AN ANALYSIS OF CURRENT PROSTHETIC AND ORTHOTIC AUTHORSHIP CHARACTERISTICS, STUDY DESIGN, AND LOCATION

Johnsen, Mariah MSPO; Peterson, Sara CPO, MBA, FAAOP, Fiedler, Goeran, PhD
ABSTRACT

Evidence-based practice combines a practitioner’s knowledge with evidence established through scientific research. Knowledge of where and how that research is performed as well as publishing trends will help researchers and practitioners to find and apply the type of research he or she wants. A retrospective analysis of articles published in the Journal of Prosthetics and Orthotics (JPO), the Journal of Rehabilitation Research & Design (JRRD), Prosthetics and Orthotics International (P&O International), and Archives of Physical Medicine and Rehabilitation (Archives of PM&R) between the years of 2007 and 2015 was performed. Articles were sorted based upon authorship characteristics, location, level of evidence, and data collection method. A total of 938 prosthetics and orthotics (P&O) related articles were analyzed. Authorship characteristics for P&O International were not included in the analysis because they were not published by the journal. The objective of this study was to provide quantitative information on current trends in P&O literature. It was found that the states that publish the most P&O related articles are Washington and Illinois and that these articles are usually case studies or case-control studies with the majority being performed prospectively. From 2007 to 2015, a statistically significant trend was found toward a decreased percentage of articles having a P&O professional as an author. Of the journals, JPO had the highest percentage of P&O professionals as authors. JPO was also the only journal to have a statistically significant yearly decrease in the percentage of P&O professionals as an author. These findings did not support the hypothesis that the percentage of P&O professionals as authors would increase with increasing evidence-based practice standards.

Clinical Application

This study will help clinicians easily identify which journals have the highest percentages of P&O professionals as authors, and help clinicians identify journals with potentially relevant research. In addition, this study will display the need for journals to increase their efforts to attract more P&O practitioners as authors and improve the evidence level of published articles.

Key Words

Evidence Based Practice, Study Design, Location, Prosthetics, Orthotics

INTRODUCTION

The ultimate purpose of health-related research is to benefit the patient. One way in which this is done is through the application of evidence-based practice (EBP). EBP is defined as “the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients”¹. The field of P&O began focusing on increasing EBP in the 1990’s and its importance has since increased due to pressure to improve patient outcomes and to justify component use. However, EBP standards in the field of P&O are still not as developed as in other medical fields². There is currently a divide between published research and the usefulness of that research to practitioners. In his 2009 study, Geil states that even clinically based research, which should be the most clinically applicable, often fails to meet the expectations of clinicians³. Geil concluded that the more clinicians perform research, the more that research should be clinically applicable⁶. Despite difficulties, EBP in allied health professions is commonly accepted as a necessary and important step to improve patient outcomes².
The effectiveness of evidence based practice relies on both the availability of research and the ability of practitioners to use it appropriately. When EBP is instated into a P&O practice, the manner is often haphazard\(^4\). This can affect the clinician’s ability to access information and to constructively discuss or apply his or her findings. To this end, Titler and Ramstrand proposed multiple models that could be used to implement EBP into clinical use\(^4,5\). Encouraging clinicians to use EBP is only the first step. Geil proposed that the more clinicians perform research, the more that research should be clinically applicable because clinicians have insight into what evidence is needed that other researchers might not\(^3\).

However, the field of P&O is also suffering from a lack of evidence and research in general to support clinical practice. This lack of research may be due to a lack of funding or funding for topics not related to clinical application, a lack of time on the part of the clinicians, research done by manufacturers not being published, and difficulty achieving high levels of evidence due to study type or low numbers of subjects\(^3\). This lack of specific research may also be due to the inherent nature of the field. For example, the ratio of upper limb prosthetic fittings to lower limb fittings is 1:30\(^6\). This affects the number of patients available for studies focusing on upper limb prostheses and therefore the level of evidence of these studies\(^7\). Even when numbers of patients are relatively high, they are still generally not high enough to produce studies with high levels of evidence. Randomized control trials (RCTs) may be difficult to perform because of difficulty blinding patients or the lack of a control. However, as defined by Ramstrand and Brodtkorb in 2008, the use of EBP by P&O practitioners should be defined by the use of the best available evidence and integrated with professional experience to achieve the best result\(^8\).

Another potential reason for the lack of practitioner involvement in research is due to education. Van Twillert et al. advocated for a cultural change in which clinicians are “educated as lifelong, self-directed learners and are encouraged to pursue relevant clinical research themselves”\(^9\). One way to do that is through education of both practitioners and researchers. Gholamreza and O’Toole said that the “geographical dispersion, relatively recent institutional establishment and small number of programmes all contribute to the potential isolation and consequent repetition of ineffective curricular development” of education from P&O schools\(^10\). Increasing education standards could help to better prepare practitioners to interpret and perform research and to incorporate EBP into clinical decisions. To this end, the American Board for Certification in Orthotics, Prosthetics and Pedorthics raised their education requirement to a bachelor’s degree in 1986 and raised their standards to a master’s degree in 2010 which was formally implemented in 2013\(^11\). If Van Twillert et al. are correct, changing the education standards should help to improve practitioner involvement in the research process\(^9\).

This study attempts to quantify the changing rates of P&O practitioners publishing research over the years 2007 to 2015. Visualizing the locations and type of research in a heat map provides insight into the current state of P&O literature and where it is being performed. It was hypothesized that as the education standards rise and EBP becomes more important, the percentage of P&O professionals publishing literature should increase.
METHODS

A total of 938 P&O related articles from *Journal of Prosthetics and Orthotics (JPO)*, *Prosthetics and Orthotics International (P&O International)*, *Journal of Rehab Research and Development (JRRD)*, and *Archives of Physical Medicine and Rehabilitation (Archives of PM&R)* published from the years 2007 to 2015 were sorted into an Excel database. Journals were selected from the list of the top-cited articles in limb prosthetics as set by Eshraghi et al. (2013). It is assumed that these four journals provide a nearly comprehensive amount of articles based on the percentage of the results of a PubMed search for prosthetic limb and orthotic device articles from the years 2007 to 2015. Articles that included the keywords, “Amputation,” “Prosthesis,” “Orthosis,” “Brace,” “Splint,” or “Amputee” were included. All P&O related articles were included in this study except for editor’s notes, professional opinion, and conference notes. Articles were manually sorted for relevance. Data from each article was then sorted into key categories: Title, Journal, Issue, Volume, Publication Year, Sackett’s Rule of Evidence as described by Eshraghi et al. and Ramstrand and Brodtkorb, Research Design, Country, State (if US), City, P&O Professional as an Author, and P&O professional as First or Second Author\(^8,12\). Categories were based upon Ramstrand and Brodtkorb’s six year retrospective study of primary authors in *JPO* and *Prosthetics and Orthotics International* from 2000 to 2006\(^8\). Levels of evidence are shown in Table 1 below.

<table>
<thead>
<tr>
<th>Levels of Evidence</th>
<th>Description</th>
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<tbody>
<tr>
<td>1a</td>
<td>Systematic reviews of RCTs</td>
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<tr>
<td>1b</td>
<td>Individual RCTs</td>
</tr>
<tr>
<td>2a</td>
<td>Systematic review of cohort studies</td>
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<tr>
<td>2b</td>
<td>Individual cohort study</td>
</tr>
<tr>
<td>3a</td>
<td>Systematic review of case-control studies including case-series</td>
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<tr>
<td>3c</td>
<td>Individual case-control study</td>
</tr>
<tr>
<td>4</td>
<td>Case-series</td>
</tr>
<tr>
<td>5</td>
<td>Design and development</td>
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</tbody>
</table>

**Table 1**: Levels of evidence according to Ramstrand and Brodtkorb (2008) and Eshraghi et al.\(^8,12\).

Means of data collection was defined as prospective, cross-sectional, retrospective, longitudinal, or other according to the description provided by Song and Chung and Ramstrand and Brodtkorb\(^8,13\). The category of “other” was used for studies which did not have human subjects.

**Data Analysis:**

Data from the 938 analyzed articles was organized into heat maps according to publication location and year as well as bar graphs by year, P&O professional authorship percentages, and into pie charts by level of evidence and data collection method. Location was determined as the location where the study was performed. If this information was not available or not applicable as in the case of a systematic review, the location was determined by the location of the corresponding author. Heatmaps were created using amcharts.com. A linear regression analysis was performed to determine statistically significant trends in percentage of P&O professional authorship per year.
The linear regression used a 95% confidence interval and defined statistically significant as having a P value of less than 0.05.

RESULTS

The heat maps were created of the United States according to P&O related literature published within each state from 2007 to 2015 (Figure 1). Number of articles published by country was recorded in a table (Table 2) for ease of reading.

![Heat map of the United States](image)

**Figure 1**: Articles published in the United States sorted by number of P&O related articles published between 2007 and 2015. The largest number of articles in the United States were published with locations in Washington (52), Illinois (50), Ohio (38), and Florida (35). There were a total of 415 articles published in the USA in *JPO, JRRD, Archives of PM&R*, and *P&O International* between 2007 and 2015. N = 415.

In addition, it was found that 94% of articles published in Washington were published in Seattle, 86% of articles from Illinois were published in Chicago, 52% of Ohio’s articles were published in Cleveland, and 54% of Florida’s articles were published in Tampa.

Next, the number of articles was sorted based upon publishing country. Since a heat map would be too difficult to read, the top ten countries that published the most P&O related literature were sorted into a table. This can be seen in Table 2.
### Table 2: The top ten countries with the most P&O related articles published between the years of 2007 and 2015 in *JPO, JRRD, Archives of PM&R*, and *P&O International*. N = 523

<table>
<thead>
<tr>
<th>Number of Articles Published</th>
<th>Country</th>
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<tbody>
<tr>
<td>415</td>
<td>USA</td>
</tr>
<tr>
<td>78</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>73</td>
<td>The Netherlands</td>
</tr>
<tr>
<td>61</td>
<td>Canada</td>
</tr>
<tr>
<td>43</td>
<td>Iran</td>
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<tr>
<td>36</td>
<td>Australia</td>
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<tr>
<td>28</td>
<td>Sweden</td>
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<tr>
<td>25</td>
<td>Japan</td>
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<td>22</td>
<td>Turkey</td>
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</table>

Articles were also sorted based upon authorship characteristics. Only 571 of the original 938 articles could be analyzed for authorship characteristics because *P&O International* did not publish the certifications of every author.

**Figure 2**: A statistically significant negative trend with slope of negative 2.6% per year was found for *JPO*. \( P = 0.048 \), and the \( R^2 \) value is 0.4479. Neither of the other two journals displayed a significant trend. N=571
Data from all three applicable journals was combined in order to find the overall percentages of P&O professionals as either an author or 1st or 2nd author in published P&O literature between 2007 and 2015. A significant negative trend was found after linear regression analysis for a P&O professional being an author on a published paper.

Levels of evidence and means of data collection were arranged into pie charts shown in Figure 5 and 6 which combined all articles from 2007 to 2015.
**Figure 5:** P&O related literature published 2007-2015 in *JPO, JRRD, Archives of PM&R, and P&O International* by level of evidence. N=938.

**Figure 6:** P&O related literature published 2007-2015 in *JPO, JRRD, Archives of PM&R, and P&O International* by study type. N=938.
DISCUSSION

Study Design:

As shown in Figure 5 and 6, case studies (28.04%) and case-control studies (25.59), were the most commonly published level of evidence. This is likely because they are the least expensive and time-consuming because neither case studies nor case-control studies require large numbers of subjects or blinding. The majority, 55.55%, of articles were prospective studies followed by retrospective studies. Further analysis could be performed to determine if these findings change based upon the publishing journal or year, and if there are any significant trends to those changes. This knowledge could be used by researchers planning on publishing their findings or by those looking to read certain types of studies.

Location:

Within the top four states, the majority of publications were from a single city: Seattle, Washington 93%; Chicago, Illinois 86%; Cleveland, Ohio 53%; and Tampa, Florida 54%. States with the largest number of publications each contain a school dedicated to P&O, with the exception of Ohio. In addition, those schools are located in or near the main publishing city. However, there was a potential for bias. Papers included authors from more than one location. Figure 1 and Table 2 could be biased toward locations which have the facilities to support research or that contributed the most corresponding authors. Corresponding authors aren’t always the ones performing or leading the research. The analyzed journals were written in English, so there is an expected bias toward English speaking countries.

Authorship Characteristics:

Ramstrand and Brodtkorb found that the percentage of P&O professionals as first authors between 2000 and 2006 increased significantly. In contrast, Figures 2 and 4 show a statistically significant decrease of P&O professionals as authors between 2007 and 2015. This could be due to factors such as P&O professionals who wish to perform research lacking funding, time, or interest. These findings refuted the initial hypothesis that increasing education standards and awareness of EBP would cause an increase in the percentage of P&O professionals publishing articles.

Potential bias could result from the fact that P&O certifications differ depending upon country of origin. Certifications in P&O can be written as a BSc(hons) or simply a BSc or MSc making them difficult to identify. In addition, authors don’t always publish using their full credentials. An additional search was performed for any author with a BSc or MSc to identify their specialty, but not all could be determined. This could have contributed to the lower percentage of P&O professionals publishing in JRRD and Archives of PM&R as these journals had a greater number of articles published outside the US than JPO. In order to counteract this downward trend, clinics and journals should place more emphasis on clinicians publishing relevant research. In order to increase the use of EBP in the field of P&O, there first needs to be an increase in the base of clinically relevant research.
CONCLUSION

Analysis of literature published between 2007 and 2015 indicates that the percentage of P&O professionals publishing P&O related research is falling. This trend may indicate less available clinically relevant data that could be used to justify clinical decisions, and a decrease in interest in publishing research from the P&O community. Many of the states that publish the most P&O related literature also contain research universities which offer a P&O degree. Currently, there is a tendency toward publishing case studies and case control articles. Additional analysis could be done to determine trends in level of evidence of articles or means of data collection depending upon year and journal. Increased awareness of this issue and encouragement to publish may help to reverse the decreasing percent of P&O professionals as authors.

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REFERENCES


