



NTU Library

Measuring research impact with metrics

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Measuring impact with metrics

Citation metrics are based on the number of articles a researcher has published and the amount of times these articles have been cited by others; this information can then be utilised to compare research entities including individual researchers, research groups, organisational, sectors or even countries.

This guide is limited to looking how research impact can be measured at an individual level; further information and guidance on the use of more in depth citation analysis (including the use of [SciVal](#)) can be acquired by contacting colleagues in the [Library Research Team](#).

The most basic metric used to measure research impact is scholarly, the amount of outputs a researcher has published. The average number of citations per author provides a little more information but is still a fairly unsophisticated way of measuring research impact. The last decade has given rise to more complex metrics based on citation to ascertain research impact beyond just counting; the most commonly recognised of these is the [h-index](#).

There have also been many other developments in the world of scholarly communications including a much broader and diverse understanding of what impact looks like beyond traditional academic scholarship, this has been accompanied by a new generation of metrics known as alternative metrics.

Data sources - Where to find citation information?

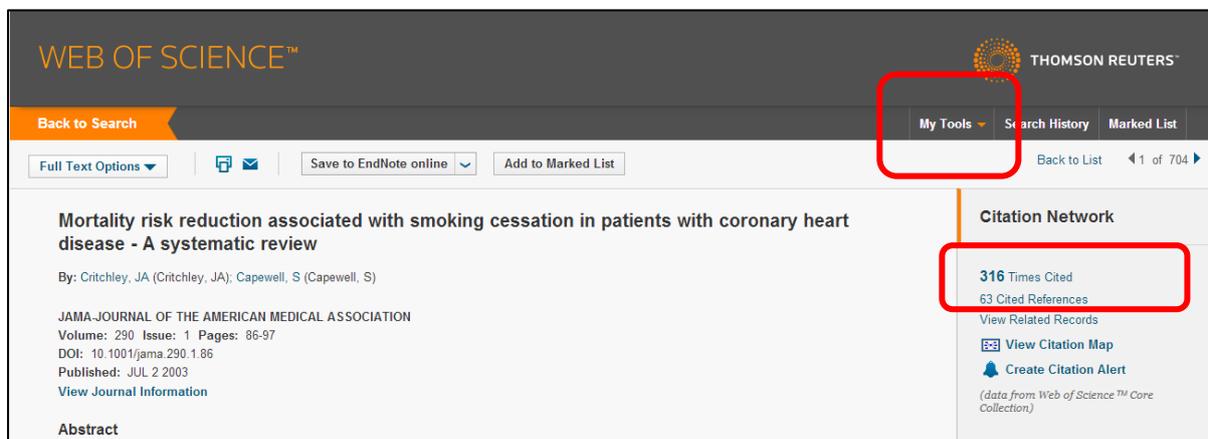
Citation information can be discovered from three main sources:

1. Web of Science
2. Scopus
3. Google Scholar

It is important to be aware that citation metrics vary between data sources, so when referring to citation numbers the data source must always be acknowledged, this is essential to make meaningful comparisons.

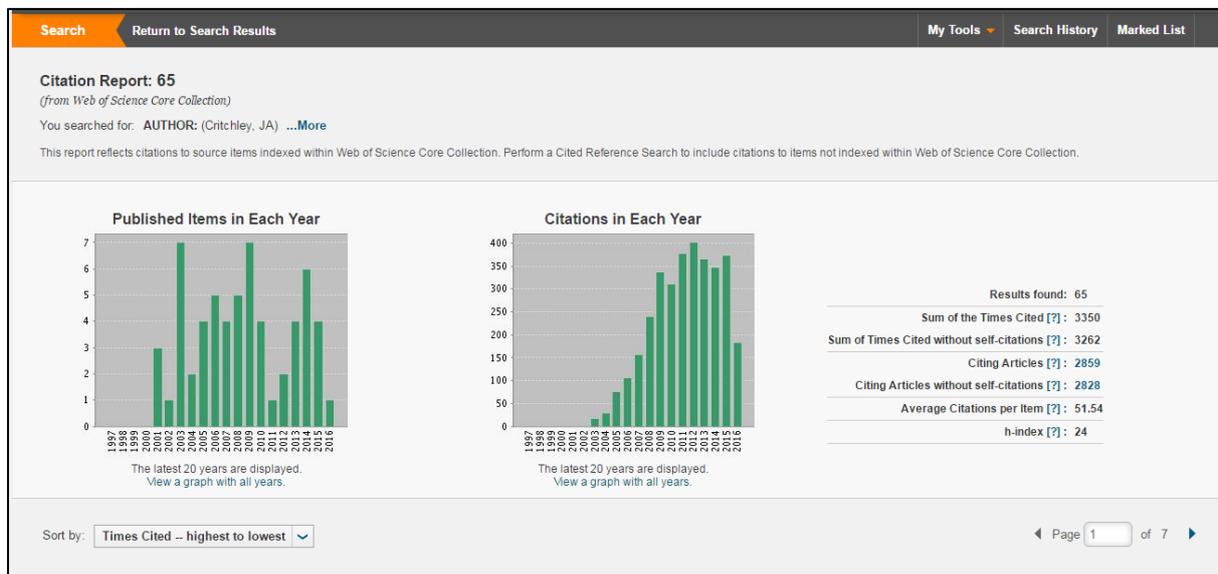
[Web of Science](#)

This data source measures how often an article has been cited and provides details of the citing articles by following the number of **Times Cited**.



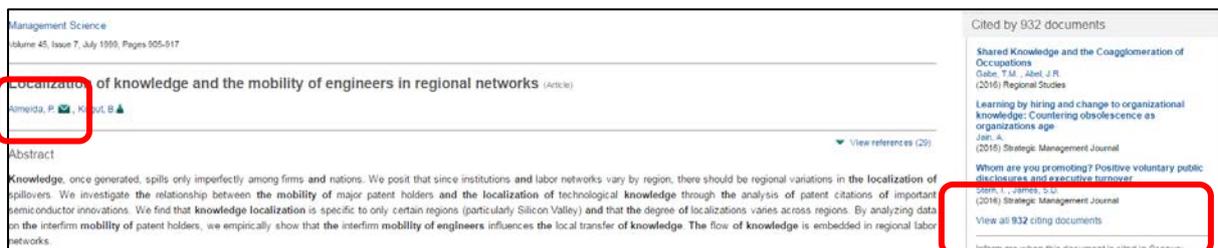
The screenshot displays the Web of Science interface for a specific article. The article title is "Mortality risk reduction associated with smoking cessation in patients with coronary heart disease - A systematic review". The authors listed are Critchley, JA (Critchley, JA); Capewell, S (Capewell, S). The article is from the JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, Volume: 290 Issue: 1 Pages: 86-97, DOI: 10.1001/jama.290.1.86, Published: JUL 2 2003. The citation network section on the right shows that the article has been cited 316 times, with 63 cited references. The interface includes navigation options like "Back to Search", "Full Text Options", "Save to EndNote online", and "Add to Marked List". The Thomson Reuters logo is visible in the top right corner.

This source also contains author pages which provide more information about a researcher's citation activity. This information can be located by searching **ResearcherID** from the **My Tools** drop down menu.

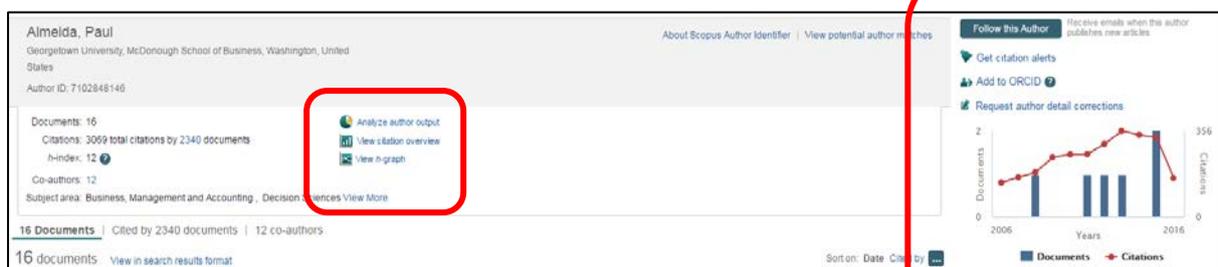


Scopus

This data source shows how often an article has been cited and provides details of the citing articles by following the link to **View all citing documents**.



Scopus also provides detailed author pages containing citation information and analysis which can be located by undertaking an **Author search** or by selecting the author from the publication details (hover over the name, it is a live link).



Google Scholar

This data source shows a **Cited By** link in the search results, this will take you to a list of citing sources. Google Scholar includes citations from an array of (non-traditional) sources including PowerPoints, reports etc.

[Electronic cigarette: users profile, utilization, satisfaction and perceived efficacy](#) [PDF] from unige.ch
JF Etter, C Bullen - *Addiction*, 2011 - Wiley Online Library Find it @ NTU

... **Electronic cigarette**: users profile, utilization, satisfaction and perceived efficacy. Jean-François Etter 1,* ; Chris Bullen 2. ... Table 4. Reasons for using the **electronic cigarette**, among ever users. Among ever **e-cigarette** users: I use (used) the **e-cigarette**

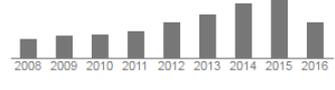
Cited by 151 Related articles All 14 versions Web of Science: 73 Import into RefWorks Save More

Information about an author or researcher can be accessed if they have an Google Scholar profile; a researcher can also create their own profile.

 **Dr Mark Griffiths** [Follow](#)
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Gambling addiction, Video game addiction, Internet addiction, exercise addiction, sex addiction
Verified email at ntu.ac.uk - Homepage

Google Scholar

Citation indices		All	Since 2011
Citations	29967	18835	
h-index	91	69	
i10-index	383	324	



Co authors [View all](#)

- Dr Daria Kuss
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- Zaheer Hussain
- Dr Gillian W Shorter
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- Katalin Nagygyörgy
- Attila Szabo

Title	Cited by	Year
Does Internet and computer" addiction" exist? Some case study evidence M Griffiths <i>CyberPsychology and Behavior</i> 3 (2), 211-218	762	2000
Social interactions in massively multiplayer online role-playing gamers H Cole, MD Griffiths <i>CyberPsychology & Behavior</i> 10 (4), 575-583	618	2007
Internet addiction: Does it really exist M Griffiths <i>Psychology and the Internet: Intrapersonal, interpersonal and transpersonal ...</i>	617	1998
Prevalence of pathological Internet use among university students and correlations with self-esteem, the General Health Questionnaire (GHQ), and disinhibition K Niemz, M Griffiths, P Banyard <i>CyberPsychology & Behavior</i> 8 (6), 562-570	490	2005
Breaking the stereotype: The case of online gaming MD Griffiths, MNO Davies, D Chappell <i>CyberPsychology & Behavior</i> 6 (1), 81-91	480	2003
A 'components' model of addiction within a biopsychosocial framework M Griffiths <i>Journal of Substance Use</i> 10 (4), 191-197	472	2005
Online computer gaming: a comparison of adolescent and adult gamers MD Griffiths, MNO Davies, D Chappell	453	2004

The *h-index* – what is it?

Originally developed by [Hirsch](#) (2005) the *h-index* was developed as an indicator of impact based on citation measurement. It attempts to measure both scientific productivity and scientific impact with one number.

An individual researcher can have an *h-index* but so can any collection of papers, so it can be used at a range of levels (research groups, universities etc.). A researcher's *h-index* can be located in all of the above citation data sources. As with all citation data any comparisons must be made using the same data source; it is also important that meaningful comparisons rely on individuals from the same discipline and career stage.

The *h-index* = how many of a researcher's total publications (N_p) that have at least (h) citations each.

“A scientist has index h if h of his or her N_p papers have at least h citations each and the other $(N_p - h)$ papers have $\leq h$ citations each.”¹

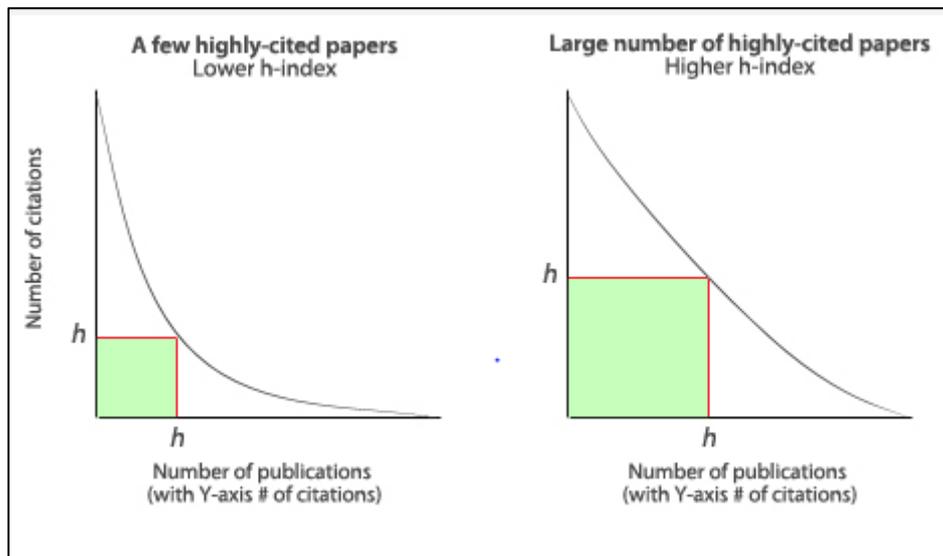


Figure above shows variation in h-index between to researchers with the same amount of publications.

e.g. If a researcher has an h -index of 5 this means at least at 5 of their publications have been cited at least 5 times. The researcher must have accrued at least $5 \times 5 = 25$ citations in total.

Ascertaining what is a 'good' h -index is not simple, varying citation between disciplines and the career stage of a researcher are all influential. Context really is key and h -indices vary over time.

Despite being a commonly recognised metric for research evaluation it has several fundamental flaws:

- An h -index can never be more than the amount of papers published
- Seasoned researchers will always outscore early career researchers (even if they are not currently research active, they will have had more time and a greater body of work necessary to accrue citation)
- There is no standard (considerable variation between data sources)
- Makes no distinction by level of contribution (i.e. the corresponding author receives the same 'citation credit' as all other authors)
- Does not distinguish between cited good or bad papers i.e. has little to do with quality

To counteract these shortcomings many variants have emerged including (in brief):

- *g-index* (gives weight to highly cited journal articles)
- *Contemporary h-index* (weights more recent citation)

¹ Hirsch, J.E., 2005. An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America*, 102 (46), 16569-16572

- *h5-index* (used by Google Scholar, just looks at the last 5 years)
- *i10* (the amount documents have been cited 10 or more times)

Article level metrics – beyond citation

Page views and downloads

Many researchers have access to a plethora of information about how their individual papers are being accessed and read. Lots of different platforms: online journals, researcher network sites (ResearchGate, Academia.edu) institutional and subject repositories etc. are now able to collect information about online page views, downloads etc.

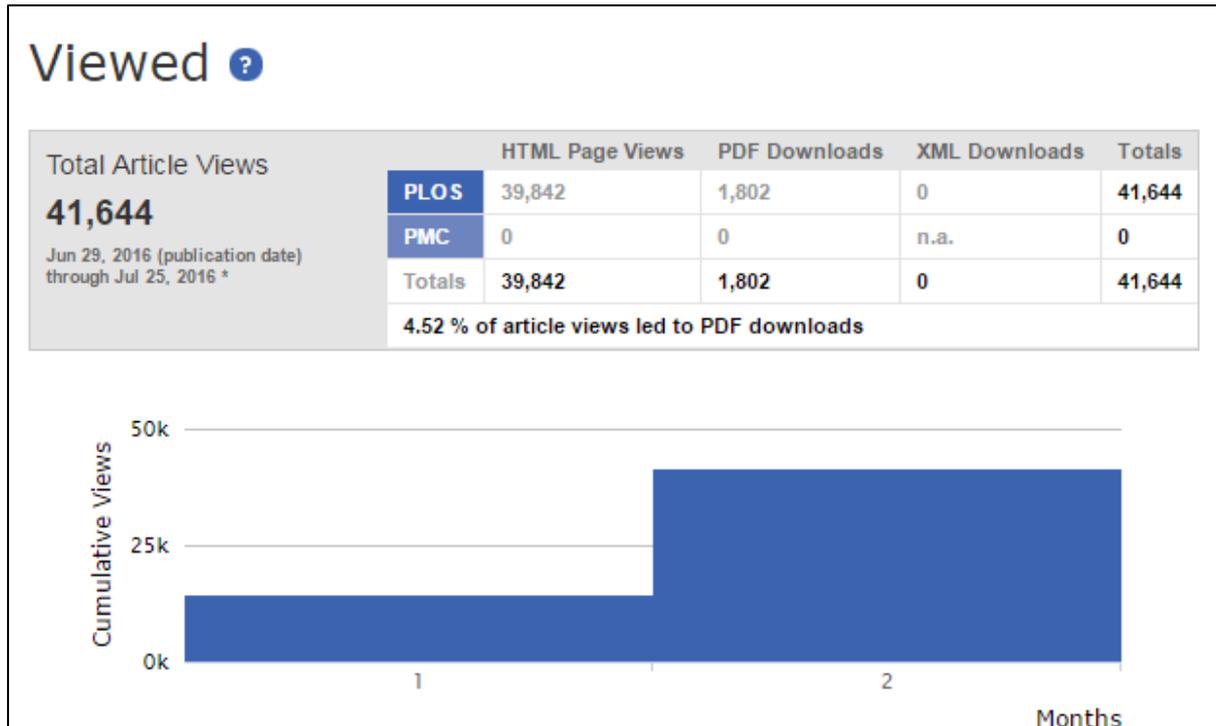


Figure taken from [PLOS One](#)

Although offering some indication of the reach and interest generated by research there are currently no standards for these and often little clarification about what and how this information is being collected.

These counts tend to be specific to the source and currently there is no way of combining statistics from different sources and alternative versions of papers. With the growth of open access there is also much greater potential for different versions of a paper to exist in multiple locations.

Alternative metrics (Altmetrics)

Beyond the above a progressively more diverse set of metrics have been enabled by Web 2.0 technologies which help give a more holistic 'story' around the reach and impact of research beyond traditional citation. Increasingly these metrics are seen alongside citation metrics.

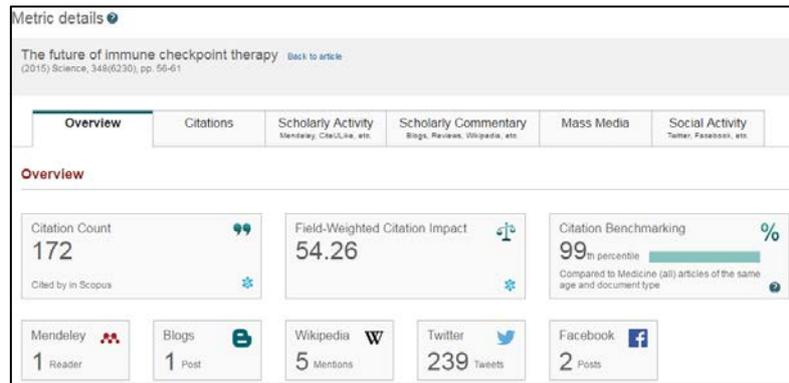


Figure taken from Scopus: <https://www.scopus.com/record/pubmetrics.uri?eid=2-s2.0-84928774156&origin=recordpage>

Two of the biggest advantages of alternative metrics are the speed at which they accrue (as opposed to citation and peer review which take considerable time) and ease of availability. In some cases it has been found alternative metrics can function as early indicators of future citation.²

Alternative metrics can be applied to a wider range of research outputs including datasets, design protocols, coding etc. (as long as they have an accompanying *doi* or *url*).

Again alternative metrics do not currently have any standards, although work is underway in this area³ and there have been accusations that they are vulnerable to gaming⁴.

Although the alternative metric universe is ever evolving, these metrics tend to fall into two main areas.

Scholarly activity / commentary

These metrics may refer to different types of scholarly activities (beyond citation) that can be indicative of engagement and influence. An example of this is when researchers add publications to personal libraries within reference management software such as [Mendeley](#) and [CiteULike](#).

² Shema, H., Bar - Ilan, J. and Thelwall, M., 2014. Do blog citations correlate with a higher number of future citations? Research blogs as a potential source for alternative metrics. *Journal of the Association for Information Science and Technology*, 65(5), pp.1018-1027.

³ <https://www.altmetric.com/blog/altmetric-and-the-niso-altmetrics-initiative/>

⁴ <http://altmetrics.org/altmetrics12/lin/>



Taken from: <https://www.scopus.com/record/pubmetrics.uri?eid=2-s2.0-84923096541&origin=recordpage#tabs=2>

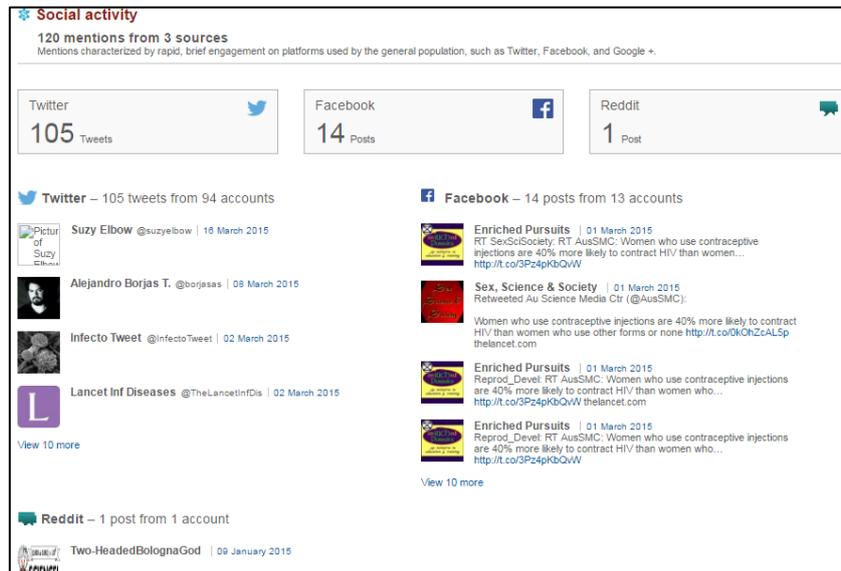
Scholarly commentary tends to include mentions of papers on key scientific blog sites and academic websites and can also include online peer review.

Overview	Citations	Scholarly Commentary <small>Blogs, Reviews, Wikipedia, etc.</small>	Mass Media
<p>Scholarly Commentary 5 mentions Reviews, articles, and blogs by experts and scholars, such as F1000 Prime, research blogs, and Wikipedia.</p>			
<p>Blogs</p> <p>Is Your Birth Control Contributing to the Spread of HIV? Skeptoid 17 January 2015</p> <p>Recent research about injectable long-acting hormone contraceptive suggests it may be increasing the risk of acquiring human immunodeficiency virus (HIV). Research with scary compelling narratives always get media exposure. This research</p> <p>Depo-Provera May Hike HIV Risk in Women MedPage Today HIV/AIDS 10 January 2015</p> <p>(MedPage Today) -- Meta-analysis shows increased risk versus nonhormonal or no contraception.</p> <p>Do birth control shots raise HIV risk? Futurity 09 January 2015</p> <p>Women who used a kind of injectable birth control had a moderately higher risk of contracting HIV, according to a large meta-analysis of 12 studies in sub-Saharan Africa. The contraceptive, depot medroxyprogesterone acetate, is sold under the brand name De</p>			
<p>Post-publication peer reviews</p> <p>F1000Prime Recommended in F1000 Prime 21 January 2015</p>			
<p>Wikipedia</p> <p>Depot medroxyprogesterone acetate Doc James 09 January 2015</p> <p>Depot medroxyprogesterone acetate (DMPA) is a long acting reversible hormonal contraceptive birth control drug that is injected every 3 months.</p>			

Taken from <https://www.scopus.com/record/pubmetrics.uri?eid=2-s2.0-84921027231&origin=recordpage#tabs=3>

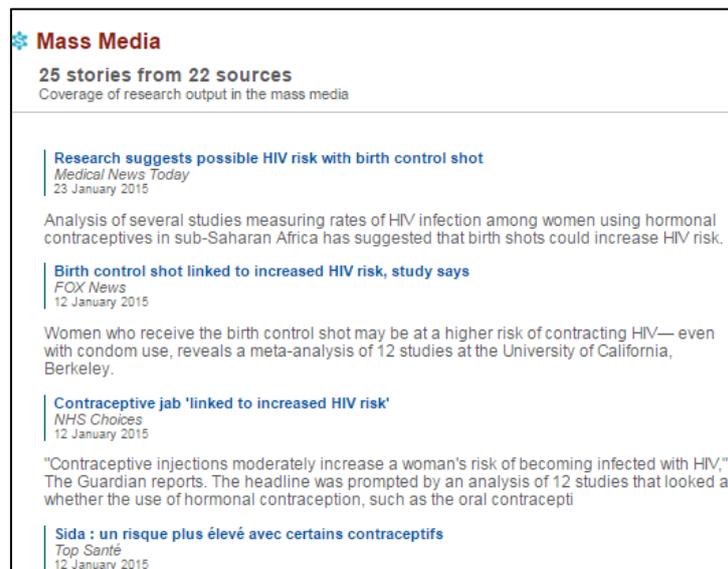
Social and Mass Media activity

These metrics tend to capture engagement with research by the general public and include aggregation of activities such as book-marking, non-academic blogging and mentions and 'likes' on social media including Facebook, Twitter, Google+ etc.



Taken from: <https://www.scopus.com/record/pubmetrics.uri?eid=2-s2.0-84921027231&origin=recordpage#tabs=5>

They can also function to provide a potential audience with an interest in a particular area of research. These metrics also include mentions within the popular media where they tend to be less about how much is being said but what is being said.



Taken from: <https://www.scopus.com/record/pubmetrics.uri?eid=2-s2.0-84921027231&origin=recordpage#tabs=4>

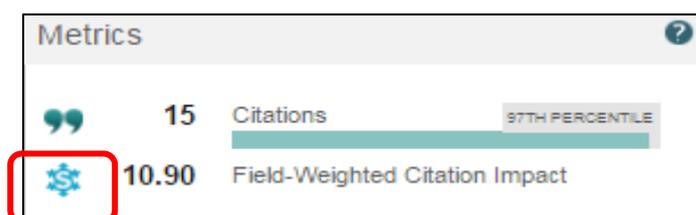
Data sources for alternative metrics

Social media sources tend to all provide their own analytics and reference management software like [Mendeley](#) provide information about who has added a paper to their library, as well as their academic status, area of research, etc.

Various other tools such as [Altmetric.com](#) agglomerate information from many different platforms including mentions in public policy documents, mainstream media, academic blogs, reference managers, Wikipedia, peer review platforms⁵ etc. [Newsflo](#) is another provider which tracks over 55,000 news outlets⁶. Other tools include [Plum Analytics](#) and [Impact Story](#).

Standardisation and metrics

Although currently without formal standards, movement have been made towards this end for both citation and alternative metrics. In 2012 a group of research intensive universities started to develop a set of agreed methodologies for the use of metrics that is robust and transparent to enable confident comparison. These metrics are known as Snowball Metrics⁷, can be applied to any data source and can be easily identified in Scopus by the accompanying snowflake logo.



Normalised metrics

One of the main drawbacks when using metrics to measure research impact is the significant variation between subject discipline, publication behaviour, output type etc. A range of 'normalised' metrics have emerged to contextualise this information and provide a useful way to evaluate the prestige of a researcher's citation performance.

Field-weighted impact (FWCI)

The FWCI metric indicates how the number of citations received by a researcher's publications compares with the average number of citations received by all other similar publications. A FWCI of 1.00 indicates that the publications have been cited at world average for similar publications.

A FWCI greater than 1.00 indicates that publications have been cited more than would be expected based on the world average for similar publications e.g. a FWCI score of 1.97 means that the outputs have been cited 97% more times than expected. A FWCI of less than 1.00 indicates that publications have been cited less than would be expected based on the world average for similar publications.

⁵ <https://www.altmetric.com/about-our-data/our-sources/>

⁶ <http://www.newsflo.net/>

⁷ <https://www.snowballmetrics.com/>

FWCI can be applied to any research entity - individual researcher, research group, institutional, country etc. FWCI impact information can be most easily accessed via [Scopus](#).

Responsible metrics use

The use of metrics (citation and beyond) should only ever be used only in conjunction with qualitative, expert opinion. The length of research career and discipline influence metric counts and metrics are not necessarily indicative of the quality of an output or an individual researcher. For more information on responsible metrics see The San Francisco Declaration on Research Assessment⁸ or Hicks, D. et al⁹.

For further advice and support please contact the [Library Research Team](#).

⁸ <http://www.ascb.org/dora/>

⁹ Hicks, D. et al. (2015): The Leiden Manifesto for research metrics. Nature 520 (7548), 429-431, <http://www.nature.com/news/bibliometrics-the-leiden-manifesto-for-research-metrics-1.17351>

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