Human Reproduction, Vol.25, No.1 pp. 2–5, 2010
Advanced Access publication on September 30, 2009 doi:10.1093/humrep/dep336

human reproduction

EDITOR'S CORNER

100 papers to read before you die

Johannes L.H. Evers
Deputy Editor Human Reproduction

E-mail: Jlh.evers@mumc.nl

I don't want to achieve immortality through my work, I want to achieve it through not dying.
Woody Allen

Success in science is related to productive authorship of research publications that become highly cited by other scientists (Jones, 2005). The acknowledgement that one article gives to another is a reference; the acknowledgement that one article receives from another is a citation (Paladugu *et al.*, 2002). References, i.e. citations to other scientific articles, are the starting point for citation indexing and evaluating scientific impact with the underlying assumption that the number of citations to a particular article reflects its significance in the field (Jones, 2005). Citation analysis is that area of bibliometrics that deals with the study of the relationships between publications and citations. Scientific journals wish to attract well-cited manuscripts, as the more cited its articles, the higher is a journal's impact factor (Paladugu *et al.*, 2002). The impact factor of a journal is calculated by dividing the number of current year citations to the source items published in that journal during the previous 2 years (www.thomsonreuters.com).

Peer review is the system a journal uses to select the best articles from those submitted in a given field of science. The idea of peer review is to prevent the publication of poor quality work; filter out studies that have been poorly conceived, designed or executed; and to check that, of the manuscripts selected, the research has been carried out well, that there are no flaws in the design or methodology, that the work is reported correctly and unambiguously, with acknowledgement to the already existing body of work, and that the results presented have been interpreted correctly and all possible interpretations considered. In short, peer review helps journals to provide the type and quality of material they are aiming to publish for their specific audiences (Hames, 2007). Publishing highly cited articles will increase a journal's impact factor (Garfield, 2005), and therefore standing. Publishing in journals with a high standing will increase a scientist's visibility and reputation.

ISI Web of Knowledge is an online academic database managed by Thomson Reuters (Thomson Reuters, Philadelphia, PA, USA). It provides access to scientific publishing databases and other resources: Web of Science, Science Citation Index, Current Contents and Medline among others. Its Web of Science database covers over 10 000 of the highest impact journals worldwide.

Working from the assumption that the number of times an article is cited reflects its impact on a specific biomedical field, people have analyzed the most important publications in a number of different fields, including dermatology (Dubin *et al.*, 1993), molecular biology (Picknett and Davis, 1999), surgery (Paladugu *et al.*, 2002) and legal medicine (Jones, 2005) as well as in a leading US general medical journal (JAMA; Garfield, 1987). We wished to identify the 'citation classics' in reproductive medicine and biology. The 100 most frequently cited articles in journals represented in the category of 'Reproductive Biology' in ISI's Impact Factor ranking list for 2008 (Table I) were tracked down using the Web of Knowledge database (accessed 22

Table I List of journals represented in the 2008 ISI Impact Factor listing of 'Reproductive Biology' (ISI, Philadelphia, PA, USA)

Abbreviated journal title	Total cites	Impact factor
Hum Reprod Update	3784	7.590
Fertil Steril	21 960	4.167
Hum Reprod	23 132	3.773
Semin Reprod Med	863	3.512
Biol Reprod	21 365	3.469
Reproduction	4613	3.073
Reprod Toxicol	2490	2.957
Reprod Biomed Online	3139	2.954
J Reprod Immunol	1678	2.778
Placenta	3986	2.775
Reprod Biol Endocrinol	1184	2.634
Mol Hum Reprod	4018	2.537
Reprod Fert Develop	2031	2.439
Mol Reprod Dev	5837	2.287
Am J Reprod Immunol	2646	2.172
Reprod Nutr Dev	1428	2.167
Theriogenology	10 018	2.041
Reprod Sci	196	1.951
Anim Reprod Sci	3991	1.890
Sex Plant Reprod	878	1.610
J Reprod Develop	1001	1.609
Eur J Obstet Gyn R B	5070	1.565
Reprod Domest Anim	1309	1.526
Zygote	717	1.067
Invertebr Reprod Dev	569	0.673

Table II Journals in which the top cited 100 articles (1990–2009) were published

Rank	Journal	Number of cited articles in top 100
1	Fertility and Sterility	33
2	Biology of Reproduction	29
3	Human Reproduction	23
4	Molecular Reproduction and Development	6
5	Placenta	3
	Theriogenology	3
7	American Journal of Reproductive Immunology	1
	Human Reproduction Update	1
	Molecular Human Reproduction	1

Table III Specific fields of interest to which top cited 100 articles belonged

Field of interest	Number of cited articles in top 100
Assisted Reproduction Technology, clinical	29
Assisted Reproduction Technology, laboratory	15
Other fertility, clinical	12
Other fertility, laboratory	12
Animal research, modeling	19
Animal research, veterinary	13

Table IV Country of origin from which top cited 100 articles originated (only shown those with >2 articles in top 100)

Rank	Country	Number of cited articles in top 100
1	USA	36
2	Belgium*	12
	England	12
4	Australia	8
5	Canada	7
6	France*	5
7	Scotland	4

*Non-native English speaking countries.

Table V Institutions of origin of the top cited 100 articles (only if >2 articles in top 100)

Rank	Institution	Country	Number of cited articles in top 100
1	Brussels Free University (VUB), Brussels	Belgium	6
	Cornell University, New York	USA	6
	University of Pennsylvania, Philadelphia	USA	6
4	Monash University, Clayton	Australia	4
	University of Wisconsin, Madison	USA	4
6	Edinburgh University, Edinburgh	Scotland	3
	Leuven Catholic University, Leuven	Belgium	3
	Saint Luke's Hospital, St Louis	USA	3

Table VI Frequent authors of top cited 100 articles (if >2 articles in top 100)

Rank	Author	Number of cited articles in top 100
1	Devroey, P.*	8
	Van Steirteghem, A.C.*	8
3	Gardner, D.K.	5
	Nagy, Z.*	5
	Tournaye, H.*	5
6	Cohen, J.**	4
	Liu, J.*	4
8	Alikani, M.**	3
	Camus, M.*	3
	Cornillie, F.	3

* and ** Co-authors on a number of the same articles.

August 2009). A total of 51 625 original and review articles were retrieved, of which 46 010 were cited at least once; 5615 articles (10.9%) were never cited, not even as self-citations; 3446 articles were cited only once (6.7%); 612 articles were cited 100 times and more (1.2%), and the top 100 of these were selected for further analysis. The 100th ranked article had collected 182 citations at the time of this survey (22 August 2009). Of the top 100, 33 articles had been published in Fertility and Sterility, 29 in Biology of Reproduction, 23 in Human Reproduction and the remaining 15 appeared in only six different journals (Table II). Sixteen of the 25 journals from the ISI 2008 Impact Factor listing did not have any of their published articles among the 100 citation classics. Of the top 100 articles, 29 were on ART clinical issues, 19 on animal models and 15 on ART laboratory issues (Table III). The USA was the country of origin of most articles ($n = 36$; Table IV). This of course is due to the keen interest in and the high quality of reproductive research in the States. But also there are indications that USA authors may preferentially cite USA work (Campbell, 1990), and that reviewers and editors of USA

Table VII The top 10 original articles most frequently cited by articles published in Reproductive Biology journals, 1990–2009 (ISI Impact Factor listings; see Table I)

Rank	First author	Cites	Journal	Volume	First page	Year	Title
1	Van Steirteghem	841	Hum Reprod	8	1061	1993	High fertilization and implantation rates after intracytoplasmic sperm injection
2	Kimura	451	Biol Reprod	52	709	1995	Intracytoplasmic sperm injection in the mouse
3	Wells	429	Biol Reprod	60	996	1999	Production of cloned calves following nuclear transfer with cultured adult mural granulosa cells
4	Van Steirteghem	428	Hum Reprod	8	1055	1993	Higher success rate by intracytoplasmic sperm injection than by subzonal insemination: report of a second series of 300 consecutive treatment cycles
5	Munné	409	Fertil Steril	64	382	1995	Embryo morphology, developmental rates, and maternal age are correlated with chromosome abnormalities
6	Eppig	390	Biol Reprod	54	197	1996	Development *in vitro* of mouse oocytes from primordial follicles
7	Pursley	377	Theriogenol	44	915	1995	Synchronization of ovulation in dairy cows using PGF(2-alpha), and GnRH
8	Faddy	375	Hum Reprod	7	1342	1992	Accelerated disappearance of ovarian follicles in midlife: implications for forecasting menopause
9	Gosden	373	Hum Reprod	9	597	1994	Restoration of fertility to oophorectomized sheep by ovarian autografts stored at: 196°C
10	Gardner	321	Biol Reprod	50	390	1994	Enhanced rates of cleavage and development for sheep zygotes cultured to the blastocyst stage in vitro in the absence of serum and somatic cells: amino acids, vitamins, and culturing embryos in groups stimulate development

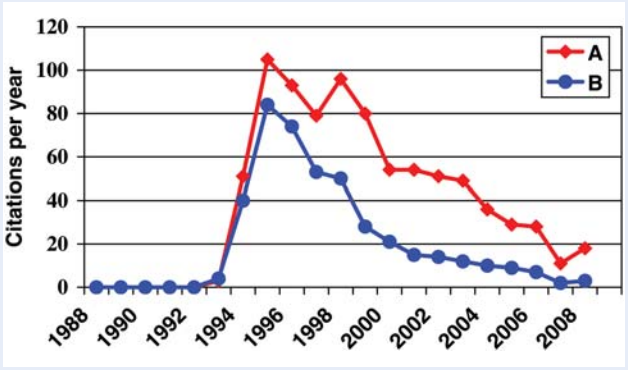

Figure 1 Citation trail of two highly cited articles by the same group from the same year; A = No. 1 in the ranking (see Table VII), Van Steirteghem and co-workers about high fertilization and implantation rates after ICSI (841 citations); B = No. 4 in the ranking, Van Steirteghem and co-workers comparing ICSI to SUZI (428 citations). Both articles are from 1993, the citation data were collected in August 2009 (ISI Web of Knowledge, Thomson Reuters, Philadelphia, PA, USA).

journals tend to favour USA articles (Lin, 1998). Brussels Free University, Cornell University, and the University of Pennsylvania topped the list with six articles each in the top 100 (Table V). Sixty-nine articles came from English speaking countries, 31 from countries that did not have English as their native language. The most prolific authors were P. Devroey and A. van Steirteghem with eight publications each in the top 100, followed by D.K. Gardner, Z. Nagy and H. Tournaye with five each (Table VI). Devroey, Van Steirteghem, Nagy, Tournaye, Liu and Camus were co-authors on a number of the same articles. The same holds for M. Alikani and J. Cohen.

Table VII presents the 10 most highly cited original articles published in the leading Reproductive Medicine and Biology journals between 1990 and 2009. Of the 100 most-cited articles, 86 were original articles and 14 review articles. Reviews are usually frequently cited, and four figured in the top 15: the 2004 simultaneous publication (in Fertility and Sterility and Human Reproduction) by the Rotterdam ESHRE/ASRM sponsored PCOS Consensus Group on diagnostic criteria and long-term health risks related to polycystic ovary syndrome, ranking second and third with 523 and 464 citations respectively, Bavister's 1995 review in Human Reproduction Update on the culturing of preimplantation embryos, which ranked fourth with 452 citations, and the Revised ASRM classification of endometriosis, figuring at rank 13 with 369 citations. Omitting these four reviews, we arrive at the top 10 list of original articles presented in Table VII.

Are these then the true 'citation classics' of our specialty or does the list also contain 'hot topics' that ceased to be so? Indeed, the 1993 ICSI article by the Brussels group leads the list (841 citations), but their original 1992 Lancet publication, with Palermo as lead author (1290 citations), is missing, since Lancet is not in the ISI 'Reproductive Biology' category. The same goes for Steptoe and Edwards (1978) announcement of the birth of Louise Brown, also published in the Lancet: Birth after reimplantation of a human embryo. The relatively low citation score (760 citations) of this landmark article in reproductive medicine is partly due to the fact that the Web of

Table VIII Publication year, number of articles in 'Reproductive Biology' category per year, number in top 100 cited articles per year, percentage in top 100 per publication year, 1990–2009

Publication year	Articles total	Articles in top 100	% of total in top 100
1990	1354	7	0.52
1991	1898	8	0.42
1992	1861	13	0.70
1993	2073	8	0.39
1994	2024	13	0.64
1995	2413	16	0.66
1996	2612	9	0.34
1997	2496	9	0.36
1998	2712	5	0.18
1999	2562	5	0.20
2000	2582	2	0.08
2001	2802	1	0.04
2002	2923	1	0.03
2003	3002	0	0.00
2004	3208	3	0.09
2005	3072	0	0.00
2006	3088	0	0.00
2007	3195	0	0.00
2008	3290	0	0.00
2009	2458	0	0.00

Knowledge database only included citations from 1990 onwards, but it also shows the effect of the so-called 'obliteration by incorporation', i.e. truly classical publications are gradually less cited since their content becomes absorbed in the general knowledge (Garfield, 1987). Some of the articles in the top 100 are long-term citation classics, invariably attracting more than 40 citations per year over a period of many years (Fig. 1). Others are publications whose time has come and gone, with a much shorter half-life, e.g. Van Steirteghem's 1993 article on ICSI versus subzonal insemination (SUZI), which attracted 84 citations in 1995 alone, when SUZI was still 'hot', but gradually fell into oblivion (Fig. 1). Journal, impact factor and circulation figures are factors significantly associated with the frequency of citation (Filion and Pless, 2008). Table VIII shows that it may take up to 15 years to collect more than 100 citations and become a citation classic. The youngest article in the top 100 dates from 2004, the youngest in the top 10 dates from 1999. In this respect it can be safely predicted that the ESHRE/ASRM consensus on PCOS, a review article, will become a citation classic, having collected 523 plus 464 citations of its two manifestations in a mere 5 years.

It's true, fame is a vapor, but how can we reach it? A scientist publishing in the field of reproductive medicine or biology, wishing to write a citation classic should concoct a new clinical treatment, preferably in ART, think up a fancy acronym, publish it in English, in a journal with a high impact factor and wide circulation, and ask Devroey and/or Van Steirteghem as a co-author. Whether it helps to move to the States remains to be elucidated.

References

Campbell FM. National bias: a comparison of citation practices by health professionals. *Bull Med Libr Assoc* 1990;**78**:376–382.

Dubin D, Hafner AW, Arndt KA. Citation classics in clinical dermatologic journals: citation analysis, biomedical journals, and landmark articles, 1945–1990. *Arch Dermatol* 1993;**129**:1121–1129.

Filion KB, Pless IB. Factors related to the frequency of citation of epidemiologic publications. *Epidemiol Perspect Innov* 2008;**5**:3–9.

Garfield E. 100 citation classics from the Journal of the American Medical Association. *JAMA* 1987;**257**:52–59.

Garfield E. The agony and the ecstasy—the history and meaning of the journal impact factor. 2005. http://garfield.library.upenn.edu/papers/jifchicago2005.pdf (accessed 22 August 2009).

Hames I. *Peer Review and Manuscript Management in Scientific Journals; Guidelines for Good Practice*. Oxford, UK: Blackwell Publishing, 2007. ISBN 978-1-4051-3159-9.

Jones AW. Crème de la crème in forensic science and legal medicine. *Int J Legal Med* 2005;**119**:59–65.

Lin AM. US and non-US submissions. *JAMA* 1998;**280**:246–247.

Paladugu R, Schein M, Gardezi S, Wise L. One hundred citation classics in general surgical journals. *World J Surg* 2002;**26**:1099–1105.

Palermo G, Joris H, Devroey P, Van Steirteghem AC. Pregnancies after intracytoplasmic injection of single spermatozoon into an oocyte. *Lancet* 1992;**8810**:17–18.

Picknett T, Davis K. The 100 most-cited articles from JBM. *J Mol Biol* 1999; **293**:171–176.

Steptoe PC, Edwards RG. Birth after the reimplantation of a human embryo. *Lancet* 1978;**8085**:366.