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Research article

Trends and age-period-cohort effect on the incidence of falls from 1990 to 2019 in BRICS

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ABSTRACT

Background: The increasing burden of falls in BRICS countries warrants a comprehensive investigation to understand the dynamics and trends. This study utilized data from the Global Burden of Disease Study (GBD) 2019 to assess fall incidence rates in Brazil, Russia, India, China, and South Africa (BRICS) to provide valuable insights for the development of targeted prevention and management strategies.

Methods: Data from the GBD 2019 were employed to estimate fall incidence rates. The study utilized age-period-cohort (APC) model analysis, implemented using R 4.3.0 software and the R package apc, to examine fall incidence trends from 1990 to 2019.

Results: In 2019, the BRICS nations collectively reported 32.32 million fall cases. The overall fall incidence rate increased from 2681.7 per 100,000 people in 1990–2896.3 per 100,000 people in 2019. China and India exhibited escalating trends, with China experiencing the highest growth rate at 21%, followed by India at 5.8%. South Africa displayed a comparatively lower overall incidence rate increase. Notably, the 90–94 age group in China exhibited the most significant deterioration, with men and women experiencing annual increases of 4.23% and 1.77%, respectively. Age effects indicated a higher susceptibility to falls among preschool children and the elderly. Period effects revealed no improvement in the fall state for India (2005–2019) and China (2015–2019). Cohort effects adversely impacted the incidence rate for individuals born earlier in South Africa.

Conclusion: The present study highlights a consistent upward trend in fall incidence rates across BRICS countries from 1990 to 2019. With an aging population, the burden of fall-related diseases is on the rise in these nations. Our results underscore the necessity of formulating evidence-based disease prevention and management approaches tailored to the distinctive demographic attributes of each nation. Addressing these trends is crucial for mitigating the growing impact of falls on public health in BRICS countries.

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1. Introduction

The World Health Organization defined falls as events that "cause a person to unintentionally fall to the ground, floor, or other lower level," and they are the second leading cause of accidental death globally [1,2]. They represent the most prevalent type of injury and can lead to severe consequences, including death, disability, and functional impairment [3]. Annually, there are 37.3 million serious cases of falls globally, resulting in approximately 17 million disabilities and 684,000 fall-related deaths, with over 80% of these incidents occurring in nations with lower to moderate income levels [2]. Falls frequently happen among older individuals [4]. Statistics indicate that the global fall incidence rate ranges from 28% to 35% for those aged over 65 and up to 32%–42% for individuals over 70 [5]. The BRICS countries—Brazil, Russia, India, China, and South Africa—function as a collective unit [6] and account for over 40% of the world's population, 25% of the gross national income, and 40% of the burden of disease [7]. As emerging markets with developing economies, the BRICS nations possess a sizable and growing older population [7]. In 2016, the number of people aged 60 and older reached 400 million, constituting approximately 42% of the world's elderly population. According to the latest projections, this demographic will have expanded to 940 million people by 2050, making up 45% of the world's elderly population [8]. Consequently, the BRICS countries face a significant challenge in effectively addressing the issue of falls brought on by population aging. In this context, evaluating, monitoring, and comparing the status and trends of falls in the BRICS countries is crucial for informing resource allocation and policy adjustments. This study investigated the current status and changing trends of fall incidence in BRICS countries using data from the Global Burden of Disease Study 2019 (GBD 2019). Furthermore, we sought to explore the independent effects of age, period, and cohort on falls in BRICS countries. Overall, this study provides a thorough comparison of the impact of falls on public health across BRICS nations serving as a reference for the rational allocation of medical resources. It also aids policymakers in formulating fall prevention and management strategies based on local conditions.

2. Methods

2.1. Data sources

Fall population data for BRICS countries were from the GBD 2019 public database, available at https://ghdx.healthdata.org/. The database, spanning from 1990 to 2019, compiled information from 195 countries and regions. Data collection involved cause of death surveillance, nutrition and health surveys, cause-of-death inference, chronic disease and its risk factor surveillance, literature studies, and other relevant sources. The database assessed the burden of disease for 264 diseases and 84 risk factors. The research team obtained ethical approval from the Institutional Review Board Committee of the First Affiliated Hospital of Nanchang University, while all data are available online upon request from the EPHI-IHME office [9] or the GBD 2019 database, which does not contain participant privacy information [10].

2.2. Statistical analysis

The research utilized an age-period-cohort (APC) model to analyze the data. Considering the gender disparities in falls demonstrated by the APC model, separate analyses were conducted for falls, stratified by gender, in BRICS nations. In this model, age, period, and cohort were treated as independent variables, while the incidence of events within the population served as the dependent variable. The model adopted a particular probability distribution for the dependent variable and was grounded in retrospective cross-sectional repeated measures data, encompassing age-specific incidence rates across various time periods. The APC model sought to measure the influences of age, period, and birth cohort factors on the incidence rate. The age effect quantifies the risk of outcomes at different ages, while the period effect illustrates how temporal changes affect outcomes across all age groups. Additionally, the cohort effect highlights disparities in outcomes among individuals within the same birth cohort.

The APC model yields two primary output parameters: net drift, which indicates the annual percentage change in the logarithm of incidence, adjusted for nonlinear period and cohort effects, and local drift, which reflects the annual percentage change in the logarithm of incidence across distinct age groups. The timeframe from 1990 to 2019 was divided into six periods, each spanning five consecutive years. Birth cohorts were identified by subtracting age from each subject's period. Median values for age, period, and birth cohort were employed to establish the respective control groups, thereby preventing data overlap. As specified, the age control group was defined as (number of age groups + 1)/2, the period control group as (number of period groups + 1)/2, and the birth cohort control group as the period control group minus the age control group plus the age group median. When an equal number of age, period, or birth cohort groups were present, the control group was identified as the group with the lower median value among the two middle quartile groups. Estimated parameters were obtained using the Age-Period-Cohort web tool offered by the National Cancer Institute [11]. The statistical significance of estimable parameters and functions was evaluated using Wald's chi-square test at a significance level of $\alpha = 0.05$ (two-sided). Data compilation was performed using Excel 2019 software, and graphical representations were generated using R 4.3.0 software.

Table 1
Characteristics of falls incidence in BRICS countries from 1990 to 2019.

		BRICS		Brazil		Russia		India		China		South Africa	
		1990	2019	1990	2019	1990	2019	1990	2019	1990	2019	1990	2019
Population	Total,n × 1,000,000	2376.0	3232.0	148.8 (138,159)	216.7 (190,243)	151.0 (139,163)	146.7 (129,165)	855.6 (792,919)	1390.7 (1238,1559)	1183.7 (1103,1272)	1422.4 (1239,1597)	36.8 (33,41)	55.6 (49,63)
	Percentage of global	44.4	41.8	2.8	2.8	2.8	1.8	16.0	18.0	22.1	18.4	0.7	0.7
Falls	Incidence rate per 100,000	2681.7	2896.3	3987.4	3485.8	5836.3	5679.4	2874.9	3041.9	2025.7	2451.7	1071.2	987.0

Note: BRICS: Brazil, Russia, India, China, South Africa.

3. Results

3.1. Trends in incidence of falls

Table 1 and Fig. 1 illustrate the trend of falls incidence rates in BRICS countries. In 2019, the number of fall patients in these nations reached 32.32 million. The incidence rates of falls in BRICS countries rose from 2681.7 to 2896.3 per 100,000 people from 1990 to 2019. Fig. 1A and B show that both India and China exhibit upward trends, with China experiencing the highest growth rate at 21%, followed by India at 5.8%. Conversely, Brazil, Russia, and South Africa demonstrate a trend toward decline, with Brazil showing the most significant decrease at 12.6% and Russia experiencing the smallest decrease at 2.7%.

Fig. 1B indicates a gradual rise in falls incidence rates across BRICS countries from 1990 to 2019, followed by a transient gradual decrease and another slow upward trend. Brazil and China undergo comparable transformation trends, while Russia's incidence of falls exhibits a bell-shaped shift, transitioning from a rapid spike to a sharp decline during this period. India's incidence rate of falls shows a gradual rising trend, while South Africa maintains the lowest fall incidence rate among the BRICS nations, with an insignificant trend. China's fall occurrence rate experienced a rapid increase from 2012 to 2019, rising by 48.1% over the 8-year period (from 1655.52 per 100,000 in 2012–2451.68 per 100,000 in 2019). Brazil witnessed growth in 2016 and 2017, increasing from 3680.57 per 100,000 to 3777.06 per 100,000, followed by a decline to 3694.95 per 100,000 after 2018. From 1992 to 2005, Russia observed an increase in the incidence rate of falls, reaching 7801.83 per 100,000 in 2005, with a period of high growth from 1996 to 1999, growing by 15.00% (from 6277.39 per 100,000 in 1996–7239.53 per 100,000 in 1998). The incidence rates of falls in Russia decreased from 2006 to 2018, dropping from 7786.82 per 100,000 people in 2006–5660.53 per 100,000 people in 2018. From 2011 to 2019, India observed an increase in the incidence rate of falls, rising from 2741.44 per 100,000 in 2011–3041.92 per 100,000 in 2019.

3.2. Age-specific incidence of falls

The incidence rate of falls was segmented into specific age groups spanning various time periods, with two 5-year periods from 1990 to 1994 (median year, 1992) and from 2015 to 2019 (median year, 2017), and a comprehensive analysis of 19 consecutive birth cohorts, encompassing individuals born between 1903 and 1907 (median birth year, 1905) and those born from 1988 to 1992 (median birth year, 1990).

The trends in the incidence rate of falls in the BRICS nations from 1990 to 2019 are visually represented in Figs. 2–6. As can be seen from Fig. 4A and B, the trend in fall incidence rates among Indian women is broadly similar to that among men. Fig. 3A and B indicate similar features in China, while Fig. 5A and B also show similar features in Russia. In Fig. 6A, a noticeable peak in the curve is observed for the 20–30 age range. Fig. 6B illustrates the extremes of the incidence rate of falls among South African women aged between 90 and 100. Fig. 2A and B underscore distinctions between men and women in Brazil.

3.3. Net drift and local drift by age group

Net drift and local drift were assessed by age group in this study, with net drift representing the overall annual percentage change over the entire study period and local drift indicating the annual percentage change in incidence rates relative to the net drift for each age group (Fig. 7). In Fig. 7A, the overall net drift exhibits similar trends in Brazil (0.04% [95% CI, −0.07 to 0.14]) and China (0.06% [95% CI, −0.08 to 0.19]). Notably, South Africa exhibites the lowest overall net drift, indicating a slower increase in the overall incidence rate compared to Brazil, China, India, and Russia over the entire study period. In South Africa, a significant gender difference in the overall yearly change is observed, indicating a more substantial improvement in incidence rates among males (−0.73% [95% CI,

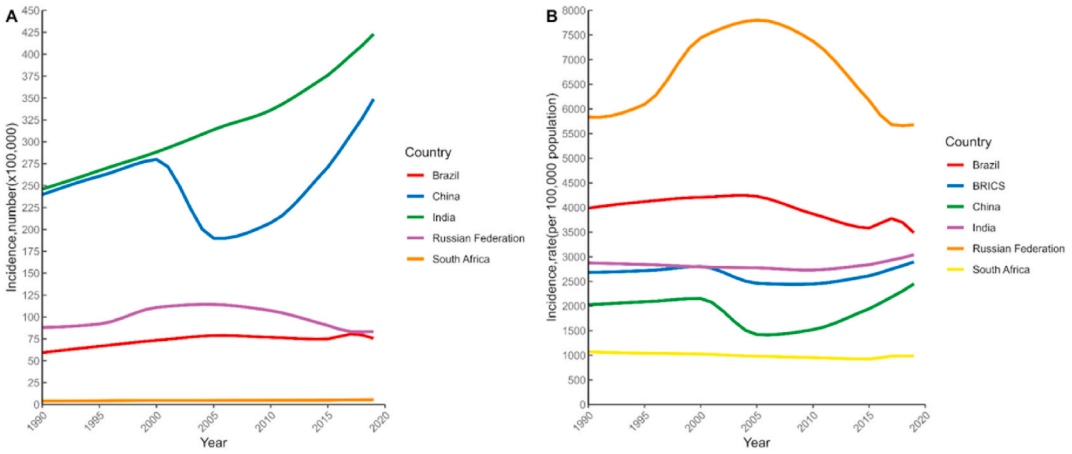

Fig. 1. (A) Number of new cases and (B) incidence of falls in BRICS countries from 1990 to 2019.

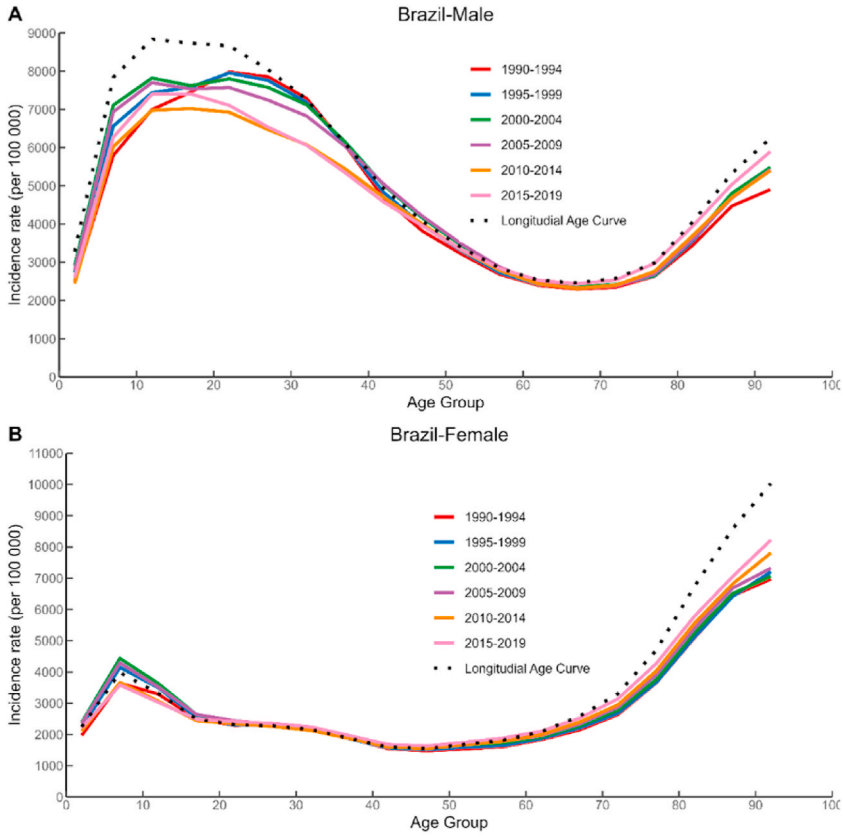

Fig. 2. Incidence rates of falls by age group in Brazil from 1990 to 2019, categorized by period. Note: Area A in each graph represents the age-group curve for males, while area B represents the age-group curve for females.

−0.91 to −0.54] to −0.20 [95% CI, −0.30 to −0.10]) compared to females.

It is well-established that local drift provides insights into additional age-related changes in the incidence rate trend. In Fig. 7B, local drift values greater than 0 are observed among Chinese men aged 45 to 94, indicating a worsening trend in fall-related incidence rates. Exceptions to this trend are observed in specific age groups, such as 0 to 24 in Russia (−0.40 to −0.42), 0 to 44 in Brazil (−0.45 to −0.21), 10 to 94 in South Africa (−0.08 to −0.57), 0 to 44 in China (−0.63 to −0.22), and 0 to 29 in India (−1.32 to −0.08). Fig. 7B and C show that the most significant deterioration occurred among Chinese men in the 90–94 age group (4.23% per year) and women (1.77% per year), followed by Russian men in the 70–74 age group (2.47% per year) and women (1.56% per year). The local drift curves for the populations of Brazil, China, Russia, and India exhibit an overall upward trend, while the population of South Africa displays an overall downward trend in the local drift curve.

3.4. Age-period-cohort impact on falls incidence

Figs. 8–10 illustrate the impact of age, period, and cohort on the incidence rate of falls. In Fig. 8A, Russian men aged 25 to 29 exhibit the most rapid rise in the incidence rate of falls with age,while Fig. 8B shows that in India, the incidence rate of falls increases most rapidly with age among women aged 55–94 years. Furthermore, India, Brazil, and China exhibited an increase in the incidence rate of falls in later years. Fig. 8A and B highlight that preschool children and older adults were more susceptible to falls. The incidence ratio of falls in India from 2005 to 2019 and in China from 2015 to 2019 was greater than 1, indicating that the incidence of falls in these countries did not improve during the specified periods. From 2005 to 2019, period effects positively impacted the incidence rates of falls in Brazil and South Africa, and from 2010 to 2019, period effects positively influenced the incidence rates of falls in Russia, and from 2005 to 2014 in China. A comparison between Fig. 9A and B reveals that, from 2015 to 2019, the period effects for women in South Africa shifted in an unfavorable direction.

Fig. 10A and B show that in recent years, the cohort effect has had a positive impact on men in BRICS countries and women in China, Brazil, and India, but has little impact on women in Russia and South Africa. Russia is more affected by cohort effects, while Brazil is least affected. For South Africa, cohort effects have a negative impact on the incidence rate of falls among those born earlier, while for Russia, cohort effects yield a positive impact on the incidence rate of falls among those born earlier.

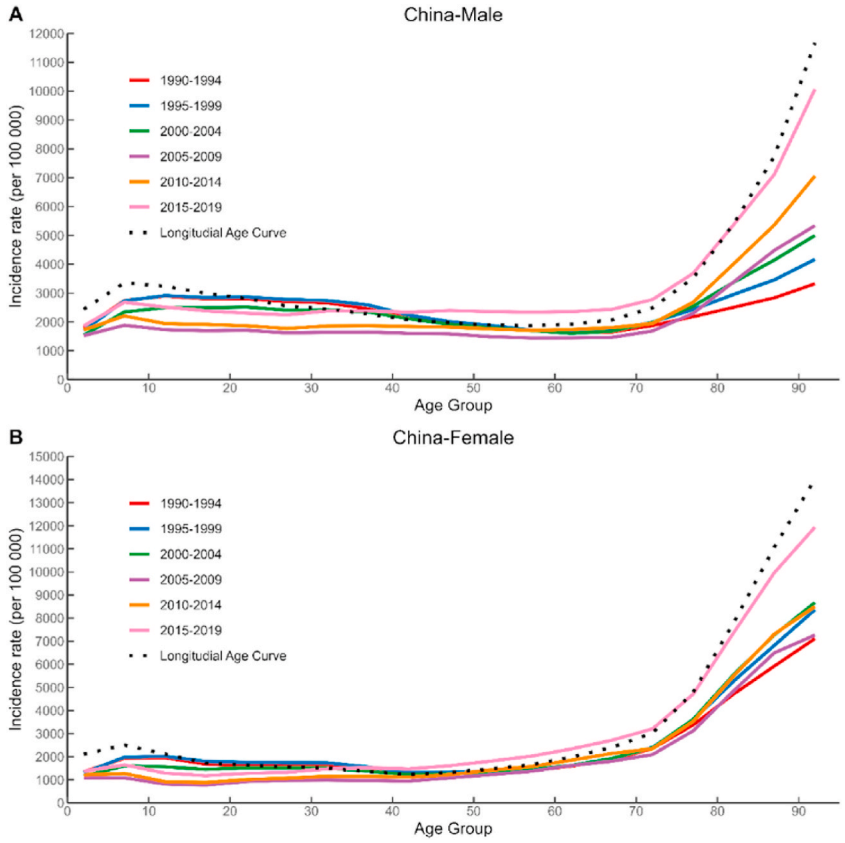

Fig. 3. Incidence rates of falls by age group in China from 1990 to 2019, categorized by period. Note:Same as in Fig. 2.

4. Discussion

From 1990 to 2019, Brazil, Russia, and South Africa made significant strides in preventing falls, with Brazil showing the most notable improvement. However, India and China should continue their efforts to control falls. Among the BRICS countries, South Africa experienced a lower overall increase in incidence rates compared to Brazil, China, India, and Russia. From 2015 to 2019, the incidence rate of falls for the whole population did not improve in China and India, while Brazil, Russia, and South Africa saw improvements in the incidence rate for the entire population over the last four years. Russia was more affected by cohort effects, while Brazil was least affected. From 1990 to 2019, the BRICS countries achieved positive results in preventing falls, but there were still some shortcomings. BRICS countries should develop targeted falls prevention strategies for high-risk populations based on national circumstances and global experience.

Between 1990 and 2019, China experienced the most rapid increase in falls incidence among the BRICS nations, mainly related to aging status [12]. Indeed, it has been reported that China is one of the fastest-aging countries in the world [13]. In 2019, the population aged 65 and over accounted for approximately 11.5% of China's total population, and the United Nations estimates that this proportion will reach 16.9% by 2030 [14]. It is widely thought that aging will have a significant impact on the Chinese population, including inadequate prevention and monitoring of chronic diseases, leading to an increased risk of chronic diseases [15]. With the changing disease spectrum and rapid population aging, the number of chronic disease cases in China is rapidly increasing, and the number of diagnosed chronic disease patients has exceeded 260 million [16]. The accelerated progression of aging and chronic diseases in China has resulted in a continuous escalation of the burden associated with falls [17]. The cascade of consequences stemming from falls contributes to an augmentation in medical costs, imposing a substantial burden on individuals, families, and society [18]. In 2003, the government instituted the New Rural Cooperative Medical Scheme (NRCMS), predominantly funded by the government, necessitating farmers and collectives to make modest contributions to cover medical expenses [19]. During this period, the Chinese government's NRCMS policy provided assurance and assistance to rural residents, significantly enhancing rates of medical consultations and hospitalizations while alleviating the economic strain of seeking medical care [20]. To some extent, the adverse impacts of aging and chronic diseases were mitigated, resulting in the control and decline of fall incidence among the elderly in China. In 2007, the Urban Residents Basic Health Insurance (URBHI) was introduced by the government to extend coverage to the urban population not encompassed by the URBHI. Subsequently, China implemented a medical assistance system for the most economically vulnerable citizens, extending medical services to over 68.76 million people and providing direct support for the severely disabled, the elderly, and low-income families with serious illnesses. These multiple systems complement each other, significantly expanding the scope of

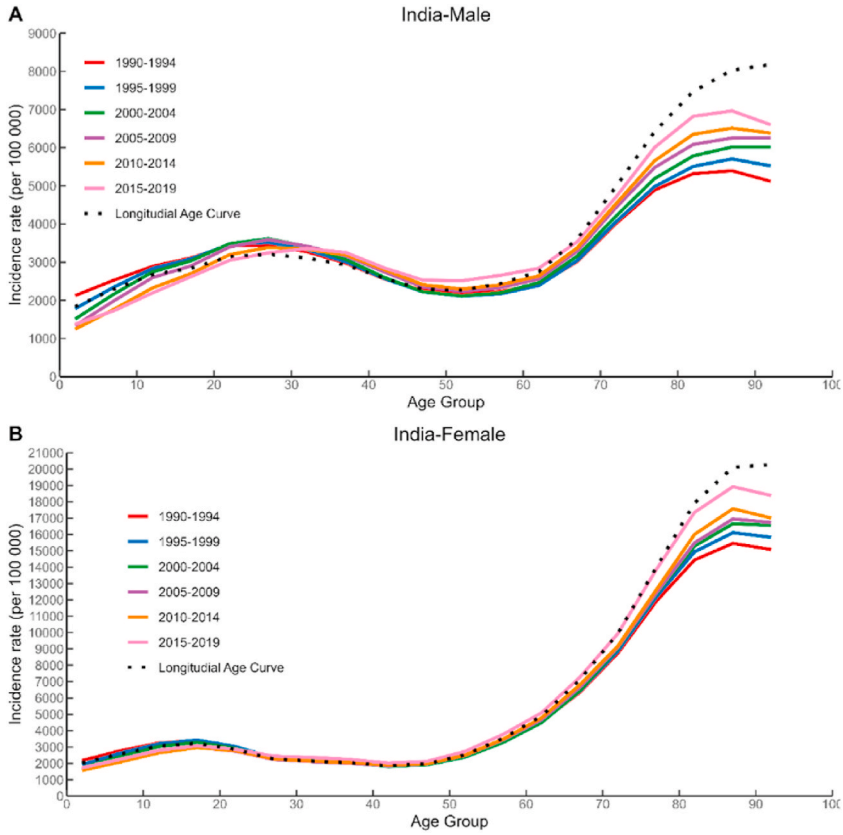

Fig. 4. Incidence rates of falls by age group in India from 1990 to 2019, categorized by period. Note:Same as in Fig. 2.

medical service coverage [19,21]. In China, the frequency of falls was effectively managed during this period, demonstrating a gradual upward trend.

India's demographic landscape is undergoing rapid aging [22]. Between 2001 and 2031, the percentage of individuals aged 60 and above is projected to nearly double, reaching an estimated 20% by mid-century [23]. In addition, the 'feminization of aging' has emerged as a significant concern, as women's life expectancy surpasses that of men, contributing to a further imbalance in the sex ratio among the elderly population. Consequently, the incidence of falls among the elderly in India was notably higher among women than men. In 2004, financial barriers in India resulted in approximately a quarter of the population lacking access to health services, and 35% of hospitalized patients fell into poverty [19]. This financial constraint might be a crucial factor in the stagnation of fall rates in the Indian population since 2005. In 2010, the escalating costs of medical expenses pushed 60 million Indians below the poverty line, significantly contributing to the rise in falls in India in 2010, highlighting the challenge of impoverished areas in accessing primary healthcare services [24,25]. Physical frailty was found to be strongly correlated with falls among older individuals in India [26]. Consistently, a multinational study by Biritwum et al. [27]. revealed a higher prevalence of frailty among the aging population in India compared to countries such as China, Russia, and South Africa. Additionally, obesity and chronic diseases constitute major risk factors for falls, with obesity affecting the Indian population most, followed by diabetes and hypertension [28]. In summary, the burden of falls in India is generally high, stemming from issues related to aging, frailty, poverty, and obesity. Furthermore, India faces challenges in healthcare infrastructure, with only about 860 hospital beds per million population, significantly lower than the World Health Organization's global average of 3960 hospital beds per million population. This scarcity of resources poses limitations in addressing chronic diseases and injuries related to falls [28]. Unlike other BRICS countries, nearly 70% of India's hospitals and 40% of its beds are private, with the private sector primarily responsible for the initial treatment of falls patients in most cases [29]. However, a challenge lies in the fact that most private doctors may not provide accurate diagnosis and treatment [30], contributing to delayed treatment of fall-related injuries and an increased burden of fall-related illnesses.

The dissolution of the Soviet Union led to drastic social changes that had a significant impact on the lives of the Russian population [31]. From 1992 to 1996, Russia experienced a steady decline in GDP per capita, coupled with a continuous rise in the unemployment rate [32]. Studies have shown that socioeconomic factors have some influence on falls [33], and during this period, the rate of falls in Russia continued to increase. As a stress coping mechanism, there was a notable increase in alcohol consumption in Russia, with men consuming significantly more alcohol than women [31,34], linking falls in Russia predominantly with men. Furthermore, Russia's geographical setting presents unique challenges, with outdoor falls affected by environmental hazards, weather and seasonal changes [35]. The harsh weather conditions in northern Russia, characterized by long and cold winters, heavy snowfall, and strong winds,

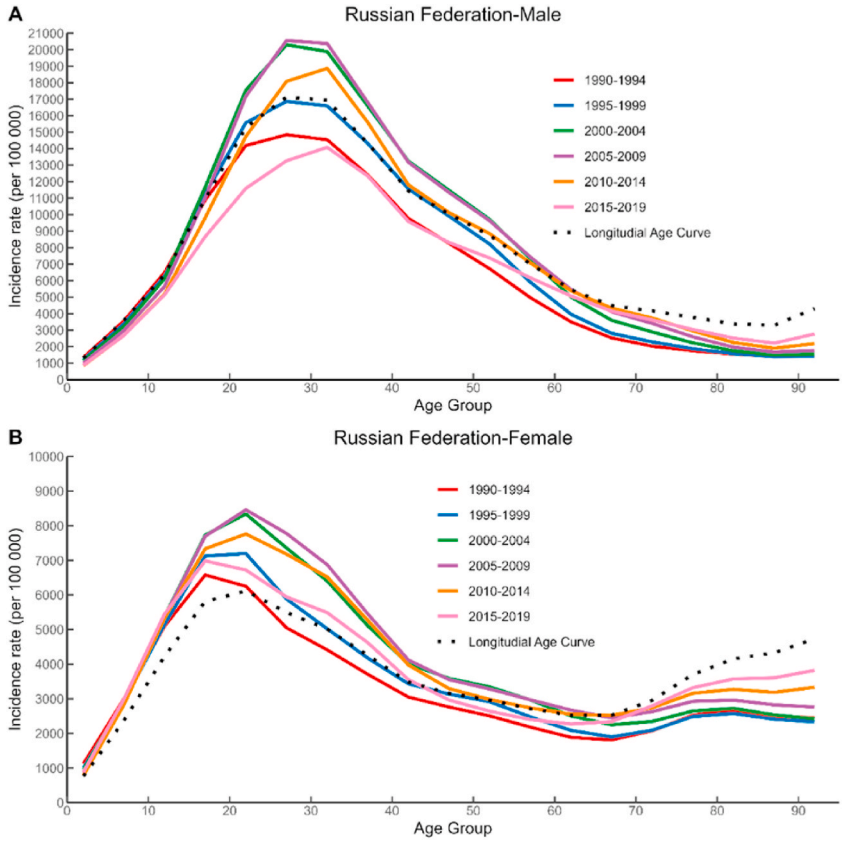

Fig. 5. Incidence rates of falls by age group in Russia from 1990 to 2019, categorized by period. Note:Same as in Fig. 2.

increase the likelihood of falls even with a slight misstep [35]. Smoking is a risk factor for falls [36]. In 2010, the Russian government adopted the "National Strategy for the Development of Public Policy to Counter Tobacco Consumption from 2010 to 2015" [37], followed by the implementation of the Law of the Russian Federation "On Protecting Citizens' Health from the Effects of Environmental Tobacco Smoke, the Consequences of Tobacco Consumption, or the Consumption of Nicotine-Containing Products" in 2013 [38]. The rate of tobacco use declined from 39.4% in 2009 to 30.9% in 2016 [39]. Interestingly, during the same period, there is a noticeable downward trend in falls incidence in Russia.

Among the BRICS countries, South Africa has the least aging population [40], resulting in minimal impact from aging on falls in the country. The falls incidence rate in South Africa is the lowest among the BRICS nations. Several factors contribute to this low falls incidence rate in South Africa. Firstly, the country lags behind others in achieving universal health coverage [41]. Secondly, the public health system in South Africa faces severe constraints, characterized by a shortage of health professionals and often inappropriate allocation and utilization of limited resources. Inequitable distribution of resources among departments and geographical regions leads to insufficient provision of equitable access to necessary and effective healthcare, particularly for the impoverished population [19,42]. Thirdly, the current youth unemployment rate in South Africa is exceptionally high at 66.5%, making it one of the countries with the highest unemployment rates globally [43]. These various factors make it challenging for individuals in South Africa to secure sufficient income and medical security, resulting in a reluctance to seek medical attention when falls occur. Consequently, hospital admissions for falls are low, contributing to the overall low falls incidence rate.

According to the World Bank, Brazil has achieved remarkable success in reducing hunger and malnutrition [44]. Over the past few decades, the number of hungry people in Brazil has decreased by approximately 80%, and in 2014, the country was removed from the United Nations' world hunger map [45]. Hunger and malnutrition are closely related to falls [46], as they can cause symptoms such as fatigue, dizziness, irritability, and muscle wasting [47]. The decline in hunger and malnutrition likely contributed to the reduction in Brazil's incidence of falls between 2005 and 2014. Research has indicated that individuals with cardiovascular disease are at a higher risk of falling [48]. From 2017 to 2019, Brazil has demonstrated some control over the falls incidence rate, possibly attributed to the Brazilian healthcare system's effective management of cardiovascular risk factors, including hypertension and smoking, in recent years. Additionally, optimization of treatment conditions for acute cardiovascular events may have played a role [49]. A Brazilian study found a significant association between falls and women and the elderly [50], aligning with the findings of this study that reveal a higher incidence of falls among elderly women in Brazil compared to elderly men. As individuals age, their physical function declines, rendering them more susceptible to falls. Furthermore, they are more likely to experience chronic diseases and cognitive impairments, which are high-risk factors for falls in the elderly and increase the overall risk [51,52]. It is now understood that older

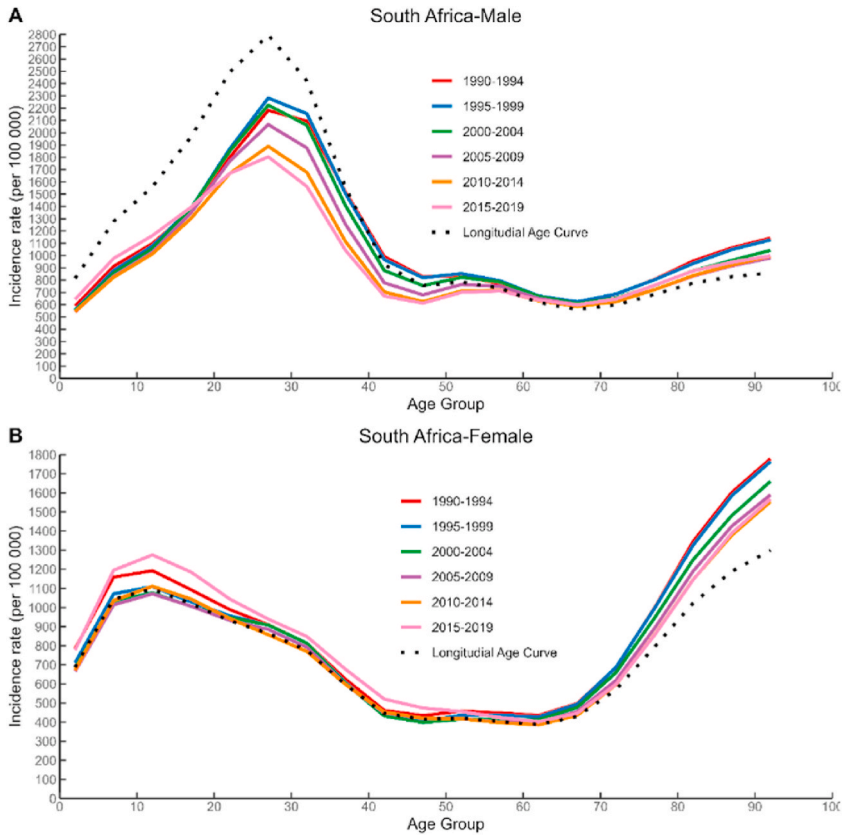

Fig. 6. Incidence rates of falls by age group in South Africa from 1990 to 2019, categorized by period. Note:Same as in Fig. 2.

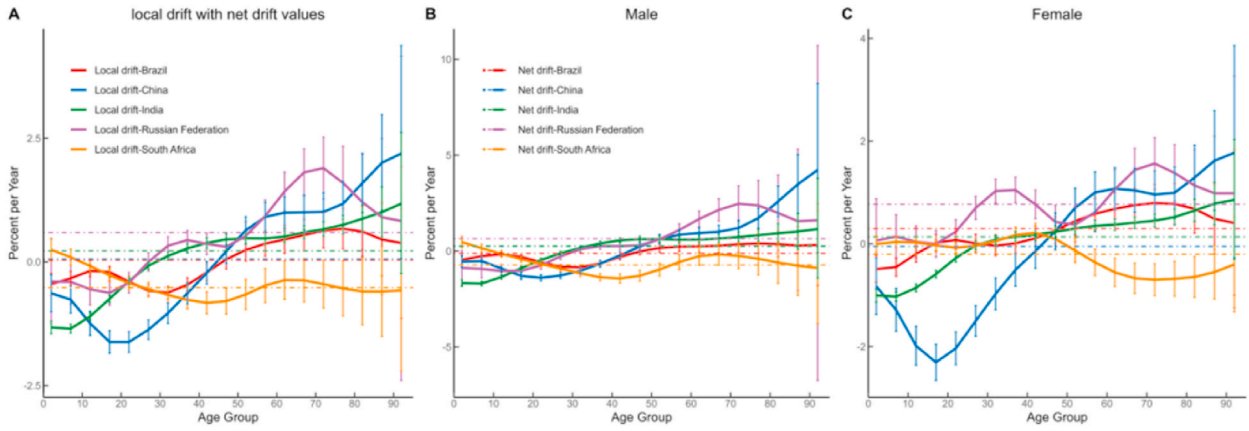

Fig. 7. Local and net drift values of falls incidence in BRICS countries from 1990 to 2019. Note: B and C represent the results for men and women, respectively.

women are particularly prone to falls, possibly due to decreased estrogen secretion after menopause, leading to reduced vitamin D levels, inducing osteoporosis, and heightening the risk of falls [53]. Therefore, it is crucial to monitor and manage falls in older women.

This study utilized an APC model to highlight the changing patterns in the burden of falls across BRICS countries. The model enabled the observation of changes in the risk of falls in each country, facilitating the identification of significant trends in specific populations and the formulation of targeted recommendations. Despite the initiation of significant health system reforms aimed at improving the quality of medical services and ensuring financial stability [54], the overall increase in the number of falls across these BRICS nations underscores the imperative of allocating adequate medical resources for falls and integrating falls prevention and management into future national strategies. Functioning as an economic alliance of developing countries, BRICS have undergone rapid

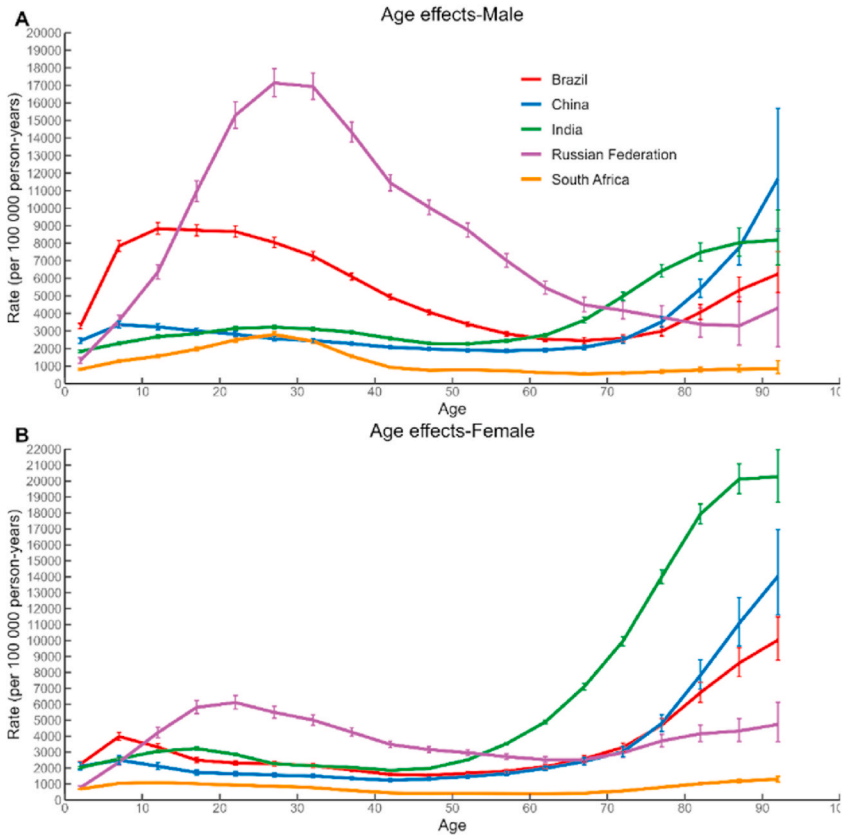

Fig. 8. Age-effect parameter estimates of falls incidence rate in BRICS countries from 1990 to 2019, with gender-based analysis. Note: Block A represents male, while Block B represents female.

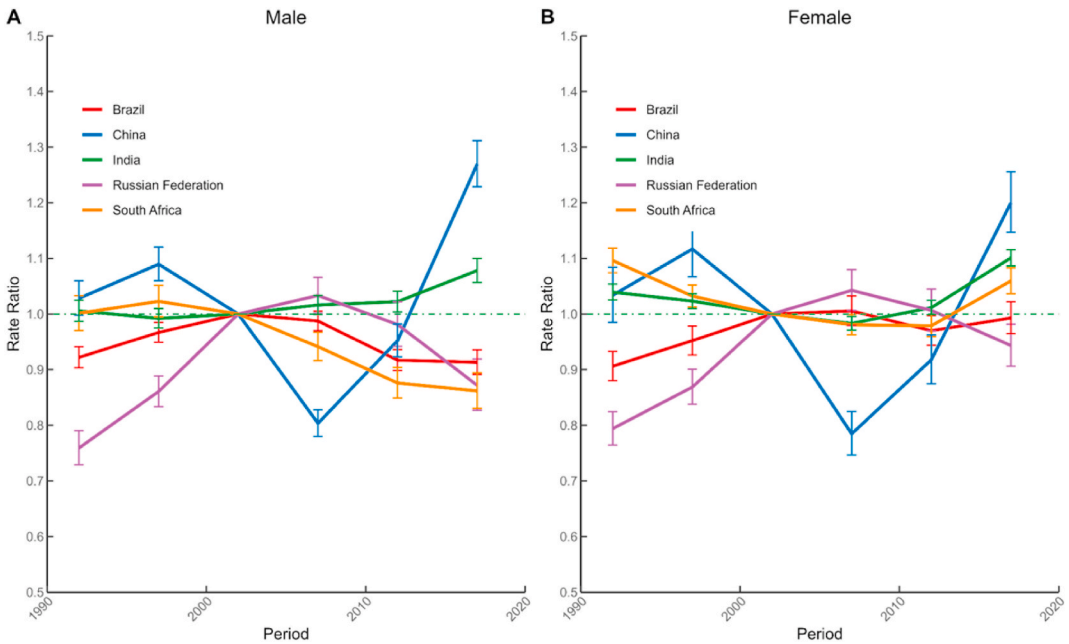

Fig. 9. Period-effect parameter estimates of falls incidence rate in BRICS countries from 1990 to 2019, with gender-based analysis. Note:Same as in Fig. 8.

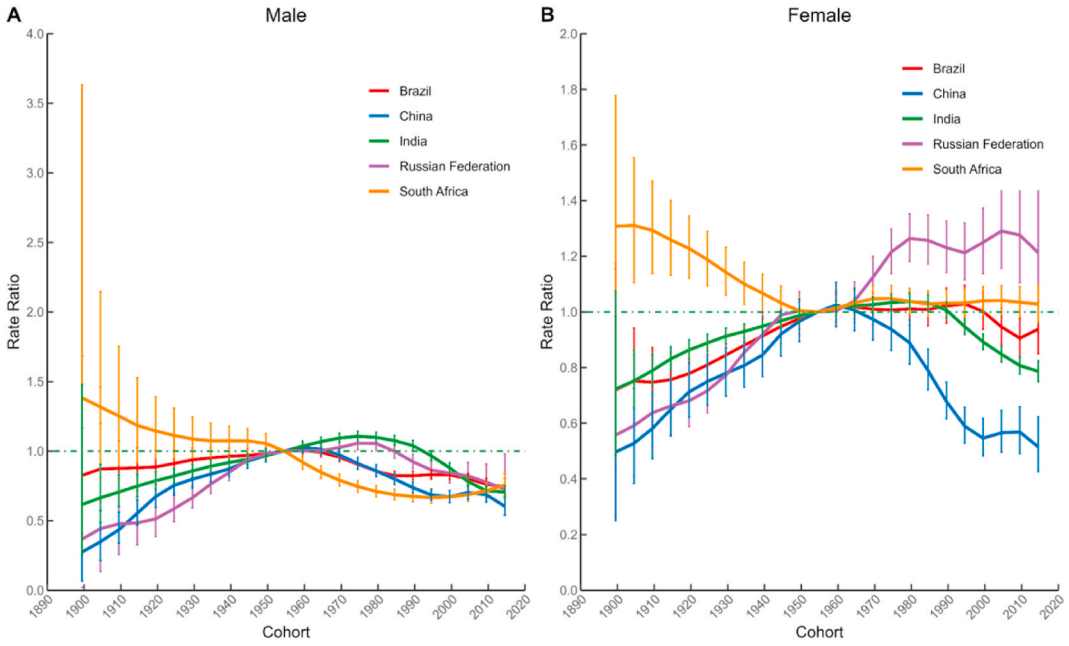

Fig. 10. Cohort-effect parameter estimates of falls incidence rate in BRICS countries from 1990 to 2019, with gender-based analysis. Note:Same as in Fig. 8.

economic expansion coupled with population growth, health resource inequalities, and an escalating disease burden [55,56]. As other developing countries may face similar challenges during the process of economic transformation, the fall prevention and management policies adopted by the BRICS countries have important implications for developing countries.

The study is subject to certain limitations that warrant consideration. Firstly, the falls data in GBD 2019 are secondary, derived through algorithms based on existing falls data from various countries. The precision of these estimates relies on the quality and quantity of the input data, potentially influencing the calculated burden. Secondly, the GBD 2019 time interval is 5 years, which may obscure subtle changes in age, period and cohort effects. Thirdly, our study's age-period-cohort analysis is based on cross-sectional data estimated from GBD 2019 rather than a cohort study, making it challenging to ascertain relative risks at specific locations and times within the BRICS countries. Lastly, our research relies on GBD 2019 data from BRICS countries, and the generalizability of findings and policy applicability may be constrained by differences in national conditions compared to other countries.

5. Conclusion

Over the past three decades, the incidence of falls in BRICS countries has demonstrated a consistent overall upward trajectory. Notably, China experienced the most significant rise in falls incidence, closely tied to a high disease burden and the complexities posed by an aging population. Following China, India exhibited a substantial rise. The ongoing impact of falls on public health remains a concern in both China and India, underscoring the importance of boosting investment in medical and healthcare resources. The cohort effects demonstrate that earlier birth cohorts in South Africa constitute a population susceptible to falls, necessitating dedicated policy interventions. The elderly and preschool children in BRICS countries face a notably elevated risk of falls compared to other age demographics. Furthermore, there are notable gender disparities among the elderly, with the incidence of falls being higher among elderly women in BRICS countries than among elderly men. Based on these findings, developing targeted health policies for elderly and preschool children should be a priority for BRICS nations to urgently address the public health burden of falls. These countries need to implement apt evidence-based policies focused on fall prevention and treatment in order to mitigate the morbidity and mortality associated with falls in these vulnerable groups. The analysis of temporal fall incidence patterns across BRICS countries offers an evidentiary foundation to inform policy-making focused on curbing the burden imposed by falls in these nations. Implementing effective fall prevention and management strategies tailored to the distribution characteristics of falls in each country is crucial for mitigating the escalating impact of falls on public health.

Data availability

This study analysed publicly available datasets. All data are available at https://vizhub.healthdata.org/gbd-results/.

CRediT authorship contribution statement

Zhiqin Xie: Writing – original draft, Methodology, Data curation. **Shihan Chen:** Writing – review & editing, Validation. **Chaozhu He:** Software, Data curation. **Ying Cao:** Resources, Conceptualization. **Yunyu Du:** Visualization, Software. **Linxia Yi:** Formal analysis. **Xiuqiang Wu:** Methodology. **Zequan Wang:** Resources. **Zhen Yang:** Validation, Supervision, Funding acquisition. **Pinghong Wang:** Validation, Supervision, Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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