Preplanned Studies

Urban-Rural Disparity in Mortality Patterns of Respiratory Diseases Among Older Adults — China, 1987–2021

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Summary

What is already known about this topic?

Respiratory diseases (RDs) are the primary cause of death in older adults in China. However, there is limited evidence regarding the disparity in mortality rates of RDs between urban and rural areas among the elderly population.

What is added by this report?

The age-standardized mortality rate (ASMR) due to RDs in the elderly population in both urban and rural areas of China has shown a consistent decrease. This trend is observed in both males and females. However, there was no significant change in the average annual percentage of ASMR for pneumonia among the urban elderly population and rural elderly men throughout the study period.

What are the implications for public health practice?

Efforts should be made in China to reduce mortality from chronic lower respiratory disease and pneumonia among the elderly, particularly in urban populations.

Respiratory diseases (RDs) are a significant cause of mortality in China, ranking fourth after heart disease, cancers, and cerebrovascular diseases. This burden is particularly prominent among the elderly population (*1*). However, there is limited evidence on the disparity in mortality patterns of RDs, pneumonia, and chronic lower respiratory disease (CLRD) between urban and rural areas among the elderly in China. This study aims to address this research gap by analyzing mortality trends of RDs among individuals aged 60 years or older in both urban and rural areas of China from 1987 to 2021. The study utilized joinpoint regression models and age-period-cohort (APC) models to assess the trends, revealing a decline in RDs mortality. However, there was no statistically significant average annual percentage change (AAPC) in the age-standardized mortality rate (ASMR) for pneumonia over the past 35 years. These findings highlight the importance of addressing pneumonia in the elderly population, while also emphasizing the need for preventative measures and treatment for CLRD and RDs as a whole.

Age-specific mortalities of RDs, pneumonia, and CLRD between 1987 and 2021 were obtained from China's National Health Commission (NHC) death registration system, which collects data from administrative organizations. The World Standard Population was used to calculate ASMRs (*2*). Joinpoint regression models using the Joinpoint Regression Program (version 4.9.10, Statistical Research and Applications Branch, National Cancer Institute, Washington, USA) were performed to identify years with significant changes in RD mortality trends during the study period. To address the exact collinearity among age effects, period effects, and cohort effects, APC models were employed (*3*). We used the web tool developed by the US National Cancer Institute (https://analysistools.cancer.gov/apc/). Statistical significance was determined at a *P*-value of <0.05 (two-tailed).

Figure 1 presents the long-term trends in ASMR for RDs, pneumonia and CLRD in China's elderly population, stratified by geographical area and sex. From 1987 to 2021, there was a decline in ASMR for the elderly in both urban and rural areas, as well as in both sexes. Old men consistently had higher ASMR than old women, regardless of their residential area. The ASMR was also consistently higher in rural areas compared to urban areas, although the gap between the two narrowed over time. The ASMR for CLRD followed a similar trend, while the ASMR for pneumonia showed a peculiar pattern where the ASMR in urban residents exceeded that in rural residents. Over the study period, there was a notable decline in ASMR for RDs in China's elderly population, with reductions of 78.29% in urban areas and 79.34% in rural areas, respectively.

Table 1 presents the findings of the joinpoint regression analysis. Among rural residents, there was a consistent declining trend in ASMR of RDs, with an AAPC of –4.62%. In urban residents, although the

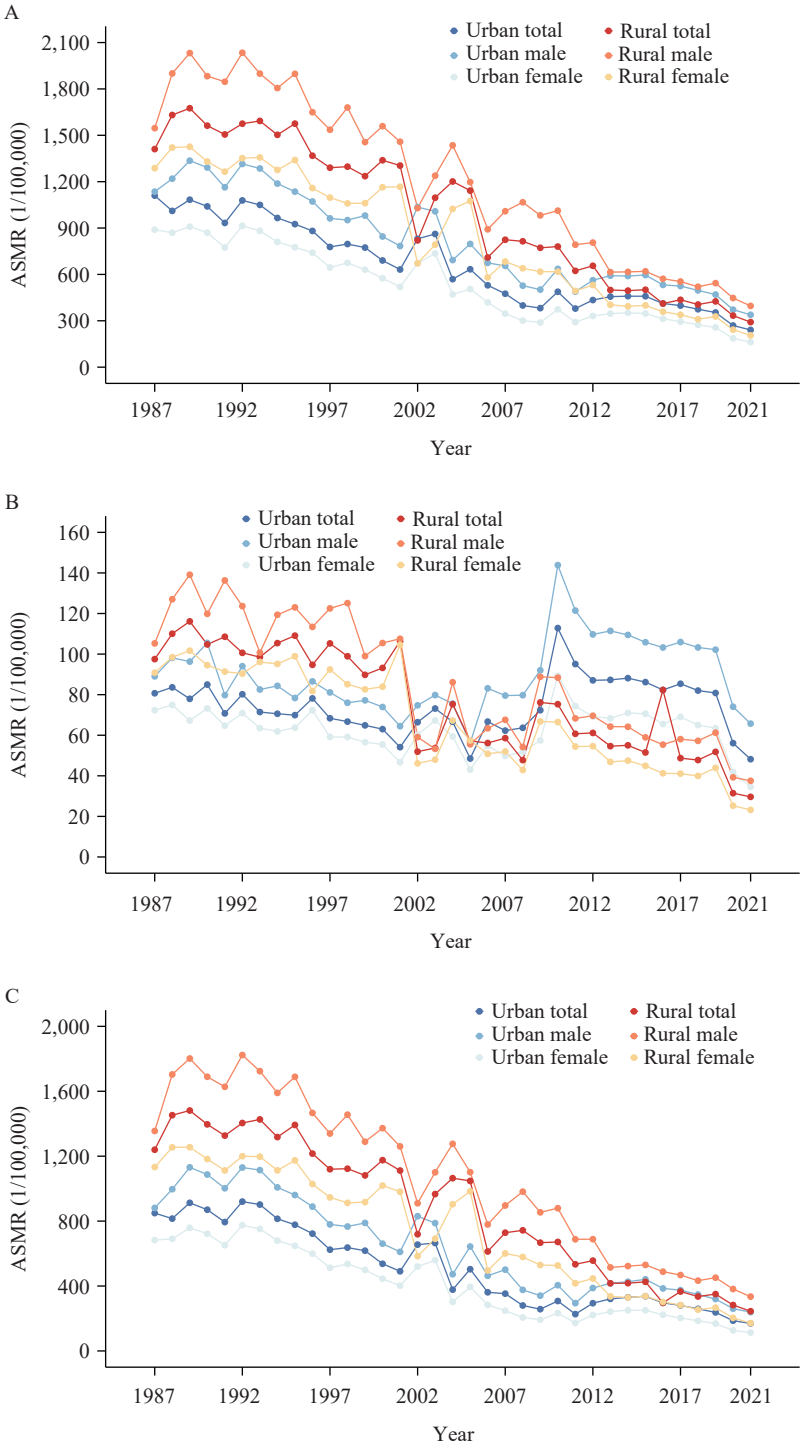

FIGURE 1. Trends in ASMR of the elderly in urban and rural China by sex, 1987–2021. (A) From RDs; (B) from pneumonia; (C) from CLRD.
Abbreviation: ASMR=age-standardized mortality rate; CLRD=chronic lower respiratory disease; RDs=respiratory diseases.

ASMR of RDs also decreased with an AAPC of –4.30% per year, there was a non-significant upward trend between 2008 and 2016, with an annual percentage change (APC) of 1.21% per year. No significant changes were observed in ASMR of pneumonia among urban residents and rural males from 1987 to 2021. However, in rural residents and rural females, there was a consistent downward trend. In terms of CLRD, the ASMR for the entire population showed a decreasing trend throughout the

TABLE 1. Joinpoint analysis of ASMR of the elderly in China from RDs, pneumonia, and CLRD in urban and rural areas.

Categories	ASMR (per 100,000)		Total study period		Period 1		Period 2		Period 3		Period 4	
	1987	2021	AAPC (%)	95% *CI*	Years	APC (%)	Years	APC (%)	Years	APC (%)	Years	APC (%)
Urban												
RDs												
Total	1,109.77	240.93	−4.30*	(−5.82, −2.74)	1987–2003	−2.71*	2003–2008	−10.50*	2008–2016	1.21	2016–2021	−11.21*
Male	1,135.18	338.67	−3.79*	(−5.49, −2.05)	1987–2003	−2.51*	2003–2009	−8.44*	2009–2015	2.70	2015–2021	−8.56*
Female	889.29	162.30	−4.88*	(−6.47, −3.28)	1987–2003	−2.74*	2003–2008	−12.32*	2008–2016	1.46	2016–2021	−13.33*
Pneumonia												
Total	93.62	48.18	−1.67	(−4.17, 0.89)	1987–2007	−1.74*	2007–2010	18.49	2010–2019	−2.24	2019–2021	−23.17*
Male	89.02	65.72	−1.28	(−2.79, 0.26)	1987–2005	−2.14*	2005–2010	12.17*	2010–2019	−1.88	2019–2021	−20.17*
Female	72.35	34.50	−2.35	(−5.00, 0.37)	1987–2007	−1.96*	2007–2010	15.03	2010–2019	−2.05	2019–2021	−27.56*
CLRD												
Total	849.29	169.42	−4.82*	(−6.83, −2.77)	1987–2003	−3.25*	2003–2009	−12.21*	2009–2015	5.05	2015–2021	−10.49*
Male	881.1	239.09	−3.95*	(−6.35, −1.48)	1987–1993	2.61	1993–2011	−6.27*	2011–2015	6.68	2015–2021	−9.78*
Female	682.84	113.04	−5.43*	(−7.44, −3.38)	1987–2003	−3.37*	2003–2009	−13.77*	2009–2015	5.74	2015–2021	−12.42*
RDs												
Total	1,410.73	291.47	−4.62*	(−5.38, −3.86)	1987–2000	−1.66	2000–2021	−6.41*	–	–	–	–
Male	1,546.07	396.05	−4.01*	(−4.83, −3.18)	1987–1995	0.91	1995–2021	−5.48*	–	–	–	–
Female	1,287.15	205.73	−5.26*	(−6.08, −4.42)	1987–2004	−2.87*	2004–2021	−7.58*	–	–	–	–
Rural												
Pneumonia												
Total	97.52	29.63	−4.15*	(−7.01, −1.20)	1987–2019	−2.69*	2019–2021	−24.82	–	–	–	–
Male	105.27	37.54	−3.06	(−6.74, 0.78)	1987–2000	−0.78	2000–2003	−20.17	2003–2010	4.66	2010–2021	−5.28*
Female	90.82	23.20	−4.65*	(−7.19, −2.03)	1987–2019	−3.07*	2019–2021	−26.63	–	–	–	–
CLRD												
Total	1,239.77	244.72	−5.10*	(−5.89, −4.29)	1987–2004	−2.69*	2004–2021	−7.44*	–	–	–	–
Male	1,355.28	334.68	−4.15*	(−5.04, −3.25)	1987–1995	1.04	1995–2021	−5.69*	–	–	–	–
Female	1,132.66	171.22	−5.44*	(−6.28, −4.60)	1987–2004	−2.91*	2004–2021	−7.92*	–	–	–	–

Note: "–" means no joinpoints identified.

Abbreviation: RDs=respiratory diseases; CLRD=chronic lower respiratory disease; ASMR=age-standardized mortality rate; APC=annual percent change; AAPC=average annual percent change; *CI*=confidence interval.

* $P<0.05$.

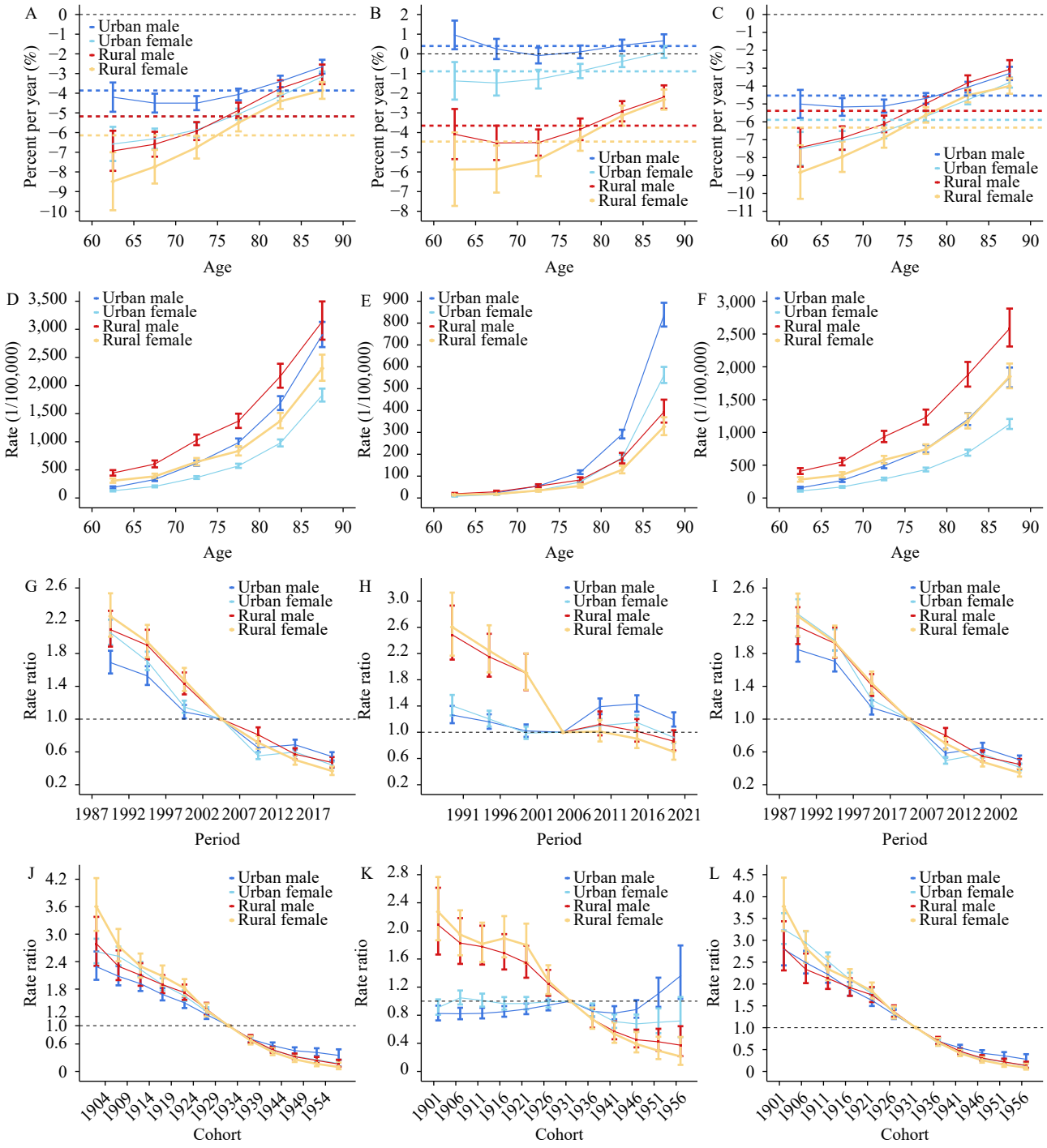

FIGURE 2. Local drifts with net drifts and age-period-cohort effects for mortality from RDs and selected RDs of the elderly in China from 1987 to 2021. (A) Local drifts with net drifts for mortality from RDs; (B) local drifts with net drifts for mortality from pneumonia; (C) local drifts with net drifts for mortality from CLRD; (D) age effects for mortality from RDs; (E) age effects for mortality from pneumonia; (F) age effects for mortality from CLRD; (G) period effects for mortality from RDs; (H) period effects for mortality from pneumonia; (I) period effects for mortality from CLRD; (J) cohort effects for mortality from RDs; (K) cohort effects for mortality from pneumonia; (L) cohort effects for mortality from CLRD.
Abbreviation: RDs=respiratory diseases; CLRD=chronic lower respiratory disease.

study period from 1987 to 2021.

Figure 2A–C illustrates the netdrift and localdrift for RDs. In the entire urban population, the netdrift was –4.35% [95% confidence interval (*CI*): –4.59, –4.12]. Among rural residents, the netdrift was –5.53% (95% *CI*: –5.87, –5.19). Notably, females and rural residents

experienced greater declines in RDs. Across all age groups, the local drifts were negative, indicating improvements. The most significant improvements were observed in rural women aged 60 to 65 years, with a netdrift of –8.49% per year (95% *CI*: –9.95, –7.00). The netdrift and localdrifts for CLRD followed similar trends as RDs. However, pneumonia showed a different pattern. In urban males, the netdrift for pneumonia was positive at 0.40% per year (95% *CI*: 0.13, 0.67), and the local drifts for urban males aged 60 to 65 years and 80 years and older were also positive.

The age, period, and cohort effects on mortality from RDs are illustrated in Figure 2D–L. After adjusting for period effects, RDs mortality increased with age in the reference cohort, with a more rapid increase in older age groups. Males consistently had higher mortality rates across all age groups. Rural residents had higher rates of RDs and CLRD compared to urban residents, while pneumonia exhibited a different pattern (Figure 2D–F). Regarding period effects, both males and females in urban and rural areas experienced a decline of RD mortality over time. The period from 1987 to 1991 had the highest risk in each subgroup (Figure 2G–I). Cohort effects revealed that older birth cohorts had a higher risk across most subgroups (Figure 2J–L).

DISCUSSION

This study utilized mortality data from China's NHC to analyze the mortality patterns of RDs among individuals aged 60 years or older in urban and rural areas of China over a 35-year period. The findings demonstrate a consistent decline in RDs mortality among the elderly population in both urban and rural areas, irrespective of gender. The study also observed that although the ASMR was lower for the urban elderly population compared to the rural elderly population throughout the study period, the rural elderly population witnessed a more significant reduction, resulting in a narrowing of the disparity between the two groups. Additionally, elderly women, who initially had a lower RDs ASMR, experienced greater improvements in mortality rates from RDs compared to elderly men. The analysis of age-period-cohort effects revealed that individuals in younger age groups, later study periods, and younger birth cohorts had a lower risk of RDs mortality.

The declining trend in RDs ASMR among Chinese elderly individuals across all age groups, accompanied by a decrease in risk among different time periods and birth cohorts, signifies notable achievements in the prevention and treatment of RDs in China, especially considering the aging population. The diminishing urban-rural disparity in RDs mortality may be attributed to improvements in the rural healthcare system and the quality of illness prevention and control efforts (*4*). In contrast to the urban-rural disparities, males continue to experience higher RDs mortality rates and have derived fewer benefits from 1987 to 2021, likely due to the high smoking prevalence among Chinese men (*5*). In order to further reduce RDs mortality rates and accomplish the goals outlined in Healthy China 2030, it is imperative to reduce smoking rates, particularly among Chinese men. Strong national tobacco control regulations and strict adherence to the WHO Framework Convention on Tobacco Control could facilitate this process.

The relatively stable trend in ASMR for RDs and CLRD among the urban elderly population in China from 2008 to 2016 can be attributed to multiple factors. These include the worsening aging situation (*6*–*7*) and increasing air pollution in urban areas (*8*), which may also explain the higher ASMR for pneumonia in the same population during the later study period. Additionally, the implementation of the Environmental Protection Law of the People's Republic of China, effective from January 1, 2015 (*9*), may have contributed to the subsequent decline in ASMR for RDs and CLRD after 2016.

The pneumonia ASMR in the urban elderly population and rural elderly men did not show significant differences during the study period. This finding highlights the need for increased attention to pneumonia in the elderly. Prior research has shown a substantial decline in mortality from lower respiratory infections (LRI) in children under 5 years old from 1990 to 2019; however, progress in reducing LRI mortality among older age groups has been more limited (*10*).

This study has certain limitations. First, the data analyzed in this study were monitoring data rather than cohort data. Second, the categorization of deaths was coded using ICD-9 prior to 2002, and transitioned to ICD-10 from 2002 onwards. However, a previous study has demonstrated that the impact of these coding changes on the results is minimal (*11*).

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