Nutrition Research in India

Underweight, Stunted, or Wasted?

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ABSTRACT

India has experienced dramatic economic growth in the past 2 decades accompanied by a rising burden of noncommunicable diseases, which coexists with the unfinished agenda of undernutrition. Tackling these dual challenges requires strong investment in nutrition research. We compared India's research output with another rapidly developing country (China) and an established developed country (USA). We analyzed trends for each country between the periods 2000 to 2005 and 2006 to 2010, in terms of quantity and quality of the publications. India produced 2,712 articles (1.9% of the global total) in the 2000 to 2005 period and 3,999 articles (2.1%) in the 2006 to 2010 period, and the country impact factor was 191 and 174, respectively. The contributions to the top 10 nutrition journals during 2006 to 2010 was 1%. India must increase investment in and attention towards quality nutrition research and address potential barriers to publish.

India is undergoing rapid economic growth and development [1]. Despite this positive trend, India remains burdened with an unfinished agenda of undernutrition and communicable diseases on the one hand, and a burgeoning epidemic of overnutrition and noncommunicable diseases on the other.

Addressing this dual burden of over- and undernutrition is critical to achieving improved health and sustained economic growth throughout India, and nutrition research is key to effectively tackling the challenges [2]. For example, there is evidence that poor health resulting from nutritional deficiencies can perpetuate poverty and undermine economic growth [3,4]. The Copenhagen Consensus noted that nutrition interventions generate returns among the highest of 17 potential development investments [5]. Furthermore, investment in research is a cost-effective way of improving health [6]. Previous studies suggest a deficiency in India's research output in the fields of science and public health [7–11]; however, no studies have specifically examined the country's research output in nutritional sciences.

Here, we analyze trends in India's nutrition research output from the periods 2000 to 2005 and 2006 to 2010, in terms of quantity (measured by number of publications) and quality (measured by impact factor) and compare it to China, another rapidly growing emerging economy facing similar dual health threats, and the USA, a developed country with a well-established field of nutrition research [12]. The disease burden related to nutrition is high in all 3 countries. While India and China grapple with the dual burden of malnutrition [13–15], USA is in the midst of an obesity epidemic, where no state has a prevalence of obesity >20% [16]. The USA's food consumption trends are often implicated as the leading drivers of the epidemic. Given that malnutrition (including over- and undernutrition) is largely preventable, it is of interest to assess and compare the research energy devoted to these issues, in the form of research outputs (i.e., publications).

We used 3 measures of research output: 1) the total number of nutrition publications for India, China, and USA in the last decade (using PubMed); 2) contribution in the top 10 nutrition journals (using Journal Citation Reports) [17]; and 3) quality of those published papers (using countrywise aggregated impact factor) in the top 10 nutrition journals.

To tally the number of publications during each 5-year period (2000 to 2005) and (2006 to 2010), we performed a search of all "nutrition" categories in the Medical Subject Headings (MeSH) database under the PubMed homepage. This yielded 31 MeSH terms out of which those relevant to humans only (n = 27) were selected (Table 1).The results yielded were then categorized into the 3 countries of interest (India, China, and USA) based on the corresponding author's affiliation/country provided in the address bar. The rest (other than those from the 3 countries) were excluded. Using Excel 2007 (Microsoft, Redmond, WA, USA) and EndNote X4 (Thomson Reuters, Carlsbad, CA, USA), a dataset was created that compiled, tabulated, and summarized all extracted publications. Even though the same terms may have been differently weighted in terms of research priorities in the 3 countries, for consistency and fair comparability, the same search terms and criteria were used to compare the number of publications across the 3 countries. The obtained results (number of publications) countrywise are tabulated.

To measure the relative quality of India's nutrition research, we assessed each country's research output in the top 10 nutrition journals in the world according to

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the 2009 impact factor rankings by Journal Citation Reports (JCR) citation index (JCR Science Edition 2009). Under JCR Science Edition 2009, the most appropriate subject category available was selected to represent the field of nutrition ("Nutrition & Dietetics"). The top 10 journals under this category based on the impact factor ratings were selected. Each journal name was then added to the existing search builder (Table 1). The number of articles in each journal from each country in the specified duration was multiplied by the journal's most recent individual impact factor (2009) to get each country's "journal impact factor" (JIF). These JIF were totaled to determine each overall "country impact factor" (CIF). Thus for each country, we computed 2 CIF—1 for 2000 to 2005 and 1 for 2006 to 2010. An example is shown in Table 2. The computation of aggregated CIF can be seen as a superior measure to reporting overall mean impact factor of all journals because the former allowed taking the number of publications into account. This is important because summing the product of both quantity (number of publications) and quality (impact factor of the journal) for each country gave a comparable picture and allowed us to make intercountry comparisons for the same journal and across the top 10 journals.

Because country-specific journals may be more likely to publish articles from their own country, and because many of the top nutrition research journals are USA-based, we also examined selected common nutrition journals from other regions: the *European Journal of Clinical Nutrition* (EJCN), *Asia Pacific Journal of Clinical Nutrition* (APJCN), and the *British Journal of Nutrition* (BJN).

RESULTS

Figure 1 shows the nutrition research output and JIF and CIF for India, China, and the USA. Together, the countries produced approximately one-third of global nutrition research output. India produced 2,712 articles (1.9% of the global total) in 2000 to 2005 and 3,999 articles (2.1% of the global total) in 2006 to 2010. In comparison, China produced 5,146 articles (4.7% of global total) in 2000 to 2005 and 10,982 (5.8% of global total) in 2006 to 2010, and the USA published 42,089 articles (26% of global total) in 2000 to 2005 and 47,408 articles (25.2% of global total) in 2006 to 2010 (Table 3).

Similarly, the CIF for the USA was far higher than that for China or India. India's CIF was 191 in 2000 to 2005 and 174 in 2006 to 2010, whereas China's was 96 and 360 and the USA's was 10,675 and 11,293 in 2000 to 2005 and 2006 to 2010, respectively.

Table 4 shows the contributions from India, China, and the USA in the top 10 nutrition journals in the world (based on 2009 JCR ranking). The USA contributed a much larger percentage than either India or China to the top 10 nutrition journals. Of note, while India's contribution stayed roughly the same between 2000 to 2005 and 2006 to 2010, China's contribution tripled (from 0.3% to 1.4%). A similar pattern was found when

TABLE 1. Search strategy and selection criteria

Database: PubMed
Date search done: November 30, 2010
Years—2 time spans: November 30, 2005 to November 30, 2010; November 30, 2000 to November 29, 2005 Keywords: "Diet"[Mesh] OR "Diet, Sodium-Restricted"[Mesh] OR "Diet, Carbohydrate-Restricted"[Mesh] OR "Diet, Protein-Restricted"[Mesh] OR "Diet, Fat-Restricted"[Mesh] OR "Diet, Reducing"[Mesh] OR "Diet, Gluten-Free"[Mesh] OR "Diet Records"[Mesh] OR "Diet, Vegetarian"[Mesh] OR "Diet Therapy"[Mesh] OR "Diet Surveys"[Mesh] OR "Diet Fads"[Mesh] OR "Ketogenic Diet"[Mesh] OR "Diet, Mediterranean"[Mesh] OR "Diet, Macrobiotic"[Mesh] OR "Diet, Cariogenic"[Mesh] OR "Diet, Atherogenic"[Mesh] OR "Diabetic Diet"[Mesh] OR "Food Habits"[Mesh] OR "Food"[Mesh] OR "Legislation, Food"[Mesh] OR "Food Preferences"[Mesh] OR "Food Labeling"[Mesh] OR "Food-Processing Industry"[Mesh] OR "Food Technology"[Mesh] OR "Food Industry"[Mesh] OR "Health Food"[Mesh] OR "Food Packaging"[Mesh] OR "Food, Fortified"[Mesh] OR "Food Habits"[Mesh] OR "Food Analysis"[Mesh] OR "Functional Food"[Mesh] OR "Food and Beverages"[Mesh] OR "Dietary Supplements"[Mesh] OR "Fast Foods"[Mesh] OR "Nutrition Policy"[Mesh] OR "Diet Records"[Mesh] OR "Diet Fads"[Mesh] OR "Soy Foods"[Mesh] OR "Foods, Specialized"[Mesh] OR "Seafood"[Mesh] OR "Nutritional Sciences"[Mesh] OR "Child Nutrition Sciences"[Mesh] OR "Nutrition Assessment"[Mesh] OR "Nutrition Therapy"[Mesh] OR "Parenteral Nutrition, Home Total"[Mesh] OR "Nutrition Surveys"[Mesh] OR "Nutrition Processes"[Mesh] OR "Fetal Nutrition Disorders"[Mesh] OR "Nutrition Policy"[Mesh] OR "Child Nutrition Disorders"[Mesh] OR "Infant Nutrition Disorders"[Mesh] OR "Nutrition Disorders"[Mesh] OR "Enteral Nutrition"[Mesh] OR "Nutritional Physiological Phenomena"[Mesh] OR "Prenatal Nutritional Physiological Phenomena"[Mesh] OR "Nutritive Value"[Mesh] OR "Nutritional Requirements"[Mesh] OR "Maternal Nutritional Physiological Phenomena"[Mesh] OR "Adolescent Nutritional Physiological Phenomena"[Mesh] OR "Infant Nutritional Physiological Phenomena"[Mesh] OR "Child Nutritional Physiological Phenomena"[Mesh] OR "Nutritional Status"[Mesh] OR "Food Labeling"[Mesh]
Extra Notes: Combinations with different countries (the country specified in the corresponding author's address was used) and journals (the top 10 selected based on the impact factor 2009) were used.