

## The most cited articles in the Saudi medical literature

*Bakur A. Jamjoom, BMedSci, BMBS,  
Aimun A. Jamjoom, BMedSci, BMBS,  
Abdulahkim B. Jamjoom, FRCS, FRCS(SN).*

The number of citations an article receives after its publication reflects its impact on the medical community in general or on a specialty in particular. It is also the basis for calculating the impact factor (IF) of a journal, which is a topic that had generated considerable interest in recent years. Review of the top cited articles (citation classics) in a medical specialty is also a subject that continues to attract attention.<sup>1-3</sup> It is more than 30 years since the first medical journal in the Kingdom of Saudi Arabia (KSA) was established. Over the years other general and specialty journals were launched and the Saudi medical literature expanded. Many of the publications in Saudi journals became cited in biomedical search engines making them accessible to researchers from all over the world. There have been no reports that looked at the citation numbers and nature of the most cited publications in the Saudi medical journals. Hence, the objectives of this study were to identify and analyze the characteristics of the most cited articles in the Saudi medical literature.

Using the article citation numbers provided by the Google Scholars during September 2011, we identified and reviewed 50 most cited articles from the Saudi medical journals. We selected papers published in KSA journals only irrespective of the authors' nationality. Articles published by Saudi authors in journals outside KSA were not included. The articles were identified by searching on the Google Scholar in the following journals: Saudi Medical Journal, Annals of Saudi Medicine, Journal of Saudi Heart Association, Saudi Journal of Ophthalmology, Saudi Journal of Kidney Diseases and Transplantation, Saudi Journal of Obstetrics and Gynecology, Saudi Journal of Sports Medicine, Saudi Journal of Gastroenterology, Saudi Journal of Disability and Rehabilitation, Neurosciences, Journal of Family and Community Medicine, and Annals of Thoracic Medicine. During selections, articles written by multiple authors from different departments or hospitals were allocated to the first author.

The citation numbers ranged from 108-22 (median 30). Thirty-eight (76%) were published in the Saudi Medical Journal (established in 1979, IF - 0.56) while 12 (24%) were published in the Annals of Saudi Medicine (established in 1985, IF - 0.697). None of the other

journals published any of the 50 most cited papers. The articles were published during the period 1985-2008 as follows: 2 (4%) before 1990, 4 (8%) during 1991-1994, 12 (24%) during 1996-2000, 27 (54%) during 2001-2005 and 5 (10%) after 2006. The citation and citation numbers of the articles are summarized in Table 1. In 34 (68%) articles, authors were from KSA and in 16 (32%) were from other countries. These were: Turkey (3), Jordan (2), Australia (1), Iran (2), Gulf States (2), Qatar (1), Oman (1), Yemen (1), Pakistan (1), India (1), and Germany (1). Twenty-six (52%) articles were from Riyadh, 5 from Jeddah, Abha (1), Al-Khobar (1), and Gizan (1). Twenty-four (48%) articles were written by authors from King Saud University, Riyadh. The publishing departments of the 50 articles were as follows: Medicine 13 (26%), Family and Community Medicine including Public Health 11 (22%), Medical Biochemistry 8 (16%), Pediatrics 4 (8%), Medical Microbiology 4 (8%), Medical Education 1 (2%), Physiology 2 (4%), Orthopedics 1 (2%), ENT 1 (2%), Obstetrics 1 (2%), Anatomy 1 (2%), Clinical Pharmacology 1 (2%), Nuclear Medicine 1 (2%), and Nutrition 1 (2%). In 34 (68%) articles, the research was prospective. It was a community based epidemiological survey in 20; a serological and imaging screening in 10 and a hospital based clinical study in 4. In the remaining articles, the research was a randomized controlled trial (RCT) in 1 (2%), a review article in 6 (12%), a retrospective study in 7 (14%), an experimental work in 1 (2%), and an assessment of a new operative technique in 1 (2%). The statistical analysis was carried out using Microsoft Excel 2010.

There may be some limitations in our findings as the accuracy of the citation numbers as quoted by Google Scholar could be disputed particularly for older publications<sup>4</sup> and some of the KSA articles are not indexed in Google Scholar. Other authors used citation numbers from Science Citation Index Expanded,<sup>2,3</sup> and from the Institute for Scientific Information Web of Science,<sup>1</sup> but even those sites have their limitations.<sup>4</sup> However, based on a previous experience with Google Scholar,<sup>5</sup> we believe that the citation numbers provided are adequate for the objectives of this communication. In addition, the findings allowed us to make a number of observations, which we believe were appropriate

There are many articles published by Saudi researchers in the international journals that have a high citation numbers, but these were not the subject of this study. Although the citations of the 50 articles reviewed in this study were in Saudi and international journals, the citation numbers were low (median citation number 30) and close (8 citations separating articles ranked 26-50). This highlights the need for KSA journals to be more

**Table 1** - List of the most cited medical articles in the Saudi literature.

Citations number	Article
108	Al-Nozha MM, Al-Maatouq MA, Al-Mazrou YY, Al-Harhi SS, Arafah MR, Khalil MZ, et al. Diabetes mellitus in Saudi Arabia. <i>Saudi Med J</i> 2004; 25: 1603-1610.
59	Al-Nozha MM, Al-Mazrou YY, Al-Maatouq MA, Arafah MR, Khalil MZ, Khan NB, et al. Obesity in Saudi Arabia. <i>Saudi Med J</i> 2005; 26: 824-829.
52	Bahijiri SM, Mira SA, Mufti AM, Ajabnoor MA. The effects of inorganic chromium and brewer's yeast supplementation on glucose tolerance, serum lipids and drug dosage in individuals with type 2 diabetes. <i>Saudi Med J</i> 2000; 21: 831-837.
48	El-Hazmi MAF, Warsy AS. Prevalence of obesity in the Saudi population. <i>Ann Saudi Med</i> 1997; 17: 302-306.
47	El-Desouki M. Bone mineral density of the spine and femur in the normal Saudi population. <i>Saudi Med J</i> 1995; 16: 30-35.
45	Ozguner M, Koyu A, Cesur G, Ural M, Ozguner F, Gokcimen A, et al. Biological and morphological effects on the reproductive organ of rats after exposure to electromagnetic field. <i>Saudi Med J</i> 2005; 26: 405-410.
	Al-Nozha M, Al-Khadra A, Arafah MR, Al-Maatouq MA, Khalil MZ, Khan NB, et al. Metabolic syndrome in Saudi Arabia. <i>Saudi Med J</i> 2005; 26: 1918-1925.
	Al-Nozha MM, Arafah MR, Al-Mazrou YY, Al-Maatouq MA, Khan NB, Khalil MZ, et al. Coronary artery disease in Saudi Arabia. <i>Saudi Med J</i> 2004; 25: 1165-1171.
41	Al-Rowais NA. Herbal medicine in the treatment of diabetes mellitus. <i>Saudi Med J</i> 2002; 23: 1327-1331.
	El-Hazmi MM. Prevalence of HBV, HCV, HIV-1, 2 and HTLV-I/II infections among blood donors in a teaching hospital in the Central region of Saudi Arabia. <i>Saudi Med J</i> 2004; 25: 26-33.
40	Bener A, Abu-Zidan FM, Bensiali AK, Al-Mulla AA, Jadaan KS. Strategy to improve road safety in developing countries. <i>Saudi Med J</i> 2003; 24: 603-608.
37	Shaikh MA, Singla R, Khan NB, Sharif NS, Saigh MO. Does diabetes alter the radiological presentation of pulmonary tuberculosis. <i>Saudi Med J</i> 2003; 24: 278-281.
	Al-Ghamdi SM, Akbar HO, Qari YA, Fathaldin OA, Al-Rashed RS. Pattern of admission to hospitals during muslim pilgrimage (Hajj). <i>Saudi Med J</i> 2003; 24: 1073-1076.
36	Al-Sekait MA, Al-Nassar AN. Dental caries prevalence in primary Saudi schoolchildren in Riyadh District. <i>Saudi Med J</i> 1988; 9: 606-609
35	Al-Jurayyan NA, El-Desouki ME, Al-Herbish AS, Al-Mazyad AS, Al-Qhtani MM. Nutritional rickets and osteomalacia in school children and adolescents. <i>Saudi Med J</i> 2002; 23: 182-185.
	Khoury SA, Massad DF. Consanguinity, fertility, reproductive wastage, infant mortality and congenital malformations in Jordan. <i>Saudi Med J</i> 2000; 21: 150-154.
34	El-Hazmi. Haemoglobinopathies, thalassaemias and enzymopathies in Saudi Arabia. <i>Saudi Med J</i> 1992; 13: 488-499.
33	El-Hazmi MAF, Warsy AS. Genetic disorders among Arab populations. <i>Saudi Med J</i> 1996; 17: 108-123.
	Abolfrouh MA, Abdel Aziz M, Alakija W, Al-Safy A, Khattab MS, Mirdad S, et al. Smoking habits of King Saud University students in Abha, Saudi Arabia. <i>Ann Saudi Med</i> 1998; 18: 212-216.
	Al-Frayh A, Bener A, Al-Jawadi TQ. Prevalence of asthma among Saudi schoolchildren. <i>Saudi Med J</i> 1992; 13: 521-524.
32	Azer SA. Problem-based learning. Challenges, barriers and outcome issues. <i>Saudi Med J</i> 2001; 22: 389-397.
31	Erggelet C, Steinwachs MR, Reichelt A. The operative treatment of full thickness cartilage defects in the knee joint with autologous chondrocyte transplantation. <i>Saudi Med J</i> 2000; 21: 715-721.
	Bener A, Al-Suwaidi J, Al-Jaber K, Al-Marri S, Dagash MH, Elbagi IE. The prevalence of hypertension and its associated risk factors in a newly developed country. <i>Saudi Med J</i> 2004; 25: 918-922.
	Bhansali A, Masoodi SR, Reddy KS, Behera A, das Radotra B, Mittal BR, et al. Primary hyperparathyroidism in north India: a description of 52 cases. <i>Ann Saudi Med</i> 2005; 25: 29-35.
	Al-Sekait MA. Seroepidemiology survey of brucellosis antibodies in Saudi Arabia. <i>Ann Saudi Med</i> 1999; 19: 219-222.
29	Al-Rukban MO. Obesity among Saudi male adolescents in Riyadh, Saudi Arabia. <i>Saudi Med J</i> 2003; 24: 27-33.
	Al-Khlaiwi T, Meo SA. Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance in Saudi population. <i>Saudi Med J</i> 2004; 25: 732-736.
	Rindom Schiott C, Engbaek HC, Vergmann B, Al-Motez M, Kassim I. Incidence of drug resistance among isolates of drug resistance amongst isolates of <i>Mycobacterium tuberculosis</i> recovered in the Giza area, Saudi Arabia. <i>Saudi Med J</i> 1985; 6: 375-378.
28	Zubaid M, Rashed WA, Al-Khaja N, Almahmeed W, Al-Lawati J, Sulaiman K, et al. Clinical presentation and outcomes of acute coronary syndromes in the gulf registry of acute coronary events (Gulf RACE). <i>Saudi Med J</i> 2008; 29: 251-255.
	Shammas AG, Maayah JF. Hypertension and its relation to renal function 10 years after pregnancy complicated by pre-eclampsia and pregnancy induced hypertension. <i>Saudi Med J</i> 2000; 21: 190-192.
27	Osoba AO. Hepatitis C virus genotypes in Saudi Arabia. <i>Saudi Med J</i> 2002; 23: 7-12.
	Kader AA, Kumar A. Prevalence and antimicrobial susceptibility of extended-spectrum beta-lactamase-producing <i>Escherichia coli</i> and <i>Klebsiella pneumoniae</i> in a general hospital. <i>Ann Saudi Med</i> 2005; 25: 239-242.
26	Hashim TJ. Smoking habits of students in College Of Applied Medical Science, Saudi Arabia. <i>Saudi Med J</i> 2000; 21: 76-80.
	Yaghoobi-Ershadi MR, Hanafi-Bojd AA, Javadian E, Jafari R, Zahraei-Ramazani AR, Mohebbi M. A new focus of cutaneous leishmaniasis caused by <i>Leishmania tropica</i> . <i>Saudi Med J</i> 2002; 23: 291-294.
	Khandekar RB, Abdu-Helmi S. Magnitude and determinants of refractive error in Omani school children. <i>Saudi Med J</i> 2004; 25: 1388-1393.
	Nasr AH, Khatri ML. Head and neck squamous cell carcinoma in Hajjah, Yemen. <i>Saudi Med J</i> 2000; 21: 565-568.
	El-Hazmi MA, Warsy AS. The prevalence of obesity and overweight in 1-18-year-old Saudi children. <i>Ann Saudi Med</i> 2002; 22: 303-307.
	El Mouzan MI, Al Salloum AA, Al Herbish AS, Qurachi MM, Al Omar AA. Consanguinity and major genetic disorders in Saudi children: a community-based cross-sectional study. <i>Ann Saudi Med</i> 2008; 28: 169-173.
	Al-Turki YA. Smoking habits among medical students in Central Saudi Arabia. <i>Saudi Med J</i> 2006; 27: 700-703.
	Al-Nozha MM, Abdullah M, Arafah MR, Khalil MZ, Khan NB, Al-Mazrou YY, et al. Hypertension in Saudi Arabia. <i>Saudi Med J</i> 2007; 28: 77-84.
25	Al-Harithy RN, Al-Ghamdi S. Serum resistin, adiposity and insulin resistance in Saudi women with type 2 diabetes mellitus. <i>Ann Saudi Med</i> 2005; 25: 283-287.
	Elhadd TA, Al-Amoudi AA, Alzahrani AS. Epidemiology, clinical and complications profile of diabetes in Saudi Arabia: a review. <i>Ann Saudi Med</i> 2007; 27: 241-250.
24	Soker M, Kervancioglu M. Plasma concentrations of NT-pro-BNP and cardiac troponin-I in relation to doxorubicin-induced cardiomyopathy and cardiac function in childhood malignancy. <i>Saudi Med J</i> 2005; 26: 1197-202.
	Al-Hazzaa HM. Physical activity, fitness and fatness among Saudi children and adolescents: implications for cardiovascular health. <i>Saudi Med J</i> 2002; 23: 144-150.
23	Kucukerdonmez O, Koksall E, Rakicioglu N, Pekcan G. Assessment and evaluation of the nutritional status of the elderly using 2 different instruments. <i>Saudi Med J</i> 2005; 26: 1611-1616.
	Haque A, Ahmed J, Qureshi JA. Early detection of typhoid by polymerase chain reaction. <i>Ann Saudi Med</i> 1999; 19: 337-340.
22	Bawazir SA. Prescribing patterns of ambulatory care physicians in Saudi Arabia. <i>Ann Saudi Med</i> 1993; 13: 172-177.
	Alrajhi AA, Abdulwahab S, Almodovar E, Al-Abdely HM. Risk factors for drug-resistant <i>Mycobacterium tuberculosis</i> in Saudi Arabia. <i>Saudi Med J</i> 2002; 23: 305-310.
	Farhat A, Khademi G, Mazlouman SJ. The prevalence of hepatitis B carrier state in Khorassan province of Iran. <i>Saudi Med J</i> 2003; 24: 549-551.
	Al-Nozha MM, Ali MS, Osman AK. Arterial hypertension in Saudi Arabia. <i>Ann Saudi Med</i> 1997; 17: 170-174.

accessible and to have more exposure. Saudi researchers should be encouraged to promote KSA journals by publishing their quality research in KSA. Effort should be made to ensure that published articles are cited in all medical search engines. In addition, KSA journals should consider advertising in major international journals and during scientific conferences. They should

also consider providing free online articles and regularly inviting experts to submit original work. The finding that a third of the 50 most cited articles in the Saudi medical literature were by researchers from outside KSA reflects an international status for KSA journals, which should be promoted. Interestingly, more of these articles were published in the Saudi Medical Journal (76%)

compared to the Annals of Saudi Medicine (24%) despite both journals having comparable IF figures. None of the 50 articles was published in specialty journals despite some of them such as the Saudi Journal of Ophthalmology (stated in 1986) and the Journal of the Saudi Heart Association (stated in 1988) are considered well-established. Such observation can be taken as an argument against the establishment of too many new journals as it could result in diluting citation numbers for the Saudi medical literature. Of interest also is the observation that approximately half of the most cited articles were from Riyadh and mostly came from King Saud University (48%). This is likely to be related to positive research culture in that institute and to the effort of individual researchers such as Al-Nozha et al and El-Hazmi et al (Table 1) who between them published more than fifth of the 50 top-cited articles. The low number of top cited articles (6 out of 34) published by Saudi researchers outside universities could be attributed to facilities and opportunities. More likely however, the reason is interest in research which is enhanced in the academic environment of universities. More than half of the 50 most cited articles were published during the last decade with maximal number of articles published in 2005. This implies that the year of publication does not necessarily correlate with being among the most cited in the Saudi medical literature. This could be the result of Google Scholar's miscalculation of citation numbers for old articles<sup>4</sup> or related to the inclusion of more Saudi articles in the various medical search engines in recent years. Two thirds of the most cited articles were prospective studies (Evidence Level II-2) with clear dominance (60%) of epidemiological surveys and serological screening. Six of the top 10 articles were community based epidemiological studies of common diseases such as diabetes, obesity, coronary artery disease

and metabolic syndromes. Sixty-four percent of the most cited articles were published by the Departments of Medicine, Medical Biochemistry and Community Medicine Departments. The clear low rates of RCTs, trials without randomization (Evidence Levels I and II-1), basic experimental research and surgical research among the top cited articles is an important matter that Saudi researchers must address in the future.

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*From the Trauma and Orthopedics Department (Jamjoom BA), Kettering General Hospital, Kettering, Northamptonshire, Neurosurgery Department (Jamjoom AA), Western General Hospital, Edinburgh, United Kingdom, and Section of Neurosurgery (Jamjoom AB), King Khalid National Guard Hospital, Jeddah, Kingdom of Saudi Arabia. Address correspondence and reprints request to: Dr. Professor Abdulhakim Jamjoom, Chairman, Department of Surgery, Head, Section of Neurosurgery, King Khalid National Guard Hospital, PO Box 9515, Jeddah 21423, Kingdom of Saudi Arabia. Tel. +966 (2) 6240000 Ext. 22071. E-mail: jamjoomab@gmail.com*

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