The Evolution of Physical Activity and Health Research in China: A Bibliometric Analysis of Study Areas and Sex Balance in Authorship

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Background: This article evaluates the evolution of physical activity and health research in China through a bibliometric analysis focused on number of publications, study areas, and sex balance in authorship. Methods: A systematic review was conducted by the Global Observatory for Physical Activity for “physical activity and health” publications between 1950 and 2019. Here, we focus on the 610 Chinese publications identified, defined as those in which data collection took place in China. We assessed the number of publications, classified them into 5 areas (1) surveillance, (2) correlates and determinants, (3) health consequences, (4) interventions, and (5) policy, and analyzed female participation in authorship. Results: The first Chinese publication identified in the review was in 1990. Since, the average number of physical activity and health publications increased from one per year in the 1990s to 7.6 per year in the 2000s, and to 47 per year in the 2010s. Most publications focused on the correlates and determinants (38.7%) and the health consequences of physical activity (35.9%). Physical activity policy accounted for 2.3% of the publications. In the 1990s, 64% of the publications included at least one female author; this proportion increased to 90% in the 2010s. Conclusion: Despite a slow start, China’s research on physical activity and health has grown rapidly since 2000. The distribution of publications by study areas and female participation in authorship is similar to that observed globally, with fewer publications focused on interventions and policy as compared with other topics.

Keywords: public health, exercise, review

Physical inactivity is one of the leading risk factors for noncommunicable diseases (NCDs) worldwide—inactivity has been shown to be responsible for 5.3 million deaths per year globally.1 The fact that physical activity became a public health priority over the past few decades is strongly connected to 3 societal transitions that are taking place: the demographic transition, the nutritional transition, and the epidemiological transition. The proportion of the world’s population 60+ years of age is estimated to increase by 22% in the next 50 years, while the number of people 80+ years of age will reach 426 million.2 Population aging relates to an increased burden of NCDs—which are also closely related to overweight and obesity and brain health. Physical activity has been shown to decrease with age3 and to be a protective factor for both NCDs4 and impaired cognition.5

China is one of the most populous countries in the world; and therefore, its large and growing aging population will continue to face a high burden of NCDs. More than 60% of the Chinese population live in urban areas where life expectancy at birth is almost 80 years, and over 80% of all deaths in China are due to NCDs.3,5 In 2012, the Global Observatory for Physical Activity (GoPA!) was launched to keep track of country-level surveillance, research, and policy related to physical activity.6 China has been part of the GoPA! network since its inception. The 2020 China GoPA! country card showed that 86% of the Chinese adult population reached the 150-minute-per-week threshold for physical activity,7 a result that is particularly explained by the high levels of transport-related physical activity observed among the Chinese population.8 China has a physical activity plan, national guidelines on physical activity, and a surveillance system regularly collecting population information about physical activity.8

In 2021, GoPA! published a systematic review of the trends and patterns in global physical activity research since 1950.9 Despite having 17.7% of the world’s population, China was responsible for 2.6% of the articles on physical activity and health identified in the GoPA! systematic review.9 To the best of our knowledge, no studies have analyzed the evolution of physical activity and health research in China. Data are also lacking in the distribution of publications across the main areas in the field of physical activity and health and on sex equity in authorship in the field. This paper explores the progress in physical activity and health research in China through a bibliometric analysis focused on number of publications, study areas, and sex balance in authorship.

Methods

The original literature review comprised the period between 1950 and 2019. Details about the methodology used are available in the GoPA! global article published by Ramírez Varela et al.9 In short,
authors searched for studies on physical activity and health using a combination of keywords in PubMed, SCOPUS, and ISI Web of Knowledge. All titles and abstracts were screened by a pair of authors using predefined inclusion and exclusion criteria. More than 500,000 articles were analyzed, of which more than 23,000 were eligible. We first calculated the absolute number of Chinese articles published each year since the first publication in 1990. A paper was classified as Chinese based on data collection. Therefore, (1) articles for which data collection took place exclusively in China and (2) multicountry articles in which one of the countries included was China, were included in the present analysis.

For most analyses, we grouped years by decade (1990–1999; 2000–2009; and 2010–2019). We also present the average number of articles published by decade. Each publication was also categorized according to the main area of physical activity and health research, into one of the following categories:

**Surveillance**
Descriptive studies on physical activity levels, studies on time trends of physical activity, and studies on physical activity measurement.

**Correlates and Determinants**
Studies on the factors associated with physical activity practice, including individual, interpersonal, environmental, regional or national policy, and global variables.

**Health Outcomes**
Studies on the consequences of physical activity for health. For example, articles on the effects of physical activity on the risk of coronary heart disease, all-cause mortality, cancers, mental health, and cognition.

**Interventions**
Studies on the efficacy or effectiveness of interventions aimed at increasing population levels of physical activity. For example, campaigns and informational approaches, behavioral and social approaches, policy, and environmental approaches.

**Policy**
Studies on physical activity policy, including development of physical activity guidelines, and evaluation of physical activity policy indicators.

We also examined all Chinese publications and collected information on the sex of the authors. In the analysis, we calculated the proportion of articles with at least one female coauthor, the proportion of articles with a female first author, and the proportion of articles with a female last author, using the authorship order in each article. The sex of author was determined by searching the author’s name using social media, university websites, and government websites, as fully described elsewhere.10

**Results**
Of the eligible articles, 610 were from China and were included in the present analysis. Interestingly, the first publication dates to 1990. During the first 10 years since the first identified publication, the number of articles was very small (average of one publication per year), with no more than 3 articles published in any given year. In the second decade (2000–2009), the average number of publications rose to 7.6 articles per year. In the most recent decade analyzed, the average number of publications was 47 per year, with a record of 109 Chinese publications on physical activity and health in 2019 (Figure 1).

In Figure 2, we present the distribution of Chinese physical activity publications according to the 5 main areas of physical activity and health research. Most publications focused on the correlates and determinants of physical activity (38.7%) and the health outcomes of physical activity (35.9%). Physical activity policy publications accounted for 2.3% of all Chinese-identified physical activity and health publications. Table 1 presents the number of articles published in each of the 5 main areas of physical activity and health research in China by decade. In the 1990’s, only 11 articles were identified, of which 7 were on the health consequences of physical activity. Although the absolute number of articles increased to 79 articles in the 2000s and to 520 in the 2010s, the proportion of articles on the health consequences of physical activity decreased from 63.6% in the 1990s to 35.2% in the 2010s. The proportion of articles on the correlates and determinants of physical activity more than doubled between the 1990s (18.2%) and the 2010s (39.8%). It was only in the 2000s that the first Chinese articles on physical activity interventions were published —the absolute number of intervention articles increased from 6 in the 2000s to 37 in the 2010s. Only one policy article was identified in each of the first 2 decades, but 12 articles on physical activity policy were identified between 2010 and 2019.

Table 2 shows female participation in physical activity and health authorship in China for the 3 decades. Overall, an increasing number of females involved in physical activity and health studies were identified. In the 1990s, 64% of the publications included at least one female author; this proportion increased to 87% in the 2000s. In the most recent decade analyzed (2010–2019), 9 out of every 10 Chinese articles on physical activity and health included female authors. On one hand, female participation as first authors varied by decade, but the overall proportion was consistently close to 50%. On the other hand, despite female participation as the last author doubled (from 18% in the 90s to 36% in the 2010s), figures are still below 50%.

**Discussion**
We observed very little progress in physical activity and health research in China, one of the 2 most populous countries in the planet, between 1950 and 2000. This finding is consistent with the mismatch between population size and availability of physical activity interventions described in the paper by Pratt et al.13 in the 2012 Lancet Physical Activity Series, and the update conducted by the Global Observatory for Physical Activity GoPA! in 2021. Low- and middle-income country research is clearly needed in the field of physical activity and health, as the characteristics of physical activity may differ from those observed in high-income countries. Since 2000, the number of publications on physical activity and health coming from China has increased markedly. If the recently observed upward trend in publications continues, China has the potential to become one of the global leaders in the field of physical activity and health. This is highly needed, as the country is home to more than 17% of the world’s population. A global analysis of the physical activity and health literature between 1950 and 20199 found that the number of publications related to physical activity...
and health globally has gradually increased over the past 60 years. In our study, we show that, in China, this increase was only observed since 2000. Despite the slow start, a sharp surge in the number of publications during the last 10 years (2010–2019) was observed in China.

The types of publications in the 5 major fields of physical activity and health research in China were consistent with those globally observed over the past 60 years. The global article by Ramirez et al. found that the proportions of papers in the fields of surveillance (32.5%) and health consequence (31.7%) were the highest, while the lowest proportions were on interventions (8.3%) and policy (3.9%). Similarly, Chinese publications also showed the highest proportion of health outcomes (36%) and the lowest in interventions (7%) and policy (2%). However, slight deviations from the global overall trend were observed in both the surveillance and the correlates and determinants fields. While globally, research on correlates and determinants of physical activity accounted for a moderate proportion (23.2%) of all publications, in China, the proportion of articles on surveillance of physical activity (16%) was lower than that of correlates and determinants (39%). Nonetheless, publications on correlates and determinants experienced an explosive growth rate during the last decade (2010–2019), with the number of articles increasing from 27 between 2000 and 2009 to 207 between 2010 and 2019.

The contribution of women to science through a gender equity lens has been a topic of debate in public health. Sugimoto et al. found that only 54% of research articles in public health reported the gender of the researchers. Additionally, reporting of gender in clinical medicine research and biomedical (laboratory) studies was below 50%. Hawkes et al. pointed out that studies in which women are the first or last authors are more likely to report gender, as they tend to consider gender as an important factor in their research and analysis. From 1990 (64%) to 2019 (90%), there has been significant progress in the involvement of female authors in physical activity and health research in China. The proportion of female first authors has been around 50%, which is great news. However, the participation of women as senior (last) authors was consistently lower than that of first or middle authors. This finding indicates that the senior position is still dominated by males, a trend that should be reverted in coming years, as female first authors are expected to start leading their own labs and getting more publications as last authors.

This study has limitations. The research only screened publications on physical activity and health in 3 international databases, which require an abstract in English. This restriction might have excluded articles published in Chinese-language journals that are not indexed in the 3 databases used. However, this limitation does not impede the analyses of the impact of Chinese publications in the international literature. Another issue is that this study involves the analysis of the quantity of publications, without evaluating the quality of the articles published or details about the samples included in the articles; for example, there might be sex biases in study participation, in addition to those observed in authorship. In the future, GoPA! plans to run in-depth analyses of the research conducted in different countries, including target groups, types of correlates and determinants analyzed, health outcomes, types of interventions, among other topics. Some strengths of this article include the comprehensive analysis of

Figure 1 — Number of Chinese publications on physical activity and health between 1990 and 2019.

Figure 2 — Distribution of Chinese physical activity and health publications according to the 5 main areas of physical activity research.
Table 1  Evolution of Chinese Physical Activity and Health Publications by Decade According to the 5 Main Areas of Physical Activity Research

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<tr>
<td>Surveillance</td>
<td>1 (9.1)</td>
<td>16 (20.3)</td>
<td>81 (15.6)</td>
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<tr>
<td>Correlates and determinants</td>
<td>2 (18.2)</td>
<td>27 (34.2)</td>
<td>207 (39.8)</td>
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<tr>
<td>Health consequences</td>
<td>7 (63.6)</td>
<td>29 (36.7)</td>
<td>183 (35.2)</td>
</tr>
<tr>
<td>Interventions</td>
<td>0 (0.0)</td>
<td>6 (7.6)</td>
<td>37 (7.1)</td>
</tr>
<tr>
<td>Policy</td>
<td>1 (9.1)</td>
<td>1 (1.3)</td>
<td>12 (2.3)</td>
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Table 2  Female Participation in Chinese Physical Activity and Health Authorship by Decade

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<td>At least one female author, %</td>
<td>64% (7/11)</td>
<td>87% (66/76)</td>
<td>90% (458/510)</td>
</tr>
<tr>
<td>Female first author, %</td>
<td>63% (5/8)</td>
<td>42% (32/76)</td>
<td>52% (253/491)</td>
</tr>
<tr>
<td>Female last author, %</td>
<td>18% (2/11)</td>
<td>33% (25/76)</td>
<td>36% (185/510)</td>
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academic progress in the field of physical activity and health in China over several decades (1950–2019). This method allowed comparisons with data from various countries in terms of publication volume and type. To the best of our knowledge, there has been no previous publication examining the contribution of Chinese publications to the worldwide literature on physical activity and health. Overall, over the past 3 decades (1990–2019), China has shown significant progress in the number of publications in the field of physical activity and health, particularly in the last decade (2010–2019). This is related to the progress China has achieved over the past 40 years (1978–2019), during which the number of people in poverty decreased from 770 million to 5.5 million, owing to substantial economic growth and the eradication of poverty. Economic growth has promoted improvements in quality of life and health care, leading to an increase in China’s life expectancy from 68 (1990) to 78 years (2019). However, with the expansion in life expectancy, a growth in the burden of NCDs has been observed. Promoting physical activity is one of the most effective strategies for preventing and controlling chronic diseases, while physical inactivity leads to a higher risk of developing chronic illnesses. As life expectancy has increased and the number of people with chronic diseases has grown, China’s primary health care system has faced a greater burden. Furthermore, over the past 4 decades, the education level of the Chinese population has made rapid progress, especially in the last 10 years. China continues to maintain its position as the world’s largest higher education system, with over 44.3 million individuals studying at higher education institutions and 240 million individuals having attained higher education. The increase in educational attainment and the burden of chronic diseases have also led more Chinese scholars to focus their attention on research related to physical activity and health.

China has allocated more financial resources and attention to public health research in recent years, compared with previous periods. This includes initiatives promoting physical activity for health, such as the formulation of policies, financial allocations, and infrastructure development. For example, China launched the Outline of the Healthy China 2030 Plan in 2016, emphasizing public health and disease prevention and control in the health care sector. Particularly, the goal was to shift the focus from treating existing diseases to preventing the onset of diseases. The plan also advocates for the development of mass fitness and leisure activities, encouraging the promotion of popular sports activities among the public. It also supports the development of exercise prescriptions. Moreover, as outlined in the Implementing the National Fitness Program (2016–2020) released in 2016, the target by 2020 is to have 700 million individuals participating in physical activity at least once a week and 435 million individuals engaging in physical activity regularly, with a per capita sports or exercise area exceeding 1.8 square meters. In 2021, the physical activity guidelines for Chinese were published. In addition to general guidelines, the document provides specific recommendations for children aged 2 years and younger, children aged 3–5 years, children and adolescents (ages 6–17 y), adults (18–64 y), older adults (65 y or older), and individuals with chronic diseases.

From the previously mentioned factors, it is clear that the rapid development of physical activity and health publications in China cannot be separated from the progress that China has made in the last decade. Based on the trends reported here, it is foreseeable that China may soon take a leading position in terms of the quantity of publications in the field of physical activity and health worldwide. There is a clear need to increase the share of research focused on physical activity interventions and policy, as most publications, similarly to what is observed worldwide, are still focused on surveillance, correlates and determinants, and health-consequences of physical activity.

References