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Bio-medicolegal scientific research in Europe: a comprehensive bibliometric overview

Santo Davide Ferrara · Thomas Bajanowski · Rossana Cecchi · Rafael Boscolo-Berto · Guido Viel

Abstract In times of globalisation, the future of bio-medicolegal sciences in Europe depends on the scientific community's ability to develop new strategies for research, to introduce new and generally accepted standards, to develop new analytical methods, all in order to draw up inter-site, multidisciplinary and interdisciplinary long-term research projects, eligible for European Union (EU) funding. To analyse the scientific output and to identify the topics of greatest interest and appeal in these sciences, an innovative method has been developed to select and analyse publications. This method has been applied to analyse a total of 21,176 records from PubMed out of which 5,826 papers were suitable for further analysis because they were published in national and international journals in the time between January 1, 2005 and June 1, 2010 by European authors in the field of interest. In 69% of all manuscripts, authors presented results of systematic research (original articles); 84% of the papers were written in English language. The cumulative impact factor increased from 1,670 points in 2005 to 1,878 in 2009, and extrapolated 2,812 points in 2010. The most frequent topics were the description of new analytical methods in forensic toxicology (5.7% of all papers), the analysis of short tandem repeat systems (STR, 5.6%) as well as the analysis of injury mechanisms in forensic pathology and clinical forensic medicine (4.9%). If the impact factor related potential of different topics is calculated (ratio of frequency of papers and frequency of impact points achieved), SIDS research reaches 1.64 points, followed by studies on mtDNA (1.59) and the development of new analytical methods in forensic toxicology (1.49). The findings made in the present bibliometric analysis reveal a clear and interesting overall picture of the European scientific production and productivity and could be used to identify the most innovative research lines.

Keywords Research in bio-medicolegal sciences · Scientific output · Topics · Impact factor · Analytical strategies

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Introduction

The loss of unitariness in bio-medicolegal knowledge is leading to a potentially irreversible fragmentation process, causing knowledge to crumble into a multitude of sub-disciplines and specialties [1]. In this setting, all attempts to give a comprehensive picture of ongoing scientific research and innovation in the bio-medicolegal sciences have become complex and fraught with difficulties.

However, it is of utmost importance to provide an overall picture since this is the key to identifying special competencies and innovative lines of research, as well as frontline medicolegal institutions in order to draw up

inter-site, multidisciplinary and interdisciplinary long-term research projects, eligible for European Union (EU) financing.

A preliminary analysis of the European picture was recently performed on the basis of National Guidelines and Protocols, which are the fruit of an interpretative synthesis of the scientific findings reported in the literature [1].

The main aim of the present study was to analyse the scientific output of the European bio-medicolegal sciences in the last 5 years using an innovative technique for extracting sensitive data and selecting publications pertinent to the medicolegal field. The use of objective quali- and quantitative bibliometric parameters [2] has the additional endpoint of identifying the more active sub-disciplines and branches, as well as the topics of greatest interest and appeal, thus providing a qualitative and quantitative analytical picture of bio-medicolegal publications.

Materials and methods

The innovative selection process of references involved the following five sequential steps:

1. Making an extensive search of the published literature retrieved using the MEDLINE database;
2. Pooling and filtering the retrieved records within pre-defined limits;
3. Constructing a database;
4. Categorising the records;
5. Revising and verifying the quality of the entire process.

Step 1

In June 2010, an extensive search of the published literature was made using the MEDLINE database (PubMed.gov; U.S. National Library of Medicine—National Institutes of Health). The MEDLINE search involved a complex strategy necessitating both medical subject headings (MeSH) and free-text protocols, both a multi-step semantic and geographic inquiry being made, as follows.

(a) Medicolegal area of interest:
    – the MeSH search was conducted by combining the following terms retrieved from the MeSH browser provided by MEDLINE: ("Forensic Sciences" [Mesh]) OR (((("Criminology"[Mesh] NOT "Fraud"[Mesh]) NOT "Theft"[Mesh]) NOT "Criminal Law"[Mesh]) NOT "Euthanasia, Animal"[Mesh]) OR "Malpractice"[Mesh] OR "Social Security" [Mesh] OR "Social Medicine"[Mesh] OR "Medical Errors"[Mesh];
    – multiple free-text searches were also made using the following terms individually as search entries

in the fields "Title" and "Abstract" of the records, thus including all MeSH terms found under the main term in the MeSH tree: (Forensic AND (sciences OR anthropology OR ballistics OR dentistry OR medicine OR genetics OR pathology OR psychiatry OR nursing OR toxicology)) OR (legal medicine OR autopsy OR "blood stains" OR dermatoglyphics OR "DNA fingerprint" OR exhumation OR "lie detection" OR paternity) OR (abuse AND (sexual OR rape OR spouse OR child OR elder OR battered child)) OR euthanasia OR infanticide OR homicide OR "corpse dismember-ment" OR "criminal abortion" OR terrorism OR "chemical terrorism" OR "mass casualty inci-dents" OR torture OR "war crimes" OR "biolog-ical damage" OR "social security" OR "social insurance" OR "social medicine" OR malpractice OR "medical error" OR "medical liability" OR "forensic entomology".

(b) Affiliation of the corresponding author:
    – multiple free-text searches were made using the following terms individually in the "Affiliation" field: (forens*[Affiliation]) OR (lega*[Affiliation]).

(c) Country of affiliation of the corresponding author:
    – the MeSH search was conducted by combining the following terms, retrieved from the MeSH browser provided by MEDLINE: Albania, Andorra, Arme-nia, Austria, Azerbaijan, Belarus, Belgium, "Bosnia-Herzegovina", Bulgaria, Croatia, Cyprus, "Czech Republic", Denmark, Estonia, Finland, France, "Georgia (Republic)", Germany, "Great Britain", Greece, Hungary, Iceland, Ireland, Italy, Kazakhstan, Latvia, Liechtenstein, Lithuania, Luxembourg, "Macedonia (Republic)", Malta, Moldova, Monte-negro, "Vatican City", Netherlands, Norway, Poland, Portugal, Yugoslavia, Romania, Russia, "San Mar-ino", Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine. Note that "Yugosla-via" contains the term Kosovo, while no MeSH term for Montecarlo was identified;
    – multiple free-text searches were also performed using the following terms individually as search entries in the "Affiliation" field: Albania OR Andorra OR Armenia OR Austria OR Azerbaijan OR Belarus OR Belgium OR Bosnia, Herzegovina OR Bulgaria OR Croatia OR Cyprus OR "Czech Republic" OR Denmark OR Estonia OR Finland OR France OR Georgia OR Germany OR Greece OR Hungary OR Iceland OR Ireland OR Italy OR Kazakhstan OR Latvia OR Liechtenstein OR Lithuania OR Luxembourg OR Macedonia OR

Fig. 1 Histogram showing the number of published papers in the bio-medicolegal sciences and the total impact factor over the investigated time period (January 2005–June 2010); the numbers reported above the *bars* show the mean impact factor for the corresponding year

Number of Papers
&
Total Impact Factor
2005-2010
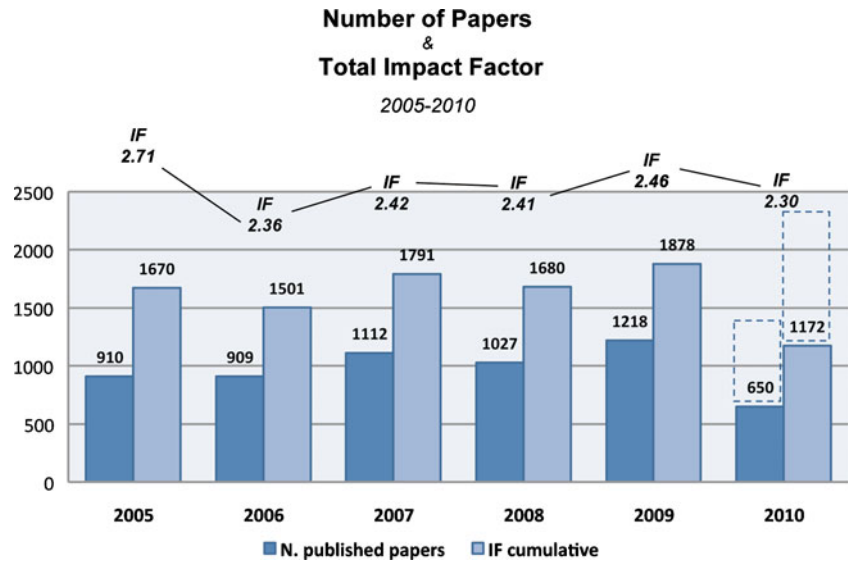
Malta OR Moldova OR "Principality of Monaco", "Montecarlo" OR Montenegro OR "Vatican City" OR Netherlands OR "Northern Ireland" OR Norway OR Poland OR Portugal OR Republic of Kosovo OR Romania OR Russia OR "San Marino" OR Serbia OR Slovakia OR "Slovak Republic" OR Slovenia OR Spain OR Sweden OR Switzerland OR Turkey OR Ukraine OR "United Kingdom" OR England OR UK.

(d) Journal of publication:
– 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:
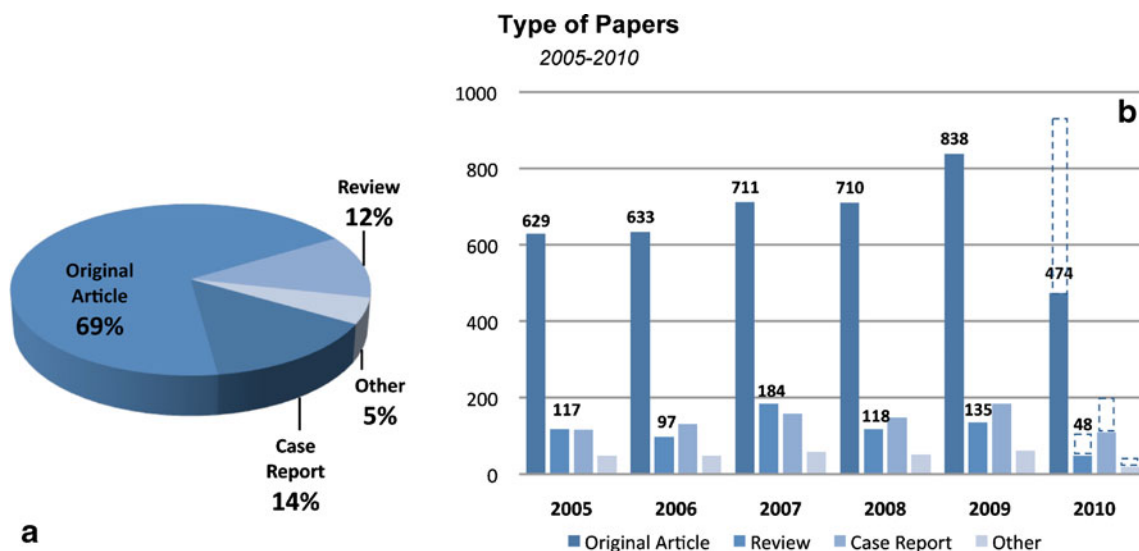
__jrid3760] OR "Forensic Sci Int Genet"[Journal:__jrid33849] OR "Int J Legal Med"[Journal:__jrid1818] OR "J Forensic Sci"[Journal:__jrid4738] OR "Med Sci Law"[Journal:__jrid5702] OR "Sci Justice"[Journal:__jrid8762]. We included only the journals pertaining to the actual core of forensic science and legal medicine journals and falling within the category "Medicine, legal" as defined by the Journal Citation Report (JCR). 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,

Type of Papers
2005-2010

Fig. 2 The pie-chart (**a**) reports the type of published articles (Original article, Case report, Review, Other). The histogram (**b**) shows pattern for the number of articles classified according to typology published in the time period considered (January 2005–June 2010)

Indexed
vs
ImpactedJournals

Classes of Impact Factor

Fig. 3 The histogram reports the percentage of papers published in journals indexed in MEDLINE but without impact factor, and the percentages of papers published in impacted journals, subdivided into clusters of impact factors
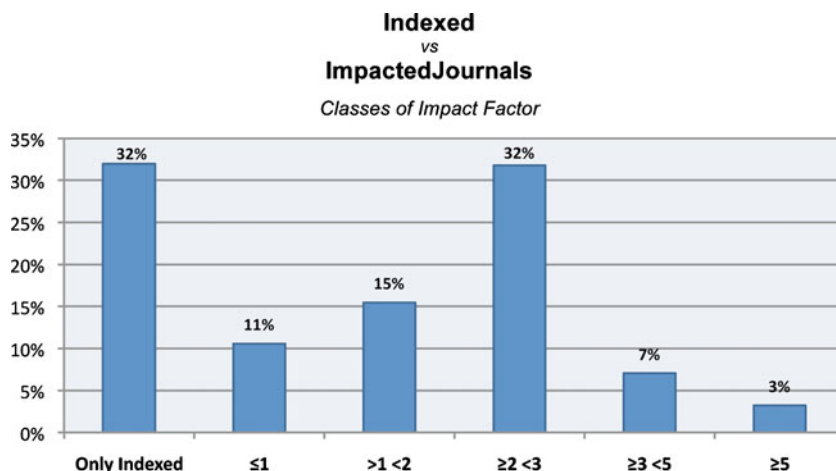
Medicine & Ethics", which covers issues related to public health, health disparities, patient safety and quality of care, and biomedical science and research. Since the new entry, "Romanian Journal of Legal Medicine", has not yet been indexed by PubMed, it was not included.

inclusion criteria: pertinence of the paper to the biomedicolegal discipline for containing at least one issue of specific interest recognisable from the title, abstract, affiliation, journal or keywords. Records referring to data pertaining to a European country, but reported by author(s) other than a European corresponding author were excluded.

Step 2

Data yielded by the search were pooled, and the following selection criteria were used: article published between January 1, 2005 and June 1, 2010; type of article limited to Clinical Trial, Meta-Analysis, Randomized Controlled Trial, Review, Case Reports, Classical Article, Clinical Trial, Phase I, Clinical Trial, Phase II, Clinical Trial, Phase III, Clinical Trial, Phase IV, Comparative Study, Controlled Clinical Trial, Evaluation Studies, In Vitro, Journal Article, Legal Cases, Multicenter Study, Research Support, American Recovery and Reinvestment Act, Research Support, N I H, Extramural, Research Support, N I H, Intramural, Research Support, Non U S Gov't, Research Support, U S Gov't, Non P HS, Research Support, U S Gov't, P HS, Technical Report, Validation Studies. No limitations regarding languages, species, gender, subsets, ages and text options were used.

Step 3

A single database including all the retrieved records from the MEDLINE/PubMed search was built using EndNote (Thomson Reuters EndNote X4®, CA, USA) and common software for data organisation and analysis (Microsoft Excel 2007®, WA, USA; SPSS Statistics 17.0®, IL, USA). The database contained the following entries: title, authors, abstract, keywords provided by the authors, affiliation, year of publication, journal and language.

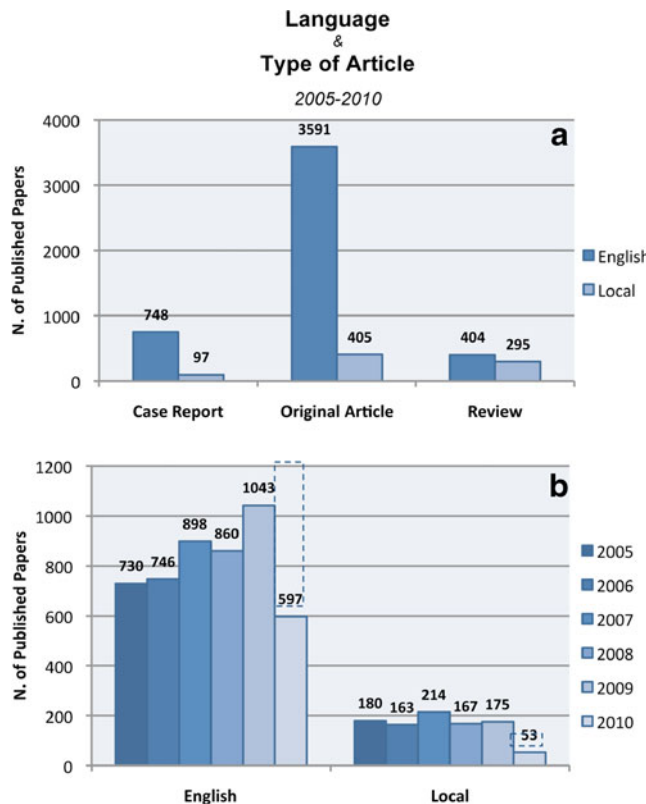The authors reviewed the records and selected the papers deemed relevant on the basis of the following

Language
&
Type of Article
2005-2010

Fig. 4 The histogram (**a**) shows the language used in the different types (Original, Case report, Review) of article. The histogram (**b**) shows the time pattern of papers classified on the basis of the language (Local vs English) used
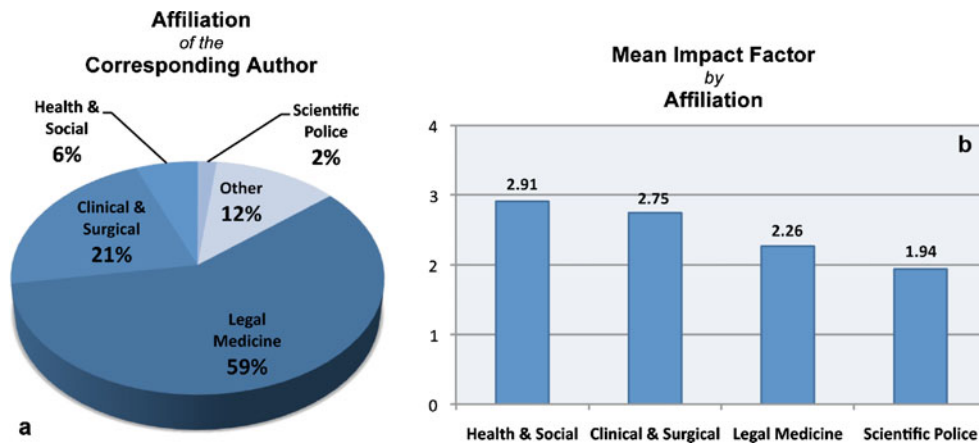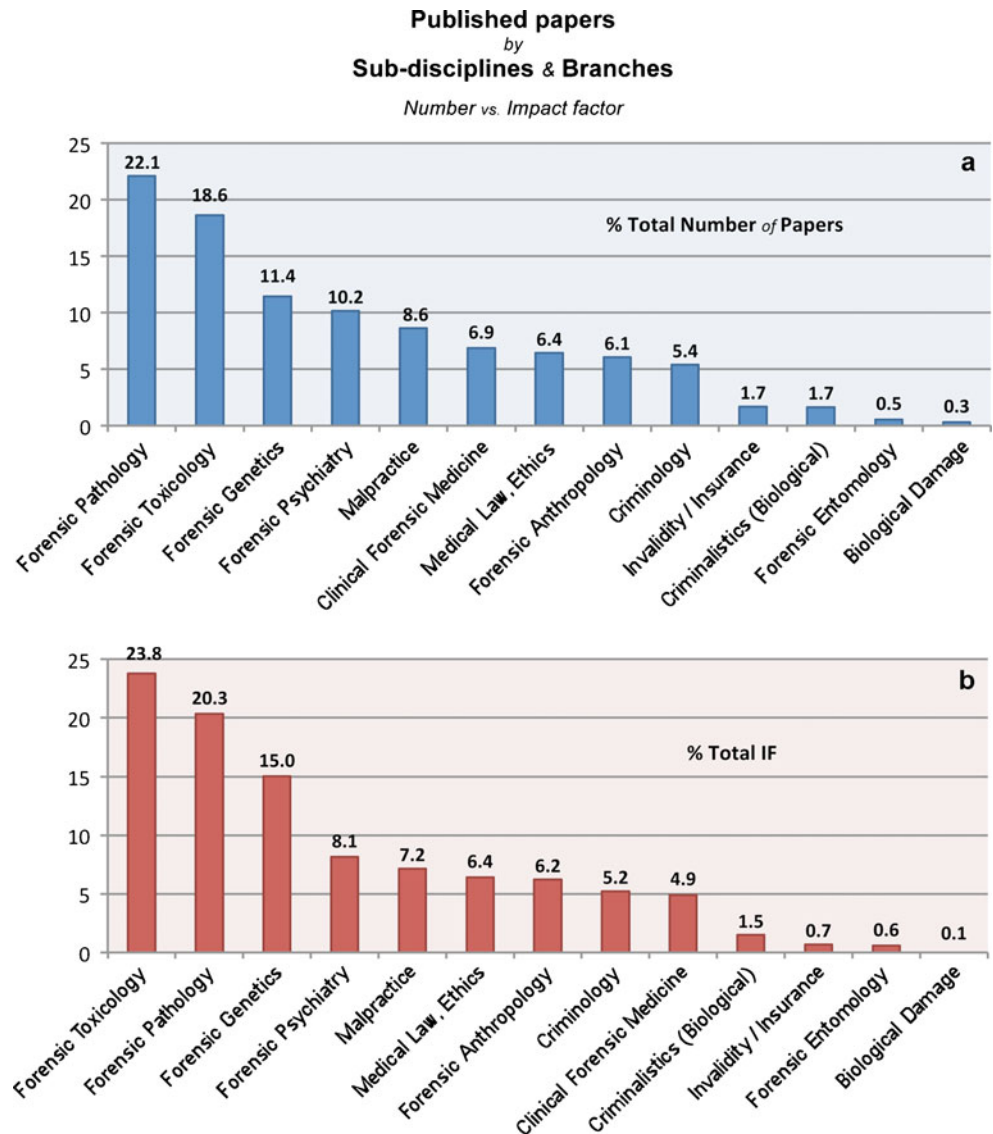
Fig. 5 The pie chart (**a**) depicts the percentages of papers classified on the basis of the affiliation of the Corresponding author, while the histogram (**b**) shows the mean impact factor for the typology of Affiliation

Fig. 6 Histogram (**a**) shows the percentages of papers published in each sub-discipline and histogram (**b**), the impact factor percentages

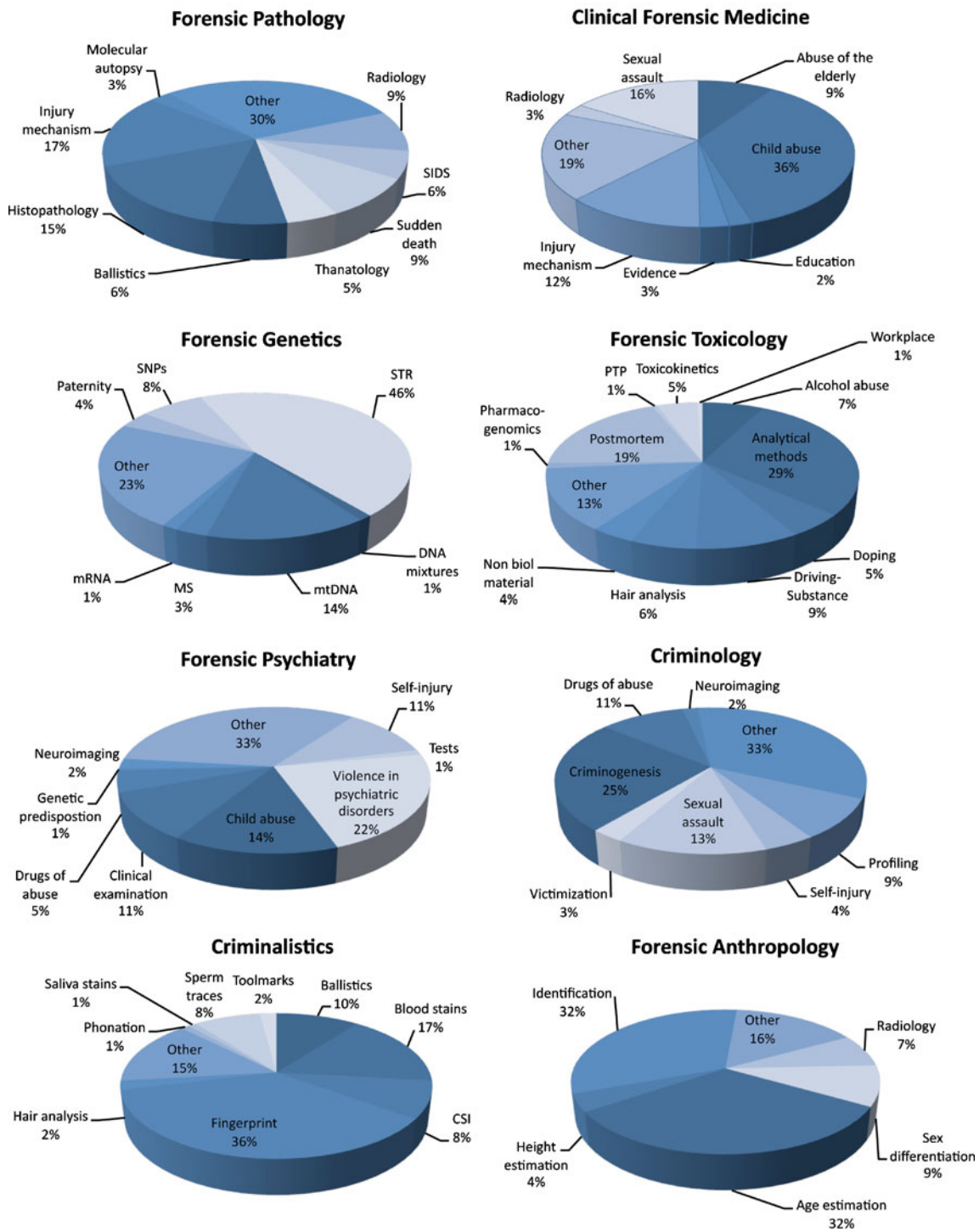**Fig. 7** The pie charts show the most relevant topics in each sub-discipline, expressed in terms of the percentage of pertaining papers

Step 4

After the above process, the selected papers were categorised with regard to the type of document, sub-discipline/branch and main topic of interest, country and professional area of affiliation, and impact factor (IF) of the journal (Journal Citation Report 2009—Thomson Reuters).

Step 5

Finally, the entire process was revised and confirmed datum by datum, by performing an internal double-check for coherence. In doubtful cases, the full text of the article was consulted and uncertainties were resolved by open discussion.

Results

Of 21,176 records retrieved at the initial search, 5,826 were considered suitable on the basis of the inclusion criteria and were categorised following the above-described method.

At in-depth analysis, it was found that there has been an increasing trend of publication over the last 5 years, from 910 papers published in 2005 to 1,218 papers published in 2009 (+33.8%). The provisional data available for the early months of 2010 allowed us to calculate a potential output of 1,560 scientific papers by the end of 2010 (+71.4%), confirming an increasing trend also for the current year (Fig. 1). On the other hand, the cumulative impact factor (IF) increased from 1,670 points in 2005 to 1,878 points in 2009 (+12.5%), and to the estimated 2,812 points (+68.4%) by the end of 2010. In this scenario, the mean impact factor decreased from 2.71 in 2005 to 2.46 in 2009 (−9.2%), with an exponential decrease over time (Fig. 1).

As for the type of article, 69% were "Original Articles", 14% "Case Reports", 12% "Reviews" and 5% "Others". An increasing trend, observed over the last 5 years (2005–2009), is confirmed by the statistical projection to the end of 2010 for both "Original Articles" (+33% over the 5 years, +81% as projection to the end of 2010) and "Case Reports" (+59% and +126%, respectively), whereas "Reviews" were stable over time (+15% and −1.5%, respectively), as shown in Fig. 2b.

A simple PubMed indexing without impact factor involved 32% of the published articles, while the remaining 68% were published in a journal with an impact factor, divided into IF clusters in Fig. 3.

The English language was predominant (84% of papers), with local languages accounting for 16% of the published papers. On correlating the language used with the type of article published, the figures for reviews published in English (404) and those in the local language (295) were similar, at least with respect to the high discrepancy observed for original articles (3,591 versus 405, respectively) and case reports (748 versus 97, respectively) (Fig. 4a). Over the last 5 years, the number of papers written in English increased: from 730 articles in 2005, to 1,043 in 2009 (+42.9%), the tendency being confirmed also by the estimation to the end of 2010 (1,433 expected articles, +96.3%) (Fig. 4b). In contrast, a decrease was found in the number of articles published in local languages: from 180 units in 2005 to 175 units in 2009 (−2.7%) and to 127 estimated papers in 2010 (−29.4%) (Fig. 4b).

Fifty-nine percent of the corresponding authors were affiliated to an Institution of "Legal Medicine", 21% to a "Clinical or Surgical" Unit, 6% to a "Health and Social" Department and 2% to a "Scientific Police" Unit (Fig. 5a). The computation of impact factor based on affiliation is reported in Fig. 5b.

The categorisation of the scientific output into sub-disciplines and branches is summarised in Fig. 6, while the most frequently published topics are depicted in Fig. 7.

The most recurrent topics in "*Forensic Pathology*" were "Injury mechanism" (17%), "Histopathology" (15%) and "SIDS"/"Sudden Death" for an aggregate 15% (Fig. 7). For "*Clinical Forensic Medicine*", we observed that "Abuse of Children and the Elderly" accounted together for 45% of topics, while "Sexual Assault" and "Injury mechanism" covered 16% and 12%, respectively. "*Forensic Genetics*" examined "STR" in 46% of the pertaining articles, "mitochondrial DNA" (mtDNA) in 14% and "SNPs" in 8%. In "*Forensic Toxicology*", 29% of the articles discussed an "Analytical method", 19% were related to "Postmortem" analysis, while 9% regarded the issue of driving under the influence of drugs ("Driving substance"). "*Forensic Psychiatry*" referred to the topic "Violence in psychiatric disorders" in 22% of articles, "Child abuse" in 14%, "Clinical examination" and "Self-injury" in 11% (Fig. 7). In "*Criminology*", 25% of the topics were related to "Criminogenesis", 13% to "Sexual assault" and 11% to "Drugs of abuse". "*Criminalistics (Biological)*", or rather the forensic sub-discipline analysing biological traces from a criminalistic viewpoint, treated the issue of latent "Fingerprints" in 36% of the pertaining articles, blood pattern analysis (referred as "Blood stains") in 17% and "Ballistics" in 10%. "*Forensic Anthropology*" treated the topic of "Age estimation" in 32% of articles, "Identification" in 32% and "Sex differentiation" in 9% (Fig. 7). "*Forensic Entomology*" focused on "Calliphoridae" in 31%, "Molecular entomology" in 25% and "Postmortem interval estimation" in 13% (data not shown). As for the branch "*Malpractice*", a "Clinical" topic involved 33% of papers, "Risk management" accounted for 27%, and "Surgery" for 18% of pertaining articles (data not shown). The branch "*Invalidity*" treated "Work ability" as a topic in 39% of published items, "Social insurance" in 20% and "Disability evaluation" in 17% (data not shown). "*Biological damage*" analysed the issue of "Examination" in 56% of published articles, "Compensation" in 22% and "Disability evaluation" in 11% (data not shown).

The 15 most published topics in bio-medicolegal sciences are summarised in Table 1.

Table 1 The 15 most published topics showing the frequency of special topics compared to all papers and the relative amount of the IF

Topic	Sub-disciplines or branches of pertinence	% Papers in the total $N=5,826$	% IF in the total $N=9,692$	Ratio of IF/papers
Analytical methods	Forensic toxicology	5.7	8.5	1.49
STR	Forensic genetics	5.6	6.0	1.07
Histopathology	Forensic pathology	3.6	3.9	1.08
Postmortem toxicology	Forensic toxicology	3.8	3.7	0.97
Injury mechanism	Forensic pathology *or* Clinical forensic medicine	4.9	3.2	0.65
Child abuse	Clinical forensic medicine *or* Forensic pathology	4.2	3.2	0.76
Radiology	Forensic pathology *or* Clinical forensic medicine	2.9	2.9	1.00
mtDNA	Forensic genetics	1.7	2.7	1.59
Age estimation	Forensic anthropology	2.1	2.6	1.24
SIDS	Forensic pathology	1.4	2.3	1.64
Clinic	Malpractice	2.9	2.1	0.72
Violence in psychiatric disorders	Forensic psychiatry	2.4	2.1	0.88
Sudden death	Forensic pathology	2.1	2.0	0.95
Criminogenesis	Criminology	1.4	1.9	1.36
Risk management	Malpractice	2.5	1.9	0.76

Total number of papers $N=5,826$, cumulative impact factor of all papers $IF_c=9,692$. The third column gives the ratio of both (IF achieved by papers dealing with one topic/frequency of these papers) to demonstrate the IF related potential of the different topics and themes

Discussion

Although ideally the bio-medicolegal sciences should converge into one discipline, they do make up sub-disciplines, which sometimes straddle across areas of modern medicine that are close but not overlapping, and that can be perceived in terms of productive extent and scientific impact only when viewed as a whole [3, 4]. The debate regarding the developmental trends, the future and the destiny of scientific research in the bio-medicolegal sciences are always of current and vital interest [5–7]. Bibliometric evolution and innovation allow us to evaluate accurately sub-disciplines, countries, academic sites and authors in ways that were unknown in the past, yielding more interesting information concerning future perspectives [8].

In a recent article by Jones [9] on the development and trend of the impact factor of forensic journals, no data on the various medicolegal sub-disciplines and topics were provided. Nor, in his bibliometric analysis, did Saukko [10] propose the categorisation of the scientific production into sub-disciplines, branches and topics, because of the risk of overlapping among categories.

In order to make an in-depth analysis of the scientific output in European bio-medicolegal sciences, with the categorisation of results on the basis of sub-disciplines, branches and topics, we adopted a mixed search strategy, including both MeSH terms and free-text word inquiries, which implies high sensitivity in querying scientific databases [11]. Our method included multiple input parameters, also calling for title and abstract, a search within the

"Affiliation" field looking for a forensic/medicolegal corresponding author, and within the "Journal" field looking for a forensic journal included in the category "Medicine, Legal" of the Journal Citation Report (JCR). To minimise the risk of erroneous classification into sub-disciplines, branches and topics, keywords supplied by the author of the paper (drawn from the MEDLINE database) were also used and the classification process was submitted to internal quality control.

The scientific output in bio-medicolegal sciences was analysed with a double-faced method that has both a quantitative and qualitative orientation. It is well known that the best way of evaluating the scientific relevance and quality of a paper is to consider its citations over the years [2]. However, when considering an entire discipline (such as legal medicine or bio-medicolegal sciences), the impact factor may be a reliable index of the general quality of the scientific output, as it is calculated over the last 2 years, each paper being weighted in a time-independent manner. Moreover, by considering the total number of citations, the chance of less recent articles being cited over subsequent years would be greater than that for recently published papers on novel and promising topics.

On the other hand, the PubMed interface, used for the MEDLINE database search, does not provide the number of citations for each paper published. To overcome this limitation, we considered the impact factor of the journal; this is calculated as the mean number of citations received by all the articles published in the previous 2 years [12]. Several authors recently pointed out that the impact factor

of a journal is closely related to the citations [2, 13] and the scientific quality of the published articles [2, 13, 14]. Based on these assumptions, by inference, the journal impact factor might represent a fairly good approximation of the quality of the published articles.

The findings made in the present bibliometric analysis demonstrate that the scientific production in bio-medicolegal sciences is in constant expansion both in terms of number of articles published each year, and total IF per year, with a slight deflection of the mean IF, oscillating between 2.30 and 2.71, in the last 6 months of the period considered (January–June 2010; Fig. 1).

The fulcrum of the production lies in the "Original Articles" (69%), followed by "Case Reports" (14%) and "Reviews" (12%) (Fig. 2a). Thirty-two percent of published articles appear in a PubMed indexed journal, but without an IF, while the remaining 68% appear in a JCR-registered journal and therefore have an impact factor. A relatively large proportion of the papers (32%) have an IF of 2 to 3, whereas only 10% of the total production has an IF greater than or equal to 3 (Fig. 3). This part of published literature is, of course, included in Journals outside the "Medicine, Legal" sector of the Journal Citation Report (JCR), since the IF of the leading medicolegal Journal (Int J Legal Med) is 2.79.

Against the 84% of articles in the English language, the local languages, widely used in the "Reviews" (42%), are used less often in "Case Reports" (12%) and "Original Articles" (10%), since an analysis of the published results on a particular topic aimed at synthesising the evidences and at orientating the forensic expert in daily practice appears more fruitful and straightforward in the local language. However, in line with the process of globalisation of scientific knowledge that is investing bio-medicine in the Third Millennium, the use of the local language has undergone a constant and progressive decrease during the 5-year period analysed, in favour of the English language (Fig. 4b).

The core of the published material still is of a medicolegal origin (59%, Fig. 5a), with a good clinical participation (21%, Fig. 5a), characterised by a high IF (2.75 vs. 2.61, Fig. 5b), and a minor contribution from the social field, also with a high mean IF (2.91, Fig. 5b). Clinicians prefer to publish scientific studies of bio-medicolegal interest in Journals focusing on their own field of interest (generally with a higher IF). The contributions with "Clinical/Surgical" and "Legal Medicine" affiliations showed a constant increase in the period from 2005 to June 2010, while "Scientific Police" and "Health & Social" were stable. Twelve percent of the "Affiliations" were classified under the heading "Other" since the affiliation of the "Corresponding author" was not available. The PubMed database, in fact, includes records without Affiliations of the Corresponding author just as it does not require the

Affiliations of all the centres involved in multicentre studies to be specified.

The most interesting and innovative quali- and quantitative data found in the present bibliometric study concern the *Sub-disciplines*, *Branches* and *Topics* within the bio-medicolegal sub-disciplines (Figs. 6 and 7 and Table 1). Overall, *Pathology*, *Toxicology*, *Genetics* and *Forensic Psychiatry* account for 62% of the total number of bio-medicolegal articles and 67% of the total IF. It is interesting to note that the development and the validation of new "Analytical methods", main topic within Forensic Toxicology (29% of the forensic toxicology production), maintains a prominent position also in relation to the overall bio-medicolegal production (5.7% of the articles published and 8.5% of the total IF). Another area with a high numeric production and impact is the allelic characterisation of *Short Tandem Repeats* (STR) in Forensic Genetics (5.6% of the total number of articles and 6% of the total IF). The analysis of the *mitochondrial DNA* accounts for 1.7% of the total production with an IF of 2.7% with respect to the total number of articles produced in legal biomedicine, and this testifies that the topic is of current interest and that the quality of the Journals in which the above-mentioned topic is published is high. *Sudden death* (considered together with the *Sudden Infant Death Syndrome*—SIDS and Sudden *Adult* Death) is confirmed as a subject of current priority medicolegal interest since it comprises 3.5% of the total number and 4.3% of the total impact factor. Staying in the forensic pathology ambit, the interest for forensic *Histopathology* and *Immunohistochemistry* (3.6% of the total number of articles and 3.9% of the total IF) has proven solid. At the same time, forensic *Radiology* (2.9% of the total number of articles and of the total IF) is an emerging field. Probably due to its inter- and transdisciplinary nature, "*Child Abuse*" is confirmed as one of the most frequently published forensic topics in the bio-medicolegal sciences (4.2% of the total number of articles and 3.2% of the total IF). "*Age estimation*", a topic that is peculiar to, and the most widely studied in "Forensic Anthropology", accounts for 2.1% of the total number of articles and 2.6% of the IF. Surprisingly, "*Risk management*" is one of the first 15 topics published, accounting for 2.5% of the total number of articles and 1.9% of the total IF (Table 1).

Despite the use made in the present study of an aggressive search strategy, clear definitions, a semiautomatic data system and an accurate double-checked categorisation protocol, at internal repeated random audit the possible methodological error was estimated to be less than 5% of the selected records; this was considered acceptable.

However, only the MEDLINE database was searched, thus generating a potential loss of information with respect to a pooled analysis with other databases (e.g. Scopus, Web of Science and Embase). 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. Moreover, we attributed to each paper the affiliation of the corresponding author as self-declared in the article, being this the only affiliation extractable by the PubMed interface. Therefore, we are aware of having lost a number of contemporary intra-national and/or supranational contributors involved in multicentre studies. In any case, the number of multicentre studies (clearly defined by title, abstract or keywords) was estimated to be less than 1.5% of the selected records, which implies a non-significant loss of data. Additionally, indexing services problems for including groups of authors in the author field are well-known aspects leading to a potential bias in bibliometric analyses [15].

Conclusion

The findings made in the present bibliometric analysis reveal a clear and interesting overall picture of the European scientific production and productivity in the field of bio-medicolegal sciences during the last 5 years. The evidence collected and catalogued in the different sub-disciplines and branches may play a useful role in the identification of innovative research lines, exploiting the special competences of the different European bio-medicolegal Institutions in order to elaborate long-term, inter-institutional, multidisciplinary and interdisciplinary Research Projects, eligible for financing from the European Union.

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