

# Longitudinal Evaluation of *Journal of Athletic Training* Author Credentials: Implications for Future Research Engagement in Athletic Training

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**Purpose:** To employ retrospective trend analysis in an attempt to provide a layered description of the relative contribution (per credential) of clinical athletic trainers (those without terminal degrees) to authoring scientific literature in the *Journal of Athletic Training (JAT)*. From these data, our secondary purpose was to evaluate trends relative to changes in journal policy and increased educational rigor or professional limitations over the past decade, discussing how they may affect the potential for clinical athletic trainers to contribute to *JAT*.

**Design:** Exploratory study design with trend analysis.

**Participants:** Data collection and analysis included a trend evaluation of the credentials of clinical athletic trainer authors in *JAT* and the teams (by credential) of authorship to determine the credentials of authors who published in *JAT*.

**Measurements:** Longitudinal tabulation of *JAT* author credentials from 1995 through 2007.

**Results:** We noted increases in the absolute number of research articles per volume and the number of authors per

article and a decrease in the relative percentage of authors who were athletic trainers. The results also suggested that the bachelor of science degree (BS-ATC, representative of clinical athletic trainers without advanced degrees) and Doctor of Medicine (MD) credential may be underrepresented in *JAT* authorship.

**Conclusions:** Postgraduate research training may facilitate scientific article contribution by athletic trainers. Continued evolution in the athletic training evidence-based medicine movement should foster research-based mentorship during education. Cultivating collaborations between clinical athletic trainers and research teams may also promote outcomes assessment trials, which will benefit athletic training practices.

**Key Words:** research engagement educational models, evidence-based medicine, athletic training research mentorship, athletic training research investigation, author analysis, publication analysis

In September of 1956, the *Journal of the National Athletic Trainers' Association* was initiated by A.L. Dickinson, who stated 3 primary goals for the journal: "(1) to exchange ideas and techniques, (2) to disseminate information of professional interest from a multitude of sources, and (3) to raise the professional stature of the NATA [National Athletic Trainers' Association] through written contributions to the medical literature."<sup>1</sup> However, in the 1950s, "athletic trainers were not interested in research or publishing their ideas," and Dickinson indicated that it was like "pulling teeth to get material" for the *Journal*.<sup>1</sup> Hence, the content of early issues of the *Journal* consisted primarily of board meeting minutes, committee reports, letters from the president, certification examination dates, and reprinted material from other journals.<sup>1</sup> More than 30 years later, in 1990, the journal's name changed to the *Journal of Athletic Training (JAT)*, reflecting increased growth and support from the NATA membership. A resultant movement ensued to differentiate the society's literature into 2 distinct publications: a scholarly journal and an association-oriented newsmagazine.<sup>1</sup> In 2004, *JAT* progressed to online manuscript submission, which afforded a broader interpretation of "athletic training" among international readers and

influenced a more diverse population of authors to submit manuscripts for publication in the *Journal*. An important moment in the *Journal's* history occurred in 2007, when *JAT* was accepted for indexing in MEDLINE (with retrospective indexing back to 1992) alongside other notable peer-reviewed medical journals in the literature database. Cumulatively, these changes have increased potential diversity in manuscript submission topics and the credentialing backgrounds of authors in *JAT*.<sup>2</sup>

Concomitant with the changes in the *JAT* format, recent data indicated changes in the employment opportunities available to athletic trainers (ATs). Currently, a prevalence (>50%) of ATs are now employed in settings other than high schools, colleges, and professional sports (eg, hospitals, physician and physical therapy clinics, and industrial settings), perhaps guided by the opportunity to receive third-party reimbursements.<sup>3,4</sup> The trend toward third-party reimbursement in athletic training practice has contributed to an increased use of evidence-based outcomes to guide clinical approaches.<sup>5</sup> However, athletic training scholars are concerned that outcomes research for athletic training is "lagging behind" other health care professions and that increased educational rigor might be necessary to facilitate the needed investigations.<sup>6</sup> Athletic

training education has evolved into a more standardized and distinct academic major at the undergraduate and graduate levels, ultimately leading to an increased need for doctoral-educated ATs to fill tenure-track faculty positions.<sup>7</sup> Several authors<sup>4,7</sup> have suggested to include instruction in research methods in entry-level coursework, so that future ATs can gain the tools needed to appraise and potentially contribute to the research base. Currently, the Commission on Accreditation of Athletic Training Education indicates that statistics and research design should be included in the subject matter that constitutes the “core” of the AT academic curriculum.<sup>8</sup> Engaging students earlier in the research process may lead to future ATs with a better set of tools to read, assess, and apply the literature to current practices. This early engagement may motivate students to participate in research teams as entry-level clinicians. Research teams recognize that clinical ATs (ATs employed in outpatient clinic, clinical-outreach/contracted services, college-professional staff/athletics/clinic, corporate, industrial/occupational, military, professional sports, or secondary school settings whose primary responsibility is direct patient care) provide a specialized mechanism to scientifically investigate areas such as the utility of manufactured prophylactic devices, outcomes of surgical or rehabilitation techniques, and sport-related epidemiologic questions.<sup>5,9–11</sup>

Realizing this important potential, leaders within the NATA have encouraged ATs to increase their contributions to the “written word.”<sup>2</sup> Through greater involvement in research, ATs are able to determine outcomes of medical devices or techniques used with athletes and patients<sup>11</sup> and help produce evidence for publication as the “written word” in *JAT*.<sup>5</sup> However, fundamental differences (logic and experiential-based patient care versus randomized application of treatments) between the clinical AT and the “researcher,” coupled with the constant pressure of responsibilities and the desire to provide the “best care” (as opposed to the potential for randomization into a placebo control) for their athletes and patients, may be continuing obstacles for ATs’ research engagement. These obstacles may deter ATs employed in clinical practice from participating in clinical research investigations, which provide the critical outcomes needed to determine the “best care” based on evidence for the athlete or patient.<sup>11</sup>

It is unclear whether recent changes in the *JAT* format or athletic training educational structure have affected the limitations that dissuade ATs from collaborating with research teams that might allow them to contribute outcomes studies to *JAT* scientific articles. One method (with understood limitations) of evaluating the evolution and importance of a profession’s evidence-based practices is to appraise the society’s main research journal. The purpose of this exploratory descriptive study was to employ retrospective trend analysis in an attempt to provide a layered description of the relative contribution (per credential) of ATs in authoring scientific literature in *JAT*. From these data, our secondary purpose was to evaluate trends relative to changes in journal policy and increased educational rigor or professional limitations over the past decade and to discuss how they may affect the potential for clinical ATs to contribute as *JAT* authors.

**Table. Grouped Credential Categories**

Athletic Trainers’ Credentials	Non-Athletic Trainers’ Credentials
ATC	No credential
MA/MS/MEd/MPH, ATC	BA/BS
ATC, PT	MA/MS/MEd
MA/MS/MEd, ATC, PT	MA/MS/MEd, PT
PhD/EdD/HSD/DPH, ATC	PT
PhD/EdD/HSD/DPH, ATC, PT	PhD/EdD/HSD/DPH
MD, ATC	PhD/EdD/HSD/DPH, PT
Other, ATC	MD
	MD, PhD
	Other

Abbreviations: ATC, certified athletic trainer; BA, bachelor of arts; BS, bachelor of science; DPH, doctor of public health; EdD, doctor of education; HSD, doctor of health science; MA, master of arts; MD, doctor of medicine; MEd, master of education; MPH, master of public health; MS, master of science; PhD, doctor of philosophy; PT, physical therapist.

## METHODS

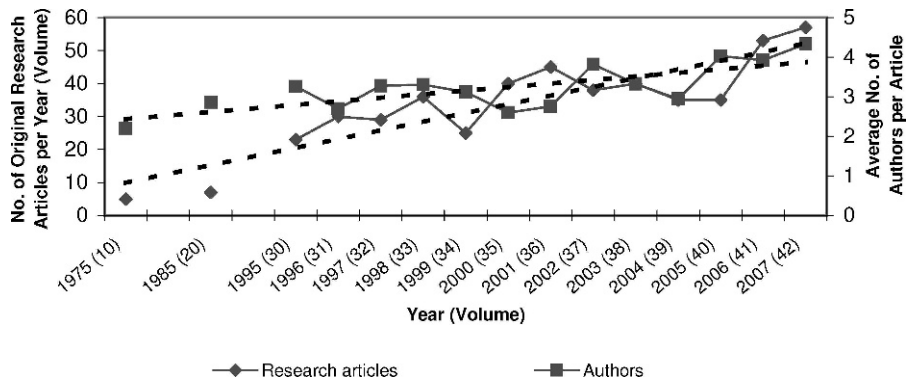
### Procedures

The primary phase of data analysis included a longitudinal trend evaluation of the credentials of AT authors and the author teams (by credential) to determine potential tendencies of authorship collaboration from those who publish in *JAT*. To obtain these data, every original research article (reviews and case reports were excluded) published in *JAT* from 1995 through 2007 (these years were available for online tabulation) was accessed from the PubMed Central Web site (<http://www.pubmedcentral.nih.gov/tocrender.fcgi?journal=131&action=archive>). From identified articles, we categorized the authors into a single-category header based on their listed credentials (Table 1). Once author credentials were tallied, the articles were grouped by volume representing each year of publication (1975, 1985, 1995–2007). To facilitate interpretation of the credential analysis, data were further synthesized into groups of author teams: (1) with an AT author (authors with an ATC and any combination of other credentials); (2) with any form of terminal degree (PhD, EdD, HSD, or MD); and (3) with ATC and terminal degree. From these data, longitudinal plots of the credential authorship of *JAT* were generated.

To gain a better understanding of the historical evolution of the *Journal*, similar data were also obtained from hard copy journal archives from the years 1975 and 1985 (volumes 10 and 20, respectively) with the assistance of the *JAT* editorial office. To demonstrate the interrelationships of the credentials of *JAT* authors, we generated and independently evaluated longitudinal regression plots.

## RESULTS

The data collected from authorship information in *JAT* were used to help establish the relative contributions of individual academic credentials and to demonstrate the frequency of contribution to *JAT*. Two trends emerged in article and authorship history of *JAT*: (1) increased absolute number of research articles per volume, and (2) increased number of authors per article (Figure 1). Also noted were trends reflecting an increase in the absolute numbers of published research articles and meta-analyses



**Figure 1.** Trends for absolute number of original research articles and average number of authors per article, 1975, 1985, 1995–2007. Dashed lines indicate trend lines.

in *JAT* and a decrease over the past decade in the relative percentage of *JAT* authors who have the ATC credential (Figure 2).

Longitudinal trends for the absolute numbers of each MD, PhD, and MS credential are presented in Figure 3A (Note: *PhD* reflects any doctoral credential, including PhD, EdD, HSD, or DPH; *MS* reflects those with the MA, MS or MEd degree.). The percentages of these author credentials relative to the total credentials tallied in each volume are shown in Figure 4A. Each of these trends suggests a growing influence of those with doctoral (PhD, etc) credentials contributing to *JAT* authorship. To delineate the trends of AT certification by academic degree, Figure 4A depicts the absolute numbers of each author credential, whereas Figure 4B provides an indication of the relative measure of each credential among all of the authors to *JAT* for each volume. These trends suggest an influx of doctoral-trained ATs contributing authorship to *JAT* and, in part, clarify the trends represented in Figure 3A and B.

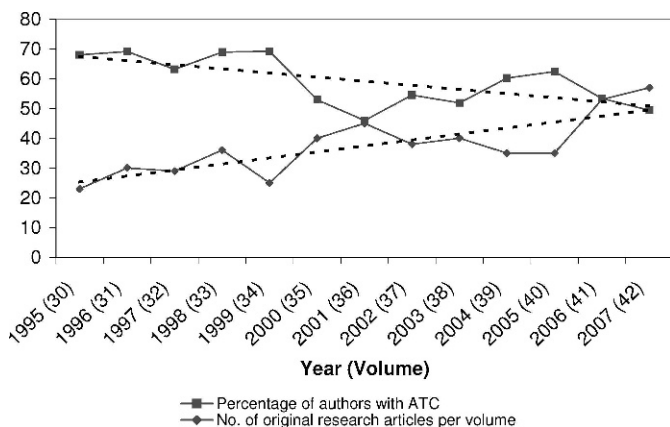
We noted strong representation by authors with terminal degrees and the AT credential from 1995 through 2007 (Figure 5). However, the BS, ATC (no advanced degree beyond a bachelor's degree) and MD credentials may be

underrepresented populations in the *JAT* authorship. The plots in Figure 6 represent author teams over the past decade. A continued theme from the previous plot (Figure 5) indicated that authors with terminal degrees (PhDs, EdDs, etc) were a critical factor for manuscript publication. Collaborations with MDs were the most underrepresented type of authorship team.

## DISCUSSION

Multiple underlying factors may affect trends in ATs' scholarly productivity via publication in the medical literature (Myer et al, unpublished data, 2008). Education and experience may play roles, but further evaluation is warranted to determine whether access to research scientists and collaboration foster constraints that limit research engagement for ATs, particularly those primarily engaged in clinical practice. Over the history of *JAT*, 2 strong trends have emerged in the absolute number of research articles per volume and the number of authors per article, which have both increased (Figure 1). Early issues of the *Journal* provided limited, if any, original research.<sup>1</sup> However, by 1990, *JAT* was established as the publication for presenting original athletic training research.<sup>1</sup> In addition, the creation of the *NATA News* provided a forum for news-oriented content, ultimately freeing more *JAT* space for publication of original research articles. Furthermore, submissions of annual NATA meeting abstracts have grown by more than 100% in the past decade; these abstracts, which were previously published in *JAT* proper, are now contained in a supplemental issue, further increasing *Journal* space for original research publications.<sup>11</sup> Cumulatively, it appears that these *JAT* changes reflect a "research evolution" in athletic training, yet obtaining the best evidence for clinical practices continues to drive the desire for strong research development in the society.<sup>11</sup>

Collaboration with ATs engaged in clinical practice may allow the development of research that can directly influence specific practices used in the field. Our data (Figure 1) indicate a trend toward collaboration, as noted by the increase in the average number of authors from 2.2 to 4.3 per research article in *JAT* from 1995 to 2007. Increased numbers of authors per article may be a measure of increased scientific rigor via increased specialty contribution to each research article or reflect the need for faculty seeking tenure and promotion to publish refereed



**Figure 2.** Overall percentage of authors who held athletic training certification credential relative to the overall number of original research articles per volume. Note: The tabulated number of authors ( $n = 1653$ ) reflects each author for every article. Some authors' credentials are represented more than once if they authored more than 1 article in any of the tallied volumes. Dashed lines indicate trend lines.

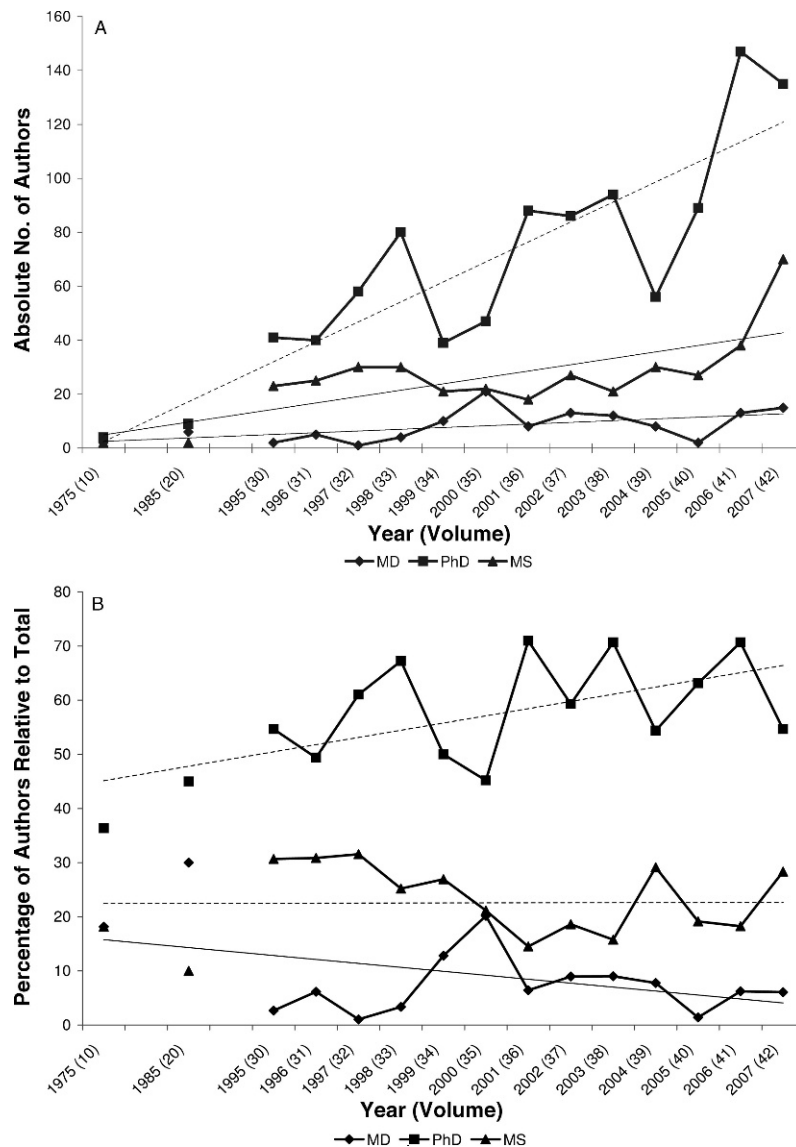


Figure 3. A, Absolute numbers of each credential for the outlined volumes. B, Percentage of author credentials relative to the total credentials tallied in each volume. Note: MD reflects an MD or DO; PhD reflects those with a PhD, EdD, HSD, or DPH; and MS reflects those with an MA, MS, or MEd. Dashed lines indicate trend lines.

articles. In addition, “new scholars in athletic training are entering the academy with expectations of publishing peer-reviewed papers and securing external grants at the same level as more mature disciplines.”<sup>12</sup> These extrinsic motivators and goals may encourage faculty members to collaborate more often, but whether this additional collaboration translates into changes in evidence-based clinical practice is unclear. Along with the changes in AT education, another factor contributing to AT research is that formal accreditation was implemented during the current study period, increasing the need for ATs with terminal degrees. In addition, more athletic training master’s degree programs have evolved, influencing students to conduct research along their faculty mentor’s research interests and likely manifesting as increased numbers of abstract and original research publications. Starkey and Ingersoll<sup>13</sup> reported that full professors in athletic training faculties demonstrated the highest scholarly productivity index relative to other academic appointments. They suggested that the tenure process should

continue to influence scholarly productivity among tenured AT faculty; however, clinical research influenced by non-doctoral-trained ATs is also crucial to achieving scholarship and developing evidence-based practices as a whole in the athletic training profession.<sup>13</sup> The prevalence of collaboration among ATs in clinical practice, doctoral-level ATs, and other specialists, as well as barriers to integration, should be further investigated. In addition, research and collaborative author efforts outside research and university settings should be assessed for potential barriers and population access.

A trend over the last decade reflects an increase in the absolute number of published research articles in *JAT* and a decrease in the relative percentage of authors who are ATs (Figure 2). This may be a sign of increased collaborations with non-ATs in combination with the shift to an online submission process; the latter may encourage those in diverse scientific fields to submit their work to *JAT*. Accordingly, *JAT* readership has also likely diversified as a result of increased scientific rigor combined with the

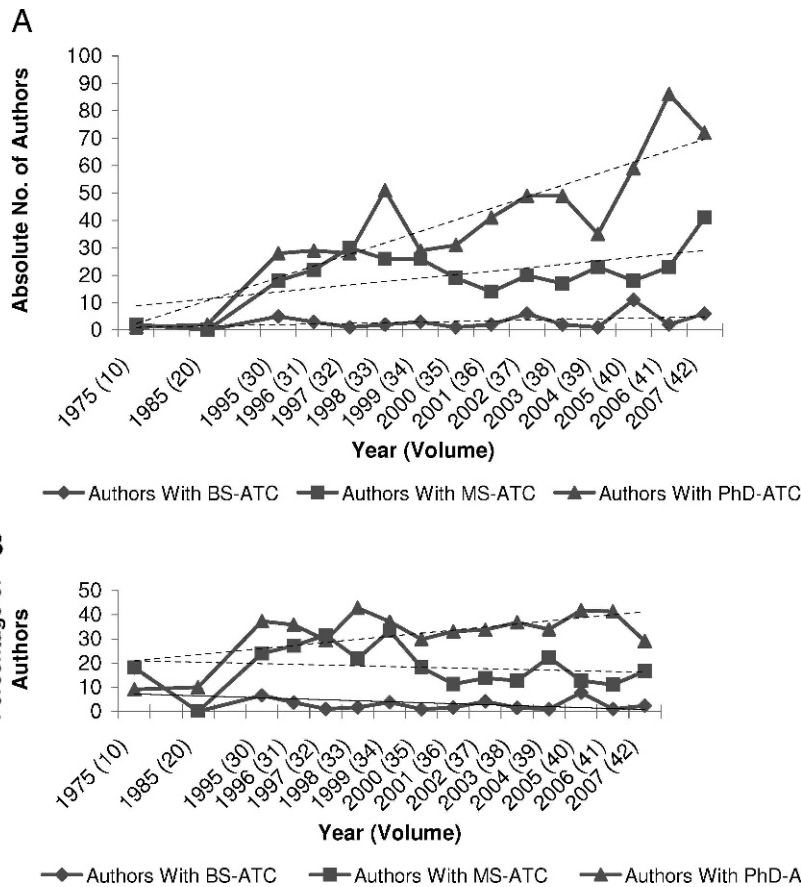


Figure 4. A, Absolute numbers of author credentials with BS-ATC, MS-ATC, and PhD-ATC for the indicated volumes. B, Percentages of author credentials with BS-ATC, MS-ATC, and PhD-ATC for the indicated volumes. Note: MS reflects those with an MA, MS, or MED and PhD reflects those with a PhD, EdD, HSD, or DPH. Dashed lines indicate trend lines.

publication of articles that may be pertinent to health care professionals outside athletic training. This diversity is positive as long as it does not exclude those within the profession for whom the *Journal* is intended. Another

contributing factor to the absolute increase in research articles is that *JAT* has adopted new standards for case reports, directing many submissions to the *NATA News*. Ultimately, this has allowed more *Journal* space to be allocated to original research.

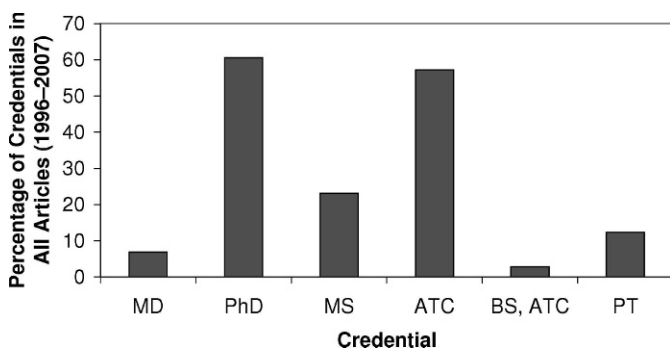


Figure 5. Relative percentages of credentials for authors of research manuscripts from 1995 to 2007. Note: The tabulated number of authors ( $n = 1653$ ) reflects each author for every article. Some authors' credentials are represented more than once if they authored more than 1 article during the time period. In addition, authors with multiple credentials are represented in each appropriate category (eg, an article with an author who indicated the credentials of PhD, ATC, and PT would be tabulated in the PhD, PT and ATC bar graph for that article but would not add to the BS-ATC category.) The categories are generalizations of the grouped credentials indicated in Table 1 (eg, PhD reflects those with a PhD, EdD, HSD, or DPH).

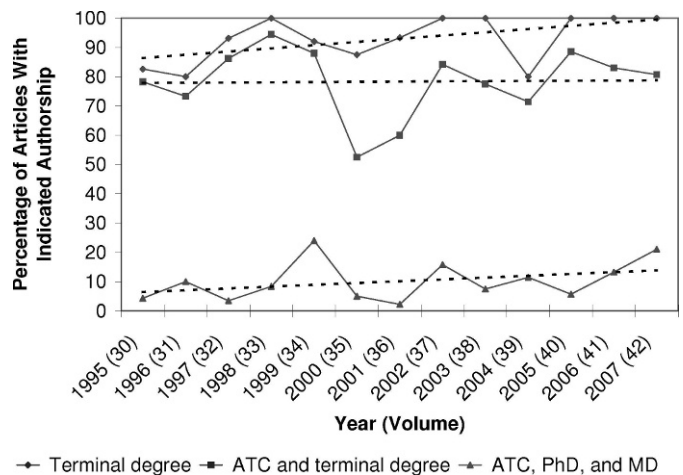


Figure 6. Authorship and trends for research collaborative teams over the past decade. One individual might represent more than 1 category depending on credentials (eg, an author with PhD, ATC credentials would represent both PhD and ATC during the tabulation of articles). Dashed lines indicate trend lines.

During the study period, the change in athletic training education requirements from a mix of internship and formally accredited programs to purely accredited educational programs increased both the need for ATs with terminal degrees as well as the number of ATs seeking tenure. Most of these faculty members had tenure-track appointments that required the conducting of research; thus, the increase in the number of research publications may be a direct result. Similarly, between 1995 and 2007 the focus of athletic training master's degree programs changed toward more active research. Students were often required to conduct research along their faculty mentor's interests, which may have also increased publications.

Longitudinal trends of the absolute and relative numbers of the MD, PhD, and MS credential possessed by *JAT* authors suggest that the strongest growth is in the area of terminal research credentials (Figure 3A). As suggested earlier, these increases may be influenced by the greater demands placed on tenure-track athletic training faculty.<sup>13</sup> The recent trend toward more doctoral-trained ATs becoming *JAT* authors is demonstrated in Figure 4A and B. Over the past decade, those ATs with terminal degrees have been strongly represented among *JAT* authors. However, the BS-ATC credential (potentially representing the clinical AT without an advanced degree) and MD may be underrepresented populations. Therefore, ATs with terminal degrees should continue to foster collaborations among ATs and MDs, who have the opportunity to ask important clinical outcome questions. In addition, the AT can provide a mechanism for tracking desired outcomes from the field. Without the contribution of the MD to provide the diagnosis and direction for research-oriented treatment plans or the AT to provide the "field" outcomes, many of these important questions will remain unanswered. We (unpublished data, 2008) indicated that education and experience may be underlying factors in constraining research engagement by clinical ATs; a lack of collaboration with research scientists may limit the AT's ability to contribute to the literature in *JAT*. Available time and mentorship may also be constraints to ATs' research collaborations.<sup>14</sup>

Our data suggested that authors with terminal degrees were critical contributors for manuscripts published in *JAT*, while collaborations with MDs provided a small authorship component (Figures 5 and 6). When performing collaborative, randomized controlled trials, an important hurdle to overcome is the potential fundamental difference between the extrinsic professional motivators of the AT to provide the "best care" and those of the researcher, who aims to determine the best evidence through randomized trials (which may involve providing patients with placebo or sham treatment strategies). However, without using the best methods in our clinical trials, we may be unable to determine the "best evidence" for optimal treatment. Without the best evidence, we are forced to treat athletes based on empirical practices that may be lacking critical outcomes as supportive evidence and, thus, may not actually be providing the "best care."<sup>11</sup>

Athletic trainers in general, and clinically practicing ATs specifically, are the critical link for performing outcomes research because of their unique combination of both skill

sets and clinical athlete or patient settings. Research teams recognize that ATs may provide the most direct mechanism for scientifically investigating such topics as the utility of manufactured prophylactic devices, outcomes of surgical or rehabilitation techniques, and sport-related epidemiologic questions.<sup>5,9-11</sup> With ATs tracking important outcomes, research teams may be able to provide evidence-based answers to the questions surrounding the many different practice techniques and sport medicine devices used today. Enabling ATs to collaborate with MDs and ATs with terminal degrees may guide needed research to many unanswered questions encompassing the appropriateness of physician treatments through return-to-sport management. Those ATs in a primarily clinical setting may be an underutilized resource (Figure 5) and can provide the "know how" and the "know who" required to determine the outcomes of epidemiologic investigations. Without trained clinicians as the eyes and ears for large-scale epidemiologic studies, emerging or noticeable trends, and field outcomes, our potential to present unbiased results may be limited. With their specialized training, clinical ATs have the ability to track the salient outcomes and exposures that generate the important evidence that might otherwise be impossible to secure.<sup>10</sup> This specialized skill set ATs possess gives them a "unique body of knowledge" to share with the medical community.<sup>12</sup> Communication of this "unique body of knowledge" via publication in *JAT* and other medical journals is a critical step if ATs are to continue the profession's contribution to the evolution of evidence-based medicine.

Another consideration is the way we prepare our entry-level ATs. The undergraduate educational curriculum is targeted toward preparing the clinicians who are the consumers of research and not the investigators who are the producers of research. However, some current undergraduate athletic training educational models are emerging that infuse a research focus early in the undergraduate education process in order to foster an educational framework for future "producers" of the medical literature.<sup>14</sup>

A major question remains. Has the athletic training profession evolved with current trends of evidence-based medicine? Current data from *JAT* indicate a resounding "yes" to this question. A retrospective review back to 1956 suggests that A.L. Dickinson's 3 primary goals for the *Journal*, "to exchange ideas and techniques, to disseminate information of professional interest from a multitude of sources, and to raise the professional stature of the NATA through written contributions to the medical literature," are being achieved.<sup>1</sup> He initially indicated that "athletic trainers were not interested in research or publishing their ideas."<sup>1</sup> Today, the *Journal* is producing more than 50 original research articles annually, with a strong trend toward continued increases (Figure 1). In addition, with volume 43 (2008), *JAT* has moved from a quarterly publication to a bimonthly schedule.<sup>12</sup> This growth of high-quality manuscripts published in *JAT* suggests that AT scientists have an increasing stake in the evidence-based medicine movement; however, ATs must continue to strive for critical evaluation beyond the "low-hanging fruit" research questions. More efforts to collaborate carry the potential to help bridge the gap between AT clinicians and

scientists.<sup>11</sup> Collaboration may foster the development and dissemination of the “unique body of knowledge” that ATs bring to evidence-based medicine.<sup>12</sup>

## Limitations

The results of the trend analysis are limited to the authors in one journal and the accuracy of the categorization of credential categories. The techniques used to group credentials of authors were subjective in nature but were needed to make the inferred evaluations and generate rationalizations of the results. In addition, based on the reported credentials, we are limited in our ability to decipher the relative clinical responsibilities of the listed authors. For example, some *JAT* authors who hold PhD-ATC credentials may be either clinical practitioner ATs or education- and research-oriented ATs. Thus, the inductive reasoning based only on author credentials may not yield inferences that can be generalized to all AT populations. We suggest that future investigators aim to identify clinical responsibilities and evaluate authorship in multiple journals, so that readers may glean more generalizable and robust interpretations. Finally, extrapolations from the clinical contributions to research are limited, because the only measure we used for clinical AT research involvement is authorship on publication. We acknowledge that numerous instances are likely in which clinical ATs are engaged in research collaborations and have not gained authorship on the resultant publications. Accordingly, the influences of these ATs’ contributions to *JAT* research publications would not be demonstrated in the currently reported trend analyses.

## CONCLUSIONS

Our trend analyses suggest that *JAT* is achieving its goal of providing evidence that can help shape clinical techniques in clinical athletic training settings. This generation and propagation of “best evidence” and a “unique body of knowledge” will better equip the clinical AT to recognize frivolous products and non-evidence-based treatment concepts.<sup>5</sup> Continuing research and publication in the field of athletic training is paramount for survival of the profession. Moreover, numerous ATs have “tips from the field”<sup>15</sup> that can be shared by word of mouth or contributions to newsletters, but empirical research and randomized clinical trials are lacking.<sup>11</sup> These tips and ideas from ATs may benefit a few clinical patients, but if they are used to generate hypotheses for scientific evaluation, then treatment strategies can be studied to improve outcomes for many. The continued engagement of clinical ATs in research through evidence-based mentorship and collaboration with the scientific community may foster the desired evolution for the athletic training profession.<sup>11,14,16</sup> That way, *JAT* and other athletic

training publications can continue to grow beyond the “low-hanging fruit” evidence, and clinical ATs can shift from research consumption to evidence-based implementation and production.

## ACKNOWLEDGMENTS

We thank Kim Barber Foss, MS, ATC, and Catherine Quatman, PhD, for their assistance with peer review of the data syntheses, analyses, and interpretations. We also acknowledge the assistance of Leslie Neistadt for her critical appraisals of the methods and aid in data collection. Gregory D. Myer, MS, CSCS, acknowledges funding support from the National Institutes of Health grants R01-AR049735 and R01-AR055563.

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Gregory D. Myer, MS, CSCS, and Ethan M. Kreiswirth, MA, ATC, contributed to conception and design; acquisition and analysis and interpretation of the data; and drafting, critical revision, and final approval of the article. Leamor Kahanov, EdD, ATC, and Malissa Martin, EdD, ATC, contributed to conception and design, analysis and interpretation of the data, and critical revision and final approval of the article.

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