

Journals publishing bio-medicolegal research in Europe

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Abstract Fragmentation of bio-medicolegal knowledge has led to a proliferation of ultra-specialised sub-disciplines and branches, often published in ‘field-oriented’ scientific journals. The aim of this work is to provide an in-depth analytical picture of bio-medicolegal sources of publication, within and outside the traditional conception of legal medicine. An extensive search of bio-medicolegal articles published in the last five and a half years was performed on the MEDLINE database according to MeSH terms combined with free-text protocols. We performed a systematic analysis of targeted journals after merging, selecting and categorising all retrieved records, taking into account data from the 2009 JCR Science Edition (released on June 2010); 1,037 different journals were identified, of

which only 48 (4.6%) focus specifically on bio-medicolegal matters, and of which only seven (14.6%) have an impact factor (IF). Despite this apparent dispersion, 47% of articles were published in bio-medicolegal journals (BML), of which 70.2% were in journals with IF (BML-IF). Articles published in BML-IF journals (33% of total papers) reach almost 50%, mainly in “Forensic Science International”, “International Journal of Legal Medicine” and “Journal of Forensic Sciences”. Instead, publications in not specifically bio-medicolegal journals (Not BML-IF) are greatly scattered and even fragmented in about 650 journals. The sub-disciplines that appear most frequently in Not BML-IF rather than BML-IF journals are Forensic Psychiatry (48.2% vs. 5.1%), Criminology (37.1% vs. 8.3%), Malpractice (50.7% vs. 4.0%), Medical Law and Ethics (46.4% vs. 6.9%) and Clinical Forensic Medicine (39.5% vs. 21.3%). The proposed bibliometric analysis revealed the preference of Forensic Pathology, Criminalistics (Biological), Forensic Genetics, Forensic Anthropology and Forensic Entomology for journals traditionally considered pertinent to the medico-legal discipline, with a considerable dispersion involving Toxicology, Psychiatry, Criminology and Malpractice, which were published in less well-known journals. This dispersion could be reduced adapting specialised forensic sections and increasing the IF of forensic journals, in order to respond suitably to the present demand for visibility by bio-medicolegal scientists, clearly oriented towards enhancing the objective impact of their curricula and attempting to attract funding to their research projects.

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Introduction

Medical publishing is expanding on a massive scale, with new journals continuing to emerge worldwide, and funding for universities is often decided by the amount and quality of research produced; hence, researchers are motivated to publish in journals with high impact factors [1, 2]. The process is based on selecting journals characterised by the most widely used index of quality, the *Impact Factor* (IF) for indexed journals by the Journal Citation Report (JCR–Thomson Reuters). The IF of a journal is calculated by dividing the number of current year citations attributable to articles published during the previous 2 years, by all citable items published during the previous 2 years (Table 1).

In the bio-medicolegal field, until June 2011, there were 11 journals with IF appearing in the JCR database (2009 JCR Science Edition, released on 2010) under the heading “Medicine, Legal”. An overview of European bio-medicolegal publications in the last 5 years shows that the fragmentation that has negatively affected and continues to affect bio-medicolegal knowledge has led to a proliferation of ultra-specialised sub-disciplines and branches [3], often overlapping with other sectors of biomedicine which, in turn, have a number of ‘field-oriented’ scientific journals [4–6]. On this basis, a country-based bibliometric in-depth analysis highlighted the prevailing role of Central and Southern Europe, for both number of publications and total impact factor. Surprisingly, countries with low economic power such as Poland, Turkey and other Eastern European countries showed good scientific output and a high productive potential in specific sub-

disciplines such as Pathology, Toxicology and Forensic Genetics [7].

In spite of the considerable efforts made by some authors who, in the past, have examined forensic journals with and without IF [2, 6, 8], this fragmentation, together with the increase in bio-medicolegal publications outside specifically forensic journals, explains the current absence of a clear-cut picture of those scientific journals that systematically or occasionally publish articles from the various bio-medicolegal areas.

The aim of this work was to examine European bio-medicolegal articles published in the last 5 years by means of a thematic inspection in the PubMed interface of MEDLINE, with subsequent classification of records according to the sub-discipline or branch for each article (i.e., Forensic Pathology, Forensic Toxicology, Forensic Genetics, Forensic Psychiatry, etc.) and the type of journal, in order to provide a qualitative–quantitative analytical picture of bio-medicolegal sources of publication, within and outside the traditional conception of our scientific field.

Materials and methods

In June 2010, a novel process of searching and categorising references related to bio-medicolegal sciences was developed [3]. An extensive search of published literature retrieved from the MEDLINE database according to MeSH terms combined with free-text protocols was performed, covering the medicolegal area of interest, the affiliation of the corresponding author, the country of affiliation of the

Table 1 Percentages of numbers of published articles in each sub-discipline and branch, as expressed by journals with IF covering bio-medicolegal areas (BML-IF) or otherwise (Not BML-IF), and similarly, by indexed journals in bio-medicolegal areas (BML-

Indexed) or not (Not BML-Indexed). Percentages are cumulated by row. Journal categorization is based on 2009 JCR Science Edition (released on June 2010)

Sub-disciplines and branches	BML-IF	BML-Indexed	Not BML-IF	Not BML-Indexed	Total
Biological Damage	11.1%	22.2%	38.9%	27.8%	100.0%
Clinical Forensic Medicine	21.3%	14.8%	39.5%	24.5%	100.0%
Criminalistics (Biological)	59.8%	12.4%	17.5%	10.3%	100.0%
Criminology	8.3%	30.5%	37.1%	24.1%	100.0%
Entomology	71.9%	9.4%	15.6%	3.1%	100.0%
Forensic Anthropology	71.2%	8.8%	9.3%	10.7%	100.0%
Forensic Genetics	64.3%	8.5%	21.1%	6.0%	100.0%
Forensic Pathology	42.5%	17.4%	29.0%	11.2%	100.0%
Forensic Psychiatry	5.1%	22.1%	48.2%	24.6%	100.0%
Forensic Toxicology	38.8%	6.8%	46.8%	7.6%	100.0%
Invalidity-Social Insurance	0.0%	30.3%	28.3%	41.4%	100.0%
Malpractice	4.0%	9.1%	50.7%	36.2%	100.0%
Medical Law & Ethics	6.9%	13.1%	46.4%	33.6%	100.0%

corresponding author, and the journal of publication, for a time window of 5.5 years (January 2005–June 2010) [3].

In detail, for journals selection multiple free-text searches were performed by searching for the following terms individually in the “Journal” field: “Am J Forensic Med Pathol” [Journal: __jrid425] or “Forensic Sci Int” [Journal: __jrid3760] or “Forensic Sci Int Genet” [Journal: __jrid33849] or “Int J Legal Med” [Journal: __jrid1818] or “J Forensic Sci” [Journal: __jrid4738] or “Med Sci Law” [Journal: __jrid5702] or “Sci Justice” [Journal: __jrid8762]. We included only the journals pertaining to the actual core of forensic science and legal medicine journals and falling within the category “Medicine, legal” as defined by the 2009 Journal Citation Report (JCR) Science Edition (effective until June 2011, when 2010 JCR Science Edition was released). We excluded “Regulatory Toxicology and Pharmacology” because it is devoted to the legal aspects of toxicological and pharmacological regulations, “Expert Opinion on Therapeutic Patents” as it reports the technological advances and developments in pharmaceutical patents and “The Journal of Law, Medicine & Ethics”, which covers issues related to public health, health disparities, patient safety and quality of care, and biomedical science and research. Since the new entry, “Romanian Journal of Legal Medicine”, has not yet been indexed by PubMed, it was not included.

After pooling and filtering the retrieved records within predefined limits [3], the scientific journals were classified as belonging or not belonging to the field of bio-medicolegal sciences (BML or Not BML) with the identification of four different categories: IF journals pertaining (BML-IF) or not pertaining to bio-medicolegal sciences (Not BML-IF), and indexed journals pertaining or not pertaining to the bio-medicolegal sciences (BML-Indexed and Not BML-Indexed). The identified journals were analysed in terms of number and type of article published in the different sub-disciplines, such as Forensic Pathology, Toxicology, Genetics, Psychiatry, Anthropology, Entomology, Clinical Forensic Medicine, and Medical Law & Ethics (Table 1).

Results

A total of 5,826 records was selected, and subsequently categorised as described in a previously published article [3]. We identified 1,037 journals publishing articles covering legal medicine; in particular, seven (0.67%) had an Impact Factor, since they appeared in the JCR category (2009 Journal Citation Report® Science Edition, ISI Web of Science™–Thomson Reuters) under ‘Medicine, Legal’; 655 (63.17%) had IF but fell into other JCR categories; 41 (3.96%) covered legal medicine but had no IF, only appearing in PubMed–MEDLINE, and 334 (32.2%) did not cover the medicolegal area and, like the previous ones,

did not have any IF but were simply indexed in PubMed (Table A—Electronic supplemental material).

Overall, 33% of bio-medicolegal articles were published in journals with IF and pertained to the JCR section ‘Medicine, Legal’ (henceforth BML-IF); 36% of articles were published in journals with IF but belonging to other JCR sections (Not BML-IF); 14% were published in bio-medicolegal journals that were simply indexed as PubMed–MEDLINE (BML-Indexed); and 17% appeared on only indexed journals not belonging to the bio-medicolegal field (Not BML-Indexed) (Fig. 1). In detail, regarding the category BML-IF, the “top five” journals appeared: “Forensic Science International” (46.3%), “International Journal of Legal Medicine” (17.6%), “Journal of Forensic Science” (15.3%), “American Journal of Forensic Medicine and Pathology” (8.7%) and “Forensic Science International Genetics” (6.9%) (Fig. 1a). Regarding the BML-Indexed category, the following journals appeared: “Archiwum medycyny sadowej i kryminologii” (21.8%), “Journal of Forensic and Legal Medicine” (15.7%), “Legal Medicine Tokyo” (12.5%), “Archiv für Kriminologie” (6.3%) and “International Journal of Law and Psychiatry” (5.6%) (Fig. 1b). In the Not BML-IF category, we find the following top five journals: “Journal of Analytical Toxicology” (4.5%), “Journal of Chromatography B” (2.0%), “Analytical and Bioanalytical Chemistry” (2.0%), “Therapeutic Drug Monitoring” (1.6%) and “Archives de Pédiatrie” (1.2%) (Fig. 1c) and, in the category Not BML-Indexed, “Ugeskrift for Laeger” (2.6%), “Revue médicale suisse” (2.2%), “Psicothema” (2.2%), “Annales Academiae Medicae Stetinensis” (2.2%) and “Sudebno-Meditsinskaia Ekspertiza” (2.2%) (Fig. 1d).

The language used by journals publishing articles on bio-medicolegal sciences was English in 100% of cases in journals with IF. This percentage fell in Not BML IF journals (88.2%), followed by indexed journals, both included within the BML area (70.3%) and not included (53.4%) (Fig. 2a).

In all groups, original articles accounted for 72.6% of IF vs. 52.0% of only indexed bio-medicolegal journals, and 74.2% of IF vs. 62.4% of only indexed and not bio-medicolegal journals (Fig. 2b). These data were reversed regarding percentages of published reviews, accounting for 6.3% of IF vs. 25.7% of only indexed bio-medicolegal journals, and 9.2% of IF vs. 17.8% of only indexed not bio-medicolegal journals. Instead, case reports were different, with 20.4% of IF vs. 16.4% of only indexed bio-medicolegal journals, and 10.7% of IF vs. 9.6% of only indexed not bio-medicolegal journals (Fig. 2b).

Most articles on legal medicine appearing in IF or indexed journals came from authors with affiliations in ‘Legal Medicine’ (73.5% vs. 63.5% respectively), followed by ‘Clinical and Surgical’ affiliations, with 12.0% and

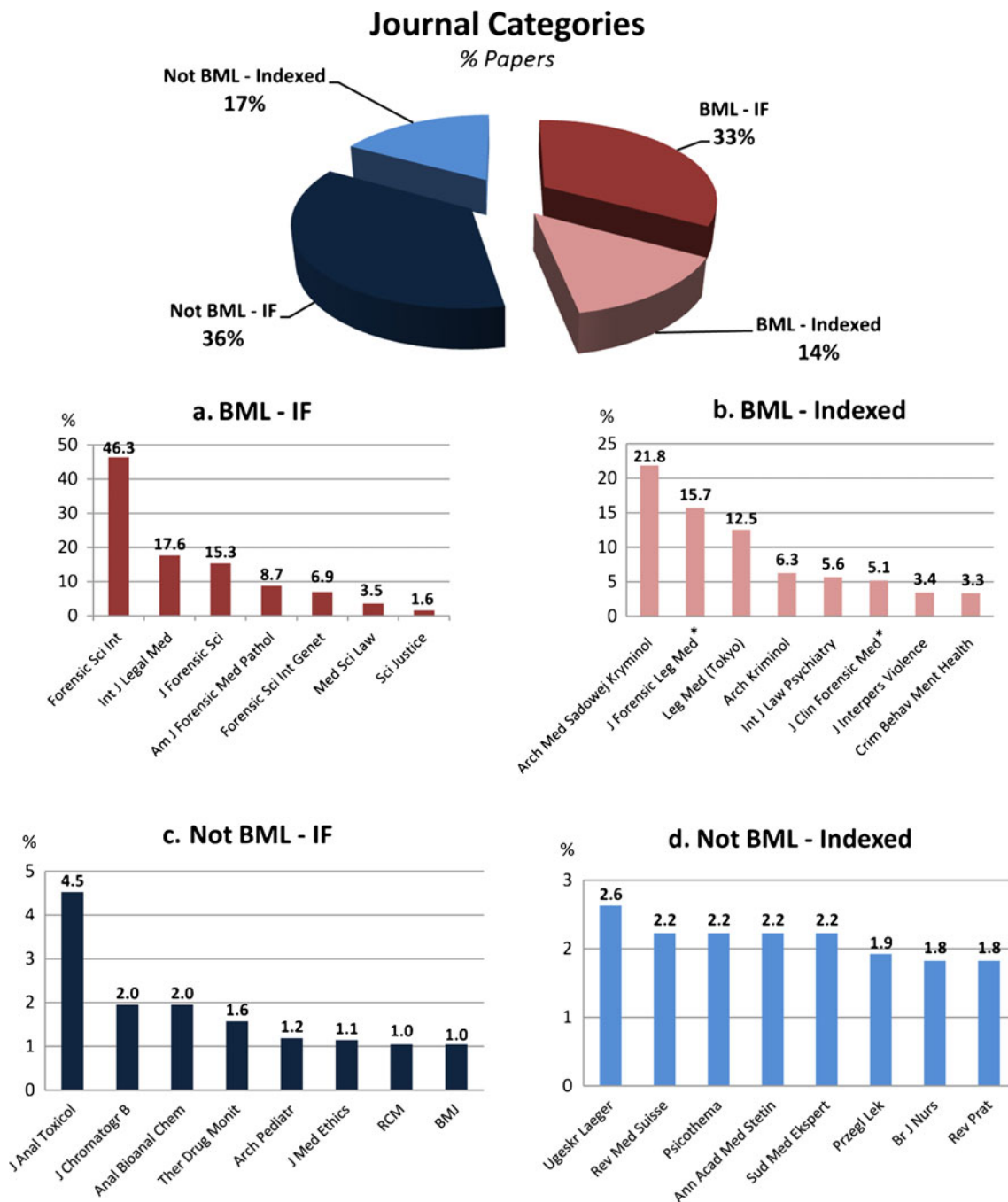


Fig. 1 Percentages of papers published in journals grouped by scientific area. **a** BML-IF: journals with IF pertaining to bio-medicolegal areas, **b** BML-Indexed: only indexed journals pertaining to bio-medicolegal areas, **c** Not BML-IF: journals with IF pertaining to areas other than bio-medicolegal, **d** Not BML-Indexed: journals

only indexed pertaining to areas other than bio-medicolegal. Journal categorization is based on 2009 JCR Science Edition (released on June 2010). *Starting from 2007, the “Journal of Forensic and Legal Medicine” continues the “Journal of Clinical Forensic Medicine”

14.8% respectively, as shown in Fig. 2c. Articles in IF or non-indexed journals mainly came from authors with ‘Legal Medicine’ affiliations (48.5% vs. 42.3% respectively), and less so, but still significantly, in the case of ‘Clinical and Surgical’ affiliations, with 31.4% and 22.9%, respectively. Articles from ‘Health and Social’ affiliations published in IF

or Non-BML journals (8.6% vs 10.6%) should be noted, as shown in Fig. 2c.

Table A (Supplementary online material) shows the percentages of articles pertinent to the various sub-disciplines and branches in the four groups of journals (BML-IF, BML-Indexed, Not BML-IF, and Not BML-Indexed).

Fig. 2 Overview. Percentages of published papers by: **a** language and group, **b** type of article and journal group, and **c** affiliation and journal group. Abbreviations: BML-IF: journals with IF pertaining to bio-medicolegal areas, BML-Indexed: journals only indexed pertaining to bio-medicolegal areas, Not BML-IF: journals with IF pertaining to areas other than bio-medicolegal, Not BML-Indexed: journals only indexed pertaining to areas other than bio-medicolegal. Journal categorization is based on 2009 JCR Science Edition (released on June 2010)

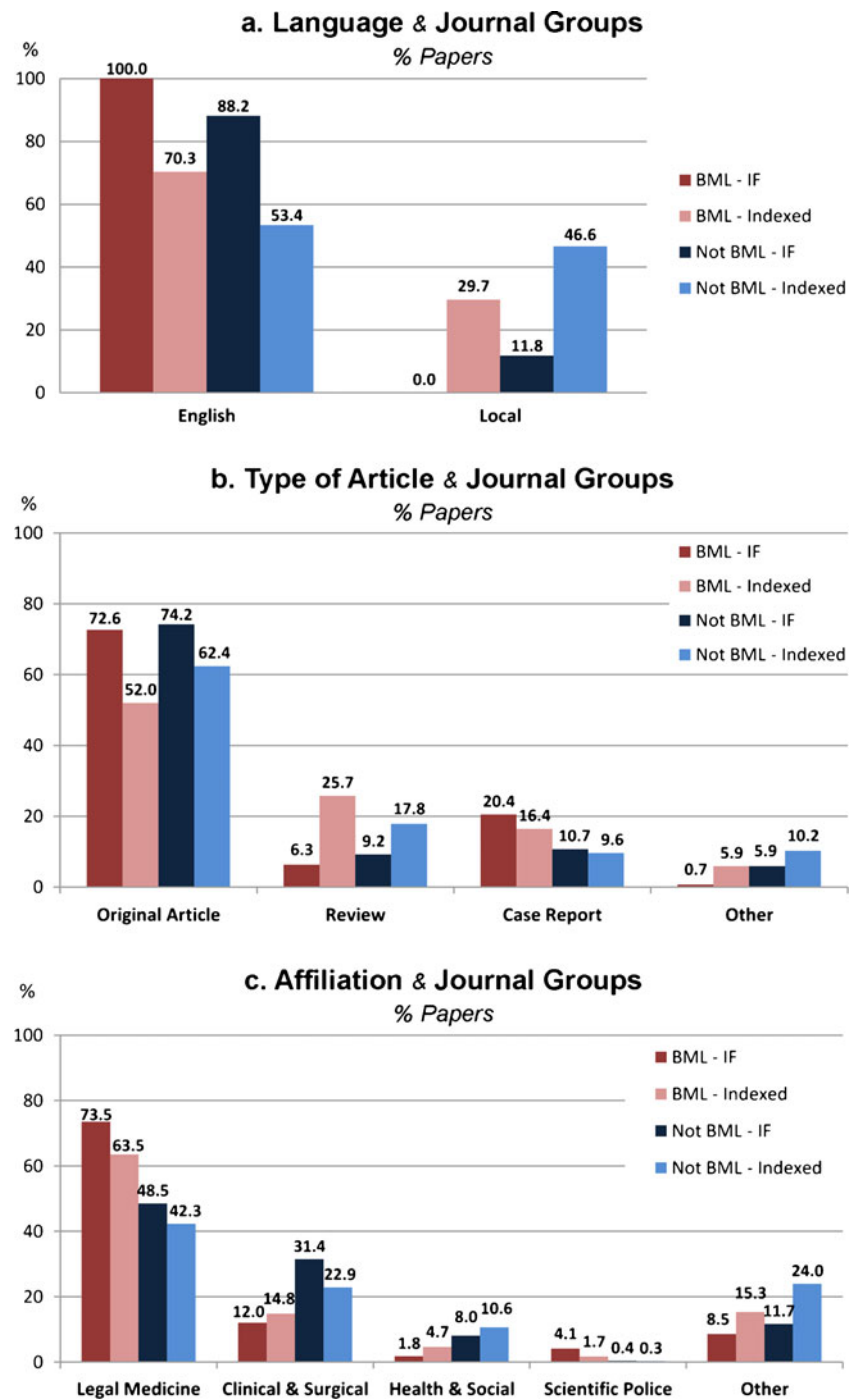


Figure 3 gives an overview of the journals that more frequently publish articles related to Forensic Pathology, Toxicology, Genetics, Psychiatry, Anthropology, Entomology, Clinical Forensic Medicine, and Medical Law & Ethics.

Discussion

In some countries, evaluating publications in terms of their quantity, quality and importance has increasingly become an

essential element in the research assessment process regarding funding to university departments [2, 9–12]. The primary means of communicating new scientific ideas, other than by presenting papers at scientific conferences, is by publishing articles in reputable scientific journals. This process gives credit for the work presented, and new information enters the public domain, often becoming abstracted by major databases and thus available for search, retrieval and citation [2, 13, 14].

The increasing degree of “technologisation” and globalisation of biomedicine in the 21st century has inevitably led

Sub-disciplines & Branches

Top 5 Journals

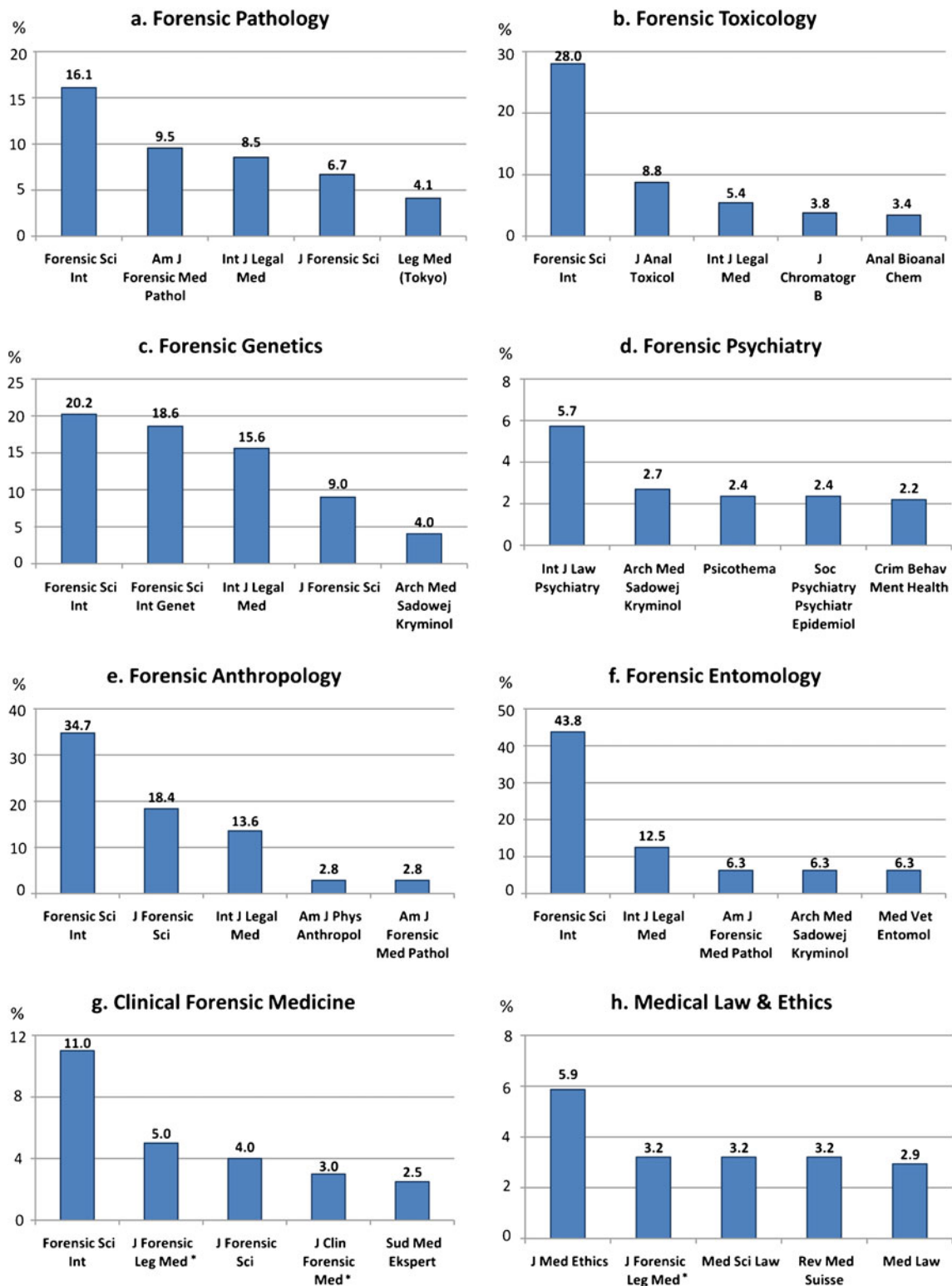


Fig. 3 Percentages of published papers by sub-discipline/branch and top five journal titles. **a** “Forensic Pathology”, **b** “Forensic Toxicology”, **c** “Forensic Genetics”, **d** “Forensic Psychiatry”, **e** “Forensic Anthropology”,

f “Forensic Entomology”, **g** “Clinical Forensic Medicine”, **h** “Medical Law and Ethics”. *Starting from 2007, the “Journal of Forensic and Legal Medicine” continues the “Journal of Clinical Forensic Medicine”

to greatly improved digitalisation of the results of scientific research [15, 16], which can now be easily retrieved and shared among web users through electronically available scientific journals and online biomedical databases, often free of charge [17, 18].

MEDLINE indexing and JCR impacting

Since 1966, most biomedical journals have been indexed by the MEDLINE database, and from 1996, easily identifiable even retrospectively by the PubMed search engine.

We limited the search to the MEDLINE database because it is freely accessible on the internet via the PubMed interface, and allows the use of MeSH terms and keywords submitted by the authors. Other contemporary databases such as Scopus, Web of Science or Embase were not considered as they can be only queried under payment of a subscription, hence limiting poorly funded individuals (specially belonging to developing countries) to profitably consult the databases.

After careful three yearly monitoring and assessment by Thomson Reuters, some journals have received an Impact Factor [19–21]. This process of extended information sharing and degree of impact has also affected the bio-medicolegal sciences, which has 11 journals classified by the 2009 JCR Science Edition (released on 2010, effective until June 2011) in the category “Medicine, Legal”, seven of which systematically publish articles specific to the field of legal medicine (see “Materials and methods”).

This could be a point of discussion for all the medicolegal community, as the aforementioned category “Medicine, Legal” includes four out of 11 journals not strictly related to our field, while other journals covering issues of bio-medicolegal interest are not comprised in the JCR classification. This phenomenon may hamper bibliometric analysis and, more importantly, may affect curricular evaluation aimed at screening any academic career advancement.

Many forensic journals, without IF but indexed by PubMed, are associated with clinical or closely connected subjects (e.g., molecular biology, biochemistry, analytical chemistry, internal medicine, psychiatry, etc.) in which studies of forensic interest often appear.

Analysis of journals publishing medicolegal issues

The panorama of scientific journals publishing bio-medicolegal articles is thus enormous, complex, and only partially explored.

In the past, some authors, to their merit, have reviewed the JCR journals, both in the bio-medicolegal sector [8] and outside it [6], and also some journals without IF and sometimes even without PubMed indexes [2]. However, no systematic analysis of medicolegal publishing of the

journals in the sector, with or without IF (such as journals which, although not directly focusing on the medicolegal field, accept articles from forensic sub-disciplines) has been made so far.

The 5,826 articles classified in sub-disciplines in this study were published in as many as 1,037 different journals, of which only 48 (4.6%) focus specifically on bio-medicolegal matters, and of which only seven (14.6%) have IF. This apparent dispersion of bio-medicolegal publishing can be considerably downsized if, instead of considering only the number of journals, we take into account the percentual distribution of the papers: 47% of articles were published in bio-medicolegal journals, of which 70.2% in journals with IF (BML-IF) and 29.8% in PubMed only (BML-Indexed).

Articles published in BML-IF journals (33% of total papers) reach almost 50%, mainly in “Forensic Science International”, published by Elsevier, indexed on MEDLINE since 1978 and with an IF in 2009 of 2.104 (IF 2010 1.821). In the BML-IF group, Forensic Science International is certainly the journal that publishes most (250–300 articles/year), is eclectic, and comes top of the list for number of contributions in the fields of Forensic Entomology (43.8% of production in this sub-discipline), Forensic Anthropology (34.7%), Forensic Toxicology (28.2%), Forensic Genetics (20.1%), Forensic Pathology (16.1%) and Clinical Forensic Medicine (11.0%).

The “International Journal of Legal Medicine” also plays an important role, being the expression of the International Academy of Legal Medicine, published by Springer and PubMed-indexed since 1990 as a continuation of the German journal “Zeitschrift für Rechtsmedizin”, with an IF in 2009 of 2,793 (IF 2010 2.939), top in the JCR ranking for the category “Medicine, Legal”. Although publishing far fewer papers than Forensic Science International (70–90 articles/year), this journal does publish a significant number of articles on Forensic Genetics (15.6% of publications in this sub-discipline), Forensic Anthropology (13.6%), Forensic Entomology (12.5%), Forensic Pathology (8.5%) and Forensic Toxicology (5.4%).

Also, to be mentioned is the “Journal of Forensic Sciences”, published by the American Academy of Forensic Sciences, MEDLINE-indexed since 1965, with an IF in 2009 of 1.524 (IF 2010 1.159). It has published many papers on Forensic Genetics (9.0% of publications in this sub-discipline), Forensic Pathology (6.7%) and Clinical Forensic Medicine.

Based on the 2010 JCR Science Edition released on June 2011, two new entries into the category “Medicine, Legal” has to be mentioned. The “Australian Journal of Forensic Sciences”, published by the Australian Academy of Forensic Sciences, MEDLINE-indexed for articles related to bioethics only, presented in 2010 a starting IF of 0.500.

“Rechtsmedizin”, published by the “Deutsche Gesellschaft für Rechtsmedizin”, has not yet been indexed by MEDLINE presenting in 2010 a starting IF of 0.876.

Surprisingly, one more entry has been classified under the JCR category “Pathology”; “Forensic Science Medicine and Pathology” has been indexed by MEDLINE since 2008, presenting in 2010 a starting IF of 0.698.

In the group of indexed journals without IF (BML-Indexed), three journals account for about 50% of articles published in this category (Fig. 1b). They are “Archiwum medycyny sądowej i kryminologii”, in Polish, MEDLINE-indexed since 2002, which publishes articles on Forensic Psychiatry (27% of total in sub-discipline), Forensic Entomology (6.3%) and Forensic Genetics (4.0%). Legal Medicine (Tokyo, Japan) expresses the views of the Japanese Society of Legal Medicine, has been MEDLINE-indexed since 2003, and mainly publishes articles on Forensic Pathology (4.1%); the “Journal of Forensic and Legal Medicine” expresses the views of the Australian College of Legal Medicine, has continued the previous “Journal of Clinical Forensic Medicine” since 2007, and has been MEDLINE-indexed since 2004. These two journals account for 8.0% of publications on Clinical Forensic Medicine and 3.6% of those on Medical Law and Ethics.

Instead, publications in not specifically bio-medicolegal journals (called here “Not BML-IF” and “Not BML-Indexed”) are greatly scattered and even fragmented. Apart from some journals of Analytical Chemistry and Biochemistry (such as the “Journal of Analytical Toxicology”, “Journal of Chromatography B”, “Analytical Technologies in the Biomedical and Life Sciences” and “Analytical and Bioanalytical Chemistry”), which account for about 10% of publications in “Not BML-IF” journals, the remaining articles almost all appear in about 650 journals, indicating that bio-medicolegal scientists who decide to publish outside journals specific to their sector have an enormously wide range of possibilities.

The sub-disciplines that most often appear in non-forensic journals with IF (“Not BML-IF”) rather than in Forensic Journals with IF (BML-IF) are Forensic Psychiatry (48.2% in Not BML-IF journals vs. 5.1% in BML-IF), Criminology (37.1% vs. 8.3%), Malpractice (50.7% vs. 4.0%), Medical Law and Ethics (46.4% vs. 6.9%) and Clinical Forensic Medicine (39.5% vs. 21.3%).

Thus, in spite of the considerable eclectic appeal of journals in the JCR sector of “Medicine, Legal” (2009 and 2010 releases), the existence of some valuable and important publications in the bio-medicolegal sector and published in journals with IF outside the forensic world is clearly revealed.

The reasons for this significant leakage of bio-medicolegal knowledge to non-forensic journals may lie in three main phenomena:

- 1) Some sub-disciplines and branches, stemming from Legal Medicine, have become so ultra-specialised that they are now autonomous with respect to their original discipline (this is the case, for instance, of Forensic Psychiatry or

Criminology). Mingling with other biomedical scientific sectors, which may now have little affinity with the bio-medicolegal discipline, they are, however, important in their partial sub-discipline or branch.

- 2) There is now a lack of specific specialised forensic journals or sections in forensic journals with IF (e.g., in Psychiatry, Criminology and Malpractice).
- 3) The natural development of scientists in the 21st century requires constant efforts to enhance the visibility of their experimental work, also in the bio-medicolegal sector. This implies that the potential “citability” of their published works and the consequent construction of first class curricula find acknowledgement and a clear-cut certification of the scientific value of their work in the IF of the world's top journals.

Conclusions

This bibliometric analysis, in revealing a clear and interesting overall picture of scientific journals, remarks the preference of some sectors of bio-medicolegal sciences (e.g., Forensic Pathology, Criminalistics (Biological), Forensic Genetics, Forensic Anthropology, and Forensic Entomology) for journals traditionally considered as pertinent to the discipline. It also reveals a significant and, at the same time, worrying dispersion of works published in journals that do not belong to the forensic sector, mainly covering Toxicology, Psychiatry, Criminology and Malpractice.

In the light of these considerations, it is to be hoped that novel forensic journals and/or sections in the existing ones might respond suitably to the present demand for visibility by bio-medicolegal scientists, who are increasingly oriented towards enhancing the objective impact of their curricula and attempting to attract funding to their research projects, in both national and international fields.

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