

Original Research

# Pediatric Orthopaedic Surgery Research Quality: A Decade of Change at POSNA Annual Meetings from 2011-2020

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## Abstract

**Background:** The Pediatric Orthopaedic Society of North America (POSNA) is a leading organization focused on disseminating research and promoting high-quality pediatric orthopaedic care. The purpose of our study was to understand how research quality in pediatric orthopaedic surgery has evolved over time by evaluating trends in clinical evidence and study design in podium presentations given at POSNA annual meetings from 2011-2020.

**Methods:** Podium presentation abstracts for all POSNA meetings from 2011-2020 were independently reviewed for number of study patients, single center versus multicenter, randomized vs. non-randomized design, and abstract focus/topic. The level of evidence (LOE) assigned in the abstract program was also recorded. Chi-squared and Mann-Whitney U tests were used to compare differences in abstract characteristics between 2011-2015 and 2016-2020. Linear regressions were performed to analyze changes in level of evidence and the proportion of multicenter studies over time.

**Results:** A total of 1589 podium presentations were reviewed including 679 from 2011-2015 and 910 from 2016-2020, representing a 34% increase in the total number of presentations. The median number of patients per abstract was higher in 2016-2020 compared to 2011-2015 (81.5 vs. 49,  $p < 0.001$ ). An increased proportion of presentations from 2016-2020 were multicenter (14.1% vs. 9.7%,  $p = 0.009$ ), with spine abstracts having the highest proportion of multicenter collaboration (23.9%,  $p = 0.002$ ). The subspecialty focus of podium presentations has remained consistent over time with the exception of spine-related abstracts (19.5% vs. 14.9%,  $p = 0.018$ ). Overall, 4.9% of the presentations

were categorized as level 1 evidence, 18.5% level 2, 41.8% level 3, and 34.8% level 4. Between 2011-2020, the proportion of LOE 3 studies increased significantly ( $p=0.039$ ). The proportion of LOE 4 studies decreased, but not significantly ( $p=0.060$ ). There was no change in the proportion of level 1 and 2 studies ( $p=0.416$ ).

**Conclusions:** POSNA podium presentations have increased in number over the past decade, in large part due to the development of subspecialty day programs. This appears to have resulted in greater diversity in the academic program, with a lower proportion of spine abstracts over time. The LOE of POSNA presentations has improved with a higher proportion of level 3 studies compared to earlier years. More recent abstracts have evaluated higher numbers of patients and there has been a significant increase in multicenter study designs, suggesting improved collaboration.

**Level of Evidence: IV**

### Key Concepts

- POSNA podium presentations have increased in number over the past decade due to subspecialty day programming.
- A decrease in the proportion of studies focused on spine-related topics has been observed.
- Improved level of evidence has been observed with a higher proportion of level 3 evidence.
- More recent podium presentations have evaluated higher numbers of patients and more commonly utilized multicenter study designs, suggesting improved collaboration.
- Further work focusing on fostering and promoting multicenter collaboration across all pediatric subspecialties should be promoted.

## Introduction

The Pediatric Orthopaedic Society of North America (POSNA) is a not-for-profit organization with the goal of advancing musculoskeletal care for children and adolescents by promoting education, research, and quality care.<sup>1</sup> One of the ways that it aims to do this is through annual meetings, which serve as valuable conduits for the dissemination of new research and ideas to a large network of pediatric orthopaedic providers. Podium presentations are an important opportunity for authors to receive criticism and input from experts in the field and discuss efforts to promote new research goals. As a result, many presentations at the POSNA annual meeting are ultimately published in prominent orthopaedic journals.<sup>2</sup>

Level of evidence (LOE), first proposed in 1986, is a frequently used tool for evaluating the quality and potential impact of clinical research.<sup>3</sup> In the field of

orthopaedic surgery, LOE is traditionally assigned based on guidelines released by the *Journal of Bone and Joint Surgery*.<sup>4</sup> The LOE can assist in the interpretation of scientific studies and the determination of how much weight to assign results.

The most recent analysis of research presented at POSNA showed minimal changes in LOE when comparing the 2001-2003 annual meetings to those in 2007-2008.<sup>5</sup> However, no studies have evaluated changes since. In this study, we aimed to assess changes in the quality and focus of research presented at POSNA. We hypothesized that both multicenter collaboration and the LOE of podium presentations has improved over the past decade.

## Methods

Every paper abstract presented via an oral presentation between 2011-2020 at the POSNA annual meetings was identified from the official abstract book made available

to delegates. Abstracts presented in poster format were excluded. Included presentations were reviewed by three separate reviewers to determine study characteristics including total number of subjects, investigation topic, study design, and level of evidence. The level of evidence assigned at the time of abstract submission was recorded. To confirm the validity of LOE assigned in the POSNA abstract books, an independent evaluation was performed of a random sample of 60 abstracts with the level of evidence blinded. Randomization was performed using a computer-based randomization program. One investigator (MAJ) reviewed each abstract and assigned a LOE per the current guidelines for authors published in the most recent *Journal of Bone and Joint Surgery*.<sup>5</sup>

Subspecialty focus was classified into one of the following categories based on review by all three reviewers: QSVI (Quality Safety and Value Initiative), Foot/Ankle/Lower Extremity, Hand/Wrist/Upper Extremity, Hip, Spine, Trauma, Sports, Neuromuscular, and Infection/Tumor.

Comparisons were made between abstracts presented between 2011-2015 and 2016-2020. Categorical variables were compared using Chi-squared tests. The Mann-Whitney U test was used to compare the number of patients across different time periods. Linear regressions were performed to analyze changes in the proportion of multicenter studies and the proportions of studies assigned each level of evidence. These regressions were calculated and reported with a slope (B) and 95% confidence interval (CI). Pearson correlation coefficients were converted to a coefficient of determination ( $r^2$ ). Studies with an unspecified level of evidence (specifically basic science abstracts) were excluded from trend analysis. Interobserver reliability between the independent reviewer and the POSNA assignment of LOE was performed. All statistical analysis was performed using SPSS software for Macintosh, version 23. A significance threshold of  $p < 0.05$  was used for all analyses.

## Results

A total of 1589 oral presentations were reviewed with 679 (42.7%) from 2011-2015 and 910 (57.3%) from

2016-2020. The lowest number of presentations occurred in 2011 ( $n=93$ ) and the highest in 2017 ( $n=232$ ). The proportion of LOE 1 or 2 presentations was similar when comparing the second half of the decade to the first (23.2% vs. 21.4%,  $p=0.386$ ). There was a significant increase in the presentation of multicenter projects in 2016-2020 (14.1% vs. 9.7%,  $p=0.009$ ) and no change in the proportion of presentations utilizing nationwide databases (8.2% vs. 8.1%,  $p=0.919$ ). A significant decrease in the proportion of spine-focused presentations between 2016-2020 (14.9% vs. 19.4%,  $p=0.018$ ) was noted. The number of patients per abstract was higher during the latter half (median 81.5, IQR 37-205) compared to the first half of the decade (median 49, IQR 24-100,  $p < 0.001$ ) (Table 1).

The proportion of LOE 3 presentations increased by an average of 2.1% per year (95% CI 0.138% – 4.022%,  $p=0.039$ ) from 44.2% ( $n=34$ ) in 2011 to 52.2% ( $n=84$ ) in 2020 ( $r^2 = 0.433$ ). The proportion of LOE 4 presentations showed an average decrease of 2.8% per year (95% CI -5.769% – 0.151%,  $p=0.060$ ) from 40.3% ( $n=31$ ) in 2011 to 31.7% ( $n=51$ ) in 2020 ( $r^2 = 0.374$ ). There was no significant change in the proportion of level 1 and 2 presentations (B = 0.725%, 95% CI -1.222% to 2.671%,  $p=0.416$ ) (Figure 1). The proportion of multicenter presentations increased by an average of 1.9% per year (95% CI 0.635% – 3.129%,  $p=0.008$ ) from 1.3% ( $n=1$ ) in 2011 to 23.0% ( $n=37$ ) in 2020 ( $r^2 = 0.602$ ) (Figure 2). The subspecialty focus with the highest proportion of multicenter presentations was spine (23.9%) and the lowest was Sports (3.9%,  $p < 0.001$ ).

The interobserver correlation coefficient between the randomly selected sample of abstracts and the POSNA LOE classification showed near perfect agreement for level of evidence assignment (ICC 0.831).<sup>6</sup>

The largest number of randomized controlled trials were presented with a focus on spine related topics ( $n=16$ , 6.2%). However, when comparing between the four largest specialties, there was no difference in the proportion of randomized controlled trials or prospective studies ( $p=0.233$ ) (Figure 3).

**Table 1. Characteristics of POSNA Abstracts, 2011-2015 vs. 2016-2020**

	<b>2011-2015</b>	<b>2016-2020</b>	<b>P-Value</b>
Number of Abstracts	679	910	-
Median Sample Size (IQR)	49 (24-100)	81.5 (37-205)	<b>&lt;0.001</b>
Level of Evidence			0.386
1 or 2	145 (21.4)	211 (23.2)	
3	229 (33.7)	404 (44.4)	
4	262 (38.6)	265 (29.1)	
Multicenter	66 (9.7)	128 (14.1)	<b>0.009</b>
Randomized Controlled Trial	21 (3.1)	30 (3.3)	0.820
Database	55 (8.1)	75 (8.2)	0.919
Survey	44 (6.5)	44 (4.8)	0.156
Topics			
Basic Science/Anatomy/Biomechanics	86 (12.7)	106 (11.6)	0.538
Opioids/Pain Management	14 (2.1)	26 (2.9)	0.317
Medical Education	14 (2.1)	3 (0.3)	<b>0.001</b>
Cost Analysis	15 (2.2)	14 (1.5)	0.323
Focus			
QSVI (Quality Safety and Value Initiative)	44 (6.5)	82 (9.0)	0.065
Foot/Ankle/Lower Extremity	81 (11.9)	113 (12.4)	0.769
Hand/Wrist/Upper Extremity	45 (6.6)	62 (6.8)	0.884
Hip	118 (17.4)	139 (15.3)	0.260
Spine	132 (19.4)	136 (14.9)	<b>0.018</b>
Trauma	85 (12.5)	130 (14.3)	0.308
Sports	56 (8.2)	99 (10.9)	0.080
Neuromuscular	55 (8.1)	71 (7.8)	0.828
Infections/Tumors	37 (5.4)	45 (4.9)	0.653

Values reported as number (%) or median (IQR). Statistically significant values are in bold ( $p < 0.05$ ).

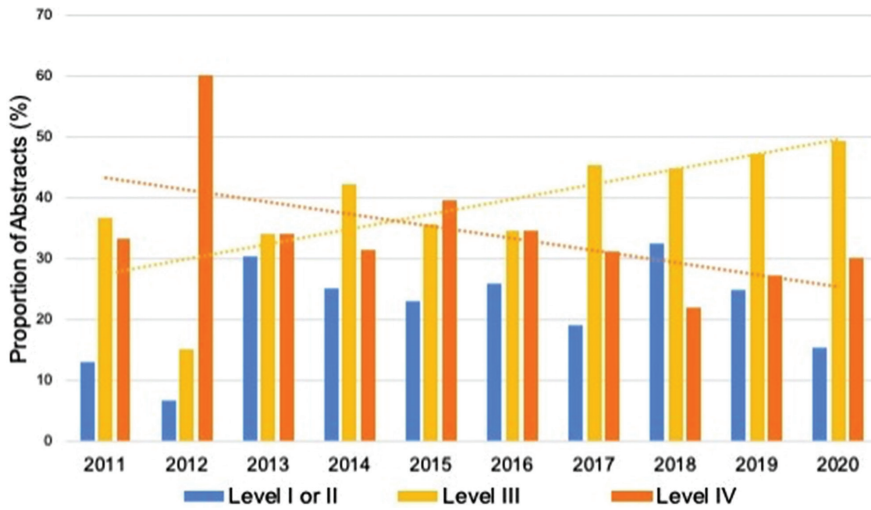
## Discussion

Our study demonstrates increasing levels of evidence at the Pediatric Orthopaedic Society of North America annual meeting since 2011. This change was predominantly driven by an increase in the proportion of LOE 3 studies. Additionally, more presentations in the latter half of the decade were the result of multicenter collaboration and included a larger number of patients.

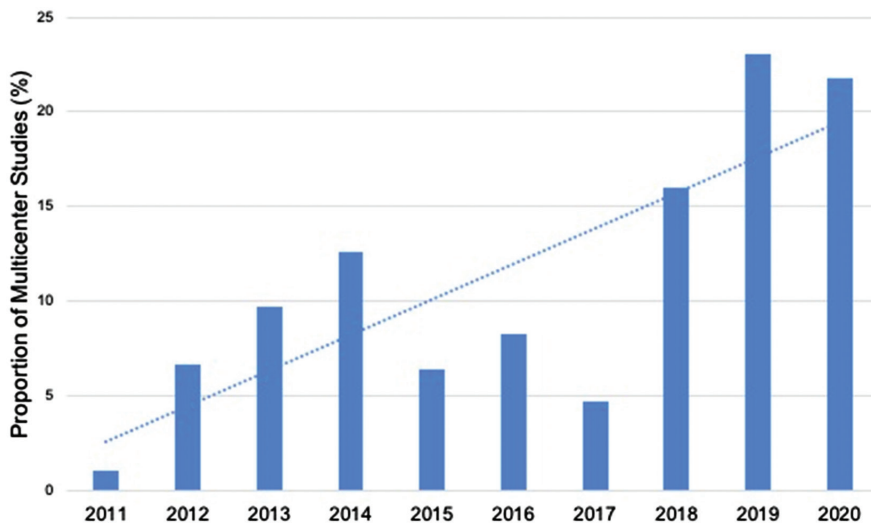
Changes in level of evidence have been studied across several orthopaedic conferences with improvements occurring at the International Society of Hip

Arthroscopy,<sup>7</sup> American Shoulder and Elbow Surgeons,<sup>8</sup> European Society of Sports Traumatology, Knee Surgery and Arthroscopy,<sup>9</sup> Scoliosis Research Society,<sup>10</sup> and the Orthopaedic Trauma Association<sup>11</sup> scientific meetings over time. Additionally, a review by Voleti et al. of presentations given at the American Academy of Orthopaedic Surgeons annual meeting demonstrated a 19% increase in the proportion of level 1 and 2 studies between 2001 and 2010.<sup>12</sup>

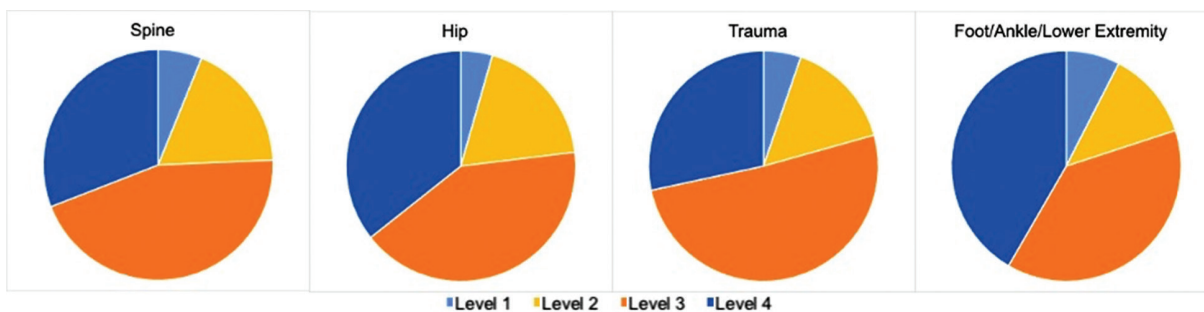
Previously documented decreases in level 4 and increases in level 3 studies at both POSNA<sup>5</sup> and in pediatric



**Figure 1.** Proportion of presentations graded as level I and II, III, and IV at POSNA annual meetings, 2011-2020. Trendlines for level III and IV indicated by dashed lines ( $r^2 = 0.433$  and  $r^2 = 0.374$ , respectively).



**Figure 2.** Proportions of presentations reporting multicenter collaboration at POSNA annual meetings, 2011-2020. Trendline indicated by dashed line ( $r^2 = 0.602$ ).



**Figure 3.** Proportion of level 1, 2, 3, and 4 evidence studies for the four largest subspecialty sections at POSNA annual meetings, 2011-2020.

orthopaedic journals<sup>13</sup> in the early 2000s were associated with no significant changes in the proportion of level 1 or 2 studies. Our findings represent a continuation of this trend, potentially indicating that authors are developing higher quality retrospective study designs by utilizing control groups to elevate level IV evidence to level III. While we did observe an increase in the total number of prospective and randomized controlled trials, the overall proportion did not increase. This is likely due to the difficulty and time investment needed to conduct level 1 and 2 studies.<sup>5</sup>

In addition to making quality improvements to clinical care, many orthopaedic surgeons value research contributions given the importance of research productivity to academic progression.<sup>14-16</sup> While many orthopaedic conferences boast high rates of publication overall,<sup>2,17-22</sup> higher level of evidence studies tend to have a higher chance of publication, thus incentivizing orthopaedic surgeons to produce higher quality study designs.<sup>12</sup> Additionally, a larger number of patients allow for greater power to detect differences between comparison groups<sup>23</sup> and may lead to a higher rates of publication.<sup>24</sup> Despite increasing availability and the use of large nationwide databases in adult orthopaedic surgery research,<sup>25,26</sup> presentations using databases were not demonstrated to be increasing at POSNA. Reasons for these study types not being utilized in pediatric orthopaedic research should be explored.

Our study also observed a significant decrease in the proportion of studies focused on spine-related topics. While the field of pediatric spine research has continued to increase,<sup>27</sup> this observed decline likely represents an attempt to include research from subspecialties across pediatrics including smaller subspecialties that continue to have clinical importance for orthopaedic providers.

Several limitations should be noted for this study. Level of evidence is not a perfect method for assessing the quality of research,<sup>28,29</sup> with some of the most impactful and frequently cited studies in orthopaedic surgery classified as level 3 and 4.<sup>30-33</sup> Additionally,

basic science, cadaveric studies, and animal studies are unable to be classified using the LOE system but may still provide valuable clinical information for providers. However, it remains a widely instituted system for categorizing the methodology of a clinical manuscript or presentation. While we observed a statistical increase in the level of evidence presented, the actual difference in the relevance of information presented remains in question. By including other quality metrics, such as multicenter collaboration and number of patients studied, we hoped to better assess quality of research. Additionally, our investigation was limited to the POSNA annual meeting and may not accurately reflect trends across the entire field of pediatric orthopaedic surgery.

Despite the increasing number of presentations given at POSNA annual meetings in recent years, there has been a significant improvement in both the level of evidence and the proportion of multicenter collaboration. Further work should be directed towards promoting multicenter collaboration across all pediatric subspecialties, the usage of nationwide databases, and the development of prospective study designs.

## Disclaimer

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