Special Article

Publication trends on adult under-nutrition versus over-nutrition in India between 1961–2016: a bibliometric analysis

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OPEN ACCESS

Received: Dec 11, 2019

Accepted: Mar 14, 2020

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ABSTRACT

Background: Despite the nearly 10-fold greater prevalence of underweight versus obesity in India, there is a strong focus on obesity and overweight in policy and media coverage in India. Our objective was to examine the ratio of research articles published on underweight vs overweight in India.

Methods: We conducted a bibliographic analysis of peer-reviewed PubMed listed publications on adult underweight (BMI<18.5 kg/m²) /severe chronic energy deficiency (SCED – BMI<16.0 kg/m²) and adult overweight (BMI 25-29.9 kg/m²)/obesity(BMI>30 kg/m²) between the years 1961-2010. Articles were categorized by two reviewers into one of three categories: 1) focused on underweight/SCED, 2) overweight/obesity or 3) both underweight/SCED and overweight/obesity. We quantified the number of articles in 5-year publication intervals and calculated the ratio between article types in each 5-year intervals.

Results: Our search strategy yielded 4099 articles eligible for review, from these a total of 1124 articles were on overweight/obesity, 247 articles on underweight/SCED and 161 articles on both underweight/SCED and overweight/obesity. The inter-coder Cohen Kappa for categorization of articles was 0.92 (standard error, 0.03; 95% confidence interval, 0.86–0.97). From 1996 onwards, there was an increased ratio of overweight/obesity related articles compared to articles on underweight/SCED from 2.7:1 between the years 1996–2000 which rose to a ratio 5:1 after 2010.

Conclusion: There is an increasing and disproportionate focus of scientific research on overweight/obesity versus under-nutrition over the past 40 years in India. While obesity requires attention, undernutrition and low body weight continue to be India's most pressing public health and are relatively under-studied in the research literature.

Keywords: India; Malnutrition; Obesity; Undernutrition

Funding

Dr. Razak is supported by an award from the Mak Pak Chiu and Mak-Soo Lai Hing Chair in General Internal Medicine, University of Toronto.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Author Contributions

Conceptualization: Subramanian S, Fink G, Razak F; Data curation: Rohailla S, Lentz E, Pablo L; Formal analysis: Rohailla S, Razak F; Supervision: Razak F; Writing - original draft: Rohailla S, Razak F; Writing - review & editing: Rohailla S, Pablo L, Subramanian S, Fink G, Razak F.

INTRODUCTION

Adult malnutrition, encompassing both underweight and obesity, is a significant contributor to negative health outcomes in India. However underweight (body mass index [BMI] < 18.5 kg/m²) and severe chronic energy deficiency (SCED) (BMI < 16.0 kg/m²),¹ are more prevalent than obesity (BMI > 30 kg/m²) and confer a greater risk of mortality compared to overweight (BMI 25-29.9 kg/m²) and obesity.²⁻⁴ Recent worldwide estimates demonstrate that SCED is not declining in most Low and Middle Income Countries (LMICs), and India continues to have the highest prevalence and greatest number of individuals with both underweight and SCED in the world.³ Nationally representative data from the National Family Health Survey-3 in India estimates an adult obesity prevalence of nearly 3.5% versus underweight prevalence of 32.8%.⁵ Despite the nearly 10-fold greater prevalence of adult underweight versus obesity in India, there is a strong focus on obesity and overweight in policy and media coverage in India.^{6,7} The interplay between scientific research and policy priorities and media coverage, is integral to addressing the primary burden of adult undernutrition still faced in India and many LMICs. In this study, we empirically examined the relative focus of the scientific literature on the topic of adult under versus over nutrition in India to assess whether the volume of studies published match the relative burden of under versus over nutrition.

METHODS

To examine the publication trends on adult under and over nutrition, we reviewed articles published between 1961–2016 using the PubMed™ database. Our search strategy used Medical Subject Headings (MeSH) terms related to: the populations of interest (e.g. India) AND nutrition status (e.g. obesity), AND the evaluation parameter (e.g. BMI). A complete list of MeSH terms used is included in **Appendix 1**. The search was limited to articles in English. Articles were included if they focused on underweight/SCED, obesity, nutrition or weight status using BMI or other measures to quantify weight in adults living in India over the age of 18 (see **Fig. 1** for search strategy summary).

Our objective was to identify articles that were focused on adults with chronic over or undernutrition. Excluded articles were those on non-Indian populations or on Indian populations living outside of India, individuals under 18 years of age or on those with normal BMI (18.5–24.9 kg/m²). Articles were also excluded if changes in weight were associated with an underlying medical condition (e.g. Cancer related weight loss or Cushing's disease related weight gain), or if the article's focus was on how maternal weight impacted child health outcomes without considering maternal outcomes.

Articles without abstracts or access to full text through the University of Toronto Library were also excluded (n = 18). Relevant articles were coded as focusing on 1) underweight/SCED in adults, 2) overweight/obesity in adults or 3) both underweight/SCED and overweight/obesity in adults. Articles were read and coded by two independent reviewers (E.L., L.P.). Inter-coder agreement was determined with the Cohen Kappa statistic using a sample of 797 articles. For this classification, a Kappa value of greater than 0.8 was considered acceptable and reviewers completed repeated samples of articles until this was achieved. Kappa statistics were reported as the Cohen Kappa value with standard error (SE) and 95% confidence intervals (CI). Coded articles were then organized into 5-year intervals and a ratio of articles

Fig. 1. Search strategy using MeSH terms.

SCED = severe chronic energy deficiency; BMI = body mass index.

^aOther exclusion criteria consisted primarily of: studies not on underweight/ SCED or overweight/obesity, studies examining disease-related weight changes (e.g. weight loss in terminal illness, malignancy, Cushing's disease-related weight gain), or studies that do not list weight or BMI.

focused on overweight/obese versus underweight/SCED was calculated for each interval. Comparisons within intervals were made using binomial testing (2-sided $P < 0.05$) to detect a significant difference in the ratio of articles in each category. Clopper-Pearson intervals were used to calculate CIs for binomial proportions.

RESULTS

Our search strategy yielded 21,839 articles, with 4,099 (18.7%) eligible for review after applying age filters (age 18+). From these, 1,532 articles (37.0%) met study criteria (Fig. 1).

Coding of the relevant articles between 1961–2016 yielded a total of 1124 articles on overweight/obesity, 247 articles on underweight/SCED and 161 articles on underweight/SCED and overweight/obesity. The inter-coder agreement for relevant articles was 0.92 (SE, 0.03; 95% CI 0.86–0.97).

Prior to 1996, the number of publications on overweight/obesity and underweight/SCED ranged from 9–40 every 5 years with a ratio between 0.7–2 (overweight/obesity vs. underweight/SCED articles). From 1996 onwards, there was an increased ratio of overweight/obesity related articles compared to articles on underweight/SCED from 2.7:1 between the years 1996–2000 which rose to a ratio 5:1 after 2010 (Table 1 and Fig. 2).

Table 1. Articles published on SCED/underweight compared to obesity/overweight on people living in India over age 18

Time period	Underweight/SCED	Overweight/obesity	Total	Obesity:Underweight articles	P-value
< 1970	9	18	27	2.00	0.122
1971–1975	18	13	31	0.72	0.473
1976–1980	21	23	44	1.10	0.880
1981–1985	30	24	54	0.80	0.497
1986–1990	14	14	28	1.00	1.000
1991–1995	25	40	65	1.60	0.082
1996–2000	28	75	103	2.68	< 0.001*
2001–2005	56	132	188	2.36	< 0.001*
2006–2010	90	337	427	3.74	< 0.001*
> 2010	117	609	726	5.21	< 0.001*

SCED = severe chronic energy deficiency.

*Binomial testing resulting in a *P*-value < 0.05 was considered statistically significant.

Fig. 2. Articles published on underweight/SCED compared to overweight/obese on people living in India over age 18. SCED = severe chronic energy deficiency.

^aBinomial testing resulting in a *P*-value < 0.05 was considered statistically significant.

DISCUSSION

The results of our study demonstrate an increasing and disproportionate focus of scientific research on overweight/obesity versus under-nutrition over the past 40 years in India, with significant differences emerging starting in 1996 and growing progressively since then. This has occurred despite the fact that a recent estimate of the prevalence of adult underweight is nearly 10 times greater than the prevalence of overweight/obesity in India.⁵ Chronic adult undernutrition is a significant public health concern in India and is associated with increased mortality, chronic disease and morbidity, reduced societal involvement, decreased birth weight and child growth restriction.^{1,2,8,9}

There may be several explanations for the growing attention on overnutrition in India. The dominant research paradigm of the “epidemiologic transition” suggests that similar to transitions that may have occurred in higher income countries,^{10,11} India is experiencing a shift of obesity to the lowest socioeconomic status (SES) groups,¹² and this paradigm may

influence research focus. However, our prior research suggests that the co-existence of underweight/SCED and overweight/obesity, or the so called 'double burden of malnutrition' does not characterize the low SES environments in India and the nutritional disparity between SES strata will likely continue as the country's economic growth is unevenly distributed in a way that maintains social segregation among weight classes.^{5,13,14}

The discordant research focus on obesity versus underweight is further affected by factors at both institutional and individual levels. Geographically, the paucity of research institutions within regions most affected by the burden of undernutrition, a condition concentrated among the rural, poor and under-educated may limit focus on these conditions.^{3,15} The majority of studies done in India are in collaboration with partners in the United States and United Kingdom, countries where there is an appropriate focus on non-communicable diseases (NCDs), and this may bias research away from India's public health needs. Research funding agencies need to assess a specific population's health burden and needs when allocating resources. At an individual level, there is a known association between being underweight, low education, decreased work capacity and low social status.^{1,3} Such individuals are less able to participate in government, academic institutions or advocacy work and the needs of these individuals may consequently receive less focus. Finally, treatment of NCD often takes a pharmacologic lens and much of the literature on NCDs is dominated by research on the use of medication. In contrast, among underweight individuals addressing issues such as food security, poverty and education may be the most important interventions, and this may result in a lack of research focus on groups where medication or clinical intervention are lower priorities.

In conclusion, the last 60 years has seen a dramatic rise in research in India tackling the health concerns of over-nutrition and its associated complications. While these are important entities needing attention, undernutrition and low body weight continue to be India's most pressing public health issue, requiring research on targeted interventions and the attention of the scientific community.

ACKNOWLEDGMENTS

We thank David Lightfoot (Librarian, St Michael's Hospital University of Toronto) for guidance on search strategy.

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Appendix 1. PubMed™ search strategy

Population	India or andaman OR arunachal OR assam OR Bengal OR bihar OR chandigarh OR dadras OR daman OR delhi OR diu goa OR gujarat OR haryana OR havel OR himachal OR jammu OR jharkhand OR karnataka OR kerala OR kashmir OR lakshadweep OR maharashtra OR manipuri OR megalaya OR mizoram OR nagaland OR nagar OR nicobar OR odisha OR andhra pradesh OR madhya puducherry OR punjab OR rajasthan OR sikkim OR tamil nadu OR tripura OR uttarakhand OR "Indian subcontinent" OR (south asia* and indo OR india) NOT (Asian Americans OR American Native Continental Ancestry Group OR Indians, Central American OR Indians, North American OR Indians, South American OR Inuits OR "emigration and immigration")
AND	
Chronic Energy Deficiency	CED OR "Chronic energy deficiency" OR "deficiency diseases" OR "starvation" OR "famine" OR "Food insecurity" OR "malnutrition" OR "maternal nutritional physiological phenomena" OR "protein-energy malnutrition" OR "thinness" OR Undernourishment OR under nourishment OR under-nourished OR undernourished OR "maternal under-nutrition" OR "maternal weight" OR Underweight
OR	
Overweight/Obese	"body weight" OR (waist AND ratio) OR "waist-hip ratio" OR "abdominal obesity" OR "obesity" OR "adiposity" OR "adiposity" OR "adipose tissue" OR "abdominal obesity metabolic syndrome" OR "metabolic syndrome x" OR "nutritional status" OR "overweight" OR "overnutrition"
OR	
Evaluation	body weights and measures OR "body fat distribution" OR "body mass index" OR BMI
WITH FILTERS:	
Adult: 19+ years; Young Adult: 19–24 years; Adult: 19–44 years; Middle Aged + Aged: 45+ years; Middle Aged: 45–64 years; Aged: 65+ years; 80 and over: 80+ years	