

The most cited Saudi neurosurgical publications

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Bibliometrics are a set of methods that are used to analyze the scientific literature quantitatively. Citation analysis, which is the examination of frequency and patterns of citations in articles and books is the most commonly used method. The number of citations an article receives after its publication is important as it reflects its usage, its impact on the specialty, and possibly its academic strength. In addition, article citation numbers are the basis for calculating a journal's impact factor (IF), author's h-index, and g-index as well as the ranking of High Impact Universities. Modern neurosurgery has been practiced in the Kingdom of Saudi Arabia (KSA) for more than 30 years, and over the years KSA neurosurgeons have published in the international and national literature. As there is a lack of information on the impact of these articles, the objective of this study was to assess the contribution of Saudi neurosurgeons to the literature by reviewing their most cited publications.

Using article citation numbers provided by Google Scholar, we identified and reviewed the 52 most cited Saudi neurosurgical publications. The study was carried out at King Khalid National Guard Hospital, Jeddah, KSA between November and December 2011. The work was a literature review based on routinely available data with open access; hence, it did not require an ethical approval by our hospital. Articles were identified by searching on Google Scholar for: Neurosurgery, Saudi Arabia, and by names of individual KSA neurosurgeons. We selected papers in which the name of a KSA neurosurgical center was stated in the authorship, and the article was written by a neurosurgeon who worked in KSA irrespective of nationality and duration. Papers that were published in neurosurgical journals were included if they had at least one KSA neurosurgeon among the authors. However, to avoid gift authorship, publications in non-neurosurgical journals were included if they had at least 2 KSA neurosurgeons, or one if he/she was the first author, or the article was a dual authorship. The following data were collected from each article: citation number, year of publication, journal and its IF, article's sub-specialty, article's type of research, KSA neurosurgical center and any international collaboration.

Fifty-two articles were identified as the most cited Saudi neurosurgical publications in the literature (50 and an extra 2, due to articles having identical citation numbers). The citation numbers ranged from 110 to 21 (mean 35). The articles were published between 1985-2005 (median 1995). Table 1 summarizes the

characteristics of the most cited Saudi neurosurgical articles with regards to the number of articles and their mean citation number in relation to the year of publication, the publishing journal, the article's sub-specialty, the article's research type, and the KSA neurosurgical center. Please also refer to Appendix 1 to access a full list of the 52 most cited Saudi neurosurgical articles and their citation numbers. Five of the 10 neurosurgeons with the highest total citation numbers in relation to the 52 articles were non-Saudis.

There may be some limitations to the study as the accuracy of the citation numbers in Google Scholar could be disputed, particularly for older publications.¹ An alternative source of article citation numbers is the Science Citation Index Expanded and the Institute for Scientific Information Web of Science,^{2,3} but even those sites have their limitations.¹ In addition, based on previous experience with Google Scholar,⁴ we believe that the citation numbers provided are adequate for the objectives of this communication. Ponce and Lozano^{2,3} defined a "citation classic" as a neurosurgical article that had more than 400 citations. They also labeled a publication in a neurosurgical journal as "top cited" if the article had more than 287 citations. Hence, citation numbers of 21-110 for the most cited Saudi neurosurgical articles are very modest. Ponce and Lozano³ reported that 81% of the neurosurgical citation classics were published during 1980-2005. Our 52 articles were published during 1985-2005 (median 1995). This implies that it takes 10-20 years for articles to be among the top cited. Twenty-three percent of the papers were published in journals with an IF ≥ 3 , and 21% were in non-neurosurgical journals. As expected, articles published in journals with an IF ≥ 3 had higher mean citation numbers (40 versus 34); however, mean citation numbers for articles published in neurosurgical and non-neurosurgical journals were fairly comparable (36 versus 38). Sixty-four percent of the 52 articles were published in 5 neurosurgical journals: Surgical Neurology (IF 1.4) 19%, British Journal of Neurosurgery (IF 1.01) 13%, Acta Neurochirurgica (IF 1.33) 12%, Journal of Neurosurgery (IF 2.74) 10%, and Neurosurgery (IF 3.3) 10%. None of them were published in KSA journals. Jamjoom et al⁴ reviewed the 50 most cited articles in Saudi medical literature and found no neuroscience-related article among them. This can be taken as an argument for the need for KSA neurosurgeons to support the existing national journals rather than the establishment of a new KSA neurosurgical journal. Ponce and Lozano² reported dominance of articles related to vascular and traumatic brain injury among the top cited articles in neurosurgical journals. Among our 52 articles there was a dominance of papers related to tumor and skull base (35%) and pediatrics (21%), which is a reflection of the nature of the contributors' workload. In addition,

Table 1 - Characteristics of the 52 most cited Saudi neurosurgical articles.

Features	Number of articles (%)	Mean citation numbers
<i>Year of publication</i>		
81-85	4 (8)	48
86-90	8 (15)	41
91-95	15 (29)	33
96-00	17 (33)	35
00-05	8 (15)	31
<i>Publishing Journal</i>		
Surgical Neurology	10 (19)	38
British Journal of Neurosurgery	7 (13)	29
Acta Neurochirurgica	6 (12)	37
Journal of Neurosurgery	5 (10)	44
Neurosurgery	5 (10)	45
International Journal of Radiation Oncology Biology Physics	3 (6)	44
Child's Nervous System	3 (6)	26
Pediatric Neurosurgery	2 (4)	28
Minimally Invasive Neurosurgery	2 (4)	41
Neurosurgical Review	2 (4)	24
Journal of Neurology Neurosurgery and Psychiatry	1 (2)	30
Clinical Neurophysiology	1 (2)	42
International Ophthalmology	1 (2)	21
Ophthalmology	1 (2)	32
Stroke	1 (2)	23
Stereotactic and Functional Neurosurgery	1 (2)	27
Skull Base	1 (2)	25
Journals with impact factor ≥3	12 (23)	40
Journals with impact factor <3	40 (77)	34
Neurosurgical Journals	41 (79)	36
Non-Neurosurgical Journals	11 (21)	38
<i>Article's sub-specialty</i>		
Tumor and Skull Base	18 (35)	40
Pediatrics	11 (21)	31
Infection	7 (13)	32
Trauma	6 (12)	31
Spine	4 (8)	32
Vascular	4 (8)	49
Others	2 (4)	25
<i>Article's Research Type</i>		
Retrospective case series (>10 patients)	19 (37)	41
Retrospective case series (3-10 patients)	9 (17)	43
Retrospective case series (2 patients)	4 (8)	37
Case Report	16 (31)	28
Prospective study	2 (4)	27
Review Article	2 (4)	24
<i>KSA Neurosurgical center</i>		
KFSH&RC, Riyadh	20 (38)	42
King Khalid University Hospital, Riyadh	19 (37)	30
King Fahad University Hospital, Alkhobar	6 (12)	24
King Fahad National Guard Hospital, Riyadh	2 (4)	31
PSMMC, Riyadh	2 (4)	28
Dammam Central Hospital, Dammam	1 (2)	30
King Faisal Hospital, Taif	1 (2)	110
Erfan & Bagedo General Hospital, Jeddah	1 (2)	33
KSA center alone	41 (79)	33
KSA center in collaboration with international centers	11 (21)	46

KSA - Kingdom of Saudi Arabia, KFSH&RC - King Faisal Specialist Hospital and Research Centre, PSMMC - Prince Sultan Military Medical City

most of the articles were retrospective case series (62%), and case reports (31%). Ponce and Lozano³ reported that 37% of neurosurgical citation classics were case series/reports, 27% were randomized, and 15% were prospective. Among the reviewed articles in this study, only 4% were prospective studies with no randomized controlled trials and no experimental work, a finding that highlights the need for high caliber neurosurgical research in KSA. Seventy-five percent of articles were from 2 KSA neurosurgical centers reflecting the need for other centers to be involved in quality research. Articles written in collaboration with international centers had higher mean citation numbers than those by KSA neurosurgeons alone (46 versus 33) indicating that multicenter research with international collaboration should be encouraged. In addition, the fact that half of the top 10 contributing neurosurgeons were non-Saudis may be taken as an argument that there is still a need for elite research minds of any nationality to be employed in the KSA. This would give opportunity for the young Saudi neurosurgeons to learn, and in the long run would prove more beneficial than paying researchers abroad for their affiliation.⁵

In conclusion, the determinants for being a top cited neurosurgical article is the journal in which the work published, the time of publication, the field of study, and the research type.² We need to develop our elite neurosurgical research minds. This can be achieved by promoting “research culture” amongst juniors through mentorship, the establishment of designated academic neurosurgical units staffed by Saudi PhD-holders, and the development of PhD programs that are linked to strong international universities.

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3. Ponce FA, Lozano AM. Highly cited works in neurosurgery. Part II: the citation classics. *J Neurosurg* 2010; 112: 233-246.
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Appendix 1 - List of the 52 most cited Saudi neurosurgical articles and their citation numbers.

Citation Number	Article
110	Alexander MS, Dias PS, Urtley D. Spontaneous subarachnoid hemorrhage and negative cerebral panangiography. Review of 140 cases. <i>J Neurosurg</i> 1986; 64: 537-542.
72	Hassounah M, Al-Mefty O, Akhtar M, Jinkins JR, Fox JL. Primary cranial and intracranial chondrosarcoma. A survey. <i>Acta Neurochir (Wien)</i> 1985; 78: 123-132.
67	Bouchama A, al-Kawi MZ, Kanaan I, Coates R, Jallu A, Rahm B, et al. Brain biopsy in tuberculoma: the risks and benefits. <i>Neurosurgery</i> 1991; 28: 405-409.
64	Jenkin D, Shabanah MA, Shail EA, Gray A, Hassounah M, Khafaga Y, et al. Prognostic factors for medulloblastoma. <i>Int J Radiat Oncol Biol Phys</i> 2000; 47: 573-584.
64	Kinjo T, al-Mefty O, Kanaan I. Grade zero removal of supratentorial convexity meningiomas. <i>Neurosurgery</i> 1993; 33: 394-399.
62	Al-Mefty O, Fox JL, Rifai A, Smith RR. A combined infratemporal and posterior fossa approach for the removal of giant glomus tumors and chondrosarcomas. <i>Surg Neurol</i> 1987; 28: 423-431.
59	Sheikh BY, Siqueira E, Dayel F. Meningioma in children: a report of nine cases and review of the literature. <i>Surg Neurol</i> 1996; 45: 328-335.
55	Naim-Ur-Rahman, Jamjoom Z, Jamjoom A, Murshid WR. Growing skull fractures: classification and management. <i>Br J Neurosurg</i> 1994; 8: 667-679.
54	Jamjoom ZA. Acute spontaneous spinal epidural hematoma: the influence of magnetic resonance imaging on diagnosis and treatment. <i>Surg Neurol</i> 1996; 46: 345-349.
53	Al-Mefty O, Fox JL. Superolateral orbital exposure and reconstruction. <i>Surg Neurol</i> 1985; 23: 609-613.
48	Murshid WR. Endoscopic third ventriculostomy: towards more indications for the treatment of non-communicating hydrocephalus. <i>Minim Invasive Neurosurg</i> 2000; 43: 75-82.
45	Murshid WR. Management of minor head injuries: admission criteria, radiological evaluation and treatment of complications. <i>Acta Neurochir</i> 1998; 140: 56-64.
43	Al-Mefty O, Hassounah M, Weaver P, Sakati N, Jinkins JR, Fox JL. Microsurgery for giant craniopharyngiomas in children. <i>Neurosurgery</i> 1985; 17: 585-595
42	Dong CC, Macdonald DB, Akagami R, Westerberg B, Alkhani A, Kanaan I, Hassounah M. Intraoperative facial motor evoked potential monitoring with transcranial electrical stimulation during skull base surgery. <i>Clin Neurophysiol</i> 2005; 116: 588-596.
36	Khafaga Y, Jenkin D, Kanaan I, Hassounah M, Al Shabanah M, Gray A. Craniopharyngioma in children. <i>Int J Radiat Oncol Biol Phys</i> 1998; 42: 601-606.
34	Jamjoom ZA, Okamoto E, Jamjoom AH, al-Hajery O, Abu-Melha A. Bilateral arachnoid cysts of the sylvian region in female siblings with glutaric aciduria type I. <i>J Neurosurg</i> 1995; 82: 1078-1081.
34	Kanaan I, Lasjaunias P, Coates R. The spectrum of intracranial aneurysms in pediatrics. <i>Minim Invasive Neurosurg</i> 1995; 38: 1-9.
33	Khafaga Y, Hassounah M, Kandil A, Kanaan I, Allam A, El Husseiny G, et al. Optic gliomas: a retrospective analysis of 50 cases. <i>Int J Radiat Oncol Biol Phys</i> 2003; 56: 807-812.
33	Najjar MW, Baeesa SS, Lingawi SS. Idiopathic spinal cord herniation: a new theory of pathogenesis. <i>Surg Neurol</i> 2004; 62: 161-170.
32	Al Ferayan A, Russell NA, Al Wohaibi M, Awada A, Scherman B. Cerebrospinal fluid lavage in the treatment of inadvertent intrathecal vincristine injection. <i>Childs Nerv Syst</i> 1999; 15: 87-89.
32	Liu D, Al Shail E. Retained orbital wooden foreign body: a surgical technique and rationale. <i>Ophthalmology</i> 2002; 109: 393-399.
31	Al-Mefty O, Fox JL, Al-Rodhan N, Dew JH. Optic nerve decompression in osteopetrosis. <i>J Neurosurg</i> 1988; 68: 80-84.
30	Basit AS, Ravi, B, Banerji AK, Tandon PN. Multiple pyogenic brain abscesses: an analysis of 21 patients. <i>J Neurol Neurosurg Psychiatry</i> 1989; 52: 591-594.
30	Kanaan IU, Ellis M, Safi T, Al Kawi MZ, Coates R. Craniocervical junction tuberculosis: a rare but dangerous disease. <i>Surg Neurol</i> 1999; 51: 21-25.
30	Russell NA, Benoit BG, Joaquin AJ. Diastematomyelia in adults. A review. <i>Pediatr Neurosurg</i> 1990-1991; 16: 252-257.
29	Murshid WR, Gader AG. The coagulopathy in acute head injury: comparison of cerebral versus peripheral measurements of haemostatic activation markers. <i>Br J Neurosurg</i> 2002; 16: 362-369.
29	Jamjoom A, Nelson R, Stranjalis G, Wood S, Chissell H, Kane N, et al. Outcome following surgical evacuation of traumatic intracranial haematomas in the elderly. <i>Br J Neurosurg</i> 1992; 6: 27-32.
29	Chaudhri KA, Choudhury AR, al Moutaery KR, Cybulski GR. Penetrating craniocerebral shrapnel injuries during "Operation Desert Storm": early results of a conservative surgical treatment. <i>Acta Neurochir (Wien)</i> 1994; 126: 120-123.
27	Al-Anazi A, Hassounah M, Sheikh B, Barayan S. Cerebellar mutism caused by arteriovenous malformation of the vermis. <i>Br J Neurosurg</i> 2001; 15: 47-50.
27	Kanaan I, Ahmed M, Rifai A, Alwatban J. Sphenoid sinus brown tumor of secondary hyperparathyroidism: case report. <i>Neurosurgery</i> 1998; 42: 1374-1377.
27	Msaddi AK, Mazroue AR, Shahwan S, al Amri N, Dubayan N, Livingston D. Microsurgical selective peripheral neurectomy in the treatment of spasticity in cerebral-palsy children. <i>Stereotact Funct Neurosurg</i> 1997; 69: 251-258.

Appendix 1 cont'd - List of the 52 most cited Saudi neurosurgical articles and their citation numbers.

Citation Number	Article
26	Jamjoom AB, al-Hedaithy SA, Jamjoom ZA, al-Hedaithy M, el-Watidy SF, Rahman N, et al. Intracranial mycotic infections in neurosurgical practice. <i>Acta Neurochir (Wien)</i> 1995; 137: 78-84.
26	Naim-Ur-Rahman, Jamjoom A, al-Hedaithy SS, Jamjoom ZA, al-Sohaibani MO, Aziz SA. Cranial and intracranial aspergillosis of sino-nasal origin. Report of nine cases. <i>Acta Neurochir (Wien)</i> 1996; 138: 944-950.
25	Naim-Ur-Rahman, Salih MA, Jamjoom AH, Jamjoom ZA. Congenital intramedullary lipoma of the dorsocervical spinal cord with intracranial extension: case report. <i>Neurosurgery</i> 1994; 34: 1081-1083.
25	Kanaan I, Jallu A, Kanaan H. Management strategy for meningioma in pregnancy: A clinical study. <i>Skull Base</i> 2003; 13: 197-203.
25	Murshid WR. Spina bifida in Saudi Arabia: is consanguinity among the parents a risk factor? <i>Pediatr Neurosurg</i> 2000; 32: 10-12.
25	Ibrahim AW. E. coli meningitis as an indicator of intestinal perforation by V-P shunt tube. <i>Neurosurg Rev</i> 1998; 21: 194-197.
25	Sheikh BY. Cranial aneurysmal bone cyst "with special emphasis on endovascular management". <i>Acta Neurochir</i> 1999; 141: 601-610.
24	Al-Mefty O, Jinkins JR, el-Senoussi M, el-Shaker M, Fox JL. Medulloblastomas: a review of modern management with a report on 75 cases. <i>Surg Neurol</i> 1985; 24: 606-624.
24	Naim-Ur-Rahman, El-Bakry A, Jamjoom A, Jamjoom ZA, Kolawole TM. Atypical forms of spinal tuberculosis: case report and review of the literature. <i>Surg Neurol</i> 1999; 51: 602-607.
24	Hadzikaric N, Nasser M, Mashani A, Ammar A. CSF hydrothorax--VP shunt complication without displacement of a peritoneal catheter. <i>Childs Nerv Syst</i> 2002; 18: 179-182.
23	Rahman NU, al-Tahan AR. Computed tomographic evidence of an extensive thrombosis and infarction of the deep venous system. <i>Stroke</i> 1993; 24: 744-746.
23	Al-Rodhan NR, Fox JL. Al-Zahrawi and Arabian neurosurgery, 936-1013 AD. <i>Surg Neurol</i> 1986; 26: 92-95.
22	Al-Mefty O, Fox JL, Sakati N, Bashir R, Probst F. The multiple manifestations of the encephalocraniocutaneous lipomatosis syndrome. <i>Childs Nerv Syst</i> 1987; 3: 132-134.
22	Ibrahim AW, Farag H, Naguib M, Ibrahim E. Neuroepithelial (colloid) cyst of the third ventricle in identical twins. <i>J Neurosurg</i> 1986; 65: 401-403.
22	Jamjoom A, Kane N, Nicoll J. Metastasis of a renal carcinoma to a cerebellar haemangioblastoma in a case of von Hippel-Lindau disease. <i>Neurosurg Rev</i> 1992; 15: 231-234.
21	Jamjoom A, Williams C, Cummins B. The treatment of spondylotic cervical myelopathy by multiple subtotal vertebrectomy and fusion. <i>Br J Neurosurg</i> 1991; 5: 249-255.
21	Jamjoom ZA. Solitary brainstem abscess successfully treated by microsurgical aspiration. <i>Br J Neurosurg</i> 1992; 6: 249-253.
21	Jamjoom ZA, Jamjoom AB, Sulaiman AH, Naim-Ur-Rahman, al Rabiaa A. Systemic metastasis of medulloblastoma through ventriculoperitoneal shunt: report of a case and critical analysis of the literature. <i>Surg Neurol</i> 1993; 40: 403-410.
21	Rahman NU, Jamjoom A, Jamjoom ZA, Abu el-Asrar A. Orbito-cranial injury caused by penetrating metallic foreign bodies: report of two cases. <i>Int Ophthalmol</i> 1997; 21: 13-17.
21	Ammar A, Al-Sultan A, Al Mulhim F, Al Hassan AY. Empty sella syndrome: does it exist in children? <i>J Neurosurg</i> 1999; 91: 960-963.
21	Murshid WR, Moss TH, Ertles DF, Cummins BH. Tophaceous gout of the spine causing spinal cord compression. <i>Br J Neurosurg</i> 1994; 8: 751-754.

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