

Analysis of Parkinson's Disease Burden Trends in China (1990–2021) Using the GBD Database

Qin Zhang^{1*}

¹ Department of Rehabilitation Medicine, Affiliated Hospital of North Sichuan Medical College, Nanchong, China

*Correspondence: Qin Zhang

Received: 1 June 2026; **Accepted:** 15 July 2026; **Published:** 5 August 2026

Abstract:

Objective: To gain a comprehensive understanding of the persistent evolutionary patterns and gender disparities in the prevalence of Parkinson's disease (PD) in China between 1990 and 2021, and to uncover the link between the age-adjusted incidence rate (ASIR) and the Socio-Demographic Index (SDI), this study aims to lay the groundwork for developing targeted prevention and management strategies with a sound scientific foundation. **Methods:** Leveraging the latest Global Burden of Disease (GBD) 2021 dataset, researchers pulled out four key metrics for Parkinson's disease: mortality figures, Disability-Adjusted Life Years (DALYs), prevalence rates, and incidence numbers. To get a handle on the distribution of these indicators, they turned to descriptive statistics and broke down the data by gender. To track changes over time, they employed the Joinpoint regression model, which allowed them to compute the Average Annual Percent Change (AAPC). Finally, to dig into potential connections, they ran a Pearson correlation analysis to examine the relationship between Age-Standardized Incidence Rates (ASIR) and the Socio-demographic Index (SDI). **Results:** From 1990 to 2021, the overall burden of PD in China presented a marked upward trend, with the prevalence (678.90%) showing the largest increase, followed by the incidence (455.70%). The absolute values, growth rates, and annual growth rates of all disease burden indicators in males were higher than those in females. The age-standardized rates exhibited a fluctuating upward trend, and projections indicated that male ASIR and age-standardized mortality rate (ASMR) would remain higher than those of females from 2021 to 2040. Significant regional disparities were observed in the incidence and prevalence of PD globally, with distinct regional clustering characteristics. ASIR was significantly positively correlated with SDI ($r = 0.514$, $P < 0.001$). **Conclusion:** China is grappling with a mounting challenge as Parkinson's disease places an ever-increasing strain on its healthcare system, with men emerging as the demographic most in need of targeted interventions. The disparity in disease management across different regions has become a glaring issue, highlighting the urgent need for tailored approaches that take into account both gender-specific factors and regional epidemiological patterns to effectively address this growing public health concern.

Keywords:

Parkinson's Disease, Disease Burden, Gender Difference, Socio-Demographic Index, Age-standardized Incidence Rate

1. Introduction

Parkinson's disease (PD) is one of the major degenerative neurological diseases worldwide, marked by insidious onset, progressive progression, high disability rate and prolonged disease course[1]. Amid the ongoing transition of the global disease spectrum, the burden of PD keeps rising alongside population aging, and it has become a critical public health issue that cannot be ignored[2]. In both developed and developing countries, the epidemiological trend of PD presents complex heterogeneity. Its occurrence and progression are closely related to population age structure, socioeconomic conditions, lifestyle, environmental exposure and medical diagnostic capacity, showing prominent regional variations[3]. As the most populous country worldwide, China is undergoing rapid population aging, accompanied by shifts in residents' living habits and continuous improvement in disease detection capacity[4]. Among neurological disorders in China, PD severely impairs patients' quality of life and brings heavy care pressure to families and the healthcare system, imposing great challenges on public health services. From 1990 to 2021, China witnessed rapid socioeconomic development, continuous improvement of the medical and health system, and growing public awareness of chronic disease screening[5]. This special historical background offers a valuable research scenario to explore the dynamic changes in PD burden, and the evolutionary trends of relevant core indicators carry important implications for public health practice.

Gender difference constitutes a key research focus in the epidemiology of PD[6]. Gender disparities in physiological features, risk factor exposure, genetic susceptibility and behavioral patterns may lead to inconsistent trends in incidence, prevalence, mortality and disability burden between males and females[7]. Such discrepancies are closely linked to sex-specific endocrine and biological factors, as well as differences in external risk exposure[8]. Elucidating gender differences is essential to develop targeted, gender-specific prevention and control measures, and can guide the rational allocation of medical resources for PD among different populations[9].

Against this background, the present study aimed to systematically evaluate the long-term trends in the burden of PD in China from 1990 to 2021, comprehensively characterize the temporal evolution of key disease burden indicators, and place particular emphasis on sex disparities and their potential determinants. By integrating analyses of trends in standardized rates with correlations between these rates and the Socio-Demographic Index (SDI), this study further sought to elucidate the epidemiological profile and evolving patterns of PD burden in China. The findings are expected to provide a scientific basis for the development and refinement of evidence-based prevention and control strategies, the rational allocation of healthcare resources, the reduction of the individual and societal burden attributable to PD, and the promotion of healthy ageing.

2. Materials and Methods

2.1. Research Design

The research utilized a community-wide, backward-looking trend analysis to concentrate on the impact of Parkinson's in China between 1990 and 2021. The core of the investigation was to delve into the persistent shifts over time in four key metrics: mortality rates, disability-adjusted life years (DALYs), occurrence rates, and instances.

Additionally, the study sought to uncover gender disparities in the disease's spread, aiming to offer solid data and theoretical backing for the precise prevention and strategic handling of Parkinson's in the country.

2.2. Data Source

Data for the study were obtained from the Chinese component of the Global Burden of Disease Study 2021 dataset[10]. This comprehensive database brings together insights from diverse sources including population counts, national health monitoring networks, and mortality records—all built on consistent disease classification standards, meticulous data refinement techniques, and precise algorithm tuning. The integrity, validity, and cross-national relevance of GBD 2021 findings have undergone rigorous scrutiny through universally accepted quality control measures. In this study, we extracted gender-stratified data on core disease burden indicators of PD in 1990 and 2021 (males, females, and the overall population), including the original indicator values, percentage change (PC), average annual percentage change (AAPC), and corresponding uncertainty intervals (UI).

2.3. Research Indicators and Definitions

All core metrics were defined according to the standardized methodology of the GBD study. Deaths were defined as the total number of deaths attributable to Parkinson's disease during the study year. DALYs, calculated as the sum of years of life lost (YLLs) due to premature mortality and years lived with disability (YLDs), were used to quantify the overall health burden attributable to Parkinson's disease. Prevalence was defined as the total number of existing cases of Parkinson's disease at a specific point during the study year, whereas incidence was defined as the total number of newly diagnosed cases during the study year.

To assess changes in the burden of Parkinson's disease between 1990 and 2021, the PC was calculated as: $PC = [(value\ in\ 2021 - value\ in\ 1990) / value\ in\ 1990] \times 100\%$. In addition, the AAPC and its corresponding UI were used to evaluate the magnitude and statistical uncertainty of long-term temporal trends in disease burden indicators.

2.4. Statistical Analysis Methods

Data management and statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). To improve the robustness of the findings, outlier screening was conducted separately by sex, and extreme observations exceeding ± 3 standard deviations from the mean were excluded[11]. Temporal trends were assessed using segmented log-linear regression models implemented in the Joinpoint Regression Program (version 4.9.1.0). The AAPC and its corresponding 95% UI were calculated. All statistical tests were two-sided, and a P value < 0.05 was considered statistically significant. To minimize the potential influence of changes in the population age structure over time on comparisons of rate-based indicators, all age-related rates were age-standardized using the World Health Organization standard world population as the reference population, thereby improving the comparability of these indicators across different years.

2.5. Quality control

Throughout the data inclusion process, rigorous verification was carried out to confirm the consistency of PD diagnostic definitions, so as to guarantee the

homogeneity of data from different time periods. Gender-stratified data underwent cross-validation to sustain internal logical consistency. The whole workflow complied with standardized quality control specifications of the GBD database, ensuring data accuracy and trustworthy analytical outcomes.

3. Result

3.1. Overall Change Trend of the Disease Burden of PD in China from 1990 to 2021

Over the three-decade span from 1990 to 2021, China witnessed a marked and sustained increase in the overall health impact of Parkinson's disease, as evidenced by significant rises across all four key metrics of disease burden. This trajectory underscores the deepening foothold that Parkinson's has gained in affecting the well-being of the Chinese populace throughout this period.

Between 1990 and 2021, China witnessed a staggering surge in PD-related fatalities, jumping from 32,581 to 92,035 deaths. Over this three-decade span, the death toll climbed by nearly 60,000 cases, marking a percentage increase of 182.50% and an average annual growth rate of 3.24%. This steady climb paints a clear picture of an escalating mortality burden from the disease. Similarly, DALYs skyrocketed from 685,009 in 1990 to 2,159,514 in 2021—a net gain of over 1.4 million years representing lost health. This represents a 215.30% increase and a 3.64% annual growth rate, providing a comprehensive measure of how Parkinson's is increasingly compromising population health through both death and disability. The most dramatic rise, however, was seen in prevalent cases, which ballooned from 651,833 to an astounding 5,077,057—an increase of 678.90% and an average annual growth of 6.69%. This outpaces all other indicators, suggesting a particularly concerning accumulation of Parkinson's cases in the population. New incident cases also showed significant growth, rising from 91,492 to 508,378 over the period—a 455.70% increase with a 5.78% annual growth rate. This trajectory, while second to prevalence in terms of growth magnitude, underscores an ongoing and intensifying risk of new Parkinson's diagnoses among the Chinese population, signaling a worsening public health trend (Table 1).

3.2. Gender Differences Characteristics of PD Burden

From 1990 to 2021, the burden of PD increased steadily among both men and women in China. However, men generally had higher absolute levels and faster rates of increase than women across mortality, DALYs, prevalence, and incidence, indicating a marked sex disparity.

Regarding the number of deaths, male deaths increased from 17,265 in 1990 to 54,697 in 2021, representing a net increase of 37,432 deaths and a relative increase of 216.80%, with an AAPC of 3.71%. Over the same period, female deaths rose from 15,316 to 37,338, corresponding to a net increase of 22,022 deaths and a relative increase of 143.80%, with an AAPC of 2.63%. The number of deaths among men was higher than that among women in both 1990 and 2021. Moreover, the absolute increase and AAPC in men were 1.51 and 1.41 times those in women, respectively, indicating a more pronounced increase in the mortality burden among men.

For DALYs, the burden among men increased from 367,337 person-years in 1990 to 1,280,311 person-years in 2021, with a net increase of 912,974 person-years, a

relative increase of 248.50%, and an AAPC of 4.03%. Among women, DALYs increased from 317,672 person-years to 879,203 person-years, representing a net increase of 561,531 person-years, a relative increase of 176.80%, and an AAPC of 3.12%. Male DALYs were higher than female DALYs at both time points. The absolute increase and AAPC among men were 1.63 and 1.29 times those among women, respectively, suggesting that the overall health loss attributable to PD was more substantial among men.

The sex disparity in the number of prevalent cases widened further during the study period. In 1990, the numbers of prevalent cases among men and women were 332,023 and 319,810, respectively; by 2021, these figures had increased to 2,926,462 and 2,150,595, respectively. The number of prevalent cases among men increased by 2,594,439, corresponding to a relative increase of 781.40% and an AAPC of 7.03%. Among women, the net increase was 1,830,785 cases, corresponding to a relative increase of 572.50% and an AAPC of 6.27%. The faster increase in prevalence among men indicates a greater disease burden in the male population.

A similar sex disparity was observed in incident cases. The number of new cases among men increased from 50,337 in 1990 to 302,249 in 2021, representing a net increase of 251,912 cases, a relative increase of 500.50%, and an AAPC of 6.04%. Among women, incident cases increased from 41,155 to 206,128, corresponding to a net increase of 164,973 cases, a relative increase of 400.90%, and an AAPC of 5.42%. Men had higher values than women in terms of the baseline number of incident cases, the number of incident cases in 2021, the absolute increase, and the AAPC, indicating a more rapid increase in the incidence burden of PD among men (Table 1).

Table 1. Burden Indicators and Trends of PD in China Between 1990 and 2021 (By Sex).

Indicator	Sex	1990 Value	2021 Value	PC	AAPC UI
Deaths	Male	17265	54697	216.80%	3.71%
Deaths	Female	15316	37338	143.80%	2.63%
Deaths	Both	32581	92035	182.50%	3.24%
DALYs	Male	367337	1280311	248.50%	4.03%
DALYs	Female	317672	879203	176.80%	3.12%
DALYs	Both	685009	2159514	215.30%	3.64%
Prevalence	Male	332023	2926462	781.40%	7.03%
Prevalence	Female	319810	2150595	572.50%	6.27%
Prevalence	Both	651833	5077057	678.90%	6.69%
Incidence	Male	50337	302249	500.50%	6.04%
Incidence	Female	41155	206128	400.90%	5.42%
Incidence	Both	91492	508378	455.70%	5.78%

3.3. Age-standardized rate trends and future predictions

From 1990 to 2021, the age-standardized prevalence rate (ASPR) of PD in China rose continuously and markedly from approximately 92 to nearly 247 per 100,000, registering the largest growth among all indicators. The DALYs rate first climbed to a peak of around 116 per 100,000 in the mid-2000s, then declined and stabilized at about 108 per 100,000 after 2010. The age-standardized incidence rate (ASIR) grew steadily from roughly 13 to 25 per 100,000, while the age-standardized mortality rate (ASMR) stayed below 10 per 100,000 with minimal fluctuation. Age standardization ruled out the interference of population age structure, verifying the rising prevalence and incidence risk alongside stable mortality risk (Figure 1).

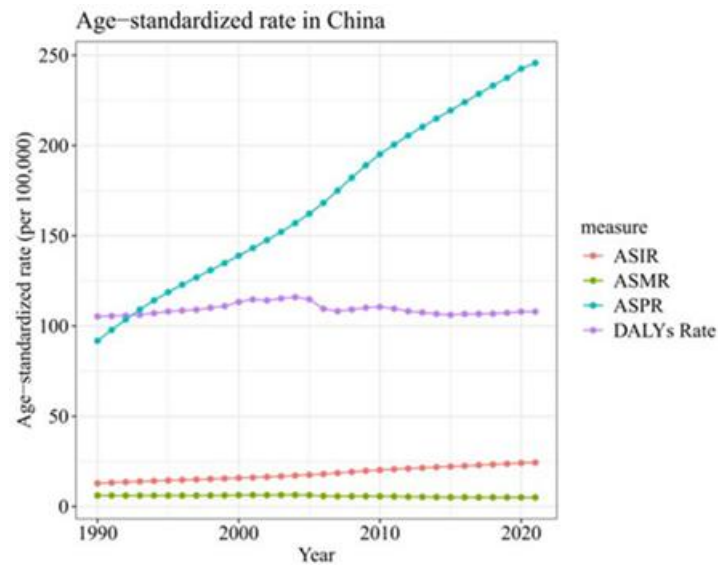


Figure 1. Trend in age-standardized rate of PD in China, 1990-2021.

Based on 1990–2021 observed data, projections indicate that from 2021 to 2040, ASIR will keep increasing in both sexes, whereas ASMR will follow divergent sex-specific trends. ASIR remains consistently higher in males, and is projected to reach nearly 40 per 100,000 by 2040 (compared with about 24 per 100,000 in females), with no narrowing sex gap. For ASMR, the male level stabilized at around 7.3 per 100,000 in 2021 and will stay steady, while female ASMR will continue declining to approximately 2.8 per 100,000 by 2040. Male ASMR stays higher throughout the period, suggesting males will remain the priority population for PD prevention and control (Figure 2).

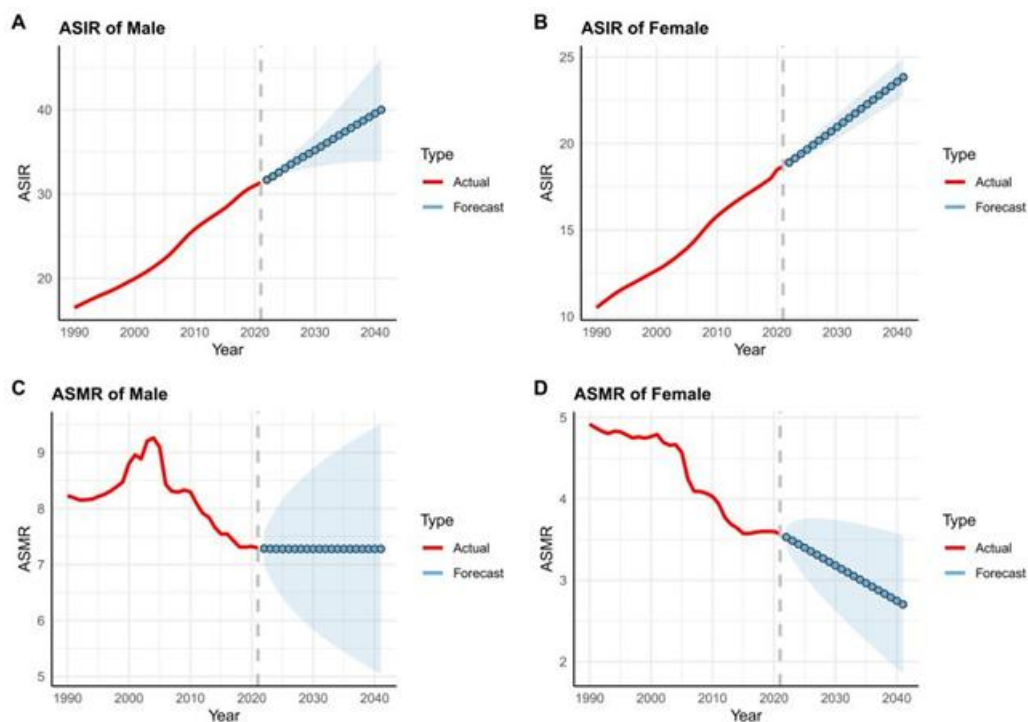


Figure 2. Gender-Specific Trends in PD Incidence: 1990-2040.

3.4. Regional distribution characteristics of PD onset and prevalence

The incidence rates of Parkinson's across various global regions vary dramatically. The figures vary from as low as 1.71 to a high of 35.73 cases per 100,000 individuals, with certain areas of high incidence soaring past the 35.73 mark. This pattern illustrates a distinct geographical clustering trend, as depicted in Figure 3. It underscores the marked discrepancies in the likelihood of developing Parkinson's among populations from different corners of the globe.

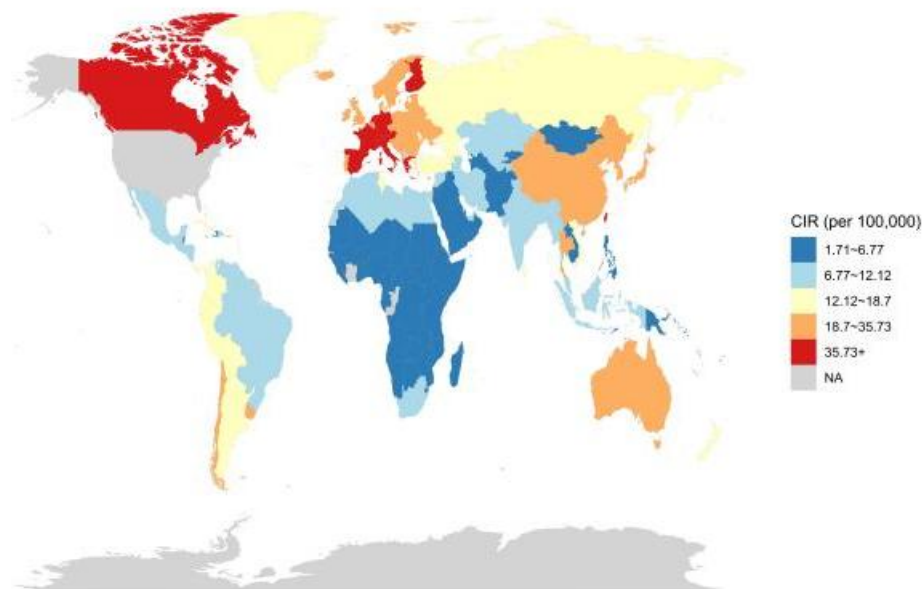


Figure 3. Geographical distribution of age-standardized incidence rates (CIR) of PD globally.

The crude prevalence rate (CPR) reveals striking variations across different regions, spanning from as low as 11.53 to a staggering 356.85 per 100,000 on a global scale. Notably, certain locales report CPR figures that surpass the upper limit of 356.85 per 100,000, underscoring the substantial differences in Parkinson's disease prevalence between various geographic locations and shining a spotlight on the glaring shortcomings in uneven disease prevention and management strategies implemented across different territories (Figure 4).

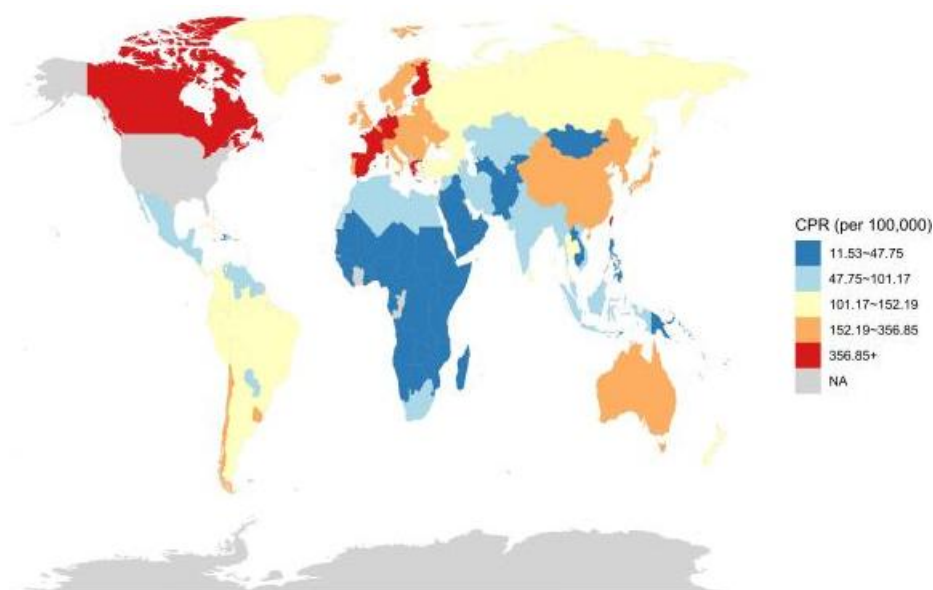


Figure 4. Geographical distribution of age-standardized prevalence rate (CPR) of PD globally.

3.5. Correlation between ASIR and Socio-demographic Index (SDI)

Correlation analysis results indicated that the global age-standardized incidence rate (ASIR) of PD was significantly positively correlated with the Socio-Demographic Index (SDI) ($r = 0.514$, $P < 0.001$), and the fitted trend line suggested a non-linear association between the two indicators (Figure 5).

In the low SDI range ($SDI < 0.5$), the ASIR of PD showed a slow upward trend with the increase of SDI, and the incidence rates in low-SDI countries represented by sub-Saharan African countries were mostly below 10 per 100 000 population. In the middle SDI range (approximately 0.5–0.7), the rising trend of incidence was accompanied by slight fluctuations, with substantial heterogeneity in incidence levels across countries. When $SDI > 0.7$, the incidence resumed a continuous upward trend; high-SDI economies including China, Canada, Qatar and most European countries were clustered in this interval, with their ASIR generally higher than 15 per 100 000 population and that of some countries exceeding 20 per 100 000 population.

The above positive correlation suggests that factors closely related to SDI, such as population aging degree, socioeconomic development level and medical diagnostic capacity, are strongly associated with the risk of PD, which can provide a scientific basis for formulating differentiated regional strategies for the prevention and control of PD.

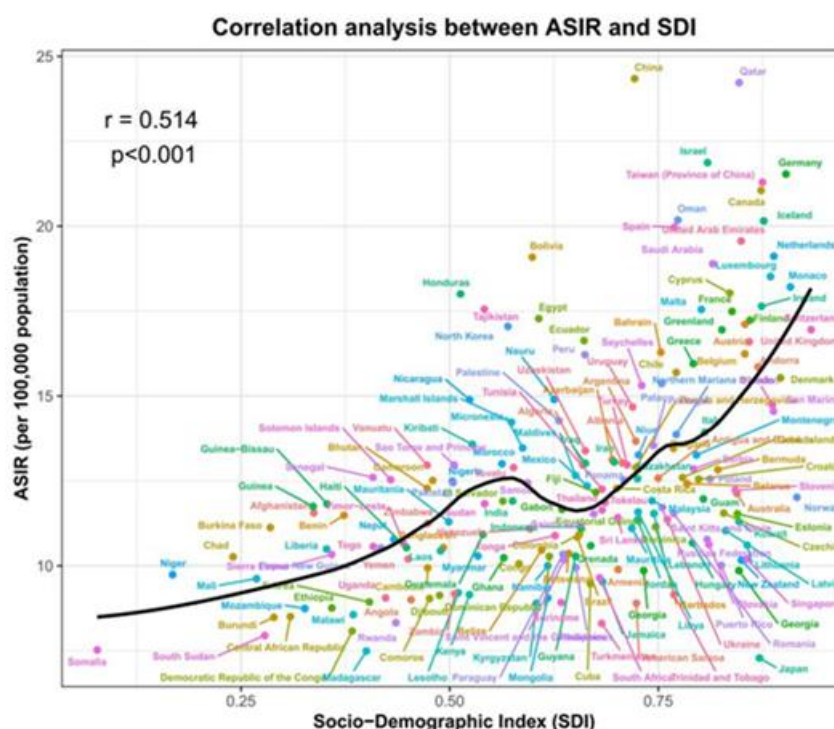


Figure 5. Correlation analysis of the ASIR of PD with the SDI.

4. Discussion

PD poses a significant health crisis worldwide, and delving into its impact in China is crucial both at home and abroad. This is because the nation's distinct demographic and economic landscape makes it a key player in the global understanding of the disease[2,12]. Building on established research, this analysis examines contextual relationships, parallels in the literature, underlying mechanisms, and the implications of our results[13]. A pronounced regional heterogeneity characterizes the global

burden of PD, with a continuous rising trend observed in middle- and high-income regions[14, 15]. Previous national epidemiological studies have confirmed obvious geographical clustering features of PD in China, with higher disease burden in developed and aging-intensive regions, which is consistent with the regional distribution characteristics observed in the present study[16]. Common drivers of the evolving PD burden, including population aging, socioeconomic development, and improved medical diagnostic capacity, provide a solid theoretical foundation for interpreting the changing epidemiological patterns in China.

Sex differences in the incidence and clinical outcomes of Parkinson's disease have been a major focus of epidemiological research[17]. Accumulating epidemiological evidence suggests that men have higher incidence, prevalence, and mortality rates of Parkinson's disease than women. These disparities may reflect sex-specific differences in genetic susceptibility, occupational and environmental exposures, lifestyle-related risk factors, as well as other biological and environmental mechanisms[18]. In contrast, females possess unique neuroprotective mechanisms mediated by estrogen, which may delay disease onset and reduce disease severity[19]. These findings explain the intrinsic gender differences in PD epidemiology and are highly consistent with the gender stratification results of this study, further complementing and supporting our core research conclusions.

The changing landscape of socioeconomic and demographic factors is a central driver of shifting PD burden dynamics[20]. Traditional influencing factors, including population aging and urbanization, have been verified to be closely correlated with increased PD risk[21]. Meanwhile, improved medical accessibility and diagnostic accuracy in high-SDI regions significantly elevate disease detection rates, further expanding the recorded disease burden[22]. Systematically analyzing the correlation between socioeconomic development level and PD epidemiological indicators can provide a scientific basis for formulating regionally differentiated and multi-targeted prevention and control strategies.

This study is well aligned with global priorities for the prevention and control of neurodegenerative diseases and China's public health strategic agenda. By systematically assessing the spatiotemporal trends, sex disparities, and socioeconomic determinants of the burden of Parkinson's disease, our findings provide robust evidence to inform the development of targeted and effective prevention and control strategies. These findings not only enhance our understanding of the epidemiological patterns and driving factors of Parkinson's disease but also offer valuable evidence for optimizing public health resource allocation, strengthening chronic disease prevention and control policies, and promoting healthy aging. Therefore, this study has important scientific implications and substantial public health relevance.

Despite the findings illustrated in this study, several limitations remain. The data adopted in this research were derived from the secondary data-set of the GBD 2021, which relies on unified global data collection and coding standards. Nevertheless, regional differences in medical diagnosis capacity and data reporting quality may cause potential bias in epidemiological indicator estimation. Future studies should combine multi-source primary epidemiological data for further verification and explore the heterogeneity of disease burden across different disease stages and clinical sub-types, so as to provide more refined evidence for the precise prevention and management of PD in China.

5. Conclusions

To sum up, the evolutionary characteristics and targeted prevention of PD burden are pivotal issues in global public health. Grounded in China's demographic and socioeconomic national conditions and building upon previous epidemiological evidence, this study systematically explored the temporal trends, gender disparities, and socioeconomic correlates of PD burden, which further enriches the research field of neurodegenerative disease epidemiology. The findings of this study provide reliable scientific support for the formulation of precise, regionally differentiated, and gender-targeted prevention and control strategies for PD. Future multidimensional and in-depth investigations are essential to further clarify the influencing mechanisms of disease burden changes and effectively reduce the overall health burden caused by PD in China.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

Funding

This work is supported by the Grassroots Health Development Research Project of Sichuan Province "Study on the Construction of DVT Prevention and Management Model for Stroke Patients in Nanchong City Based on Family-Hospital Linkage" (No. SWFZ25-Y-52).

References

- [1] Zhang, Z.X. et al. Parkinson's disease in China: prevalence in Beijing, Xian, and Shanghai. *Lancet*, 2005, 365(9459), 595-7.
- [2] Shalash, A. et al., Mapping the Parkinson's pandemic: Unveiling and addressing the global burden. *J Parkinsons Dis*, 2026, 1877718x261459875.
- [3] Wang, S. et al. Epidemiology of Parkinson's disease - Global burden of disease research from 1990 to 2021 and future trend predictions. *Clin Park Relat Disord*, 2026. 14, 100421.
- [4] Luo, Y. et al. Global, regional, national epidemiology and trends of Parkinson's disease from 1990 to 2021: findings from the Global Burden of Disease Study 2021. *Front Aging Neurosci*, 2024, 16, 1498756.
- [5] Cui, L. et al. Prevalence of Alzheimer's Disease and Parkinson's Disease in China: An Updated Systematical Analysis. *Front Aging Neurosci*, 2020, 12, 603854.
- [6] Ben-Shlomo, Y. et al. The epidemiology of Parkinson's disease. *Lancet*, 2024. 403(10423), 283-292.
- [7] Cattaneo, C.; J. Pagonabarraga. Sex Differences in Parkinson's Disease: A Narrative Review. *Neurol Ther*, 2025, 14(1), 57-70.
- [8] Schaffner, S.L. et al. Sex and gender differences in the molecular etiology of Parkinson's disease: considerations for study design and data analysis. *Biol Sex Differ*, 2025, 16(1), 7.

- [9] Thatcher, T.B.C.; S. Sharrad.; L. Bobrovskaya. Differentiating between the impact of sex and gender in Parkinson's disease: utilising these to advance current understanding and care practices. *Neurol Sci*, 2026. 47(1), 117.
- [10] Chen, S. et al. Transition and trend analysis of the burden of depression in China and different income countries: Based on GBD database and joinpoint regression model. *J Affect Disord*, 2024, 362, 437-449.
- [11] Weaver, B.; K.L. Wuensch. SPSS and SAS programs for comparing Pearson correlations and OLS regression coefficients. *Behav Res Methods*, 2013. 45(3), 880-95.
- [12] Gao, F. et al. Incidence, mortality, and burden of Parkinson's disease in China: A time-trend analysis and comparison with the global burden based on Global Burden of Disease Study 2021. *Chin Med J (Engl)*, 2025, 138(23), 3176-3183.
- [13] Yang, Q. et al. Disease Burden of Parkinson's Disease in Asia and Its 34 Countries and Territories from 1990 to 2021: Findings from the Global Burden of Disease Study 2021. *Neuroepidemiology*, 2025, 59(5), 525-557.
- [14] Ou, Z. et al. Global Trends in the Incidence, Prevalence, and Years Lived With Disability of Parkinson's Disease in 204 Countries/Territories From 1990 to 2019. *Front Public Health*, 2021, 9, 776847.
- [15] Zhang, C. et al. Burden of neurological disorders in China and its provinces, 1990-2021: Findings from the global burden of disease study 2021. *Med*, 2025, 6(8), 100692.
- [16] Meng, D. et al. Prevalence of Parkinson's disease among adults aged 45 years and older in China: a cross-sectional study based on the China health and retirement longitudinal study. *BMC Public Health*, 2024, 24(1), 1218.
- [17] Rymbai, E. et al. Molecular insights into the potential effects of selective estrogen receptor β agonists in Alzheimer's and Parkinson's diseases. *Cell Biochem Funct*, 2024, 42(3), e4014.
- [18] López-Cerdán, A. et al. Unveiling sex-based differences in Parkinson's disease: a comprehensive meta-analysis of transcriptomic studies. *Biol Sex Differ*, 2022. 13(1), 68.
- [19] Sbrini, G. et al. 17- β -estradiol potentiates the neurotrophic and neuroprotective effects mediated by the dopamine D3/acetylcholine nicotinic receptor heteromer in dopaminergic neurons. *Eur J Pharmacol*, 2024, 976, 176678.
- [20] Jiang, Y. et al. The Evolving Global Burden of Young-Onset Parkinson's Disease (1990-2021): Regional, Gender, and Age Disparities in the Context of Rising Incidence and Declining Mortality. *Brain Behav*, 2025, 15(7), e70659.
- [21] Zhong, Q.Q.; F. Zhu. Trends in Prevalence Cases and Disability-Adjusted Life-Years of Parkinson's Disease: Findings from the Global Burden of Disease Study 2019. *Neuroepidemiology*, 2022, 56(4), 261-270.
- [22] Zhang, X. et al., Global regional and national burden and trends of early-onset Parkinson's disease from 1990 to 2021. *NPJ Parkinsons Dis*, 2026.



© 2026 by the author(s); licensee International Technology and Science Publications (ITS), this work for open access publication is under the Creative Commons Attribution International License (CC BY 4.0). (<http://creativecommons.org/licenses/by/4.0/>)