

A bibliometric analysis of childhood obesity research from China indexed in Web of Science

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Background: Childhood obesity (CHO) is a serious global health threat, whose prevalence in China has gradually increased in the past two decades. The study aimed to quantify and map the scientific output of research concerning CHO published from China through a bibliometric perspective.

Methods: CHO-related publications were retrieved from the Web of Science database using the appropriate search strategy. Biblioshiny software was used to categorise and evaluate authors', institutions' and journals' contribution. VOSviewer was used for network-visualisation.

Results: A total of 1,157 CHO-related documents were identified from China [1900–2020], which was 4.4% of the global output of CHO research. The majority (75.7%) of the papers were research articles, and the average citation per document was 21. The results show a gradual increase in publication trends over the last 25 years. The leading institutions in CHO research were the Chinese University of Hong Kong (n=181) and Peking University [123], while “endocrinology metabolism” [247] was the most decisive research field. The most contributing authors included Ma J [49], Mi J [45], and Wang HJ [38], while “*PLoS One*” [41] was the most-crucial journal. The most cited article was from Ng Marie *et al.* published in 2014.

Conclusions: This analysis provides a historical perspective of progress in CHO research from China and has highlighted the leading role played by various stakeholders in addressing CHO. Besides, it highlights a need for more focus on CHO research as well as targeted interventions for effective prevention and control.

Keywords: Bibliometric analysis; childhood obesity (CHO); scientific output; Web of Science

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Introduction

Childhood obesity (CHO) has become a serious global health challenge, with an alarming increase in its prevalence all over the world (1). The condition affects both developed and developing countries. According to the World Health Organisation, over 41 million children under the age of

five were estimated to be overweight or obese worldwide in 2016. Besides, approximately half of these obese children lived in Asia, whereas one quarter lived in Africa (2). In the last decades, the prevalence of CHO in China has gradually increased, now almost equal to that in developed countries (1,3). Between 2000 and 2011, the prevalence of CHO in China nearly tripled from 6.5% to 16.8% (4).

The notable causes of CHO include unhealthy eating habits, lack of physical activities, family history, among others (5-7). If unchecked, CHO predisposes children to several chronic health conditions such as diabetes, high cholesterol, hypertension, heart disease, diabetes, asthma, joint pain, among others (8,9). Besides, CHO affects children's self-esteem due to poor self-image and depression (10). Without intervention, obese children will likely continue to be overweight during adolescence and adulthood, which is linked to a high risk of life-limiting comorbidities (6).

Research shows that approximately 260 million people in China are overweight or obese, and 50% of them are reported in China's major cities (11,12). In a recent study conducted by Musa *et al.*, a significant change in overweight and obesity rate among children and adolescents in Jiangsu Province, China was reported. However, the rate remains higher among males compared with females, and overweight and obesity rate was highest in urban children compared with rural where substantial change has been reported in early childhood, middle childhood, and adolescence (12). Although China has undergone rapid socio-economic and infrastructure development, several serious problems impeding child growth and development are still reported (13,14).

In response to the increasing burden of CHO in China, several studies have been done to address this public health challenge. This raises the need to collectively quantify and evaluate CHO research and give a historical perspective, owing to the considerable efforts and resources that have been injected into the control, treatment, and prevention of CHO.

This study, thus, aimed to map research efforts related to the CHO published from China through a bibliometric perspective using documents indexed in the Web of Science database. The study would help fill vital gaps and provide beneficial insight and information to public health authorities and researchers into the control, treatment, and prevention of CHO.

Methods

Study design

This study used a bibliometric analysis, a technic that has been progressively used as a tool and basis for monitoring research performance of various scientific disciplines, as well as supporting appropriate policy actions (15-17).

Data source

The study used the Web of Science Core Collection (WoS), which is a multi-disciplinary scientific citation indexing database and maintained by Thomson Reuters (New York, NY, USA) (18). The database covers the most important international journals. Ethical approval for this study was not necessary because the data used were obtained from a public database and involved no interaction with human or animal subjects.

Search strategy

The study used the following search query: TI = [(child* OR adolescent*) AND (obes* OR overweight)] to retrieve relevant documents from WoS published within 1900–2020 (31st October). To maximise the accuracy of the retrieved research output, the keyword was searched in the article titles and was limited to only articles from China (Mainland), Hong Kong, and Taiwan. In order to include all published documents, the advanced search method was used, and no language restriction was set.

Statistical and bibliometric analysis

The identified relevant documents were downloaded in a plain text format for further analysis. The study mainly reported descriptive statistics. The research trends and selected bibliometric indicators were classified and analysed using “Bibliometrix app.”—(using R-studio cloud) (19). These included the distribution and frequency of document types, keywords, most productive territories, institutions, authors, research fields, journals, and the journal impact factor and total citations (TCs). In this regard, the journal impact factors were obtained from the InCites *Journal Citation Reports (JCR)*[®] Ranking: 2019 (20). In addition, Microsoft excel and VOSviewer (Van Eck & Waltman, Leiden University, The Netherlands) were used for data mining, mapping, and visualisation of the network analyses (21).

Results

Document types and trends of publication

The initial search identified a total of 26,454 documents from all countries, and after refining the search to China (Mainland), Hong Kong and Taiwan, they reduced to 1,157 (4.4%). For comparison, USA had 9,013 (34.1%) CHO

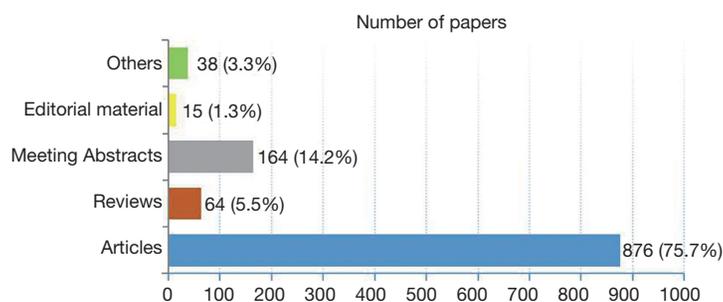


Figure 1 Types and number of CHO documents from China [1900–2020]. CHO, childhood obesity.

documents, followed by UK 6,107 (23.1%) and Germany 1,345 (5.1%).

The 1,157 documents were considered for analysis, of which only four articles were in the Chinese language, and the rest in the English language. Of the total papers, 44 (3.7%) were single-authored documents, while 876 (75.7%) were research articles, 64 (5.5%) reviews, and 164 (14.2%) meeting abstracts, 15 (1.3%) editorial material, and the rest were of other document types (*Figure 1*).

Globally, CHO research gradually increased from 74 to over 1,700 documents over a period of 25 years [1995–2020]. CHO research output from China also had a generally slight increase over the last 25 years (*Figure 2A*). In the first 13 years [1995–2007], China's output was little, with less than 20 documents per year. However, the publications gradually increased in 2008, attaining a maximum peak of 130 publications in 2019. The analysis showed that 970 (83.8%) of the publications were published in the last 10 years [2010–2020]. The mean citation per year also followed an almost similar trend, where it attained a peak of 12.8 citations per year in 2014. The average citation per document of the analysed documents was 21 (*Figure 2B*).

Most productive institutions

The studies were produced by over 1,000 institutions, of which 12 produced more than 50 articles. The most influential institutions were the Chinese University of Hong Kong (n=181), Peking University [123], Shanghai Jiao Tong University [112], Zhejiang University [109], among others (*Figure 3*).

Most influential Funding agencies and Research fields

Over 500 institutions were identified as funding agencies of CHO research in China, of which over 10 financed at least

14 studies. These included the National Natural Science Foundation of China [236], United States Department of Health Human Services [88], National Institutes of Health NIH USA [87], among others (*Table 1*). Coca-Cola Company was also noted to finance 11 CHO studies.

The analysed articles belonged to 50 research fields categorised according to the WoS fields, and of these, ten fields had at least 48 articles. The most crucial research field included “endocrinology metabolism” [247], “pediatrics” [207], “public environmental occupational health” [181], and “nutrition dietetics” [174], among others, as shown in *Table 1*.

Most contributing authors

The analysed publications were produced by 5,461 authors, of which 37 were authors of single-authored documents. Ten authors had at least 28 CHO documents and included; Ma J [49], Mi J [45], Wang HJ [38], among others (*Table 2*).

Most productive journals

The retrieved CHO articles were published in 369 journals, of which 11 of them published 17 or more papers. It was noted that foreign journals dominated the list, especially UK journals. The most ten productive journals included; “PLoS One” [41], “*International Journal of Obesity*” [37], “*Obesity Reviews*” [30], among others. The impact factor of the 11 top productive journals ranged from 2.01 to 8.19 (*Table 3*).

Collaborations and network analysis

The analysis showed that China collaborated with 122 countries within CHO research. The strongest partnership was with the USA, with which it produced 279 studies,

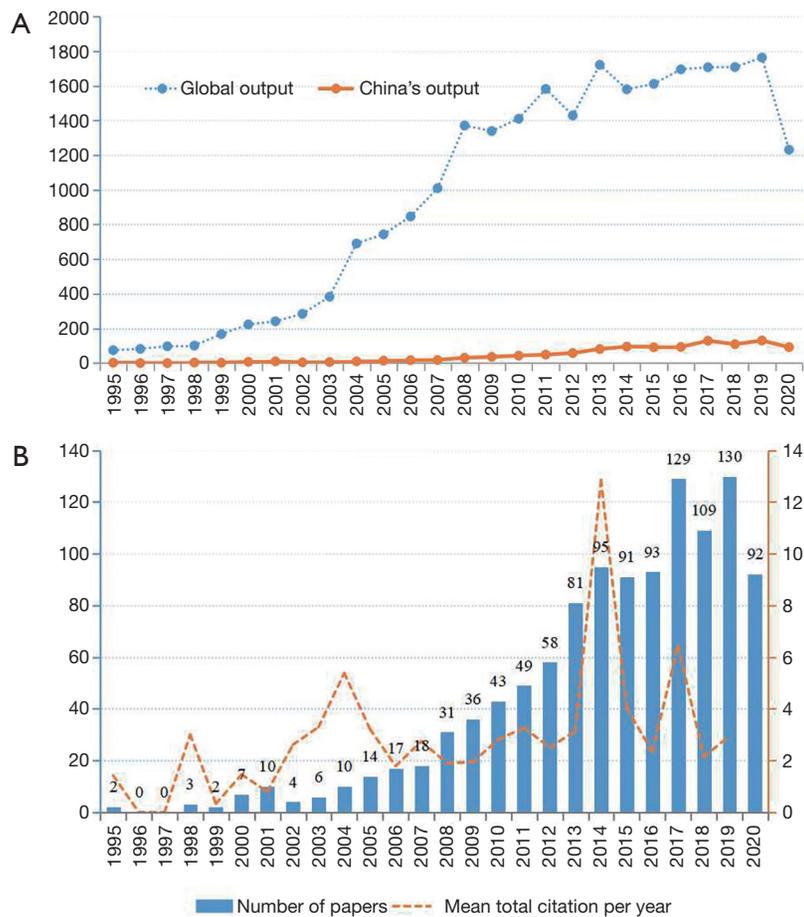


Figure 2 Trends of CHO research output: (A) China's output compared to the global output [1995–2020]; (B) number of CHO papers from China and mean TC per year. CHO, childhood obesity; TC, total citation.

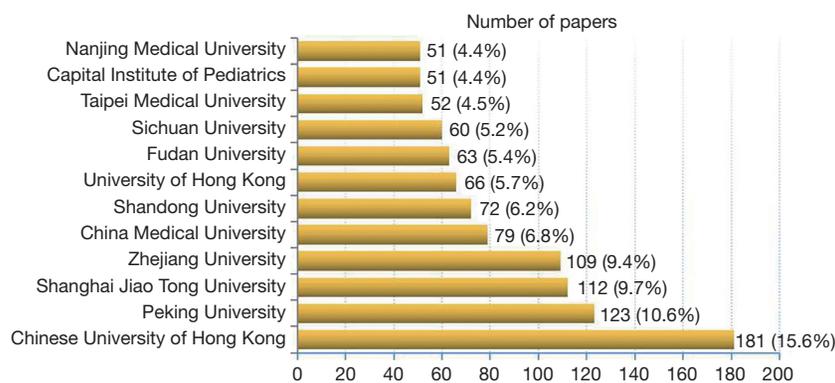


Figure 3 Institutions that produced more than 50 articles of CHO. CHO, childhood obesity.

followed by Australia [83], UK [52], among others. China also collaborated with some African countries, including South Africa and Kenya, producing 16 and 15 studies with

each, respectively (Figure 4A).

Analysis of institutional collaboration revealed that Peking University was the most collaborative institution

Table 1 The 10 top funding agencies of CHO research and the most crucial research fields in CHO

Rank	Funding agencies		Research fields	
	Agency	Number of papers (%) (n=1,157)	Research area	Number of papers (%) (n=1,157)
1	National Natural Science Foundation of China	236 (20.4)	Endocrinology metabolism	247 (21.3)
2	United States Department of Health Human Services	88 (7.6)	Pediatrics	207 (17.9)
3	National Institutes of Health NIH-USA	87 (7.5)	Public environmental occupational health	181 (15.6)
4	National Basic Research Program of China	32 (2.8)	Nutrition dietetics	174 (15.0)
5	NIH Eunice Kennedy Shriver National Institute of Child Health Human Development	31 (2.7)	Cardiovascular system cardiology	75 (6.5)
6	Ministry of Science and Technology Taiwan	28 (2.4)	Science technology other topics	68 (5.9)
7	NIH National Institute of Diabetes Digestive Kidney Diseases NIDDK	21 (1.8)	General internal medicine	59 (5.1)
8	National Key Technology R D Program	18 (1.6)	Sport sciences	52 (4.5)
9	National Key Research and Development Program of China	15 (1.3)	Environmental sciences ecology	50 (4.3)
10	Ministry of Science and Technology China	14 (1.2)	Research experimental medicine	48 (4.2)

CHO, childhood obesity.

Table 2 Top 10 Authors of CHO publications

Rank	Author	Number of papers (%) (n=1,157)	TCs
1	Ma J	49 (4.2)	2,114
2	Mi J	45 (3.9)	2,283
3	Wang HJ	38 (3.2)	656
4	Zhang J	33 (2.9)	392
5	Zhao XY	32 (2.8)	539
6	Wang YF	31 (2.7)	431
7	Zhang YX	30 (2.6)	250
8	Fu JF	29 (2.5)	501
9	Wang Y	28 (2.4)	497
10	Cheng H	28 (2.4)	569

CHO, childhood obesity; TC, total citation.

with 20 links (L) and 48 link strength (LS). This was followed by the Chinese University of Hong Kong (L =19, LS =52) and the University of Hong Kong (L =17, LS =36),

among others. A minimum of 20 documents per institution was set, and 26 institutions met the threshold, as visualised in *Figure 4B*.

The analysed papers were produced in collaboration among various authors, with a Collaboration index of 4.87. The most collaborative authors of CHO research included; Mi Jie (L =11, LS =129), Cheng Hong (L =9, LS =104), Zhao Xiaoyuan (L =8, LS =114), amongst others. A minimum of 10 documents per author was set, and 44 met the threshold, as visualised in *Figure 4C*.

Most cited documents on CHO

Among the analysed publications, 24 articles were cited more than 100 times. The most cited document was a research article written by Ng Marie *et al.* It was published in “*Lancet*” in 2014, under the title “*Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013*”, with 5,592 TCs. This was followed by Ezzati M *et al.*'s article with 1,165 TC and other documents,

Table 3 Journals that published 17 or more CHO articles

Rank	Journal	Country location	Number of papers (%), n=1,157	Impact factor [2019]
1	<i>PLoS One</i>	United States	41 (3.5)	2.87
2	<i>International Journal of Obesity</i>	United Kingdom	37 (3.2)	4.36
3	<i>Obesity Reviews</i>	United Kingdom	30 (2.6)	8.19
4	<i>BMC Public Health</i>	United Kingdom	28 (2.4)	2.69
5	<i>Biomedical and Environmental Sciences</i>	China	23 (2.0)	2.01
6	<i>Medicine and Science in Sports and Exercise</i>	United States	23 (2.0)	4.32
7	<i>Scientific Reports</i>	United Kingdom	23 (2.0)	4.12
8	<i>Annals of Nutrition and Metabolism</i>	Switzerland	18 (1.6)	2.85
9	<i>Pediatric Obesity</i>	United Kingdom	18 (1.6)	3.54
10	<i>International Journal of Environmental Research and Public Health</i>	Switzerland	17 (1.5)	2.62
11	<i>Obesity</i>	United States	17 (1.5)	3.86

CHO, childhood obesity.

including several reviews (Table 4). The 10 top-cited papers altogether were cited 9,117 times in the last 25 years.

Analysis of keywords

Keyword distribution was analysed to detect directions and topics in CHO research and to understand discipline development. The retrieved documents had 1,536 author's keywords and 2011 keywords plus. The most common author's keywords in the retrieved documents included; "obesity" [413], "children" [180], "overweight" [154], "childhood obesity" [76], "body mass index" [73], amongst others, Figure 5A. The most frequent keywords plus included; "overweight", "body mass index", "adolescents", "prevalence", among others, as visualised in Figure 5B. The size and centrality of the word reflect its frequency and magnitude. Note that keywords plus are words that frequently appear in the titles of an article's references but do not appear in the title of the article itself, and are vital in exploring the knowledge structure of scientific fields.

Discussion

This bibliometric analysis provided an insight in the trend and scientific output of CHO-related publications from China. The study revealed that the documents were produced within the last 25 years, with over 80% being published in the last 10 years. This can be explained by

the rapid increase in CHO prevalence in China, which has almost tripled just within the last two decades (4). This has resulted in increased attention being given to address CHO, which is reflected in research output. However, when compared to the global production, CHO research from China is less (4.4%), implying more focus is still required in this field.

Of the analysed documents, over 70% were original research articles, followed by other documents. Notably, meeting abstracts constituted around 14% of the published CHO articles from China. The published original articles and meeting abstracts directly translate into the research and consensus efforts to address CHO within the region.

The analysis noted that the list of most productive journals was dominated by the USA and other foreign journals, in which English is the dominant language used. This can be because most of the Chinese journals are not indexed in international databases. This implies that the preventive recommendations of CHO made by these studies may not be fully accessed to the Chinese community, especially if not translated into the Chinese language. Therefore, there is a need to build and strengthen local journals and databases to improve on the regional as well as international recognition of CHO studies from China.

Research concerning CHO was mainly funded by Chinese public or government institutions of which the National Natural Science Foundation of China led the list. However, several USA and other foreign institutions

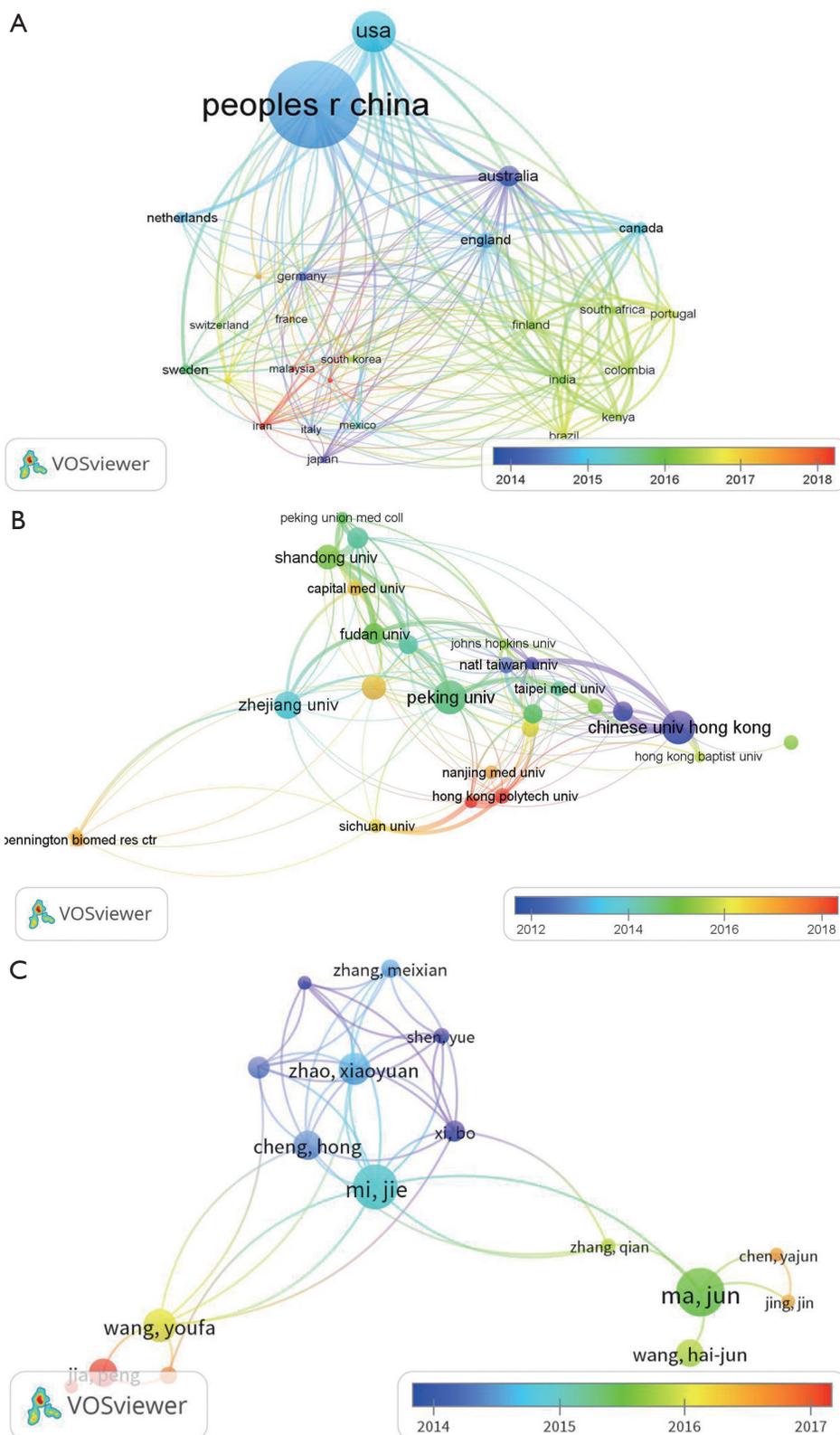


Figure 4 Overlay visualisation of network analyses: (A) countries collaborating with China in CHO research; (B) institution collaborations; (C) author collaborations. CHO, childhood obesity.

Table 4 The 10 most-cited articles of CHO from China

Rank	Title, journal	First author	Year of publication	Document type	TCs
1	Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013, <i>Lancet</i>	Ng Marie	2014	Article	5,592
2	Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults, <i>Lancet</i>	Ezzati M	2017	Article	1,465
3	Evidence that the prevalence of childhood overweight is plateauing: data from nine countries, <i>International Journal of Pediatric Obesity</i>	Olds T	2011	Review	372
4	Interventions for preventing obesity in children, <i>Cochrane Database of Systematic Reviews</i>	Waters E	2011	Review	311
5	Effects of diet and exercise on obesity-related vascular dysfunction in children, <i>Circulation</i>	Woo KS	2004	Article	304
6	The association between breastfeeding and childhood obesity: a meta-analysis, <i>BMC Public Health</i>	Yan J	2014	Article	237
7	Overweight in children is associated with arterial endothelial dysfunction and intima-media thickening, <i>International Journal of Obesity</i>	Woo KS	2004	Article	225
8	What childhood obesity prevention programmes work? A systematic review and meta-analysis, <i>Obesity Reviews</i>	Wang Y	2015	Review	217
9	Report on childhood obesity in China (1)--body mass index reference for screening overweight and obesity in Chinese school-age children, <i>Biomedical and Environmental Sciences</i>	Ji CY	2005	Article	208
10	Hepatic steatosis in obese Chinese children, <i>International Journal of Obesity</i>	Chan DFY	2004	Article	198

CHO, childhood obesity; TC, total citation.

had a significant role in financing CHO research in China, including the National Institutes of Health NIH USA, among others. This has also been noted in other research fields (15,22). Besides, Coca-Cola was the only food processing/beverage company noted to finance CHO research in China. It should be noted that the food processing industry plays a significant role in public nutrition and health, which is a vital predisposing factor to CHO and other health issues (23-25). Addressing CHO should be a joint responsibility; thus, the food processing industry and the private sector, in general, should increase their involvement in CHO research.

Network analysis showed that China exhibited a considerable degree of collaboration with several countries in carrying out CHO research. The most robust research collaboration was with the USA, followed by other

countries. This further demonstrates the importance of knowledge transfer and sharing in addressing public health issues (26).

The analysis showed that the leading institutions of CHO research are mainly Chinese Universities, where the Chinese University of Hong Kong led the list, followed by Peking University, among others. Besides, the most contributing authors of CHO research included both Chinese and authors of other nationalities. The most productive authors included Ma J and Mi J. Furthermore, network analysis revealed authors with the highest collaborations. This information could be helpful to future researchers in this field, to quickly identify the crucial researchers for potential partnerships or even consultation concerning CHO research.

The most highly cited article was from Ng Marie *et al.*

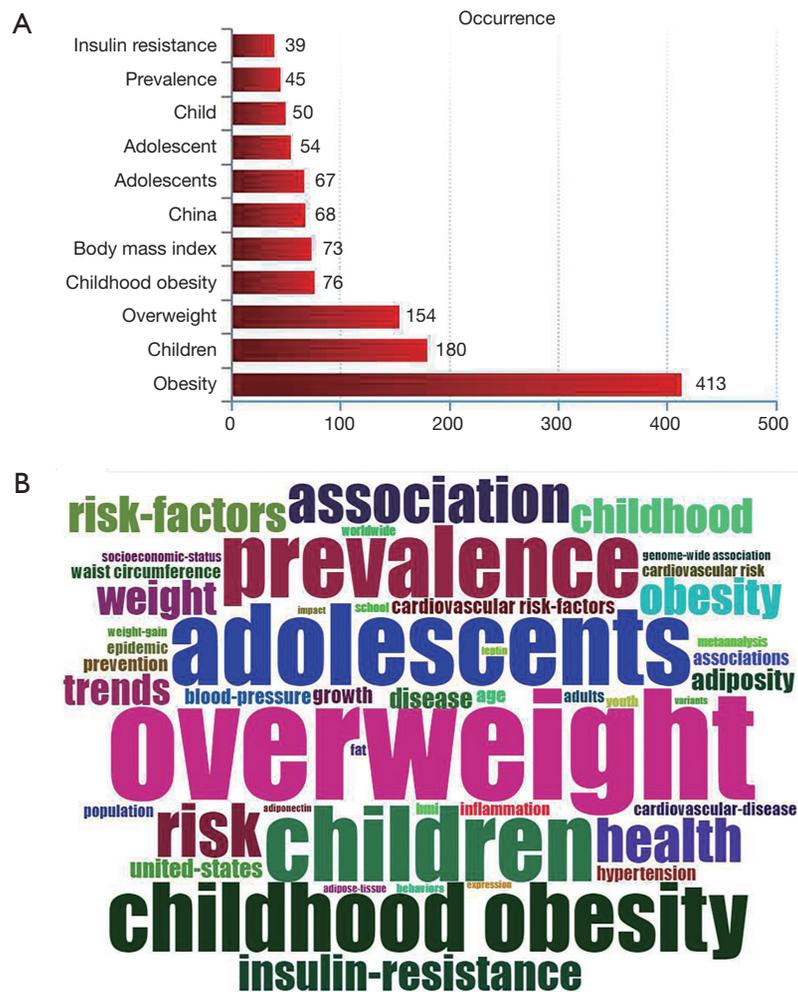


Figure 5 Analysis of keywords: (A) author keywords with at least 39 occurrences; (B) word cloud of keywords plus based on their frequency.

2014, which estimated the global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013 (27). The top citations could be because this article had a broader coverage; highlighting a significant increase in CHO's prevalence in several countries and regions, including China. As noted by previous studies, CHO obesity is still not considered a serious public health issue by some communities in China: which could be due to the cultural perception of chubby children as healthy and a display of family's wealth (4,11). This calls for culturally-sensitive health promotion programs to curb the incidence and prevalence of CHO in China (28). In addition, implementing and strengthening policies on the marketing of foods to children are needed (29,30) if the World Health Organization's target of "no increase in obesity prevalence by 2025" is to be achieved (2,31).

The most key research fields in CHO included "endocrinology metabolism", "pediatrics", "public environmental occupational health", "nutrition dietetics", "cardiovascular system" amongst others. These fields are a deeper reflection of the pathogenesis and aetiology of CHO (32,33). Besides, the analysis of keywords disclosed that the studies covered various crucial aspects of CHO, including prevalence, causes and risk factors, social-economic effects as well as prevention and treatment. Notably, body mass index (BMI) is also highlighted among the keywords with the most co-occurrence among the analysed articles. This is because BMI is the central index for the classification of overweight and obesity, so it cuts across most CHO studies (34,35).

Like any other bibliometric studies, this one also had some limitations, such as the use of a single database; not all Chinese journals are indexed in the WoS, thus a possibility

of missing out on some key publications (16,17). Besides, the citation numbers might be deceptive (22), owing to self-citations, time of publications, among other factors. Therefore, further studies are required using different databases to validate these findings.

Conclusions

The study tried to summary CHO research output from China, in which it highlighted a gradual increase in the last 25 years. The study has revealed the leading roles played by various authors, institutions, and journals in addressing CHO. The study also identified significant collaboration exhibited by China and other countries in CHO research, which is vital as it enables knowledge sharing and transfer. However, the study has noted an implementation gap of the research recommendations supported by CHO's increasing prevalence in China, especially in the last 10 years. Therefore, more efforts are needed in terms of focus and funding of CHO research, as well as strengthening local journals and indexing databases.

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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