Trends in Asthma Prevalence, Disease Burden, and Risk Factors in China, 1990-2019: A Post-print Study

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Abstract

Background Asthma is one of the most common chronic respiratory diseases. Understanding its epidemiological status, trends, and risk factors is of great significance for implementing targeted asthma prevention and control measures.

Objective This study analyzed the prevalence, disease burden, and trends of asthma in China from 1990 to 2019, and conducted a ranking analysis of asthma risk factors to provide a basis for effective asthma prevention and control in China.

Methods Based on the Global Burden of Disease (GBD) 2019 database, this study analyzed the trends in disease burden among different genders and age groups in China from 1990 to 2019 through disability-adjusted life years (DALY), years of life lost (YLL), years lived with disability (YLD), and prevalence rates. The ranking changes of asthma risk factors were analyzed through the population attributable fraction (PAF) of standardized DALY rates and mortality rates.

Results In 2019, China's age-standardized DALY rate, YLL rate, and YLD rate for asthma were 102.81 person-years/100,000, 24.50 person-years/100,000, and 78.31 person-years/100,000, respectively, with a standardized prevalence rate of 1,974.16 person-years/100,000. All rates were higher in males than in females, and higher in the 1-9 years and $ $65 years age groups than in other populations. From 1990 to 2019, the crude YLL rate in the $ $40 years age group gradually decreased, while the crude DALY rate, crude YLD rate, and prevalence rate in the <65 years age group showed some crossover, but thereafter exhibited a year-by-year decreasing trend. The ranking of asthma risk factors was tobacco use, high BMI, and occupational hazards. Smoking consistently ranked as the top risk factor causing asthma disease burden. In 2019, high BMI rose to second place, and its PAF for mortality rose to first place.

Conclusion From 1990 to 2019, the per capita health loss from asthma in China's population showed an overall downward trend, but the asthma disease burden in the 1-9 years and $ $65 years age groups remained at a high level. The asthma disease burden was higher in males than in females. The PAF of asthma-related risk factors changed, with the relative importance of occupational hazards declining, while the impact of tobacco use and high BMI became increasingly prominent. The focus of asthma prevention and treatment could be directed toward screening high-risk populations (1-9 years, $ $65 years, males, tobacco use, occupational exposure), smoking cessation education, weight control, and workplace monitoring and management.

Full Text

Big Data Analysis: Trends in Prevalence, Disease Burden, and Risk Factors of Asthma in China, 1990-2019

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Abstract

Background
Asthma is one of the most common chronic respiratory diseases. Understanding its epidemiological patterns, temporal trends, and risk factors is essential for developing targeted prevention and control strategies.

Objective
This study analyzes the prevalence, disease burden, and trends of asthma in China from 1990 to 2019, and examines the ranking of asthma risk factors to provide an evidence base for effective asthma prevention and control in China.

Methods
Based on the Global Burden of Disease Database 2019 (GBD 2019), we analyzed trends in disease burden by gender and age group in China from 1990-2019 using disability-adjusted life years (DALY), years of life lost (YLL), years lived with disability (YLD), and prevalence rates. Changes in asthma risk factors were assessed using the population attributable fraction (PAF) of standardized DALY and mortality rates.

Results

In 2019, the age-standardized DALY rate, YLL rate, and YLD rate for asthma in China were 102.81 per 100,000, 24.50 per 100,000, and 78.31 per 100,000 person-years, respectively, with a standardized prevalence rate of 1,974.16 per 100,000. All metrics were higher in males than females, and the 1-9 year and $ $65 year age groups showed higher burdens than other populations. From 1990-2019, the crude YLL rate gradually declined among those $ $40 years, while DALY crude rates, YLD crude rates, and prevalence showed crossover patterns in the <65 age group before declining annually. The secondary risk factors for asthma ranked as tobacco use, high BMI, and occupational hazards. Tobacco use consistently ranked as the top risk factor for asthma burden, while high BMI rose to second place in 2019, with its mortality PAF increasing to first place.

Conclusion
From 1990-2019, per capita health loss from asthma showed an overall downward trend, though the disease burden remained high in the 1-9 year and $ $65 year age groups. The asthma burden was higher in males than females. The PAF of asthma-related risk factors changed over time, with occupational hazards declining in relative importance while tobacco use and high BMI became increasingly prominent. Asthma prevention and control efforts should focus on screening high-risk groups (ages 1-9, $ $65, males, tobacco users, occupational exposures), smoking cessation education, weight control, and monitoring and management of occupational environments.

Keywords: Asthma; Incidence; Prevalence; Burden of disease; Trend analysis; Risk factors; DALY

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1. Methods

1.1 Data Sources

This study utilized data from the Global Burden of Disease Database 2019 (GBD 2019), which provides comprehensive assessments of prevalence, mortality, and disease burden for 369 diseases and injuries across 204 countries and territories, along with health loss attributable to 86 risk factors [7]. We extracted prevalence, mortality, years of life lost (YLL), years lived with disability (YLD), and disability-adjusted life years (DALY) for asthma in China from 1990-2019. The population attributable fraction (PAF) was analyzed to examine the ranking and changes in asthma risk factors.

1.2 Risk Factor Assessment

1.2.1 Disease Burden Indicators We employed DALY, YLL, and YLD to assess China's asthma disease burden. DALY represents the total healthy life years lost from disease onset to death, comprising both years lost due to

premature mortality (YLL) and years lived with disability (YLD), calculated as DALY = YLL + YLD [8].

1.2.2 Risk Factor Evaluation Indicator The population attributable fraction (PAF) quantifies the proportion of disease or death in a population that can be attributed to a specific risk factor exposure. Eliminating that exposure would reduce total population morbidity or mortality by that proportion, making PAF highly significant for public health research [9].

1.2.3 Asthma Risk Factors GBD categorizes risk factors causally associated with asthma into three levels: Level 1 includes behavioral, environmental/occupational, and metabolic risks; Level 2 includes tobacco use, occupational hazards, and high BMI; and Level 3 includes smoking and occupational asthmagens. This study focused primarily on Level 2 risk factors.

1.3 Statistical Methods

Data processing and statistical analysis were performed using R software. Disease burden and prevalence indicators for the population aged $ 1 year from 1990–2019 were stratified by gender and age (in 5–year groups). The average annual growth rate was c
(^{n} $\sqrt{}$ (a_n/a_{0}$) - 1) × 100%, where a_0 represents the indicator value in the baseline year (year 0) and a represents the value in year n.

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2. Results

2.1 Current Asthma Prevalence and Disease Burden in 2019

In 2019, China's age-standardized DALY rate, YLL rate, and YLD rate for asthma were 102.81, 24.50, and 78.31 per 100,000 person-years, respectively, with a standardized prevalence rate of 1,974.16 per 100,000. All rates were significantly higher in males than females (P<0.05). The 1-9 year and $ $65 year age groups showed higher DALY rates, YLD rates, and prevalence than other populations. Differences in YLL rates primarily originated from the $ $65 year group, where premature mortality loss was substantially higher in males than females (P<0.05) [Figure 1: see original paper].

The crude DALY rate in 2019 showed a slight upward trend in the 1-5 year age group, then declined and stabilized in the 5-10 year group, but rose sharply in those $ $60 years. The crude YLL rate increased markedly in the $ $60 year population. Both crude YLD rates and prevalence exhibited a bimodal distribution, with peaks in the 5-9 year and 75-79 year age groups. Between 1990-2019, the crude YLL rate gradually declined among those $ $40 years, while DALY crude rates, YLD crude rates, and prevalence showed crossover patterns in the <65 age group before trending downward annually [Figure 2: see original paper].

2.2 Trends in Asthma Prevalence and Disease Burden in China, 1990-2019

From 1990-2019, the total population's crude and standardized DALY rates initially declined, rose slightly after 2015, then fell again in 2018. Both crude and standardized YLL rates showed fluctuating declines. Crude YLD rates and prevalence declined initially, rose slightly after 2014, then fell in 2019. Standardized YLD and prevalence rates followed similar patterns to crude rates initially, then began declining after 2018 [Figure 3: see original paper]. Temporal trends in all indicators were similar between males and females, with males showing higher standardized DALY rates, YLL rates, YLD rates, and prevalence than females across all years [Figure 4: see original paper].

2.3 PAF and Trends of Asthma Risk Factors in China, 1990-2019

From 1990-2019, the average annual change rates for standardized DALY and mortality rates attributable to all eight Level 3 risk factors were negative. Metabolic risks and high BMI showed the largest absolute values of average annual change in PAF for standardized DALY and mortality rates. In 1990, the ranking of secondary risk factors by PAF for standardized mortality was tobacco use, high BMI, and occupational hazards, while the ranking by PAF for standardized DALY rate was tobacco use, occupational hazards, and high BMI. By 2019, high BMI's PAF for standardized DALY rate had surpassed occupational hazards to rank second, while its PAF for standardized mortality ranked first. Although absolute values of standardized mortality and DALY rates declined, high BMI's PAF for standardized mortality and DALY rate showed clear upward trends, with average annual growth rates of 1.82% and 3.24%, respectively. Tobacco use's PAF for standardized DALY rate increased slightly, with an average annual growth rate of 0.71% .

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3. Discussion

Our findings reveal that DALY rates, YLD rates, and prevalence attributable to asthma in China increased significantly among the 1-9 year and $ $60 year age groups from 1990-2019. The disease burden was higher in males than females across all age groups. In 2019, the three leading risk factors for health loss from asthma were tobacco use, high BMI, and occupational hazards, with high BMI's PAF increasing markedly during 1990-2019 and becoming the primary cause of asthma mortality.

Asthma risk and disease burden showed an "increase-decrease-increase" pattern with age, most pronounced in the 1-9 year and $ $60 year groups. Among children aged 1-9 years, changes in DALY rates were primarily driven by YLD rates, indicating asthma's substantial impact on quality of life and health in children—likely related to poor treatment adherence and symptom control [12].

Parents should adopt more proactive parenting approaches, and healthcare providers should strengthen attention to symptom control in young asthma patients through enhanced education to improve adherence. Older adulthood represents the second peak period for asthma prevalence and burden, possibly due to declining physiological function, reduced drug metabolism, and decreased tolerance with aging [13-14].

Gender differences in asthma risk and burden were evident, with males showing higher risks than females among both children (1-19 years) and older adults ($ $65 years). Beyond physiological factors such as genetics, sex hormones, and maternal influences, differences in tobacco use rates, overweight/obesity prevalence, occupational asthmagen exposure types and opportunities, and treatment adherence between genders may contribute to these disparities [15-16]. Targeted measures for high-risk groups are needed to reduce their disease burden and consequently lower the overall population burden.

Known risk factors for asthma are relatively concentrated among the 86 Level 4 risk factors in GBD, with asthma associated with eight factors primarily involving tobacco use, occupational hazards, and high BMI. Tobacco use represents the most significant direct risk factor for asthma [17], and its PAF for DALY rate increased during 1990-2019. Previous studies demonstrate that both active and passive smoking are independent risk factors for asthma onset and adversely affect asthma control, treatment efficacy, and prognosis [18-19]. With China's smoking rate among those $ $15 years reaching 26.6%—over 300 million smokers in 2018—and approximately 740 million people exposed to secondhand smoke [20-21], strengthened health management and smoking cessation interventions are urgently needed.

High BMI is an important asthma risk factor across all age groups [22] with potentially more severe outcomes. This study found that the PAF of standardized DALY rate attributable to high BMI increased from 4.93% to 12.44%, while its PAF for standardized mortality rose from 9.70% to 16.38%, making it a major contributor to asthma burden and the leading cause of asthma mortality. With overweight/obesity rates reaching 49.5% among school-age children [23-24] and 51.0% in adult men and 47.3% in adult women [25], high BMI has gradually become a major obstacle to asthma prevention and control in China. Weight management through dietary intervention and exercise should be recommended for overweight asthma patients to reduce inflammation and improve asthma control [26].

The PAF for occupational exposure in DALY rates declined from 1990-2019. Occupational allergens and irritant chemicals in industries such as chemicals, synthetic fibers, and rubber can induce asthma [27], though improved production technology and government regulation may have substantially reduced occupational asthmagen exposure [28]. Continued health education and emphasis on personal protective equipment for relevant occupational groups remain essential.

Asthma remains a major chronic disease affecting Chinese residents. While

health loss from asthma showed an overall downward trend from 1990-2019, the PAF of risk factors changed, with tobacco use remaining the most significant factor and high BMI's impact growing substantially. Achieving optimal asthma control and minimizing exacerbation risk are primary goals for reducing asthma burden. Our recommendations for tertiary prevention include: (1) prioritizing screening in high-risk groups (ages 1-9, $ $65, males, tobacco users, occupational exposures); (2) implementing early health education to reduce tobacco use and secondhand smoke exposure; and (3) promoting healthy lifestyles with weight management through diet and exercise.

This study has limitations. We assessed asthma burden only by gender, age group, time, and risk factors, without analyzing urban-rural differences. Future research should incorporate additional dimensions for more comprehensive results. Additionally, as this study was based on GBD 2019 data rather than direct observations, the results are inherently conservative.

Author Contributions: Qu Yuanyuan, Cao Miao, and He Xiaoshuang conceptualized the study and drafted the manuscript. Qu Yuanyuan and Cao Miao collected and processed data, performed statistical analyses, and created figures. Wang Jing, Cheng Li, and He Xiaoshuang revised the manuscript. Wang Jing and Cheng Li managed references. He Xiaoshuang supervised quality control.

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