TITLE PAGE

TITLE: Analysis of conference abstract-to-publication rate in UK orthopaedic research.

CATEGORY: Research methods and reporting

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ABSTRACT

Presentation of research at orthopaedic conferences is an important component for surgical evidence-based practice. However, there remains uncertainty as to how many conference abstracts proceed to achieve full-text publication for wider dissemination. This study aimed to determine the abstract-to-publication rate (APR) of research presented in the largest hip and knee orthopaedic meetings in the UK, and to identify predictive factors which influence the APR.

All published abstracts (N=744) from the 2006, 2008, 2009 and 2010 British Hip Society (BHS) and the 2007, 2009, 2010, and 2011 British Association for Surgery of the Knee (BASK) annual conference meetings were examined by four researchers independently. To determine whether abstracts had been published in full-text form, Google Scholar, Medline and EMBASE evidence databases were used to verify full-text publication (FTP) status. Variables including: sample size, statistical significance, grade of the first author, research affiliated institution and research design were extracted and analysed to identify whether these were associated with FTP.

176 out of 744 abstracts achieved FTP status (APR: 23.7%). Factors associated with FTP status included statistically significant results ($p<0.01$) and research design ($p=0.02$). Factors not associated included sample size, grade of the first author and research affiliated institution ($p>0.05$).

APR of the assessed BHS and BASK annual conference presentations are low in comparison to other scientific meetings. Encouragement should be provided to clinicians and academics to submit their work for publication to address this short-fall, thereby enhancing the potential for full-text research publications to inform evidence-based orthopaedics.

Key Words: Education and Training; Surgery; Orthopaedic and Trauma Surgery

Word Count: 2379

INTRODUCTION

Research evaluating publication rates has previously been poorly explored which is surprising given its intrinsic value in terms of the ability of published research to provide a stable support for evidence-based practice (EBP).[1-3] To encourage EBP, new and advancing research should be readily available. However, communication of knowledge initially requires a forum to disseminate that information. This has commonly been in the form of abstract presentation at annual scientific conference meetings.[4] Whilst abstracts provide a foundation for brief interpretation of a study's summary, a fuller understanding of the methodology, experimental results, and a critical discussion of the researcher's interpretations and conclusions can only be obtained from the full-text publication (FTP).[5,6] Thus, consulting an abstract alone may lead to inappropriate or misinformed medical decisions.[7,8]

Previous research into APRs reported low FTP rates, ranging from 19 to 65% in a variety of medical disciplines.[9-18] In orthopaedics, Sahu et al [14] investigated the APR of presentations made at the British Association for Surgery of the Knee (BASK) annual conference meetings during the years 2000-2005 with a reported APR of 38%. Whitehouse et al [16] reported the mean APR from four separate British Hip Society (BHS) annual conference meetings to be 23%.[16]

Factors such as time limitations concerning both clinical practice position and amount of co-author support, a poor standard of work presented at annual conference meetings and positive result bias have been proposed to explain why such a low proportion of abstracts are subsequently published as FTPs.[13,15,19-22] Abstracts with statistically significant results, university-hospital affiliated institutions, experimental-based study designs and those with a larger sample size have been demonstrated higher FTP rates.[13,15,19,20,23-25] However, it remains unclear whether the APR from Sahu et al [14] and Whithouse et al [16] has changed over the past 10 years, which may have occurred with further developments in EBP and clinical academic positions within the NHS and through the UK's National Institute for Health Research (NIHR) clinical academic funding streams.[27]

Accordingly, the purpose of this study was firstly to determine the APR for the BHS and BASK conferences between 2006 and 2011, and secondly to determine whether specific factors are associated with FTP.

MATERIALS AND METHODS

Eligibility Criteria

All available abstracts presented at the BHS (2006, 2008, 2009, 2010) and BASK (2007, 2009, 2010, 2011) annual meetings published in the Bone and Joint Journal's Orthopaedic Proceedings were obtained and examined. During the conduct of this study, abstracts were not available through this platform for the 2007 BHS and 2008 BASK meetings. These dates were chosen to allow a minimum of five years from initial abstract presentations to the identification of FTPs, as it has been previously reported that FTP plateaus at five years, thus justifying this interval.[9,27] No duplicates (i.e. the same abstract presented more than once) were identified across the years for each of the meetings. Both poster and podium presentation abstracts were included as eligible studies for analysis.

Data Extraction and Interpretation

Five variables were extracted from each of the published abstracts by two independent researchers and verified for discrepancies by the senior author (TS). The definition for each of these variables are presented in **Supplementary Table 1**. In summary, grade of the first author at the time of conference, in relation to the specific abstract was established by using the search engine Google. First author was determined as the first author listed in each citation. The year of the published abstract and the research affiliated institution were used as a cross-reference to obtain the (if available) specific grade of the author. The grade of the first author was only accepted to be correct if there was evidence that grade was correctly identified as that at the time of abstract presentation. Research affiliated institution was established by identifying the name of the institution associated with the first author. Hospital type was established by referring to the NHS authorities and trusts website.[28] However, some NHS hospital types were unobtainable as the study was conducted overseas. Subsequently, a Google search engine identified the type of the overseas hospital. Number of subjects in each study were recorded for each abstract based on the specified number of participants. Study designs, which included trials, observational studies, systematic literature reviews, cadaveric and experimental designs. Statistically significant findings were determined when a result was reported at $p \leq 0.05$ or if a statistically significant result was explicitly stated for the main study question(s) i.e. a primary or secondary outcome at the primary end-point. Publication status of all abstracts were initially searched for by using the first and last author's names as a reference point through computerised database searches on Google Scholar, Medline, Science Direct and EMBASE to reveal any potential FTPs. These were searched in this order until a potential match was identified and then the search was completed.

Statistical Analysis

Descriptive statistics were expressed as mean and standard deviations for continuous variables. Categorical variable values were expressed as frequencies and percentage differences (%). The probabilities of being published or not for each of the variables were assessed using odd ratios (OR) and presented with 95% confidence intervals (CI).

Univariate comparisons were conducted through the Chi-Squared test by comparing publication status to grade of first author, research affiliated institution, study design and study statistical significance. The Mann-Whitney U test was conducted in the presence of non-normally distributed data to determine whether there was a statistical difference between publication status and abstract sample size. Statistical significance was satisfied when $p \leq 0.05$. All statistical analyses were performed using IBM, SPSS version 21.0 (SPSS Inc. New York, USA) software.

RESULTS

As presented in **Figure 1**, 744 published conference abstracts were identified, 350 were presented during BHS and 394 during BASK annual meetings. Of these, 176 were published as full-text articles within the five-year assessment period (**Table 1**).

Abstract to Publication Rate

The results of the APR for the overall data and for each specific meeting are presented in **Table 2**. In summary, the BHS dataset resulted in 74 full-text articles, with a resultant APR of 21.1%. The BASK dataset resulted in 102 full-text articles, which a resultant APR of 25.9%. The combined APR for the two conferences was 23.7%. As demonstrated in **Table 1**, there did not appear to be a clear trend in change over time in APR between either the BASK or BHS data.

Factors Influencing Publication Rate

Table 3 summarises the analysis of potential predictive factors for the 23.7% publication rate. From the 744 abstracts, statistical analysis revealed two out of the five assessed variables to significantly influence FTP.

There was no significant difference between published and unpublished abstracts regarding the grade of each first author ($p=0.37$). This suggests the specific grade of the first author did not influence whether an article was more or less likely to achieve FTP. When compared by clinical versus academic role, there also did not appear to be a significant difference in publication outcome (OR:

0.86; 95% CI: 0.56 to 1.34; p=0.52). There was no significant difference between published and unpublished abstracts concerning the frequency of the research affiliated institution (p=0.47). This remained the same when compared between public and private hospitals (OR: 0.67; 95% CI: 0.25 to 1.79; p=0.42) and university and non-university affiliations (OR: 1.12; 95% CI: 0.64 to 1.98; p=0.69). There was no significant difference in the mean sample size between published and unpublished articles (p=0.60). There was no difference in publication outcome for abstracts when assessed between studies which included less than or greater than 100 participants (OR: 0.77; 95% CI: 0.52 to 1.13; p=0.18).

Overall, there was a significant difference between published and unpublished abstracts concerning the frequency of the study design, suggesting that a specific study design had an influence on abstracts achieving FTP status (p=0.02). When explored further, there was however no difference in publication rate between observational and experimental studies (OR: 0.69; 95% 0.35 to 1.34; p=0.27).

The combined BHS and BASK annual conference meetings reporting with statistically significant and insignificant results that achieved FTP were 92 and 84 respectively. Conversely, the combined BHS and BASK annual conference meetings reporting with statistically significant and insignificant results that failed to achieve FTP were 208 and 358 respectively. There was a statistically significant difference between published and unpublished abstracts (OR: 0.58; 95% CI: 0.37 to 0.74; p<0.01). Accordingly, abstracts had a 42% greater chance of being subsequently published if they presented a significant finding.

DISCUSSION

From the eight scientific conferences analysed, the mean publication rate of abstracts was 23.7% within a minimum five-year follow-up. Factors associated with FTP status included statistically significant results (p<0.01) and research design (p=0.02). Factors not associated included sample size, grade of the first author and research affiliated institution (p>0.05).

The APR reported in this analysus was lower than previous APR findings which have ranged from 19% to 65%.[9-18] The current study established an APR of 26% and 21% for the BASK and BHS annual conference meetings respectively. These results may be compared to a similar analyses undertaken from 2000-2005 [14] which reported higher APR figures. Our findings suggest this may

be attributed to an increase in rigor of research presented at meetings from 2009 to 2012 since Peng et al [13] suggested studies with greater methodological rigor are more likely to achieve FTP than those of lesser methodological quality. Furthermore, other factors such as positive result bias and time limitations concerning both clinical practice position and degree of co-author support may be additional factors which could have accounted for these differences [14,15]. These will be explored further below.

This study reported an insignificant association between the sample size of the presented abstracts and subsequent FTP's ($p=0.60$). Previous research has reported similar findings to the current study regarding sample size and subsequent publication.[29] However, many studies have reported a statistically significant association between sample size and full publication.[9,15] Previous analyses have excluded studies with very low sample size; these were included in our analyses. Bhandari et al [9] for example, excluded abstracts that only provided brief summaries, resulting in a higher exclusion rate, thereby reducing the initial sample size. Moreover, smaller sample sizes in the previous analyses reduced statistical power, thereby potentially inducing a type two statistical error resulting in unreliable interpretations.

Our results indicated that abstracts which presented statistically significant results were more likely to achieve FTP ($p<0.01$). This result is consistent with numerous other studies.[15,19,20,24] Consequently, systematic reviews may overestimate a treatment effect where publication bias contaminates orthopaedic literature. This therefore has an impact on the confidence which can be placed on the current research which underpins orthopaedic EBP.

There has been limited research to quantify similarities between the grade of the first author and FTP. As a result, comparative discussions are significantly limited. However, our results on research-affiliated institutions are not consistent with other studies. Castaldi et al [19] concluded first authors affiliated with university hospitals were more likely to achieve FTP than non-university hospitals ($p=0.001$). Winnik et al [25] also identified a significant association with university hospital affiliated institutions and the likelihood of FTP ($OR=1.53$; $p=0.03$). Conflicting results may be justified as the present study attributed research affiliated institutions into sub-groups as opposed to university and non-university groups, as identified in previous research.[19,25] This therefore limits the statistical power with too few data in each hospital-affiliated category to achieve a statistically significant difference between published and unpublished abstracts. Nonetheless, the current study established the research affiliated institutions to have no significant difference between published and unpublished studies.

Our findings are consistent with previous research reporting that greater methodological design quality is associated with FTP. In particular, Yoon and Knobloch [31] demonstrated a trend between a greater percentage of RCT's and the likelihood of achieving FTP in comparison to observational studies. Additionally, Winnik et al [25] established a significant difference between published and unpublished abstracts concerning the study design of abstracts and likelihood of publication. Whilst both these studies reported that randomised controlled trials (experimental designs) were more likely to achieve FTP in comparison to observational studies designs ($p=0.01$), this was not reflected in our analysis where there was no significant difference between the publication of randomised and non-RCTs presented at BASK and BHS ($p=0.27$). This difference may be attributed to the underpowered nature of this analysis with such a small number of RCTs identified ($n=46$).

The present study had three principal limitations. The reliability of the data extraction process was not quantified. To the author's knowledge, only one previous study established the reliability of the data extraction process. Subsequently, Fleiss Kappa values ranged from 0.85 to 1.00 for categorical variables and intraclass correlation coefficients for continuous variables from 0.99 to 1.0 respectively. [25] Subsequently, 10,020 abstracts were utilised in the data extraction process, therefore the potential for errors in the variable extraction process is marginally larger than the potential for errors in the current study as fewer abstracts were involved. Secondly, both poster and podium presentation abstracts were included in this analysis. It would have been useful to determine whether there was a difference in publication rate of podium versus poster presentations. However it was not possible to ascertain from the abstracts printed within the Bone and Joint Journal's Orthopaedic Proceedings, whether the abstract was a poster or podium presentation. Finally, we intended to analyse for the effect of time from abstract to publication. However, given the relatively small number of published abstracts when divided by year from presentation, this analysis was underpowered and therefore of limited value. Nonetheless, this is one area which could be further explored in future APR evaluations.

To conclude, the APR reported was lower in comparison to previous research findings. This indicates that both orthopaedic sub-specialities are still in transition to better portray scholarly activity. Both statistically significant results and direction of study enquiry were established to be statistically significant precursors to FTP. The data reported in this paper may aid authors within future BHS and BASK annual conference meetings to achieve FTP, increasing the scholarly activity of both orthopaedic specialities. These findings encourage orthopaedic clinicians to facilitate an unbiased translation of new scientific evidence to enhance EBP. Authors and scientific journals must strive to publish both positive and negative research results to maintain scientific integrity. Without this ideal,

systematic literature reviews will be influenced by positive results bias, causing an overestimation in treatment effects, thereby limiting orthopaedic EBP.

DECLARATIONS

Funding: No funding was received to undertake this study

Ethics: Ethical approval was not required to undertake this study type.

Conflict of Interest: No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

Data Sharing: The research team provide permission for data sharing of the source data for this analysis on request.

FIGURE AND TABLE LEGENDS

Table 1: Abstract characteristics from each included BASK and BHS study abstract (N=744)

Table 2: Abstract to publication rate for the assessed BASK and BHS meeting for each analysed year.

Table 3: Factors associated with APR from the analysed BASK and BHS meeting across the years assessed.

Figure 1: Flow chart of abstracts identification for analysis

Supplementary Table 1: Extracted predictor variables and definitions for each variable analysed.

REFERENCES

1. Bonnie S. Evidence-based practice in clinical psychology: What it is, why it matters; what you need to know. J Clin Psych 2007;63:611–632.
2. Sackett DL. Evidence-based medicine. J Epidemiol Comm Health 2006;1: 3-5.
3. Thomas G, Pring, R.Evidence-based practice in education. London: McGraw-Hill Education, 2004.
4. Melnyk BM, Fineout-Overhol E. Evidence-based practice in nursing & healthcare: a guide to best practice. Philadelphia: Lippincott Williams & Wilkins, 2011.
5. Cohen KB, Johnson HL, Verspoor K, Roeder C, Hunter LE. The structural and content aspects of abstracts versus bodies of full text journal articles are different. BMC Bioinform 2010;11:118-129.
6. Rosmarakis ES, Soteriade ES, Vergidis PI, Kasiakou SK, Faglas ME. From conference abstract to full paper: differences between data presented in conferences and journals. FASED J 2005;19:673-680.
7. Petitti DB. Meta-analysis, decision analysis, and cost-effectiveness analysis: methods for quantitative synthesis in medicine. Oxford: Oxford University Press, 1999.
8. Mayden KD. Peer review: publication's gold standard. J Adv Pract Oncot 2012;3:117–122.
9. Bhandari M, Devereaux PJ, Guyatt GH, Swiontkowski MF, Sprague S, Schemitsch EH. An observational study of abstracts and subsequent full-text publications. J Bone Joint Surg, 2002;84-A: 615-21.
10. Daruwalla ZJ, Huq SS, Wong KL, Nee PY, Murphy DP. "Publish or perish"—presentations at annual national orthopaedic meetings and their correlation with subsequent publication. J Orthop Surg Res 2015;201:1-8.
11. Guryel E, Durrant AW, Alakeson R, Ricketts DM. From presentation to publication: the natural history of orthopaedic abstracts in the United Kingdom. Postgrad Med J 2006;82:70–72.
12. Macmillan CD, Moore AK, Cook RJ, Pedley DK. Abstract-to-publication ratio for papers presented at scientific meetings: a quality marker for UK emergency medicine research. Emerg Med J 2007; 24: 425-426.
13. Peng H, Wasserman M, Rosenfeld M. Factors influencing publication of abstracts presented at the AAO-HNS Annual Meeting. Otolaryngol Head Neck Surg 2006;135:197-203.
14. Sahu A, Nazary N, Harshavardana NS, Anand SJ, Johnson DS. The publication rates of presentations made at BASK annual meeting: an in-depth observational study. J Bone Joint Surg 2010; 92-Br: Supp III: 409.
15. Scherer RR, Langenberg P, Von Elm E. Full publication of results initially presented in abstracts. Cochrane Database Syst Rev 2007;2:MR000005.
16. Whitehouse MR, Atwal NS, Blom AW. Publication rates for hip surgery-related abstracts presented at national and international meetings. J Orthop 2009;32:11-13.

17. Udovicich C, Soh B, Law S, Hoe V, Lanfranco D, Perera K, Duong C, Chan S. Predictive factors for publication of abstracts at the Royal Australasian College of Surgeons Annual Scientific Congress. ANJ J Surg 2017: In Press.

18. Basilious A, Benavides Vargas AM, Buys YM. Publication rate of abstracts presented at the 2010 Canadian Ophthalmological Society Annual Meeting. Can J Ophthalmol 2017;52:343-8.

19. Castaldi S, Giacometti M, Toigo W, Bert F. Analysis of full text publication and publishing predictors of abstracts presented at an Italian public health meeting (2005–2007). BMC Res Note 2015;8:1463-7.

20. Forlin E, Fedato RA, Altmann Junior W. Publication of studies presented as free papers at a Brazilian national orthopedics meeting. Rev Bras Ortop 2013;48:216-220.

21. Pierson J. The top 10 reasons why manuscripts are not accepted for publication. Respir Care 2004;49: 1246-1252.

22. Wuchty S, Jones BF, Uzzi B. he increasing dominance of teams in production of knowledge. Science 2007;316:1036-1039.

23. Dickersin K, Chan S, Chalmers TC. Publication bias and clinical trials. Control Clin Trials 1987;8 343–353.

24. Singleman L. Publication bias reconsidered. Political Analysis 1999;8:202-210.

25. Winnik S, Raptis DA, Walker JH, Hasun M, Speer T, Clavien PA, et al. From abstract to impact in cardiovascular research: factors predicting publication and citation. Eur Heart J 2012;33:3034–3045.

26. Goldacre MJ, Lambert TW, Goldacre R, Hoang U. Career plans and views of trainees in the Academic Clinical Fellowship Programme in England. Med Teach 2011;33:637-643.

27. Jackson KR, Dalulski A, Kay RM. Publication of abstracts submitted to the annual meeting of the Paediatric Orthopaedic Society of North America. J Paed Orthop 2000;20:2-6.

28. NHS choices. NHS choices. [Online].; 2016 [cited 2016 August 7. Available from: http://www.nhs.uk/servicedirectories/pages/nhstrustlisting.aspx.

29. Cheng K, Preston C, Ashby D, O'Hea U, Symth RL. Time to publication as full reports of abstracts of randomized controlled trials in cystic fibrosis. Paed Pulmon 1998;26:101-105.

30. Demola PM, Hill DL, Rogers K, Abboud JA. Publication rate of abstracts presented at the shoulder and elbow session of the American Academy of Orthopaedic Surgery. Clin Orthop Relat Res 2009;467: 1629-1633.

31. Yoon U, Knobloch K. Assessment of reporting quality of conference abstracts in sports injury prevention according to CONSORT and STROBE criteria and their subsequent publication rate as full papers. BMC Med Res Methodol 2012;12:1-9.

Table 1: Abstract characteristics from each included BASK and BHS study abstract (N=744)

Characteristic		**Published N =176**	**Unpublished N = 568**
Sample size (N=668)	Mean (SD)	585.37 (4970.7)	263.97 (2282.3)
	<100 participants (N=481)	110 (68)	371 (73)
	≥100 participants (N=187)	52 (32)	135 (27)
Statistical significance reported (%)	Yes	92 (52)	208 (37)
	No	84 (48)	360 (63)
Grade/occupational role of author (%)	Research Fellow/Lecturer	19 (11)	53 (9)
	Consultant	42 (24)	79 (14)
	Professor	8 (5)	19 (3)
	Registrar	47 (27)	135 (24)
	Student	3 (2)	7 (1)
	Orthopaedic Surgeon	20 (11)	32 (6)
	Unknown	37 (21)	243 (43)
Study design* (%)	Cohort study	43 (24)	188 (33)
	Case-control	27 (15)	45 (8)
	RCT	14 (8)	32 (6)
	Cross-sectional	7 (4)	35 (6)
	Case report	17 (10)	45 (8)
	Cadaveric	2 (1)	2 (0)
	SLR	1 (1)	1 (0)
	Unknown	65 (37)	220 (39)
Research affiliated institution (%)	Specialist Hospital	26 (15)	60 (11)
	General Hospital	67 (38)	221 (39)
	University Hospital	47 (27)	173 (30)
	Private Hospital	6 (3)	13 (2)
	University	17 (10)	61 (11)
	Unknown	13 (7)	40 (7)

RCT – randomised controlled trial; SD: standard deviation; SLR: systematic literature review

Table 2: Abstract to publication rate for the assessed BASK and BHS meeting for each analysed year.

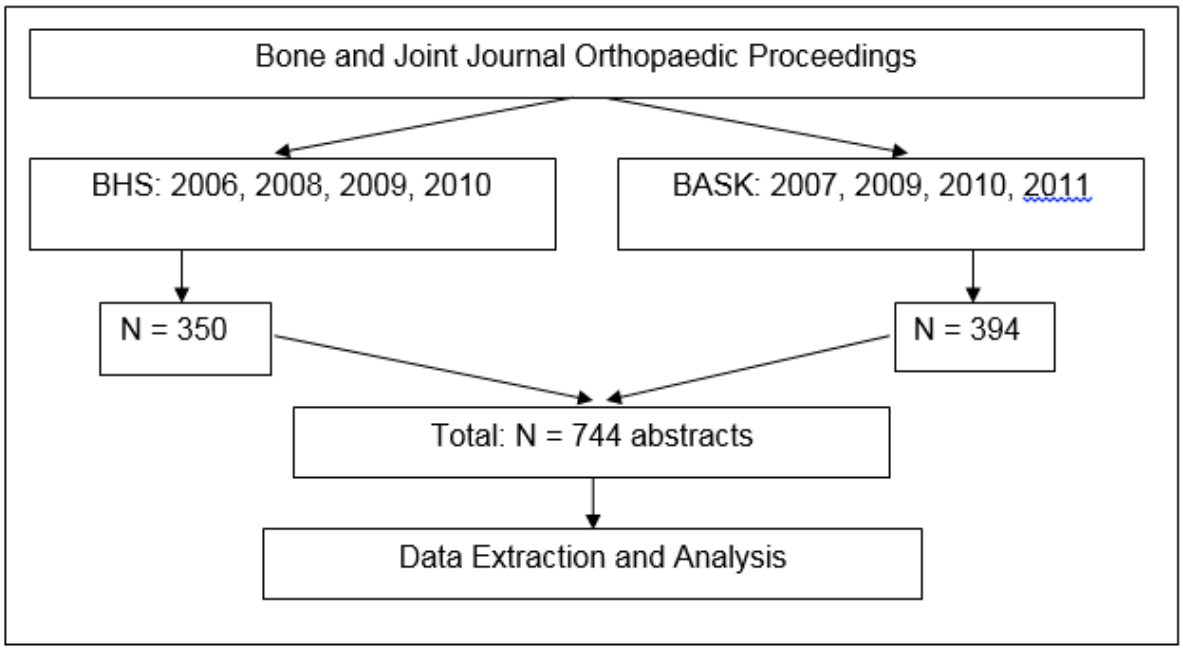
Year	BASK		BHS		Total	
	APR	N	APR	N	APR	N
2006	No Data		28.9	97	28.9	97
2008	23.8	80	11.6	129	16.3	209
2009	35.6	104	14.3	28	31.1	132
2010	24.8	101	28.1	96	27.2	191
2012	19.3	109	No Data		19.3	109
Total	25.9	394	21.1	350	23.7	744

APR: Abstract to publication rate as %: BASK – British Association for Surgery of the Knee; BHS – British Hip Society.

Table 3: Factors associated with APR from the analysed BASK and BHS meeting across the years assessed.

Variable		Odds Ratio (95% Confidence Intervals)	P-Value
Mean sample ize	<100 participants	0.77 (0.52 to 1.13)	0.1819
	≥100 participants		
Statistical significance reported	Yes	0.58 (0.37 to 0.74)	0.0002
	No		
Grade/occupational role of author	Clinical	0.86 (0.56 to 1.34)	0.5157
	Academic		
Study design	Observational	0.69 (0.35 to 1.34)	0.2704
	Experimental		
Research affiliated institution	Public Hospital	0.67 (0.25 to 1.79)	0.4226
	Private Hospital		
	University	1.12 (0.64 to 1.98)	0.6920
	Non-University		

Figure 1


Bone and Joint Journal Orthopaedic Proceedings
BHS: 2006, 2008, 2009, 2010
BASK: 2007, 2009, 2010, 2011
N = 350
N = 394
Total: N = 744 abstracts
Data Extraction and Analysis

Supplementary Table 1: Extracted predictor variables and definitions for each variable analysed.

Variable	**Extracted data**
Grade of the primary author	"Research fellow", "Consultant", "Professor" "Registrar", "Lecturer", "Student", "Orthopaedic surgeon", "Engineer"
Research affiliated institution	"Specialist", "General", "University hospital", "Private", "University"
Sample size	Not Applicable
Study design	"Prospective Cohort study", "Retrospective case control", "Randomised control trial", "Cross sectional", "Case-control", "Cadaveric", "Systematic literature review".
Statistical significance	"Yes", "No"
Publication status	"Published", "Unpublished"