

ORIGINAL RESEARCH ARTICLE

Determinants of adolescent deaths in China

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Abstract

This study examined the determinants of adolescent deaths in China, focusing on the period from 2000 to 2022. The objective is to analyze the relationship between health expenditure, GDP per capita, urbanization, and injury related mortality with adolescent mortality rate. The study employed secondary data sourced from the World Development Indicators (WDI) and the Global Burden of Disease (GBD) database. The graphical trend analysis revealed a persistent decline in adolescent deaths over the study period, corresponding with rising health expenditure and economic growth. However, injury-related deaths made up a significant percentage of adolescent deaths in the early years of the study period, before steadily decreasing in subsequent years. Evidence indicates that macroeconomic advancements and increased healthcare expenditure have significantly mitigated adolescent mortality, injury-related incidents persist as a primary structural determinant of death within this demographic. The study emphasizes the need of persistent health funding, enhanced safety protocols, and targeted injury prevention programs to further mitigate adolescent deaths rate in China. (*Afr J Reprod Health* 2026; 30 [13]: 25-32).

Keywords: Adolescent deaths, health expenditure, GDP, urbanization, injury, China

Résumé

Cette étude a examiné les déterminants de la mortalité des adolescents en Chine sur la période allant de 2000 à 2022. L'objectif était d'analyser la relation entre les dépenses de santé, le PIB par habitant, l'urbanisation, la mortalité due aux traumatismes et le taux de mortalité des adolescents. L'étude s'est appuyée sur des données secondaires provenant des indicateurs du développement dans le monde (WDI) et de la base de données sur la charge mondiale de morbidité (GBD). L'analyse graphique des tendances a révélé une baisse constante de la mortalité des adolescents au cours de la période étudiée, parallèlement à l'augmentation des dépenses de santé et à la croissance économique. Toutefois, les décès dus à des traumatismes représentaient une part importante de la mortalité des adolescents au début de la période, avant de diminuer progressivement par la suite. Si les données indiquent que les progrès macroéconomiques et l'accroissement des dépenses de santé ont considérablement réduit la mortalité des adolescents, les traumatismes demeurent un déterminant structurel majeur des décès au sein de cette tranche d'âge. L'étude souligne la nécessité de maintenir le financement de la santé, de renforcer les protocoles de sécurité et de mettre en œuvre des programmes ciblés de prévention des traumatismes afin de réduire davantage le taux de mortalité des adolescents en Chine. (*Afr J Reprod Health* 2026; 30 [13]: 25-32).

Mots-clés : Décès d'adolescents, dépenses de santé, PIB, urbanisation, traumatismes, Chine

Introduction

Adolescence, the time between childhood and adulthood (ages 10–19), is a distinct stage of human development and an important time for building a strong foundation for health.^{1, 2} To achieve a high standard of health, the World Health Organization (WHO) recently released the Global Strategy for Women's, Children's, and Adolescents' Health (2016–2030), which highlighted more strategic investments among adolescents aged 10–19 years.^{3, 4} The goal of this global strategy is to reduce premature mortality from non-communicable

diseases in adolescents by one-third from 2016 to 2030, using mortality and cause of death as indicators.⁵⁻⁷

Adolescent deaths continue to be a significant public health problem globally and within China. Mortality among children and adolescents aged 10-14 has declined significantly over the past two decades due to improvement in healthcare, socioeconomic development, and public health interventions. Globally, mortality falls from the peak at under 5, to a low in 10–14-year-olds, then increases again for older adolescents and young adults. Mortality rate among young adolescents (10

to 14 years) declined from approximately 10 deaths per 1000 children aged 10 to 3 deaths per 1000, reflecting broad improvements in child survival, although injuries remain a leading cause of death in this age group.⁷

In China, national demographic censuses data and Global Burden of Disease estimates reveal steady decline in mortality rate among adolescent aged 10-19 years, with the while aged 10-14 years' experience larger reductions when compared with the older adolescents.⁸ Mortality in children and adolescents has varied significantly across regions and countries by socioeconomic status, sex, ethnic group, and culture.⁹ There have also been major shifts over time with an epidemiologic transition from predominantly communicable diseases to noncommunicable diseases (NCDs).^{10,11} China currently accounts for around one fifth of the world's children and adolescents.¹² Although it has made great progress in reducing death rates across childhood, World Health Organization has recently noted that¹³ substantial further progress could be achieved with the extension of public health interventions to children over the age of 5 years. However, to our knowledge, there has been no systematic study of trends of mortality at subnational levels and the changes of specific causes of death among children and adolescents aged 5-19 years.

Despite this progress, mortality among the 10-14 age group remains influenced by structural determinants including regional socioeconomic status, healthcare infrastructure, and urban-rural disparities. Recent research underscores that these structural factors remain key drivers of adolescent mortality in China even as national mortality declines.⁸ But the magnitude of injury exposure leading to mortality among the 10-14 age group in China remains relatively unknown in literature. Understanding these determinants is vital for policy formulation aimed at achieving Healthy China 2030 targets and reducing premature mortality in younger adolescents. This study employs a descriptive trend analysis to explore how key socioeconomic indicators correlate with adolescent mortality in China from 2000 to 2022.

Literature review

Zhou *et al.*¹⁴ examined recent trends in child injury mortality in China using injury mortality data from

2010-2021 for children and adolescents aged 0-19 years. The study used Jointpoint regression models and revealed that the age standardized injury mortality significantly dropped among children and youth aged 0-19 years.

Liu *et al.*¹⁵ described the secular trends of cause-specific mortality among adolescents aged 10 to 24 years from 2004 to 2019 and explored the association between mortality and economic status, education level as well as health investment. Using age-period-cohort analysis and panel data regression, the result revealed that top five causes of mortality were road injuries, drowning, intentional self-harm and sequelae, leukaemia, and falls among adolescents aged 10 to 24 years in China in 2019.

Luo *et al.*¹⁶ analyzed the epidemic characteristics of injury-related deaths in children and adolescents aged 1-24years old in China from 2010-2020. Using a joint point regression, the study showed that death rate from injuries was higher in males than females. And higher in rural areas compared with urban areas. The overall injury standardized mortality rate in the 1-24-year-old group shows a decreasing trend, but it remained at a relatively high level.

Zhu *et al.*¹⁷ estimated adolescent mortality and causes of death in China, using data from the Global Burden of Disease study from 1990 to 2019. The study used autoregressive integrated moving average model to predict non-communicable disease (NCD) mortality rates and rank changes in the leading causes of death until 2030. Findings revealed a notable decline in all-cause mortality rates among Chinese adolescents aged 10-19 years.

Dong *et al.*⁸ analyzed the recent trends of mortality and rankings of causes of death in Chinese children and adolescents from 1953 to 2016, using data on mortality and causes of death in Chinese children and adolescents aged 5-19 years from the China Health Statistics Yearbook and the Global Burden of Disease Study. The results demonstrated large subnational disparities for all-cause mortality existed in national 31 provinces with higher mortality in western regions compared with eastern regions.

Injuries dominated the causes of death compared with noncommunicable diseases and communicable, maternal and neonatal, and nutritional diseases. Findings revealed that the

leading three causes of death were road injuries, drowning, and leukemia.

This literature suggests that while national adolescent mortality rates continue to decline, structural and socioeconomic factors, particularly related to injuries, urbanization, and regional disparities, remain central determinants of mortality among younger adolescents in China. This study builds on this evidence by providing focused graphical analysis on the 10-14 age group from 2000 to 2022.

Methods

This study utilized a descriptive analysis approach to estimate determinants of deaths among adolescents aged 10-14 in China from 2000 to 2022. Drawing on five-year interval data from 2000 to 2022, obtained from the World Development Indicators (WDI) by the World Bank¹⁸ and Global Burden of Disease (GBD) database¹⁹, the research examined the relationships between health expenditure, injury mortality, urbanization rate, GDP per capita, and the overall adolescent mortality in China. Injury mortality proportion was sourced from the GBD database by selecting “Deaths” as the measure, “injuries” as the cause, and “percent” as the metric for adolescents aged 10-14 years in China.

Estimation procedures

This study analysed the determinants adolescent's death in China. Adolescent mortality was used as a proxy for adolescent deaths aged 10-14, while urban population growth represented urbanization. Injury mortality proportion served as indicators adolescent deaths due to injuries. These measurement choices are consistent with previous research, including studies by.^{20,21,15} To facilitate a comprehensive analysis, graphical methods were employed, offering a clear and detailed understanding of the topic.

Ethical considerations

The study is based on publicly available statistical data from the WDI database. The data are aggregated, anonymized, and contain no personal or identifiable information; thus, there is no risk of

harm. No individual-level datasets were used, and all analyses adhered to the terms of use of the data provider. The methodological approach guiding the analysis was systematic and transparent. Because the research did not involve human or animal subjects, it did not require ethical approval.

Data analysis

To achieve the objective of this study, graphical analysis was employed as the primary data analysis technique. Graphs were utilized to assess and identify patterns, trends, and changes in the data over time, providing a clear and comprehensive understanding of the subject matter.

Results

Figure 1 shows the relationship between health expenditure (HE) as a percentage of GDP and adolescent mortality rate (AMR) in China from 2000 and 2022. In the year 2000, health expenditure was approximately 4.5% of GDP, while adolescent mortality rate was high at 1.8 deaths per 1,000 population. By 2005, health expenditure was 4.1%, and adolescent mortality rate declined to 1.5 deaths per 100,000. In 2010, a rise in health expenditure was observed with a decline in adolescent mortality to 1.2 deaths per 1,000. Health expenditure increased significantly in 2015, while adolescent mortality declined further to 1.1 deaths per 1,000. In 2020 and 2022, health expenditure continued to rise, with a constant decline in adolescent mortality to below 0.9 deaths per 1,000.

Figure 2 shows a line graph of the relationship between GDP per capita (GDPpc) and adolescent mortality rate (AMR) in China from 2000 to 2020. In 2000, GDP per capita was low at 2.8%, while adolescent mortality rate was high at 1.8 deaths per 1,000. By 2005, GDP per capita increased significantly to 4.5%, while adolescent mortality rate reduced to 1.5 deaths per 1,000. In 2010, GDP per capita increased further to 7.7%, with a continued reduction in adolescent mortality at 1.2 deaths per 1,000. In 2015, GDP per capita and adolescent mortality rate both coincided at 1.1%. By 2020 and 2022, GDP per capita rose to 1.7%, while adolescent mortality rate had a constant decline at 0.9 deaths per 1,000.

Measurements of variables

Variable	Code	Indicator Name	Measurement	Source
Adolescent mortality rate	AMR	Mortality rate, ages 10-14 (per 1,000)	Deaths per 1,000 among ages 10-14	WDI
Urbanization rate	URB	Urban population	Percentage	WDI
Economic Growth	GDPpc	GDP per capita	US Dollars (constant 2015)	WDI
Health expenditure (% of GDP)	HE	Current health expenditure	Percentage of GDP	WDI
Injury mortality proportion	INJprop	Deaths due to injuries (Ages 10-14)	Percentage of total adolescent deaths	GBD

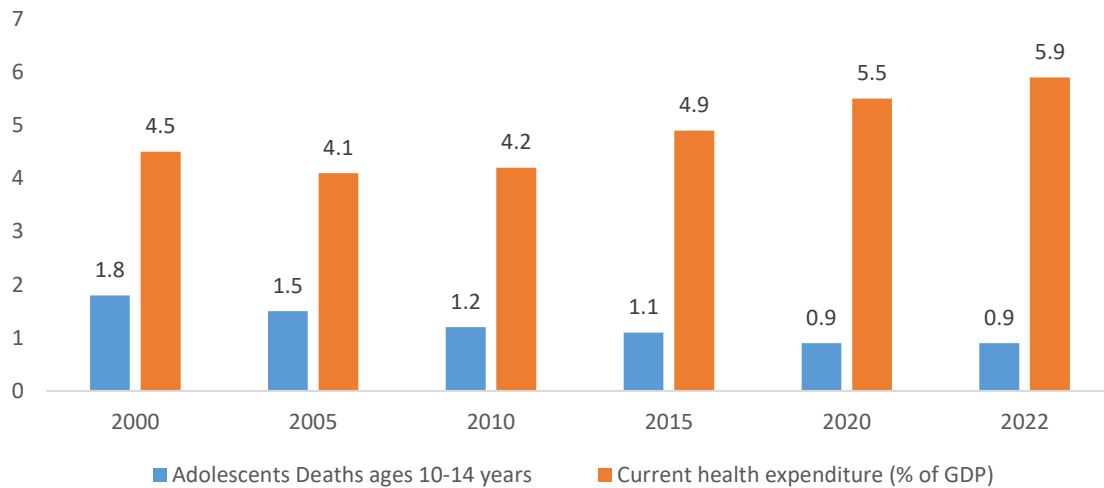


Figure 1: Adolescent mortality rate and health expenditure in China
Source: authors' computation

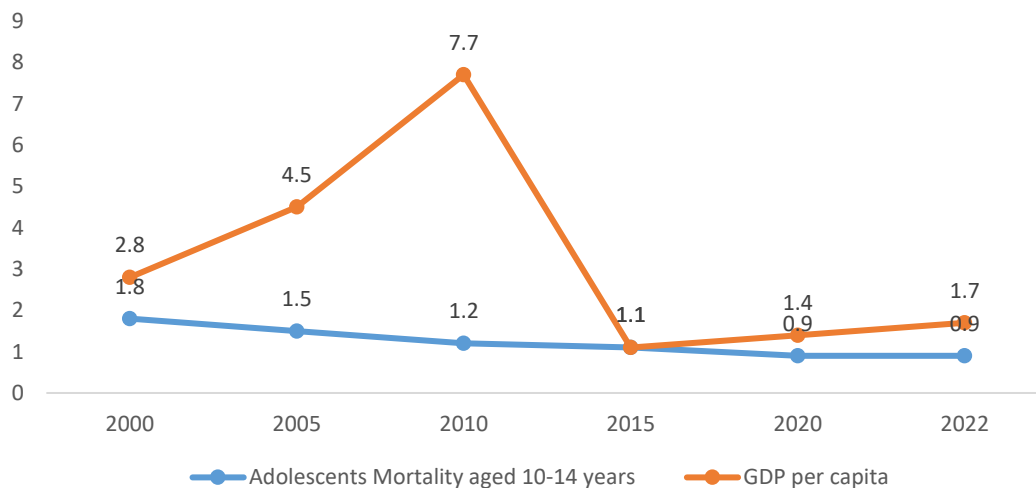


Figure 2: Adolescent mortality rate and GDP per capita in China
Source: authors' computation

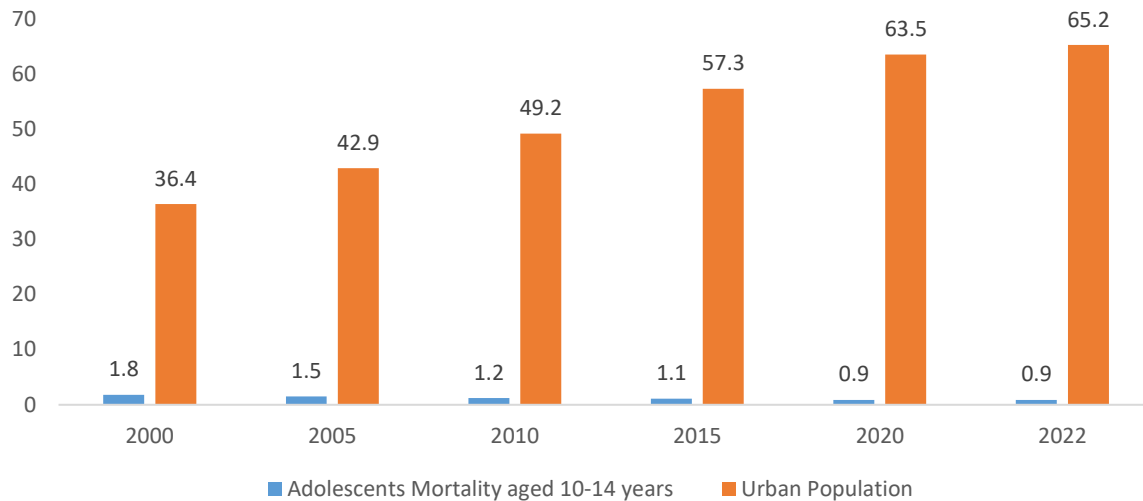


Figure 3: Adolescent mortality rate and urban population in China

Source: Authors' computation

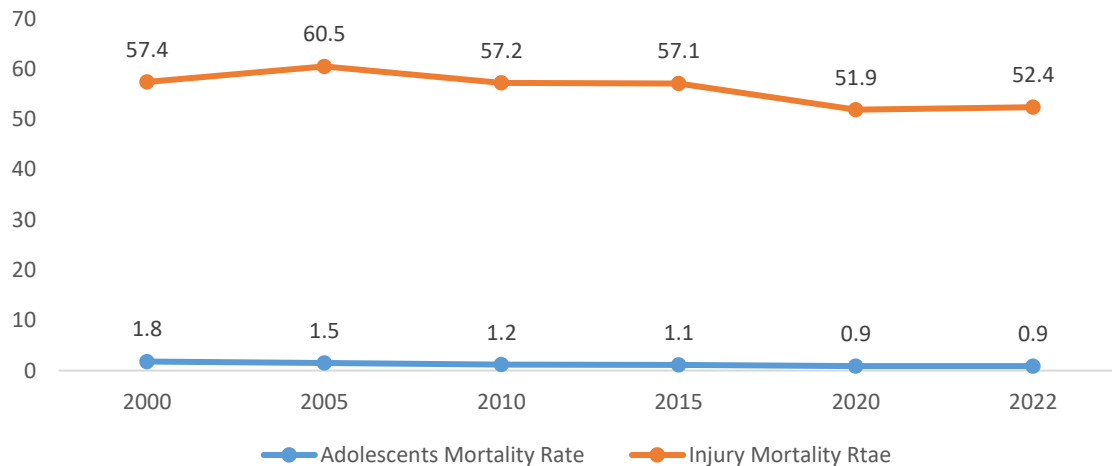


Figure 4: Adolescent mortality and injury mortality rate in China

Source: Authors' computation

Figure 3 illustrates the association between urbanization (URB) and adolescent mortality rate (AMR) in China from 2000 to 2022. In 2000, urban population was relatively low at 36.4%, and adolescent mortality rate was 1.8 deaths per 100,000. By 2005, urban population increased to 42.9%, while adolescent mortality rate began to decline at 1.5 deaths per 1,000. In 2010, urban population continued its upward trend at 49.2%, with a further decline in adolescent mortality rate at 1.2 deaths per 1,000. By 2020, urban population increased

substantially, while adolescent mortality rate continued to decline at 1.1 deaths per 1,000. In 2020 and 2022, urban population reached its peak at 65.2%, while adolescent mortality rate reduced further to 0.9 deaths per 1,000.

Figure 4 illustrates the line graph of the relationship between adolescent mortality rate (AMR) and injury mortality proportion (INJprop) in China from 2000 to 2020. In 2000, injuries revealed approximately 57.4% of deaths among adolescent aged 10-14 years, while the total adolescent

mortality rate was high at 1.8 deaths per 1,000. In 2005, injury mortality proportion rose significantly to 60.5%, demonstrating that injuries contributed a highly to adolescent deaths during this period, even with the slight decline in the total adolescent mortality rate at 1.5 deaths per 1,000. By 2015, injury related death reduced to 57.1%, with a decline in adolescent mortality at 1.1 deaths per 1,000. In 2022, injury mortality proportion remained significant but declined than its early 2000s increase, while the total adolescent mortality reduced to 0.9 deaths per 1,000.

Discussion

The results of the analysis demonstrate notable patterns in the determinants of adolescent mortality in China between 2000 and 2022. Generally, adolescent mortality rate declined consistently over the study period. The decline occurred with rising health expenditure, increasing GDP per capita and developing urbanization.

The association between health expenditure and adolescent mortality indicates an inverse relationship. As health expenditure increased in 2015, adolescent mortality declined. This trend reflects that adequate health funding catalyzed development in healthcare systems, increased access to medical care, and improved public health facilities. The continued significant increase in health expenditure in 2020 and 2022, with the sustained decline in adolescent mortality may reflects increased investment in healthcare which may have improved early diagnosis, emergency response systems, immunization coverage, and adolescent health decisions. This result indicates that public health financing has performed a key role in enhancing survival outcomes among adolescents. It is important to stress that the policymakers in China should sustain continuous investment in health sector to ensure further decline in adolescent deaths in the country. In the same vein, any time the rest of the low and middle-income countries, especially Africa want to combat adolescent deaths, the policymakers in these countries should emulate China by increasing public health financing in order to boost access to medical care and improved public health facilities in their countries.

The increase in GDP per capita followed by a significant decline in adolescent mortality over the study period indicates an inverse relationship. Economic growth may have contributed to enhanced living standards, improved nutrition, better educated, and increased access to healthcare services. Increasing income levels mostly reduce poverty related liabilities and enhance household ability to request suitable medical care. Hence, economic progress in China reveals to have subtly impacted the decline in adolescent deaths.

The association between urbanization and adolescent mortality reveals that rising urban population percentages overlapped with declining adolescent mortality rates. Increase in urbanization may create public health problems due to overcrowding and environmental burdens, but China's urban transition seems to demonstrate improvement in healthcare accessibility, progress in infrastructure, and social services. The continued increase in urban population, with the constant decline in adolescent mortality indicates that structural advancement may have outweighed possible risks related with urban growth.

Injury mortality proportion was constantly high all through the study period. In 2005, injuries accounted for a significant number of adolescent deaths among those aged 10-14 years. While the total adolescent mortality continued to decline in 2015, injuries continued to represent the primary cause of adolescent deaths. This demonstrate that improvements in infectious disease control and general healthcare access may have reduced other causes of mortality more rapidly than injury-related deaths. Injury as the principal factor to adolescent mortality highlights the structural nature of injury risks, including traffic accidents, falls, drowning, and other unintentional injuries. Economic and health system advancements have reduced total adolescent mortality, while injuries seem to have been slow in producing relative declines to adolescent mortality.

Generally, the graphical analysis shows that improvements in economic performance, healthcare spending, and urban development are closely related with declines in adolescent mortality. Meanwhile, injury related causes remain a crucial factor influencing mortality patterns among adolescents.

Strengths and limitations

Therefore, the limitations of this study have outweighed its value in analysing the determinants of adolescent deaths in China, providing useful insights to help improve public health strategies. Graphical methods are employed with ease to bring out the trends and make it easy on the policy interpreter to interpret the data. The reliability of the findings is ensured by relying more on the more reliable World Development Indicators and Global Burden of Disease. The study's use of anonymized data avoids ethical concerns, further strengthening its methodology. However, the study has limitations. First, the study relies on graphical analysis, which identifies associations but does not establish causality. The observed relationships between economic growth, health expenditure, urbanization, injury mortality, and adolescent mortality may be influenced by other confounding variables not captured in this analysis, such as education levels, environmental conditions, health insurance coverage, or regional disparities.

Second, the use of aggregate national data may mask sub-national variations, particularly differences between rural and urban provinces. Third, injury mortality proportion, while informative, does not provide detailed breakdowns of specific injury categories, limiting deeper understanding of underlying mechanisms. Lastly, the use of periodic data points may overlook short-term fluctuations or sudden policy-driven changes.

Despite these limitations, the study provides a useful descriptive foundation for understanding trends in adolescent mortality determinants in China.

Policy implications

Policy measures aiming at the determinants of adolescent deaths in China should focus on continued investment in healthcare. Firstly, developing national health expenditure and establishment of adolescent specific health programs can support reductions in mortality. Policy makers should focus on access to mental health support, preventive services, and emergency medical response systems. Secondly, sustained economic development appears to have indirect health benefits. Policies aimed at poverty reduction, social

protection, and equitable income distribution can further reduce vulnerabilities among adolescents. Economic growth strategies should continue to integrate social welfare considerations. Third, urban planning must ensure that health infrastructure keeps pace with urban population growth. Investment in public hospitals, trauma centers, sanitation systems, and community-based health services in expanding urban areas will be essential. Finally, injury prevention should be prioritized as a targeted intervention area. Strengthening road safety regulations, enforcing helmet and seatbelt laws, implementing school-based injury awareness programs, and improving emergency trauma care systems could significantly reduce adolescent deaths attributable to injuries. Reducing adolescent mortality further will require moving beyond general health improvements toward highly targeted injury prevention strategies.

Conclusion

This study explored the determinants of adolescent mortality in China. Results are indicative that while there is a sustained decline in adolescent mortality, coinciding with increased health expenditure, rising GDP per capita, and expanding urbanization, injury-related causes remained the dominant contributor to adolescent deaths, accounting for more than half of all adolescent mortality in the early 2000s. Although the proportional burden of injuries declined gradually, it remained substantial throughout the study period.

The results suggest that while macroeconomic development and healthcare investment contributed significantly to overall mortality reductions, targeted injury prevention strategies are essential for achieving further progress. Sustained improvements in safety regulation, trauma care, and adolescent-specific preventive interventions will be critical in reducing injury-related mortality and consolidating gains in adolescent health outcomes. Strengthening these areas will be critical for maintaining and accelerating progress in reducing adolescent mortality in China.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

Authors contribution

Authors contributed to the conception and design of the study, data analysis, and manuscript preparation. All authors reviewed and approved the final version of the manuscript.

Data availability

The data used in this study are publicly available on World Development Indicators website.

References

- World Health Organization. Adolescent Health. (2022). Available online at: https://www.who.int/health-topics/adolescent-health#tab=tab_1 (Accessed February 15, 2025).
- Viner RM, Barker M. Young people's health: the need for action. *BMJ*. 2005; 330:901–3. doi: 10.1136/bmj.330.7496.901
- United Nations Children's Fund. The Global Strategy for Women's, Children's and Adolescents' Health. 2016. Available at online: <https://data.unicef.org/resources/global-strategy-womens-childrens-adolescents-health/>.
- Kuruvilla S, Bustreo F, Kuo T, Mishra CK, Taylor K, Fogstad H. The global strategy for women's, children's and adolescents' health (2016–2030): a roadmap based on evidence and country experience. *Bull World Health Organ*. 2016; 94:398–400. doi: 10.2471/BLT.16.170431
- WHO, HIV/AIDS JUNPo, UNFPA, UNICEF, UN-Women, and group WB. Survive, thrive, transform global strategy for women's, children's and adolescents' health (2016– 2030) --2018 monitoring report: current status and strategic priorities. Geneva: *World Health Organization*, 2018.
- Child Health Task Force. Indicator and monitoring framework for the global strategy for women's, children's, and adolescents' health (2016–2030). Available online at: <https://www.childhealthtaskforce.org/resources/workshop-materials/2017/indicator-and-monitoring-framework-global-strategy-womens>.
- World Health Organization. World Health Statistics Overview 2019: Monitoring health for the SDGs, Sustainable Development Goals, 2019. Available online at: <https://apps.who.int/iris/handle/10665/311696>.
- Dong Y, Peijin Hu, Song Yi L. National and subnational trends in mortality and causes of death in Chinese children and adolescents aged 5 and 19 years from 1953 to 2016. *Journal of Adolescent Health* 67, 2020, S3-S13.
- Patton GC, Coffey C, Sawyer SM. Global patterns of mortality in young people: A systematic analysis of population health data. *Lancet* 2009;374: 881e92.
- Yang G, Wang Y, Zeng Y. Rapid health transition in China, 1990-2010: Findings from the global burden of disease study 2010. *Lancet* 2013;381: 1987e2015.
- Zhou M, Wang H, Zhu J. Cause-specific mortality for 240 causes in China during 1990-2013: A systematic subnational analysis for the global burden of disease study 2013. *Lancet* 2016; 387:251e72.
- National Bureau of Statistics of China. Tabulation on the 2010 population census of the People's Republic of China. Beijing, 2012. Available at: <http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm>. Accessed July 1, 2012.
- WHO. Global health estimates 2015: Deaths by cause, age, sex, by country and by region, 2000e2015. 2016. Available at: http://www.who.int/healthinfo/global_burden_disease/estimates_regiona_l_2000_2015/en/. Accessed July 24, 2017.
- Zhou J, Zhao M, Huang H, Schwebel DC, Ning P, Rao Z, Cheng P, Li L, Hu G. Injury Mortality of Children and Adolescents Aged 0–19 Years — China, 2010–2021. *China CDC Weekly*, 2024.
- Liu Y, Zhong P, Dang J, Shi D, Cai S, Chen Z, Zhang Y, Ma J, Song Y. Trends of cause specific mortality and association with economic status, education level, as well as health investment among adolescents aged 10 to 24 years in China, 2004–2019. *Future* 2023, 1, 61–75. <https://doi.org/10.3390/future1030008>
- Luo X, Zhang L, Wang W, Yang J, Chang Y. Epidemiological characteristics of injury deaths among children and adolescents in China, 2010–2020. *Chin J School Health*. 2023;44(8):1247–1251.
- Zhu J, Li Y, Zhang C, He J, Niu L. Trends in mortality and causes of death among Chinese adolescents aged 10–19 years from 1990 to 2019. *Front. Public Health*, 2023, 11:1075858. doi: 10.3389/fpubh.2023.1075858
- World Bank. World Development Indicators [Internet]. Washington, (DC): World Bank; 2023. Available from: <https://databank.worldbank.org/source/world-development-indicators> (Accessed: 25 February 2025).
- Institute for Health Metrics and Evaluation (IHME). Global Burden of Disease Study 2023 Results, IHME, Seattle. Available at: <https://vizhub.healthdata.org/gbd-results/> (Accessed: 25 February 2025).
- Zheng Y, Gong Z, Ajayi E O, Aderemi TA. Female labour participation and infant mortality in Nigeria: implication for the Sustainable Development Goal 3. *African Journal of Reproductive Health*, 2024, 28[3], 30-37.
- Ai1 W, Aderemi TA, Bassey R, and Khalid AA. Out-of-pocket expenditure and maternal mortality nexus in China: Implications for the Sustainable Development Goal 3. *African Journal of Reproductive Health*, 2023, 27(12), 94-100