31+, and unranked) for pediatric orthopedic surgery fellowships in the US ($H = 1.223$; $p = 0.747$). There was no significant association between total lifetime supplemental earnings and *Newsweek* ranking of the affiliated hospital (Top 10, Top 11–30, Top 31+, and unranked) for pediatric orthopedic surgery fellowships in the US ($H = 4.729$; $p = 0.193$). Refer to Table 2 and Figure 3 for information based on the *Newsweek* ranking. Furthermore, there was no significant association between pediatric orthopedic surgery fellowship programs directly affiliated with MBA programs and total lifetime supplemental earnings per fellowship ($p = 0.903$). There was also no significant association between total lifetime supplemental earnings per fellowship and type of program (university, mixed, or private) for pediatric orthopedic fellowships in the US ($H = 2.706$, $p = 0.259$). Similarly, there was no significant association between total H-Index per fellowship and the type of program (university, mixed, or private) for pediatric orthopedic surgery fellowships in the US ($H = 0.737$, $p = 0.692$).

Table 2. Information regarding lifetime supplemental earnings per fellowship by *Newsweek* ranking of the affiliated hospital for pediatric orthopedic surgery fellowships in the United States. Data are recorded in mean $\pm$ standard deviation as well as median for completion.

<i>Newsweek</i> Ranking	Total Life-Time Supplemental Earnings	
	Mean $\pm$ Standard Deviation	Median
Top 10 (n = 3)	\$483,207.99 $\pm$ 343,633.46	\$665,939.61
Top 11–30 (n = 9)	\$617,480.07 $\pm$ 912,716.11	\$172,713.14
Top 31+ (n = 4)	\$84,835.78 $\pm$ 149,287.36	\$15,317.28
Unranked (n = 27)	\$757,820.01 $\pm$ 1,356,121.87	\$181,562.15

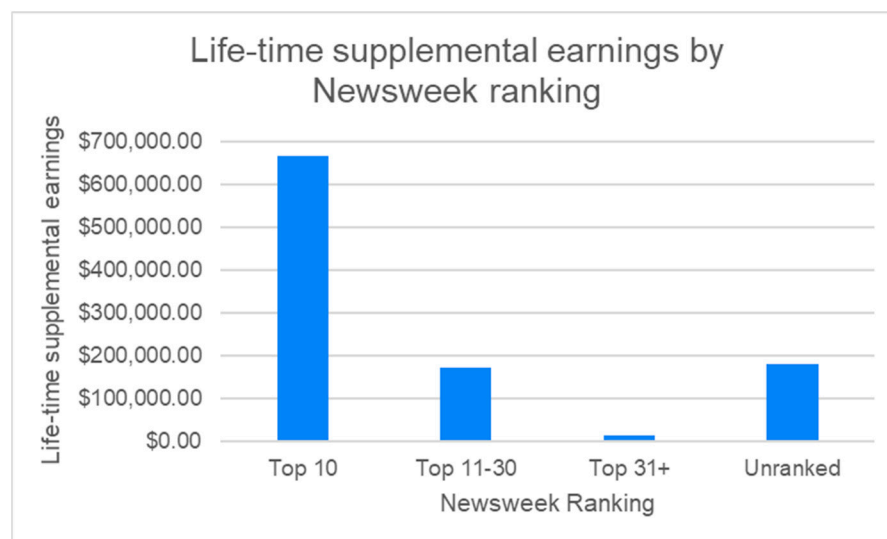


Figure 3. Bar graph depicting the lifetime supplemental earnings per fellowship by *Newsweek* ranking of the directly affiliated hospital of pediatric orthopedic surgery fellowships in the United States.

4. Discussion

The purpose of this study was to provide a transparent, comprehensive understanding of the performance of pediatric orthopedic trained surgeons as measured by the OPD. A secondary aim was to examine the various characteristics of pediatric orthopedic fellowship programs and determine if there was any correlation with industry productivity as

determined by information from the highly studied OPD. Characteristics studied included geographic region of the fellowship program, fellowship H-index, Doximity ranking of affiliate orthopedic residency program, *Newsweek* ranking of affiliate hospital, presence or absence of directly affiliated MBA program, and finally the type of fellowship program (public, private, mixed).

Among all pediatric fellowships analyzed, the mean combined physician lifetime supplemental earnings in dollars was $\$646,684.37 \pm \$1,159,507.17$ (median: $\$172,713.14$; range: $\$200.49$ – $\$5,861,272.48$). We found no significant difference in OPD payments based on geographical regions, program ranking, or public/private program designation, however, we did observe two important trends in our data.

First, the northeast and west coast geographical regions appear to be more involved in industry relations, as they generate far more supplemental earnings than the Midwest, southeast, or southwest regions. This is likely because the northeast region of the United States has been determined to be a nucleus for orthopedic academic and financial productivity, with three of the four top cities for academic productivity being located in this region [26]. Higher-ranked hospitals tend to be in larger urban regions and therefore have potentially greater visibility to both patients and industry partners, allowing for the establishment of earlier relationships with a greater number of industry partners [27].

Second, pediatric fellowships with affiliate hospitals ranked in the top 10 generate far greater lifetime earnings than all other fellowship programs with affiliate hospitals. Pediatric fellowship programs with an affiliate hospital ranked in the top 10 had graduates with a median lifetime industry earning of $\$665,939.61$, whereas the next highest group had just $\$181,562.15$. This second highest earning total belonged to unranked programs. Given the observed trend of increased lifetime earnings with higher ranking, this finding may be partially explained by the fact that certain unranked pediatric fellowship programs are private and not affiliated with a residency program despite being highly productive groups [28,29].

We did not observe any relation between fellowship H-index and industry payments. While this relationship has been reported in the literature, the observed discrepancy may be due to increased government sponsored grant funding that is not reflected in the OPD or more stringent restrictions around industry relations as determined by institutional policy amongst the groups studied [9,30].

Overall, our results demonstrate that pediatric orthopedists are actively involved in industry payments across various regions of the US and variably ranked programs. While there are notable trends across these domains, the lack of statistical significance indicates that pediatric orthopedists of all types are involved in industry payments without predilection for a specific region or program type, which is a strong indicator for the future growth and sustainability of pediatric orthopedics in a rapidly commercializing and competitive medico-entrepreneurial space [31]. Such involvement is necessary to curb the “innovation gap” that exists between adult and pediatric medical innovation, as industry engagement enables more rapid commercialization of ideas [32,33]. In addition, active industry engagement signals to trainees that pediatric fellowship programs are invested in innovation and financial prosperity, which are important considerations for trainees with large sums of academic debt.

That said, the lack of significance in our analysis does not preclude the existence of a true gap between various fellowships. Differences in pediatric fellowships likely exist but may not be observed in the greatest detail when naturally bound by the number of fellowships available or when evaluating the broader characteristics of these programs. For example, Khan et al. assessed the academic productivity of various reconstructive fellowship programs by evaluating factors such as faculty academic title and number of years in practice, finding a positive relationship between academic productivity and these more granular variables [34]. Such an approach to pediatric orthopedic fellowships may elucidate specific deterministic factors of industry payments; however, the purpose of this

paper was to present a macro-level perspective of pediatric orthopedic fellowships and industry relationships that could only be achieved by analyzing broader characteristics.

The primary limitations of this study include low statistical power due to a small sample of size of pediatric orthopedic fellowship programs. This may have prevented the detection of statistical significance despite the clear trends in our data. Additionally, about 15% of faculty at fellowship trained institutions were excluded due to missing information on the OPD website. Lastly, this study was unable to assess or quantify institutional policy/attitude toward industry relations, as the presence of stringent conflict of interest restrictions may discourage industry involvement and vice versa. Likewise, the respective contribution of government sponsored grants to each institution were not accounted for, and this may represent a potential mediating variable when considering academic productivity that is not reflected in OPD payments. Future studies should evaluate these parameters to better understand the reason for observed trends and to determine if additional trends emerge when evaluating factors such as the type of industry payments received, case volume per institution, and industry sponsored randomized controlled trials, to name a few.

5. Conclusions

As a whole, pediatric orthopedic fellowships and practicing pediatric orthopedic surgeons engage in industry relations without a statistically significant predilection for a single geographic region or academic center ranking. There are clear trends in industry engagement that reflect those seen in other specialties known to be actively engaged with industry partners. These results are encouraging when considering the long-standing “innovation gap” between adult and pediatric medical devices and function to support the growing interest in pediatric orthopedics while disproving myths of decreased financial return that have historically held the field back. Acknowledging and providing transparent information regarding the financial relationships of fellowship programs is important for program growth and trainee engagement.

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