

Diabetes Research in India - A citation profile

This study presents some recent data on diabetes research carried out globally using internationally accepted parameters for analysis. We looked at the data from the journals indexed in the Science Citation Index (Expanded) for the period 1976-2006. The search strategy was refined for obtaining maximum records. The search terms used were diabet* OR NIDDM OR IDDM OR MODY OR FCPD OR Hypoglycem* OR Hyperglycem* OR Hypoglycern* OR Hyperglycern* OR “Islet transplant*” OR “Islet encapsulation” OR “Insulin resist*” OR Retinopath* and India as authors’ address. We also mapped out the major areas of research as reflected from the subject disciplines of the published journals and looked at the citation profiles of the papers on diabetes for the study period.

Diabetes research is very young. Most of the path-breaking research has been reported in the late 1980s and early 1990s. During 1976-2006, a total of 2,77,781 papers were published all over the world in the SCI (Expanded)-indexed journals on diabetes. As many as 3,068 papers appeared from India on this topic in these journals which was just 1.04%. The major publishing institutes were: The All India Institute of Medical Sciences, New Delhi which contributed the maximum number of papers (276) followed by the Diabetes Research Centre (DRC), Chennai with 126. The other major institutions included Annamalai University, Annamalai Nagar (122), Postgraduate Institute of Medical Education & Research (PGIMER), Chandigarh (108), University of Madras, Chennai, (98), Madras Diabetes Research

Foundation (MDRF), Chennai (83), Jawaharlal Nehru University, New Delhi (70) and Central Drug Research Institute, Lucknow (66). Analysis of the authorship profile showed that V. Mohan and his colleagues from the MDRF, Chennai led with 174 papers followed by A. Ramachandran from the DRC, Chennai with 173 papers.

We also looked at the major areas of research of the papers on diabetes. A large number of papers (612) were in the area of Endocrinology followed by Pharmacology & Pharmacy (497), Biochemistry and Molecular Biology (301), Medicinal Chemistry (262), Medicine – Research & Experimental (157) and Plant Sciences (155) (Table I). The Indian contribution to the global research varied with the subject area from 0.96 per cent in Medicine - General and Internal to over 49.0 per cent in Plant Sciences. High share of publications in Plant Sciences and Chemistry - Medicinal (26.12%) perhaps reflects the strength of India in these areas. It also suggests that the research focus, apparently to find plant-based products for diabetes control coupled with India’s known capability in chemistry, is in the right direction. While the 9.0 per cent share in Pharmacology and Pharmacy is understandable, the over 9.0 per cent in Biology and Biophysics share needs another closer look at these data. Also, there appears to be a clear need for more resources and support for Medicine - General and Internal (2.8%), Cardiac and Cardiovascular Systems (1.17%), Urology and Nephrology (3.04%) and importantly

Table I. Publications in various areas in diabetes

	India	World	% of Indian papers
Total number	3068	2,77,781	
<i>Subject Categories:</i>			
Endocrinology		30646	
Endocrinology and Metabolism	612		
Medicine, General and Internal	198	7054	2.8
Peripheral Vascular Disease	65	6762	0.96
Cardiac & Cardio Vascular Systems	75	6362	1.17
Biochemistry and Molecular Biology	301	6115	4.92
Pharmacology and Pharmacy	497	5960	8.33
Urology and Nephrology	144	4730	3.04
Plant Sciences	155	314	49.36
Ophthalmology	140	3969	3.52
Chemistry, Medicinal	262	1003	26.12
Cell Biology	118	3650	3.23
Surgery	69	3576	1.92
Nutrition & Dietetics	148	3571	4.14
Medicine, Research and Experiment	157	3366	4.66
Multidisciplinary Sciences	125	963	13
Immunology	118	3111	3.79
Hematology	26	2693	0.96
Biology	114	1253	9.09
Biophysics	110	1158	9.5

Nutrition and Dietetics (4.66%) as India's share in these areas is inadequate. Changes in life-style including appropriate nutritional practices and exercise are critical in the management as engaging in moderate exercise, avoid excessive weight gain, eating whole grain carbohydrates and vegetable oils could eliminate over 80 per cent of type-2 diabetes. This is especially ironical for a poor country like India where childhood and adult obesity stare at us alongside poverty and malnutrition.

A quick analysis of the highly cited papers from India (cited 100 or more times over the period 1975-2006) showed that there were ten papers four of which were collaborative papers with scientists abroad. (Table II). Analysis of the global output on diabetes showed that of the top ten highly cited papers from all over the world, paper with the highest citations (Turner *et al*) received 4,391 citations and the tenth in the list was cited only 1,392 times (Table

III). Broad subject categorization of the type of highly cited papers in India showed that four were from the clinical sciences area followed by three epidemiological studies and three in basic science area. Interestingly, all but one of the highly cited papers from the world appear to be from the clinical research area, many of them reporting data from large clinical trials. Also, interestingly among the list of ten highly cited papers, three papers each were published in the *New England Journal of Medicine*, and *The Lancet*, *JAMA*- the *Journal of American Medical Association* had two while the *British Medical Journal* and *Diabetologia* published one paper each. None of the papers appeared in an Indian or a developing country journal. However, if the total citations for a research area were considered, papers in genetics and basic studies on the disease were very highly cited (data not shown) as such studies would help identify new sites for drug therapy and help formulate preventive strategies.

Table II. Top ten papers from India receiving 100 or more citations

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1. West KM, Ahuja MMS, Bennett PH, Czyzyk A, Deacosta OM, Fuller JH, *et al.* The role of circulating glucose and triglyceride concentrations and their interactions with other risk-factors as determinants of arterial disease in 9 diabetic population samples from the WHO multinational study. *Diabetes Care* 1983; 6 : 361-9.
Times Cited : 331.
 2. Gu SM, Thompson DA, Srikumari CRS, Lorenz B, Finckh U, Nicoletti A, *et al.* Mutations in RPE65 cause autosomal recessive childhood-onset severe retinal dystrophy. *Nat Genet* 1997; 17: 194-7.
Times Cited : 231
 3. Barba C, Cavalli-Sforza T, Cutter J, Darnton-Hill I, Deurenberg P, Deurenberg-Yap M, *et al.* WHO Expert Consultation Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* 2004; 363 : 157-63.
Times Cited : 214
 4. Bavdekar A, Yajnik CS, Fall CHD, Bapat S, Pandit AN, Deshpande V, *et al.* Insulin resistance syndrome in 8-year-old Indian children - Small at birth, big at 8 years, or both? *Diabetes* 1999; 48: 2422-9.
Times Cited : 182
 5. Som S, Basu S, Mukherjee D, Deb S, Choudhury PR, Mukherjee S, *et al.* Ascorbic-acid metabolism in diabetes-mellitus. *Metab Clin Exp* 1981; 30: 572-7.
Times Cited : 152
 6. Bhatnagar D, Anand IS, Durrington PN, Patel DJ, Wander GS, Mackness MI, *et al.* Coronary risk-factors in people from the Indian subcontinent living in West London and their siblings in India. *Lancet* 1995; 345: 405-9.
Times Cited : 137
 7. Yajnik CS, Fall CHD, Vaidya U, Pandit AN, Bavdekar A, Bhat DS, *et al.* Fetal growth and glucose and insulin metabolism in 4-year-old Indian children. *Diabetic Med* 1995; 12: 330-6.
Times Cited : 134
 8. Ramachandran A, Snehalatha C, Dharmaraj D, Viswanathan M. Prevalence of glucose intolerance in Asian Indians-urban-rural difference and significance of upper-body adiposity. *Diabetes Care* 1992; 15: 1348-55.
Times Cited : 126
 9. Sundaram RK, Bhaskar A, Vijayalingam S, Viswanathan M, Mohan R, Shanmugasundaram KR. Antioxidant status and lipid peroxidation in type II diabetes mellitus with and without complications. *Clin Sci* 1996; 90: 255-60.
Times Cited : 122
 10. Ramachandran A, Snehalatha C, Latha E, Vijay V, Viswanathan M. Rising prevalence of NIDDM in an urban population in India. *Diabetologia* 1997; 40: 232-7.
Times Cited : 116
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We do not wish to comment on the 'quality' of the papers either linked to the impact factor of the publishing journal or the number of citations received as such judgements are best left to peers. Nonetheless, the most interesting observation from our data, in our opinion, is the publication and citation profile of Indian papers that have appeared from private research institutions/foundations *viz.*,

the DRC and MDRF both from Chennai. The leaders from both the institutes V. Mohan and A. Ramachandran would have got competitive grants from the Government and have excelled through publication in highly rated journals and high citations indicating global recognition. Is there a message for the government and scientists from the publicly funded institutions and medical colleges which are

Table III. World top ten papers (by number of citations received)

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1. Turner RC, Holman RR, Cull CA, Stratton IM, Mathews DR, Frighi V, *et al.* Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998; 352 : 837-53.
Times Cited: 4391
 2. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC, *et al.* Homeostasis model assessment-insulin resistance and beta-cell function from fasting plasma-glucose and insulin concentrations in man. *Diabetologia* 1985;28: 412-9.
Times Cited: 3676
 3. Collins R, Armitage J, Parish S, Sleight P, Peto R. MRC/BHF Heart Protection Study of cholesterol lowering with simvastatin in 20536 high-risk individuals: a randomised placebo-controlled trial. *Lancet* 2002; 360: 7-22.
Times Cited: 2217
 4. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green A, Izzo JL, *et al.* The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure - The JNC 7 Report. *JAMA* 2003; 289: 2560-72.
Times Cited: 2151
 5. Stearne MR, Palmer SL, Hammersley MS, Franklin SL, Spivey RS, Levy JC, *et al.* Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes : UKPDS 38. *BMJ* 1998; 317: 703-13.
Times Cited : 1997
 6. Knowler WC, Barrett-Connor R, Fowler SE, Hamman RF, Lachin JM, Walker EA, *et al.* Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002; 346: 393-403.
Times Cited : 1944
 7. Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults, 1999-2000. *JAMA* 2002; 288: 1723-7.
Times Cited: 1717
 8. Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, *et al.* Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* 2001; 344: 1343-50.
Times Cited : 1532
 9. Brenner BM, Cooper ME, de Zeeuw D, Keane WF, Mitch WE, Parving HH, *et al.* Effects of losartan on renal and cardiovascular outcomes in patients with type 2 diabetes and nephropathy. *N Engl J Med* 2001; 345: 861-9.
Times Cited : 1453
 10. Turner RC, Holman RR, Stratton IM, Cull CA, Matthews DR, Manley SE, *et al.* Effect of intensive blood-glucose control with metformin on complications in overweight patients with type 2 diabetes (UKPDS 34). *Lancet* 1998; 352: 854-65.
Times Cited : 1392
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much better placed? This also, to the best of our knowledge, the first time where medical researchers from the private (non-industry) sector have excelled. In an era where clinician-researchers (especially diabetologists), at least in India, are busy making money through private practice, such intellectual pursuits from the DRC and MDRF deserve encouragement and support from the government.

What is more, all over the world the tribe of clinician-researcher is fast vanishing. Mohan and Ramachandran, therefore, stand out.

This study is but a quick quantitative appraisal on diabetes research and therefore just indicative of the research trends. A more indepth study is required as the limitations of publication in high

impact journals and citation profiles are well known. Some of these include, the kind of research (basic, clinical or epidemiological *etc.*) being carried out, the journal where the research appears, *etc.*, the citation profile depends upon many factors such as collaboration with scientists (especially from the US and/or Western Europe), networking skills of the developing country collaborator, strength of developed country partner, infrastructure available, number of people working, research funding, *etc.* Diabetes surely presents an interesting case study as it is a disease afflicting both the North and the South and where even the Indian poor need to buy their regular

insulin shots from the market. Global pharma, not surprisingly, has put in lot of money into finding newer products and Indian researchers can make a mark if the current trend on the plant-based approach coupled with skill in chemistry are applied for drug development. The clear message is that more research needs to be done and more support from the public sector not just to know and understand the disease but to find affordable health products for the poor diabetic patients.

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