Revised manuscript (with marked up changes accepted)

This is an postprint (Accepted Manuscript) of an article published by Oxford in European Heart Journal. Acute Cardiovascular Care on 22 November 2022,available online: https://doi.org/10.1093/ehjqcco/qcac041

EURObservational Research Programme: a bibliometric assessment of its scientific output

Xavier Rossello[1,2,3,4], Albert Massó-van Roessel[1], Ovidiu Chioncel[5], Luigi Tavazzi[6], Roberto Ferrari[7], Alec Vahanian[8], Chris P Gale[9], Bogdan A. Popescu[5], Aldo P Maggioni[10]

[1] *Facultad de Medicina, Universitat de les Illes Balears (UIB), Palma, Spain*

[2] *Cardiology Department, Health Research Institute of the Balearic Islands (IdISBa), Hospital Universitari Son Espases, Palma, Spain*

[3] *Centro Nacional de Investigaciones Cardiovasculares (CNIC), Madrid, Spain*

[4] *Medical Statistics Department, London School of Hygiene & Tropical Medicine, London, United Kingdom*

[5] *Department of Cardiology, University of Medicine and Pharmacy «Carol Davila», Emergency Institute for Cardiovascular Diseases «Prof. Dr. C. C. Iliescu», Bucharest, Romania*

[6] *Maria Cecilia Hospital, GVM Care&Research, Cotignola, Italy*

[7] *Scientific Department, MTA Group, Lugano, Switzerland (RF)*

[8] *UFR Médecine, Université de Paris, Paris, France; LVTS INSERM U1148, GH Bichat, Paris, France (AV)*

[9] *Leeds Institute of Cardiovascular and Metabolic Medicine, University of Leeds, Leeds, UK; Leeds Institute for Data Analytics, University of Leeds, Leeds, UK; Department of Cardiology, Leeds Teaching Hospitals NHS Trust, Leeds, UK*

[10] *ANMCO Research Center, Heart Care Foundation, Firenze, Italy*

Address for correspondence:

Xavier Rossello, Cardiology Department, Hospital Universitari Son Espases, Health Research Institute of the Balearic Islands (IdISBa), Palma de Mallorca, Spain.
Phone number: +34 871 20 50 50 (ext. 64527)
Email: fjrossello@ssib.es

Abstract

Aims. Given the lack of reliable observational data, network of volunteer centers, and standardised methodological procedures, the European Society of Cardiology EURObservational Research Programme (EORP) was set to provide a better understanding of real-world cardiovascular care and outcomes. We aimed to evaluate the scientific impact of EORP using a bibliometric approach.

Methods and Results. We collected data for each individual publication, and for each individual journal with at least one EORP publication. Bibliometric indicators evaluating research performance were categorised into those evaluating EORP publications (publication-based indicators), and those assessing the journals where those papers were published (journal-based indicators). During the first ~11 years since its inception, we found that EORP produced 189 publications, with most published in journals in the first quartile (60.9%) or the second quartile (33.5%) of the Web of Science Journal Citation Report. The total number of citations to EORP publications was 9630 (average citation per publication of 51, h index of 54, 29 EORP publications with ≥100 citations). Of EORP publications, 20 had an Altmetric Attention Score higher than 50 and 9 had a score higher than 100. Fifty-two EORP papers have been cited 65 times in ESC Clinical Practice Guidelines between 2013 and 2021.

Conclusion. EORP registries have contributed to impactful scientific knowledge. The high-quality metrics highlight the relevance of EORP international cardiovascular registries on the academic community. Efforts are needed to support this and other programmes aimed at delivering real-world evidence from independent patient data of cardiovascular care and outcomes across multiple geographies.

Keywords

Cardiovascular disease; Evidence-based medicine; Registries; EURObservational Research Programme; European Society of Cardiology.

Introduction

Cardiovascular disease (CVD) is responsible for more than one-third of deaths in Europe[1], accounting for 29% and 33% of premature deaths before the age of 70 in Europe, in women and men respectively)[1]. It has substantial socioeconomic consequences, costing the EU[2] and the US[3] economies an estimated €196 and $363 billion annually, respectively. This global public health problem is expected to grow as a consequence of the increasing prevalence of cardiovascular risk factors (CVRFs), and an aging and co-morbid population.[4–6] In this context, there is a need for reliable observational data on CVD.[7]

The EURObservational Research Programme (EORP),[8] launched by the European Society of Cardiology (ESC) in 2009, designs and implements registries aimed at providing a better understanding of real-world cardiovascular care and outcomes[9,10]. Unlike the ESC Atlas [11], the EORP collects, collates, and evaluates individual patient data for diagnostic processes, therapeutic approaches and adherence to Clinical Practice Guidelines (CPGs). Insights from EORP studies have already contributed to the reduction of the burden of CVD through (i) the identification of associations between CVRFs and diseases [12] (ii) the evaluation of geographical and temporal trends in clinical management and cardiovascular outcomes [13] (iii) the implementation of quality improvement through audit and feedback [14,15]; (iv) the assessment of the value of interventions in the real-world setting[16] and (v) the generation of hypotheses for future studies[17]. The second translational 'gap', or evidence-practice gap, which refers to this disconnect between the development and the implementation of new interventions in clinical practice [18], is one of the key elements that EORP aimed to evaluate.

Scientific impact is of increasing importance as a measure of research programme performance. A number of scientific societies and institutions use such an approach to evaluate the impact of their research output[19]. Given the EORP is over a decade since inception, we aimed to evaluate their 189 publications using a comprehensive bibliometric approach.

Methods

Study sponsor of EORP

The European Society of Cardiology (ESC) is a scientific society uniting >100,000 physicians, scientists, nurses and allied professionals across all cardiology subspecialties and career stages.[20] It comprises 57 National Cardiac Societies, and 29 subspecialty communities (7 Associations, 15 Working Groups and 7 Councils). The ESC's mission is to reduce the burden of cardiovascular disease.[21] To fulfil its mission, the ESC provides scientific support and educational activities[22], such as Clinical Practice Guidelines (CPGs), educational courses, and registries on specific disease areas[8].

EURObservational Research Programme: type of registries and common features

The EORP is a programme of clinical registries led by the ESC. The Oversight Committee is the main committee, responsible for the entire programme. Below the oversight committee, there are two committees that run each study: Executive Committee & Steering Committee. EORP data collection is centralised at the European Heart House (Sophia-Antipolis, France), which provides organisational support to the centres, management of databases, and liaises with statistical centres selected by the Executive Committee of each Registry, in agreement with the Oversight Committee. The main role of the EORP Coordinating Team is to coordinate the project, provide support to the Committees, National Coordinators and participating centres and ensure the use of high methodological standards.

For all registries, the ESC has acted as legal sponsor and has been responsible for the overall study management. In total, more than 3,360 recruiting centres have enrolled more than 138,000 participants through the EORP. Over 80 countries have already participated in at least one of the EORP registries.

EORP studies are classified in two broad categories: Cardiology and Prevention registries. Cardiology registries are categorized into three subtypes: (I) General/common diseases (assessing epidemiological and clinical aspects of highly prevalent cardiovascular conditions); (ii) Sentinel/intervention (evaluating the impact of interventional procedures and imaging techniques); and (iii) Special/rare diseases (assessing epidemiological and clinical aspects of rare cardiovascular conditions). Prevention Registries study CVRFs and prevention measures.

The EORP endeavour have produced registries adhering to the following principles: (i) use of appropriate methodological procedures; (ii) use of network of volunteer centres appointed by ESC constituent bodies; (iii) use of on-line electronic Case Report Form allowing user-friendly data entry; and (iv) involvement of the ESC National Cardiac Societies and relevant ESC Constituent Bodies.

Study variables: EORP publications

The study period comprised the timespan between the first EORP publication (01 May 2010), and the censored date of our study (09 April 2021). The list of EORP items is provided in the **Table S1** and **S2**, and was originally obtained from the EORP Coordinating Team. Inclusion criteria comprised those publications derived from EORP investigators and relative to EORP initiatives, whereas exclusion criteria were documents not present in Web of Science (WOS) at the time of censored date, and non-scientific documents (congress communications, press releases, website posts), regardless of whether they were present in WOS.

We collected data for each individual publication, and for each individual journal with at least one EORP publication. Hence, bibliometric indicators evaluating research performance were categorised into those evaluating EORP publications (publication-based indicators), and those assessing the journals where those papers were published (journal-based indicators).

Sources of bibliometric information and type of bibliometric indicators

We used the tools provided by the WOS.[23] Information relative to WOS indicators were collected one year later (as per March 22, 2022), to allow for all items to be finally allocated in WOS (some items were ahead of print when the study period for including publication was censored). Journal Citation Reports (JCR) from WOS was used to evaluate journal-based indicators, such as the journal impact factor (JIF), and publication-based indicators, such as the number of citations.

The Altmetric Bookmarklet[24] was used to measure metrics and qualitative data deemed complementary to traditional, citation-based metrics. This includes citations on Wikipedia, public policy documents, discussions on research blogs, mainstream media coverage, bookmarks on reference managers and mentions on social media networks.

EORP scientific performance was evaluated through several bibliometric indicators, which can either apply to the set of items present in WOS (publication-based indicator), or to the set of journals where those papers were published (journal-based indicators).

Journal-based assessment

The following journal-based indicators were collected: (1) impact factor, which is defined as all citations to the journal in the current JCR year to items published in the previous two years, divided by the total number of scholarly items (comprising articles, reviews, and proceedings papers) published in the journal in the previous two years[25,26]; (2) impact factor quartile (Q1 – Q4), number of documents that appear in a journal in a particular impact factor quartile in a given year. For journals classified in multiple WOS research areas, we used the higher quartile among those available.

Publication-based assessment

The following publication-based indicators were collected for the set of EORP publications: (1) sum of times cited, defined as total number of citations (cited references) to the set of EORP publications; (2) citations in each year, number of citations made each year to any item in the set of publications; (3) average citation per year (or period), defined as the average number of citations to articles since they were published (ratio with number of citations in the numerator and number of years in denominator); (4) average citations per item, average number of citing articles for our set of ESC EORP publications (the sum of the times cited count) divided by the number of publications; and (5) h-index (also known as Hirsch index)[27], this value is based on a list of publications ranked in descending order by the "*times cited count*" parameter: an index of *h* means that there are *h* publications that have each been cited at least *h* times.

The Altmetric Attention Score was collected for each article whenever this information was available. This score is automatically calculated with a weighted count of all of the attention a research output has received. It is based on 3 main factors: (1) volume (the score goes up as more people mention it); (2) sources (each category of mention contributes differently to the final score, (i.e. newspaper articles contribute more than a blog post); and (3) authors (how often the author mentions it).[24] Other information provided by the Altmetric Bookmarklet was collected, such as the number of platforms, citations, readers on Mendeley or countries mentioning each document.[24]

Data analysis

The number of publications is presented separately as a total count by year, and by topic. The JIF was categorized in quartiles in order to present number of publications by quartiles. Further 4-point categories were made for JIF (0-4, 4-8, 8-12, 12-16, 16-20, and >20) in order to present the number of publications by JIF. The number of citations is presented as a

total count by year. Similarly, the mean Altmetric Attention Score was also provided by year. Descriptive data were obtained using STATA software, version 15.1 (Stata Corp, College Station, TX, USA). GraphPad Prism version 6.00 (GraphPad Software, La Jolla California) was used to produce the figures.

Results

A set of 196 EORP publications were identified for the first ~11 years since the launch of EORP. Among them, 189 were available in WOS (**Table S1**). A flow chart is reported in **Figure 1.** The remaining 7 items (**Table S2**) were excluded from the analysis because they are either not present in WOS, or because they were not scientific articles (congress communications, press releases, website posts). The number of publications increased from 3 in 2010 to 23 in 2015, then reaching a plateau of around 25 publications per year between 2016 and 2020. In parallel with the COVID19 pandemic, the number of publications declined from 2021 (**Figure 2**).

By topics, the total number of publications were ranked as follows: preventive cardiology (68 publications, 36.0%), arrhythmias and device therapy (55 publications, 29.1%), and Heart Failure (31 publications, 16.4%). Further details regarding the topics of the publications are shown in **Figure 3**. According to WOS, there was co-author representation from 56 countries. **Table S3** shows the list of countries with at least one co-author in EORP publications, which was led by France (n=131), England (n=125) and Italy (n=118).

Research performance based on journal indicators

The distribution of the JIF in the EORP set of publications was skewed to the right (**Figure 4A**). Most of the documents (46%) were published in a Journal with a JIF within the range of 4 and 8. From a JIF of 8 upwards there was a large spread. In total, 48 journals have published at least one EORP paper. Most articles were published in Journals in the first quartile (Q1) of the JCR. As shown in **Figure 4B**, the number of publications in Q1 Journals were 109 (60.9%),

whereas 60 (33.5%) were in Q2 and 10 (5.6%) were in Q3-4. The number of publications by journal is shown in **Table S4**. Among them, six journals published ≥10 EORP publications: European Heart Journal (n=27), Europace (n=26), European Journal of Heart Failure (n=23), European Journal of Preventive Cardiology (n=17), and International Journal of Cardiology (n=12). There were 112 (59.3%) papers published in ESC family Journals (**Table S5**).

Research performance based on citations to EORP articles

The total number of citations (sum of times) to EORP publications was 9630 (**Figure 5**). Therefore, the average citation per year was 803 (9630/12) and the average citation per publication was 51 (9639/189). The average citation per year was 123 cites for the first period (2010-2015), and 1444 for the second period (2016-2021). The h-index for the set of 189 EORP publications was 54, meaning that there are 54 items that have at least 54 citations.

Until March 22, 2022, 29 EORP publications had at least 100 citations: 19 publications had between 100 and 200 citations, 3 had between 200 and 300 citations, 4 had between 300 and 400, and the top three were above 400 citations (439, 506 and 573). Further details of the 189 EOPR publication in WOS, sorted by times cited (highest to lowest), can be found in Supplemental **Table S1**.

Among all EORP publication, 20 had an Altmetric Attention Score higher than 50, and 9 publications had a score higher than 100 (**Figure 6)**. Other altmetric measures are provided by the Altmetric Bookmarklet are shown in **Table S6**.

To date, 52 EORP papers have been cited in ESC CPGs between 2013 and 2021 (due to some recurrent citations across CPGs, EORP papers received 65 citations). The list of CPGs is presented in **Table S7.**

Discussion

The main findings of our bibliometric assessment can be summarised as follows: (1) among the 189 EORP publications produced over 11 years, most articles were published in journals in the first quartile (60.9% in Q1), or the second quartile (33.5% in Q2) of the JCR; (2) the total number of citations to EORP publications was 9630, the average citation per publication was 51, and the h index of this set of documents was 54; and (3) among all EORP publications, 20 had an Altmetric Attention Score higher than 50, and 9 publications had a score higher than 100. The main conclusion is that EORP registries have greatly contributed to generate impactful scientific knowledge to cardiovascular health professionals and researchers, so these insights might have been translated into their clinical practice and their clinical investigations, respectively. Decision-makers have received some tools to shape evidence-based policy in support of cardiovascular health (e.g., EORP has been very useful in the identification of the areas of cardiovascular research with the greatest needs). Moreover, EORP papers have been cited 65 times in ESC CPGs between 2013 and 2021.

Assessing the research output of the EORP initiative using bibliometric data has shed light on the performance of the programme. It should be noted that the scarce number of previous attempts to report bibliometric assessments in the cardiovascular realm has mainly focused on the number of citations.[19,28] By including altmetrics and impact on CPGs on top of the standard citation analyses, this study provides a broader view about how the EORP endeavour impacted on the scientific community. In the set 189 of EORP publications, there were 29 top cited papers with >100 citations. Moreover, CPGs cited 65 times an EORP publication. The h-index, which discounts the disproportionate weight of highly cited papers or papers that have not yet been cited, was 54 (e.g., there are 54 publications having ≥54 citations). Additionally, the mean citation count for the set of EORP publications was 51, close to the h-index. These metrics are useful but rely a lot on the selected timespan (older publication benefit more from this measure). The dependence on time is actually unfavourable for EORP metrics

performance, since most of the items were published in the last 5-6 years and they have still room for further citations.

When it comes to the crossroad between journals and citations, the JIF was used as surrogate to evaluate research performance. Though not a strict mathematical average, the JIF provides a functional approximation of the mean citation rate per citable item. The use of the JIF, which is yearly updated in the Journal Citation Reports (JCR), is increasing not only among the bibliometric and scientific community, but also among science policy makers.[25,26] This is because the JIF is used as a proxy of the quality and expected impact of each of the papers published in that Journal.[25] In spite of these advantages, the use of JIF shows some caveats, which have been already summarised elsewhere.[25,26] In this regard, we should take into account the Garfield's Law of Concentration, which postulates that a relatively small core of journals (10-20%) account for the bulk (80-90%) of what is cited by all published literature.[29] In our cohort of EORP publications, there was a single journal concentrating 4 out of the 5 top cited journals (European Journal of Heart Failure).

Among the new emerging metrics challenging the dominance of citation-based analyses the Altmetric Score should be highlighted, which tracks how papers perform in media and social media. Altmetrics showcase the attention and influence of research and can measure social impact by taking into account mentions in the news, blogs, and on Twitter, article page views and downloads, coverage in the news, social sharing and blog features, as well as references in public policy documents, or commentary from experts and practitioners.[30] In our study, we focused on the metric summarising all these items, the Altmetric Attention Score. We identified some top publications with a very high score (n=9), but our main finding is perhaps the increment in mean Altmetric score between the first and the second half of the study period. Further work should be performed by the ESC to improve its dissemination strategies. In this regard, the ESC Journals Study randomized 696 papers published in the ESC Journals family (March 2018-May 2019) for promotion on Twitter or to a control arm (with no active tweeting

from ESC channels).[31] In a preliminary analysis of 536 articles (77% of total), Twitter promotion of articles was associated with a 1.43 higher rate of citations. Both Altmetric score and number of users tweeting were positively associated with the number of citations in both arms, with evidence of a stronger association (interaction) in the Twitter arm.[31] Care should be exercised when evaluating the positive impact of a high Altmetric score – some controversial topics (such as dietary and disease association, or even misreporting) might have a high impact in Social Media, but that does not necessarily translates into rigorous science and meaningful impact on clinical practice.

According to evidence-based medicine, randomised clinical trials (RCTs) are able to yield unbiased treatment effects, whereas observational studies are useful to evaluate association using real-world data.[32] In this line, observational data from EORP cohorts have assessed the burden and natural history of diseases,[33] evaluated quality of care,[14] identified risk factors or prognostic markers of cardiovascular disease,[12,34] and might have been used to report associations between exposures and outcome that can generate hypotheses for prospective testing in RCTs.[17] Data from EORP registries can be potentially used to assess the feasibility of RCTs, either by determining the number of patients that would meet eligibility criteria, determining the event rate needed for sample size estimation (if the registry is representative), or by identifying study sites (i.e., those motivated centres with high-recruitment capacity). Away from highly prevalent cardiovascular conditions, the study of rare diseases has also greatly benefited from EORP registries.[17] In spite of the remarkable growth in the uptake of national and international cardiovascular registries across the last few decades,[35] very few studies have focused on clinical conditions with low incidence, such as spontaneous coronary artery dissection or peripartum cardiomyopathy, which have been addressed by specific EORP registries (Spontaneous Coronary Artery Dissection [SCAD] Registry, and Peripartum Cardiomyopathy Registry (PPCM), respectively).

Clinical registries can be used to inform health policy, improve the quality and cost-effectiveness of patient care, and assist in monitoring the uptake and safety of novel treatments and procedures. It can serve as a platform to evaluate the use of recommended therapies and to launch initiatives aimed to improve the implementation of CPG recommendations in the real-world setting (i.e., to reduce the evidence-practice gap[18]). Of note, adherence to evidence-based CPG recommendations has been associated with improved outcomes.[32,36–38] EORP registries have enabled evaluation of CPGs adherence across Europe and, importantly, provided insights into why guideline recommendations were not implemented, which in turn, may assist policymakers in designing more efficient systems.[38] The ESC has also other instruments to complement the information yielded by EORP. It collects aggregated cardiovascular data from across its 57 members countries through its 'Atlas of Cardiology' [11]. More recently, it has launched the EUROHEART (European Unified Registries for Online Heart care Evaluation And Randomized Trials) project, which addresses the lack of continuous gathering of standardized data from clinical care, and of long-term follow-up of outcomes. The EUROHEART programme supports the development of continuous on-line CVD registries in regions and countries interested in implementing quality of care improvement, and advocates for both observational research and RCTs at national and international level.[39]

Limitations

Our approach which used bibliometric assessment has limitations. Care must be taken to not focus too much on a citation-based analysis. The nature of the study favours older published articles, exposed to longer time to be cited. In this regard, we complemented the citation analysis with the addition of altmetrics. Some bibliometric dimensions remained unexplored. Previous studies have evaluated collaboration networks through the Science Citation Index Expanded (SCIE), though this makes sense to evaluate spontaneous collaborations instead of programmes with repeated patterns of collaborations.[28] Because the ESC is the natural link between EORP and CPGs, the number of citations of EORP papers might be

overrepresented in ESC CPGs. Similarly, the bibliometric performance of the set of EORP publications might be influenced by the high number of reports published in a journal of the ESC family.

The study participants of EORP studies might not represent the whole spectrum of a disease severity (e.g., sometimes those who are the sickest and at higher risk might be excluded). This could be overcome by discussing directly with the National Leaders about strategies of center selection (proportional to number and characteristics of centers existing in each participating country), and by ensuring consecutive recruitment (e.g., one day per week, one week per month, etc). This limitation in representativeness could be also overcome by the use of inclusive and continuous complete case ascertainment registries.

Conclusions

The EORP registries have contributed to generate new and impactful scientific knowledge. Among the 189 EORP publications produced over 11 years, most articles were published in journals in the first quartile (60.9% in Q1). Moreover, the total number of citations to EORP publications was 9630, the average citation per publication was 51, and the h index of this set of documents was 54. This high-quality metrics highlight the relevance of EORP international cardiovascular registries on the academic community. Efforts are needed to support this and other programmes aimed at delivering real-world evidence from independent patient data of cardiovascular care and outcomes across multiple geographies.

Acknowledgments

See the appendix for the list of key ESC Staff and EORP chairpersons.

Funding

This study did not receive funding. Current sponsors of the EORP programme can be found at https://www.escardio.org/Research/Registries-&-surveys/Sponsorship.

Conflict of Interest

XR has no conflict of interest. AM-vR received support for attending meetings and/or travel from Pzifer and payment for presentation from AstraZeneca (both outside this research work). OC received consulting fees from Boehringer Ingelheim (outside this research work). LT has received speaker fees, support for attending meetings and advisory board fess from Servier. He also received advisory board fees from CVIE Therapeutica. RF has received speaking fees and consulting fees, as well as Support for attending meetings and/or travel. from Merck Serono, SPA Sunpharma, Lupin, Servier. He also had a leadership or fiduciary role in Art Research and Science S.r.l. (A.R.S.1), and Medical Trial Analysis. AV has received consulting and speaking fees from Edwards life sciences ,Medtronic ,abbott ,cardiovalve. He also participated in a Board (ATLANTIS ,UNLOAD ,AQUATIC). CPG has received grants from British Heart Foundation, National Institute for Health Research, Horizon 2020, Abbott Diabetes, Bristol Myers Squibb, consulting fees from Astrazeneca, Bayer, Bristol Myers Squibb, Boehringer Ingelheim, Chiesi, CYTE Ltd, Caiichi Sankyo, Menarini, Organon, speaker fees from Astrazeneca, Medisetter, Menarini, Raisio Group, Wondr Medical, Zydus, and he has served in Advisory Boards of Al Nexus Inc., Amgen, Bayer, Bristol Myers Squibb, Boehringer Ingelheim, Chiesi, Daiichi Sankyo, Menarini. He has a leadership role in the following bodies: NICE Indicator Advisory Committee,

Chair ESC Quality Indicator Committee, Chair Data Science Group (Euroheart). Moreover, he has a patent in consideration (FIND-AF), and he is Deputy Editor: EHJ – Quality of Care and Clinical Outcomes. BAP has received advisory board fees from Novartis and Bayer, speaker fees from General Electric Healthcare, Ewopharma, Pfizer, Merck, Krka, Janssen (all outside this research work). APM has received fees for participation in study committees from AstraZeneca, Novartis, Bayer, and Fresenius (all outside this research work).

Data availability statement

The data underlying this article will be shared on reasonable request to the corresponding author.

References

1. Timmis A, Vardas P, Townsend N, et al. European Society of Cardiology: cardiovascular disease statistics 2021. *Eur Heart J* 2022; 43: 716–799.

2. European Research Area Network dedicated to cardiovascular diseases (ERA-CVD). https://www.era-cvd.eu/254.php (accessed 17 March 2022).

3. Virani SS, Alonso A, Aparicio HJ, et al. Heart Disease and Stroke Statistics-2021 Update: A Report From the American Heart Association. *Circulation* 2021; 143: e254–e743.

4. Rossello X, Dorresteijn JAN, Janssen A, et al. Risk prediction tools in cardiovascular disease prevention: A report from the ESC Prevention of CVD Programme led by the European Association of Preventive Cardiology (EAPC) in collaboration with the Acute Cardiovascular Care Association (ACCA) and the Association of Cardiovascular Nursing and Allied Professions (ACNAP). *Eur J Prev Cardiol* 2019; 26: 1534–1544.

5. Rossello X, Raposeiras-Roubin S, Oliva B, et al. Glycated Hemoglobin and Subclinical Atherosclerosis in People Without Diabetes. *J Am Coll Cardiol* 2021; 77: 2777–2791.

6. Roth GA, Mensah GA, Johnson CO, et al. Global Burden of Cardiovascular Diseases and Risk Factors, 1990-2019: Update From the GBD 2019 Study. *J Am Coll Cardiol* 2020; 76: 2982–3021.

7. Bowman L, Baras A, Bombien R, et al. Understanding the use of observational and randomized data in cardiovascular medicine. *Eur Heart J* 2020; 41: 2571–2578.

8. European Society of Cardiology. EURObservational Research Programme of the ESC. https://www.escardio.org/Research/Registries-&-surveys/Observational-research-programme (accessed 2 March 2021).

9. Rosselló X, Huo Y, Pocock S, et al. Global geographical variations in ST-segment elevation

myocardial infarction management and post-discharge mortality. *Int J Cardiol* 2017; 245: 27–34.

10. Bueno H, Rossello X, Pocock S, et al. Regional variations in hospital management and post-discharge mortality in patients with non-ST-segment elevation acute coronary syndrome. *Clin Res Cardiol* 2018; 107: 836–844.

11. Barbato E, Noc M, Baumbach A, et al. Mapping interventional cardiology in Europe: the European Association of Percutaneous Cardiovascular Interventions (EAPCI) Atlas Project. *Eur Heart J* 2020; 41: 2579–2588.

12. Dauriz M, Targher G, Laroche C, et al. Association Between Diabetes and 1-Year Adverse Clinical Outcomes in a Multinational Cohort of Ambulatory Patients With Chronic Heart Failure: Results From the ESC-HFA Heart Failure Long-Term Registry. *Diabetes Care* 2017; 40: 671–678.

13. Crespo-Leiro MG, Anker SD, Maggioni AP, et al. European Society of Cardiology Heart Failure Long-Term Registry (ESC-HF-LT): 1-year follow-up outcomes and differences across regions. *Eur J Heart Fail* 2016; 18: 613–625.

14. Lip GYH, Laroche C, Popescu MI, et al. Improved outcomes with European Society of Cardiology guideline-adherent antithrombotic treatment in high-risk patients with atrial fibrillation: a report from the EORP-AF General Pilot Registry. *Europace* 2015; 17: 1777–1786.

15. Ferrannini G, De Bacquer D, De Backer G, et al. Screening for Glucose Perturbations and Risk Factor Management in Dysglycemic Patients With Coronary Artery Disease-A Persistent Challenge in Need of Substantial Improvement: A Report From ESC EORP EUROASPIRE V. *Diabetes Care* 2020; 43: 726–733.

16. Di Mario C, Eltchaninoff H, Moat N, et al. The 2011-12 pilot European Sentinel Registry

of Transcatheter Aortic Valve Implantation: in-hospital results in 4,571 patients. *EuroIntervention* 2013; 8: 1362–1371.

17. Ruys TPE, Roos-Hesselink JW, Pijuan-Domènech A, et al. Is a planned caesarean section in women with cardiac disease beneficial? *Heart* 2015; 101: 530–536.

18. Aktaa S, Batra G, Wallentin L, et al. European Society of Cardiology methodology for the development of quality indicators for the quantification of cardiovascular care and outcomes. *Eur Heart J Qual Care Clin Outcomes* 2022; 8: 4–13.

19. Shuaib W, Khan MS, Shahid H, et al. Bibliometric analysis of the top 100 cited cardiovascular articles. *Am J Cardiol* 2015; 115: 972–981.

20. Who is the European Society of Cardiology? https://www.escardio.org/The-ESC/Who-we-are (accessed 17 March 2022).

21. Badimon L. ESC Advocacy (2018-2020): contributing to the ESC mission of reducing the burden of cardiovascular disease. *Cardiovasc Res* 2020; 116: e169–e170.

22. Rosselló X, Stanbury M, Beeri R, et al. Digital learning and the future cardiologist. *Eur Heart J* 2019; 40: 499–501.

23. Web-of-Science. Research assessment and management - InCites - Web of Science Group. https://clarivate.com/webofsciencegroup/solutions/incites/ (accessed 3 March 2021).

24. Altmetric – Free tools. https://www.altmetric.com/products/free-tools/ (accessed 17 March 2022).

25. Bordons M, Fernández MT, Gómez I. Advantages and limitations in the use of impact factor measures for the assessment of research performance. *Scientometrics* 2002; 53: 195–206.

26. Fuster V. Impact Factor: A Curious and Capricious Metric. *J Am Coll Cardiol* 2017; 70: 1530–1531.

27. Hirsch JE. An index to quantify an individual's scientific research output. *Proc Natl Acad Sci U S A* 2005; 102: 16569–16572.

28. Chorro FJ, Alonso-Arroyo A, Aleixandre-Benavent R. Trend in Spanish cardiology research and global comparative analysis of major topics. *Rev Española Cardiol (English Ed)* 2021; 74: 909–918.

29. Buchan AMJ. Accountability and high impact journals in the health sciences. *Publications*; 2017; 5(1):5.

30. Jabaley CS, Groff RF 4th, Stentz MJ, et al. Highly visible sepsis publications from 2012 to 2017: Analysis and comparison of altmetrics and bibliometrics. *J Crit Care* 2018; 48: 357–371.

31. Ladeiras-Lopes R, Clarke S, Vidal-Perez R, et al. Twitter promotion predicts citation rates of cardiovascular articles: a preliminary analysis from the ESC Journals Randomized Study. *Eur Heart J* 2020; 41: 3222–3225.

32. Sheridan DJ, Julian DG. Achievements and Limitations of Evidence-Based Medicine. *J Am Coll Cardiol* 2016; 68: 204–213.

33. Maggioni AP, Dahlström U, Filippatos G, et al. EURObservational Research Programme: regional differences and 1-year follow-up results of the Heart Failure Pilot Survey (ESC-HF Pilot). *Eur J Heart Fail* 2013; 15: 808–817.

34. Chioncel O, Mebazaa A, Harjola V-P, et al. Clinical phenotypes and outcome of patients hospitalized for acute heart failure: the ESC Heart Failure Long-Term Registry. *Eur J Heart Fail* 2017; 19: 1242–1254.

35. Dawson LP, Biswas S, Lefkovits J, et al. Characteristics and Quality of National Cardiac Registries: A Systematic Review. *Circ Cardiovasc Qual Outcomes* 2021; 14: e007963.

36. Rossello X, Massó-van Roessel A, Perelló-Bordoy A, et al. Assessment of the ESC quality indicators in patients with acute myocardial infarction: a systematic review. *Eur Heart J Acute Cardiovasc Care* 2021; 10: 878-889.

37. Rossello X, Pocock SJ, Julian DG. Long-term use of cardiovascular drugs challenges for research and for patient care. *J Am Coll Cardiol* 2015; 66: 1273–1285.

38. Maggioni AP, Anker SD, Dahlström U, et al. Are hospitalized or ambulatory patients with heart failure treated in accordance with European Society of Cardiology guidelines? Evidence from 12,440 patients of the ESC Heart Failure Long-Term Registry. *Eur J Heart Fail* 2013; 15: 1173–1184.

39. Wallentin L, Gale CP, Maggioni A, et al. EuroHeart: European Unified Registries On Heart Care Evaluation and Randomized Trials. *Eur Heart J* 2019; 40: 2745–2749.

Figures

Figure 1. Flow chart

EORP, EURObservational Research Programme; WOS, Web Of Science.

Figure 2. Number of EORP publications per year

To allow for some publications to move from "ahead of print" to its printed version, the study period for articles collection finished in April 2021, although the citation-based analysis in the Web of Science took place in March 2022. Within this 1-year window, the number of publications in WOS increased from 162 to 189 for the set of 196 items. The remaining 7 items were not suitable for WOS (e.g., press release, posts in website) and were therefore excluded from the citation-based analysis.

Figure 3. Number of publications by type of registry and topic

CAD, ASC & ACC, Coronary Artery Disease, Acute Coronary Syndromes, Acute Cardiac Care; CVD, cardiovascular disease

Figure 4. Number of publications by Journal quartile and journal impact factor

There were 10 journals without JIF for their corresponding year in the Journal Citation Report.

Figure 5. Cummulative number of citations per year.

This graph shows how many citations were made each year to any item of the set of 189 papers in WOS as per March 22, 2022.

Figure 6. Mean Altmetric Attention Score of EORP publications by year

Appendix

List of key ESC members and EORP registries' chairpersons

Michel Komajda (ESC president 2010-2012), **Panos Vardas** (ESC president 2012-2014), **Fausto Pinto** (ESC president 2014-2016), **Jeroen Bax** (ESC president 2016-2018), **Barbara Casadei** (ESC president 2018-2020), **Stephan Achenbach** (ESC president 2020-2022), **Franz Weidinger** (ESC president-elect 2020-2022), **Clara Berle** (ESC staff, clinical project manager), **Carole Toulouse** (ESC staff, clinical project manager), **Afiah Zabre** (ESC staff, assistant), **Emanuela Fiorucci** (ESC staff, assistant), **Patti-Ann McNeill** (ESC staff, assistant), **Lorraine Ceccanti** (ESC staff, assistant), **Sandrine Anglars** (ESC staff, data manager), **Maryna Andarala** (ESC staff, data manager), **Gagan Chhabra** (ESC staff, data manager), **Viviane Missiamenou** (ESC staff, data manager), **Cécile Laroche** (ESC staff, statistician), **Céline Arsac** (ESC staff, past team manager), **David Salako** (ESC staff, team manager), **Karen Sliwa** (chairperson, Peripartum CardioMyopathy), **Johann Bauersachs** (chairperson, Peripartum CardioMyopathy), **Dipak Kotecha** (chairperson, Stroke prevention and rhythm control Therapy: Evaluation of an Educational Programme of the European society of cardiology in a cluster-Randomised trial in patients with Atrial Fibrillation), **Isabelle van Gelder** (chairperson, Stroke prevention and rhythm control Therapy: Evaluation of an Educational Programme of the European society of cardiology in a cluster-Randomised trial in patients with Atrial Fibrillation), **Hein Heidbuchel** (chairperson, Stroke prevention and rhythm control Therapy: Evaluation of an Educational Programme of the European society of cardiology in a cluster-Randomised trial in patients with Atrial Fibrillation), **David Adlam** (chairperson, Spontaneous Coronary Arterious Dissection), **Jolien Roos-Hesselink** (chairperson, Registry of Pregnancy and Cardiac disease II and III), **Roger Hall** (chairperson, Registry of Pregnancy and Cardiac disease II and III), **Sonia Petronio** (chairperson, Valve Durability [TAVI] Registry), **Bernard Prendergast** (chairperson, Valve Durability [TAVI] Registry), **David Wood** (chairperson, InterAspire Pilot, European survey of cardiovascular disease prevention and diabetes V), **John**

William McEvoy (chairperson, InterAspire Pilot), **Lars Lund** (chairperson, Heart Failure III Registry, Heart Failure Long-Term), **Tatiana Potpara** (chairperson, Atrial Fibrillation III), **Chris Gale** (chairperson, Non-ST-Segment Elevation Myocardial Infarction Registry), **Peter Ludman** (chairperson, Non-ST-Segment Elevation Myocardial Infarction Registry), **Alida Caforio** (chairperson, Cardiomyopathy and Myocarditis Registry), **Perry Elliott** (chairperson, Cardiomyopathy and Myocarditis Registry and pilot), **Philippe Charron** (chairperson, Cardiomyopathy and Myocarditis Registry), **Danilo Neglia** (chairperson, EURECA Imaging Registry), **Victoria Delgado** (chairperson, EURECA Imaging Registry), **Michel Komajda** (chairperson, Chronic Ischemic Cardiac Disease Long Term and pilot), **Bernard Iung** (chairperson, Valvular Heart Disease II), **Uwe Zeimer** (chairperson, Acute Coronary Syndrome STEMI), **Patrizio Lancellotti** (chairperson, Cardiac Oncology Toxicity, European Infective Endocarditis Registry), **Gilbert Habib** (chairperson, European Infective Endocarditis Registry), **Guy De Backer** (chairperson, European survey of cardiovascular disease prevention and diabetes IV and V), **Kornelia Kotseva** (chairperson, European survey of cardiovascular disease prevention and diabetes IV and V), **Aldo P Maggioni** (chairperson, Heart Failure Long-Term, Heart Failure Pilot), **Marisa Crespo-Leiro** (chairperson, Heart Failure Long-Term), **Maria Grazia Bongiorni** (chairperson, European Lead Extraction ConTRolled), **Carina Blomström Lundqvist** (chairperson, European Lead Extraction ConTRolled), **Mark La Meir** (chairperson, Epicardial/Hybrid Atrial Fibrillation Ablation Registry), **Laurent Pison** (chairperson, Epicardial/Hybrid Atrial Fibrillation Ablation Registry), **Gregory Lip** (chairperson, Atrial Fibrillation General), **Giuseppe Boriani** (chairperson, Atrial Fibrillation General), **Nikolaus Dagres** (chairperson, Atrial Fibrillation Ablation), **Josep Brugada** (chairperson, Atrial Fibrillation Ablation, and pilot), **Carlo Di Mario** (chairperson, Trans Catheter Valve Treatment pilot), **Martine Gilard** (chairperson, Trans Catheter Valve Treatment long-term), **Franz Weidinger** (chairperson, Chronic Ischemic Cardiac Disease pilot).

Figure 1

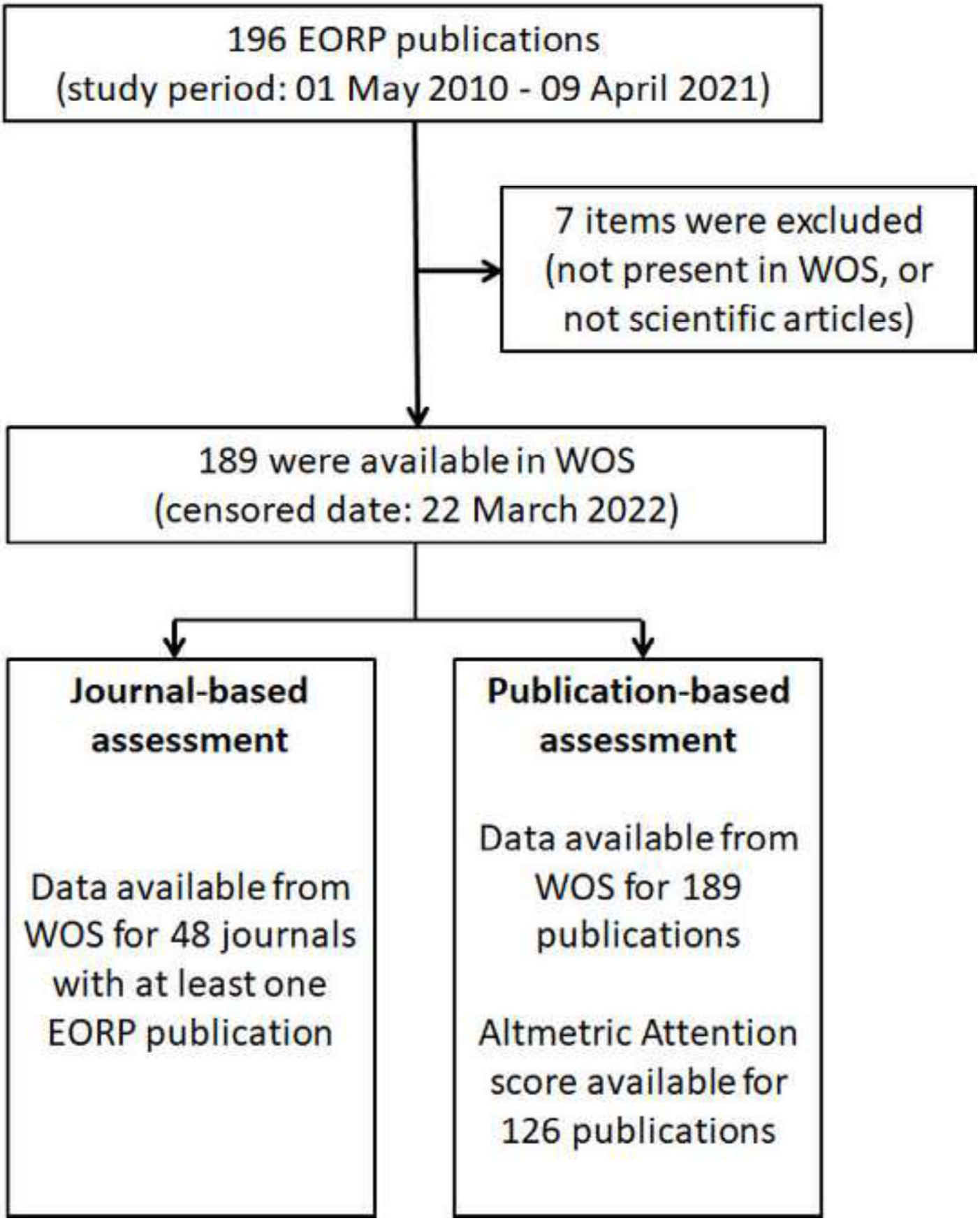

196 EORP publications
(study period: 01 May 2010 - 09 April 2021)
7 items were excluded
(not present in WOS, or
not scientific articles)
189 were available in WOS
(censored date: 22 March 2022)
Journal-based
assessment
Data available from
WOS for 48 journals
with at least one
EORP publication
Publication-based
assessment
Data available from
WOS for 189
publications
Altmetric Attention
score available for
126 publications

Figure 2

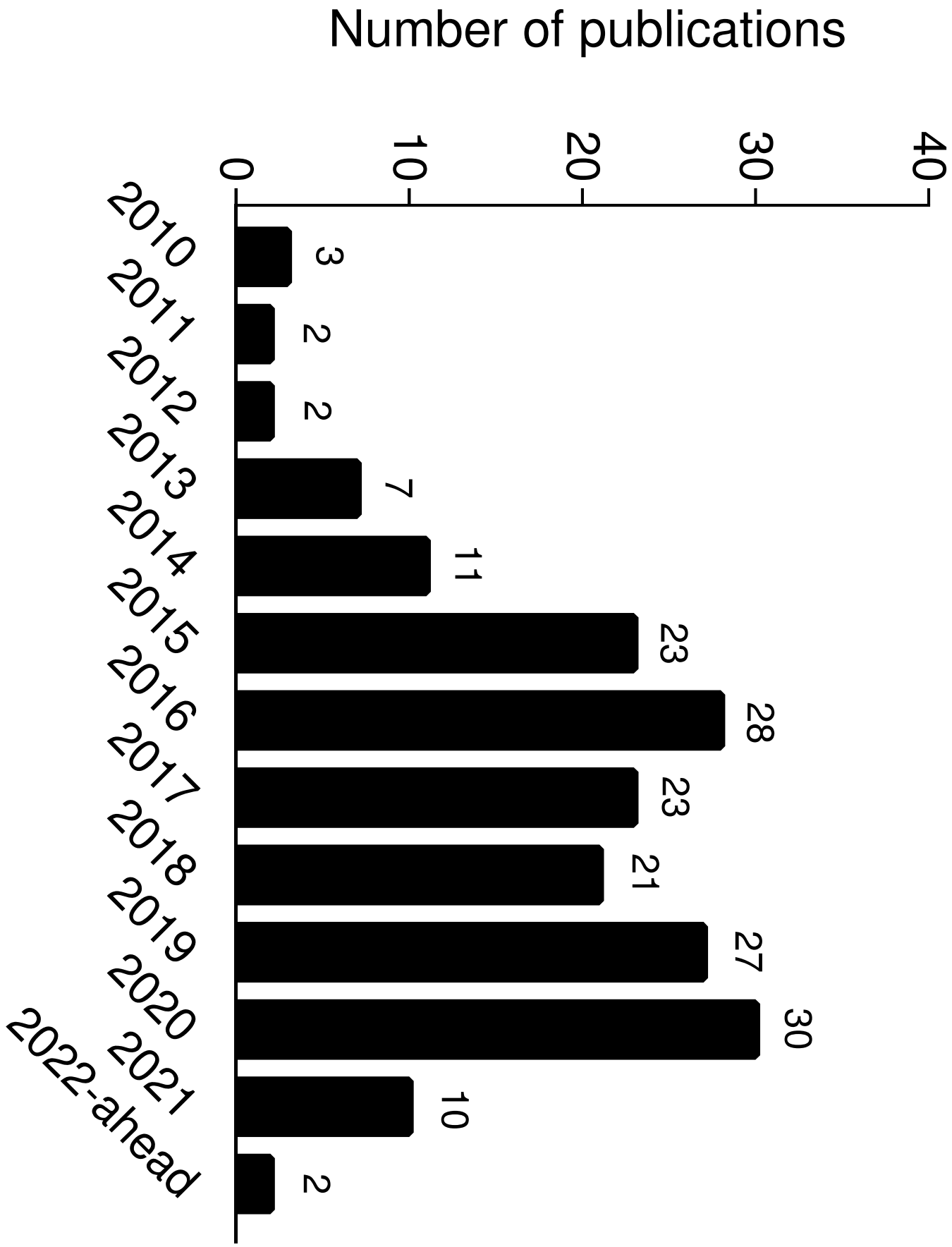

Number of publications
0
10
20
30
40
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022-ahead
3
2
2
7
11
23
28
23
21
27
30
10
2

Figure 3

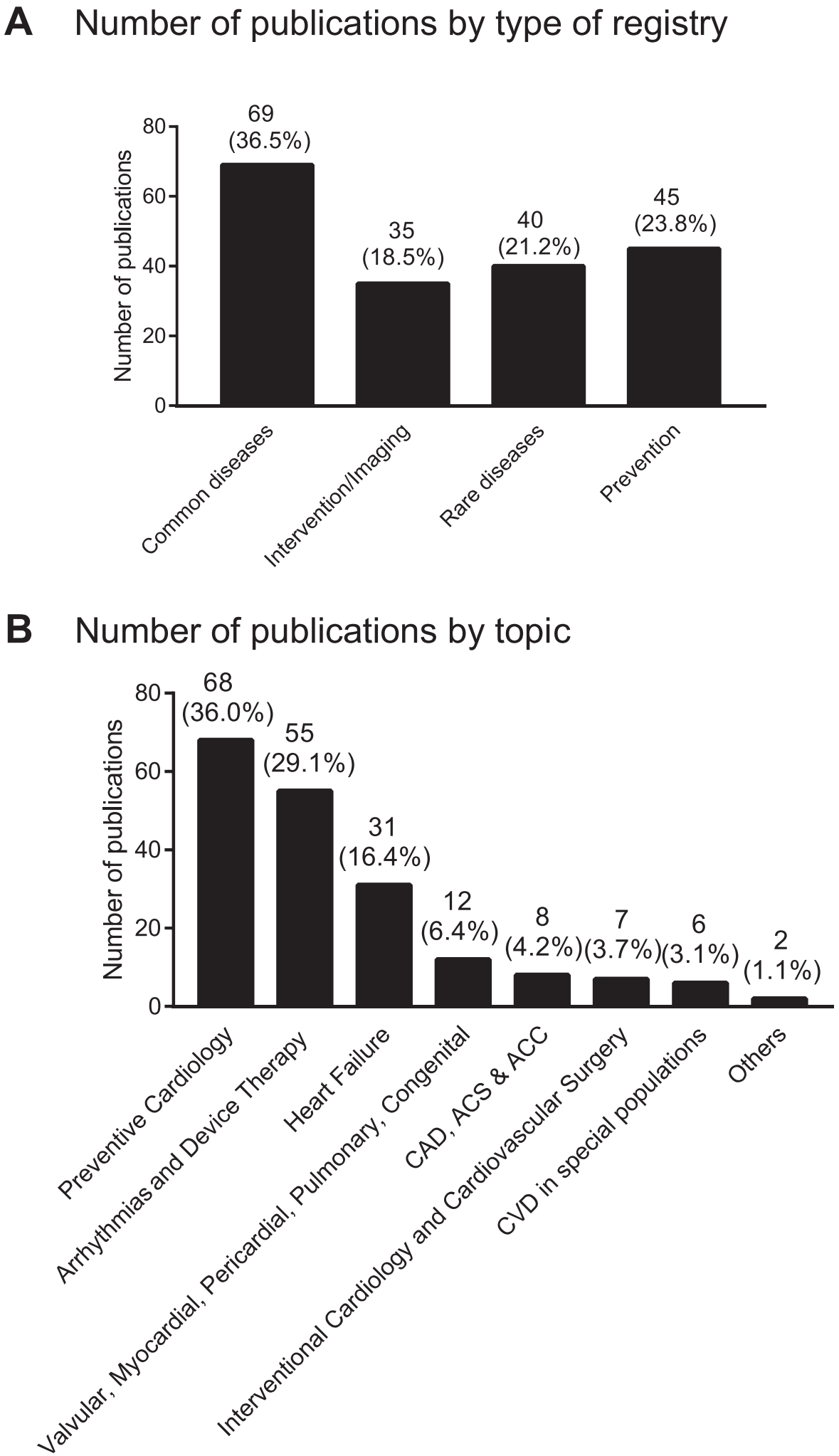

A
Number of publications by type of registry
Number of publications
0
20
40
60
80
69
(36.5%)
35
(18.5%)
40
(21.2%)
45
(23.8%)
Common diseases
Intervention/Imaging
Rare diseases
Prevention
B
Number of publications by topic
Number of publications
0
20
40
60
80
68
(36.0%)
55
(29.1%)
31
(16.4%)
12
(6.4%)
8
(4.2%)
7
(3.7%)
6
(3.1%)
2
(1.1%)
Preventive Cardiology
Arrhythmias and Device Therapy
Heart Failure
Valvular, Myocardial, Pericardial, Pulmonary, Congenital
CAD, ACS & ACC
Interventional Cardiology and Cardiovascular Surgery
CVD in special populations
Others

Figure 4

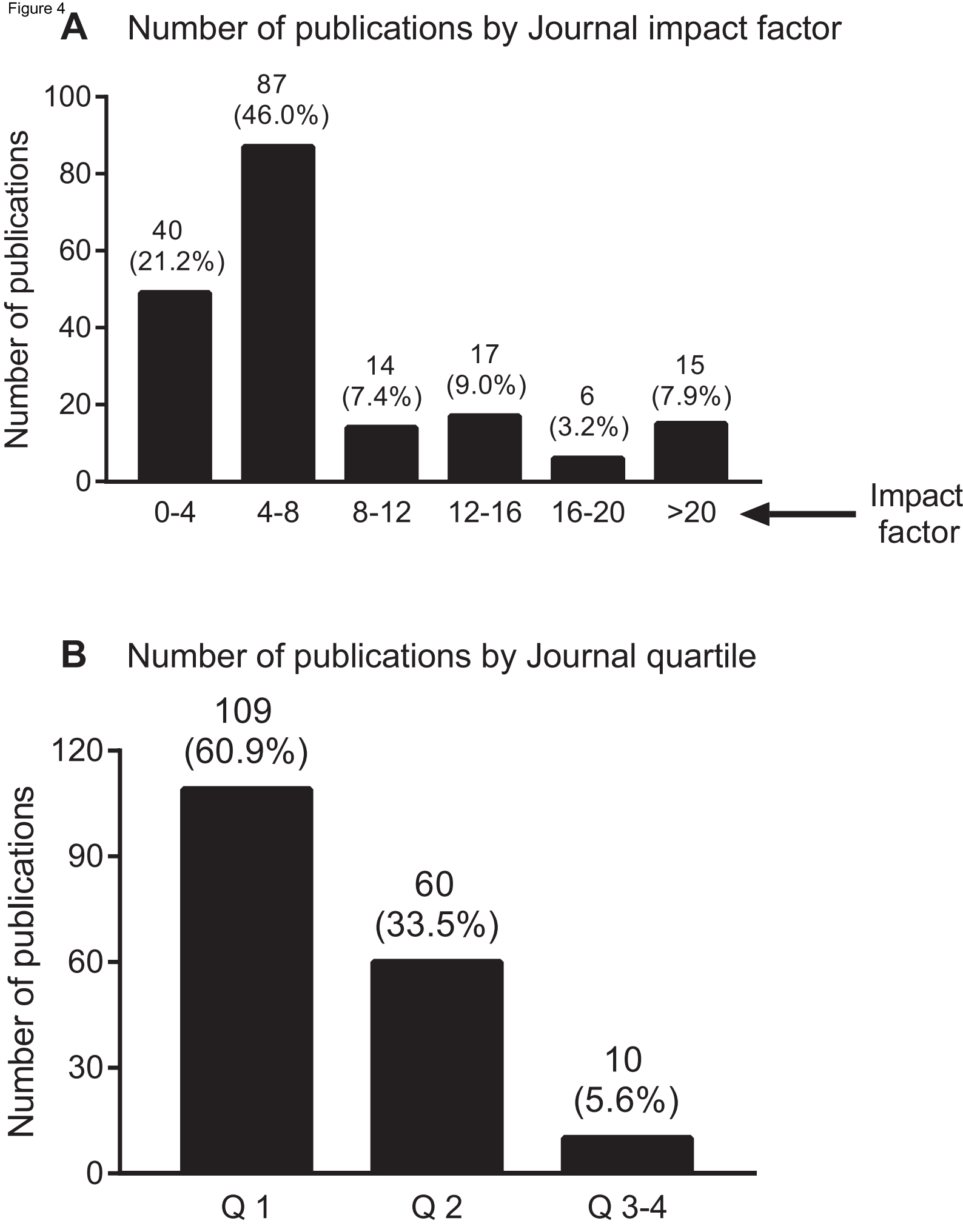

A
Number of publications by Journal impact factor
Number of publications
100
80
60
40
20
0
87
(46.0%)
40
(21.2%)
14
(7.4%)
17
(9.0%)
6
(3.2%)
15
(7.9%)
0-4
4-8
8-12
12-16
16-20
>20
Impact factor
B
Number of publications by Journal quartile
Number of publications
120
90
60
30
0
109
(60.9%)
60
(33.5%)
10
(5.6%)
Q 1
Q 2
Q 3-4

Figure 5

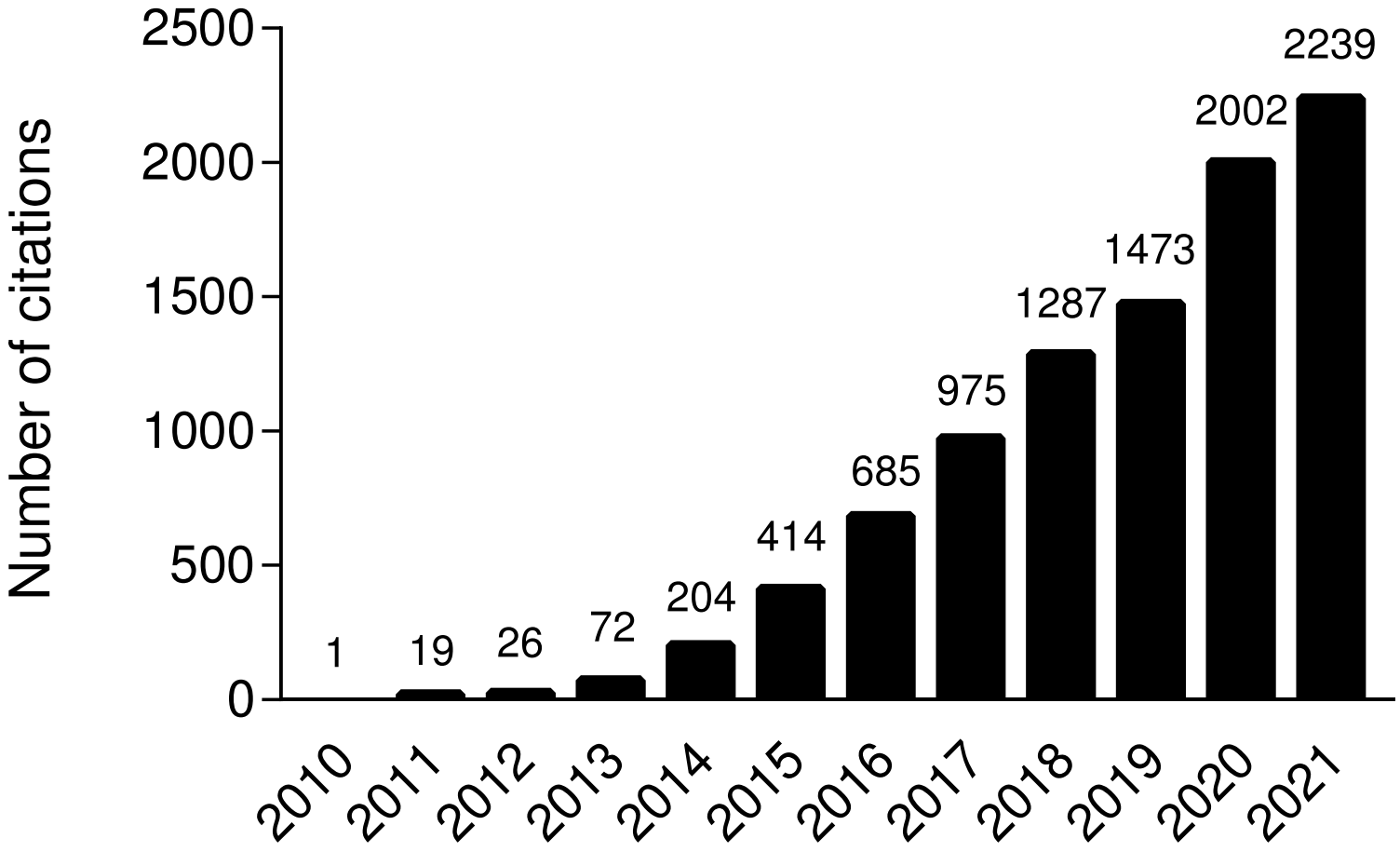
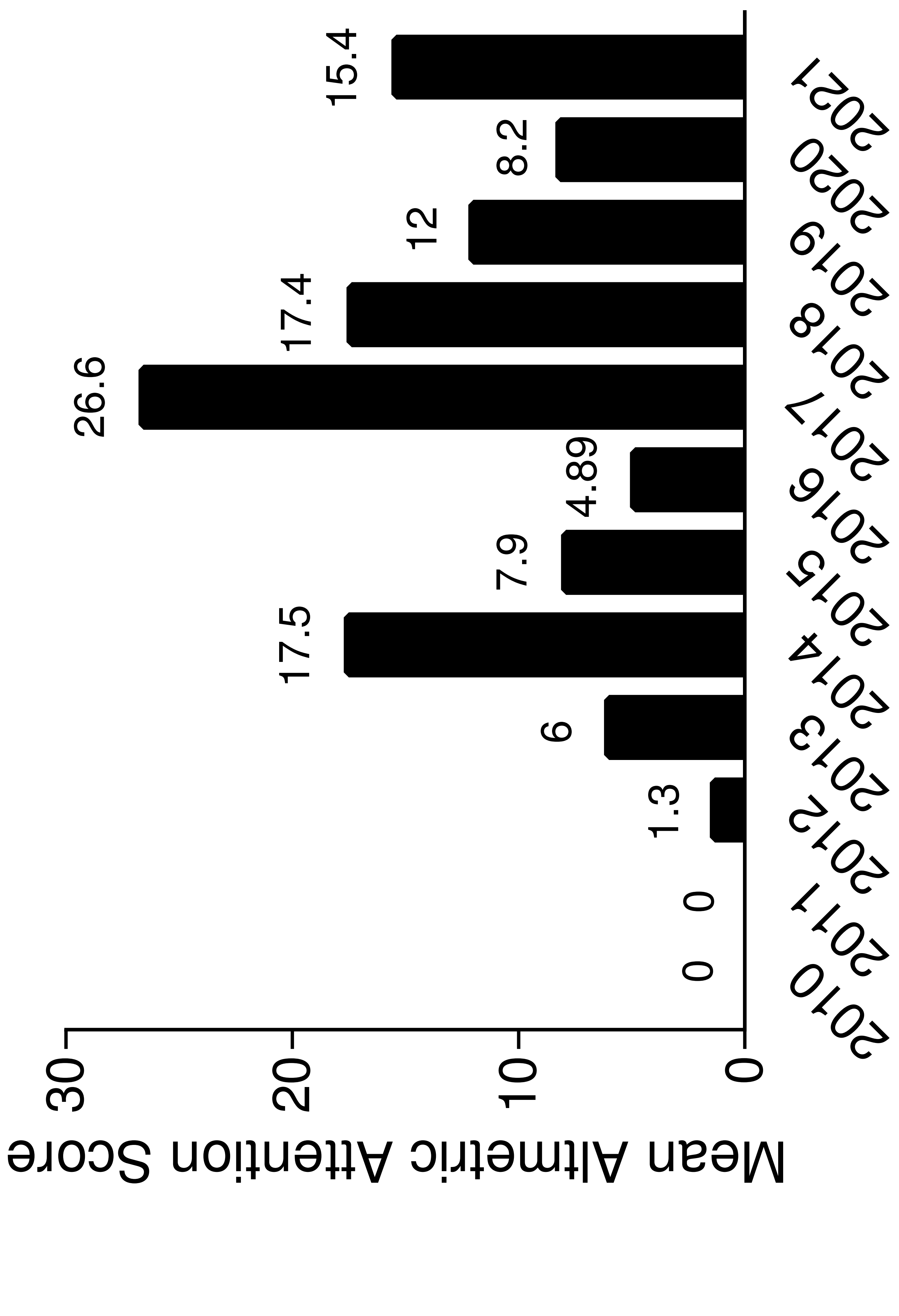

Number of citations
2500
2000
1500
1000
500
0
1
19
26
72
204
414
685
975
1287
1473
2002
2239
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

Figure 6



Mean Altmetric Attention Score
0
10
20
30
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
0
0
1.3
6
17.5
7.9
4.89
26.6
17.4
12
8.2
15.4

EURObservational Research Programme

1 Methods

Aim: to evaluate the scientific impact of EORP using a bibliometric approach

Study cohort: 189 publications

Study period: 01 May 2010 - 09 Apr 2021

Censored date: 22 March 2022

Study variables (bibliometric approach):

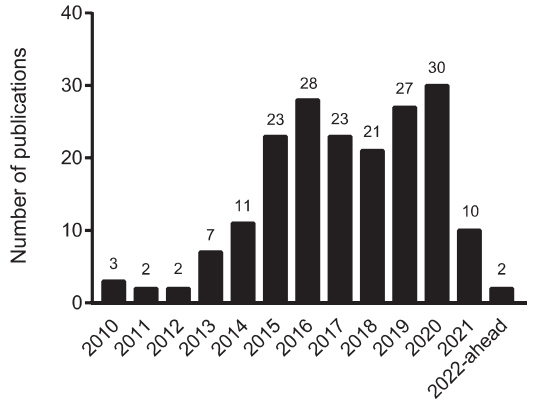
(A) Journal-based assessment

(B) Publication-based assessment

Sources of information:

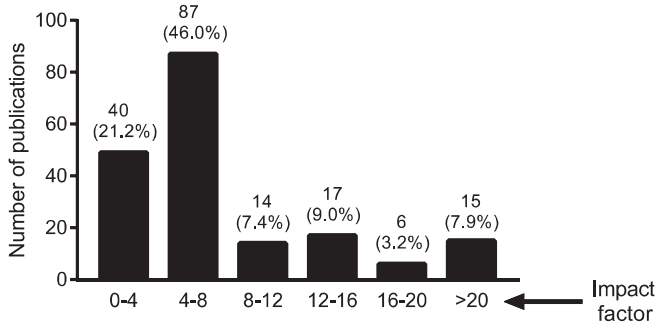
Clarivate Web of Science™ Altmetric

Distribution of publications

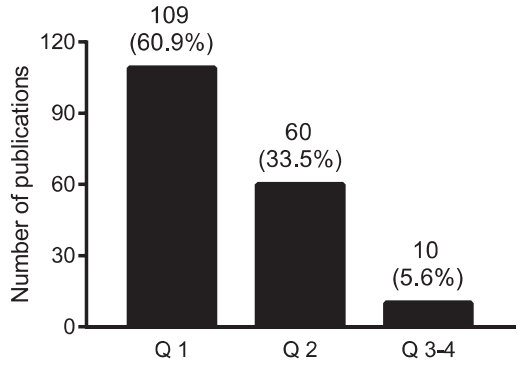


2 Journal-based assessment

A Number of publications by Journal impact factor

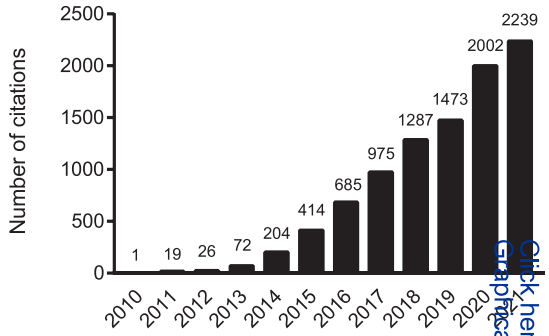


B Number of publications by Journal quartile

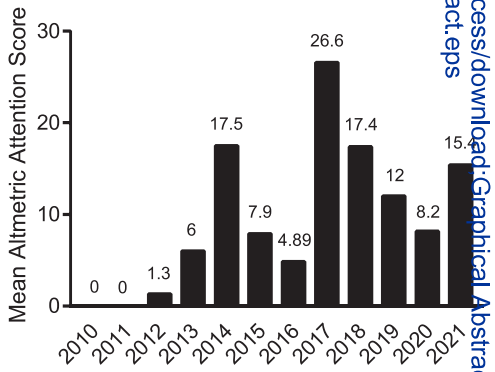


3 Publication-based assessment

A Number of Web of Science citations



B Mean altmetric score by year



Click here to access/download;Graphical Abstract;Figure - Graphical abstract.eps