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Disease burden and risk factors of children aged 0–14 years in China: a retrospective study on data from the Global Burden of Disease Study 2019

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ABSTRACT

Objectives This study aimed to analyse the current status, trends and risk factors of disease burden from 1990 to 2019 among Chinese children.

Design and participants It was a retrospective study on data from the Global Burden of Disease Study 2019 (GBD 2019). Data of disease burden and risk factors were extracted from the GBD 2019. Children were divided into two groups of <5 and 5–14 years. Data were analysed using GBD results query tool, Excel and Pareto analysis.

Primary outcome measures Disability-Adjusted Life Years (DALYs) and deaths.

Results The overall disease burden for both children <5 years and those aged 5–14 years significantly decreased from 1990 to 2019. For children aged <5 years, in 2019, the leading cause of deaths and DALYs were 'neonatal disorders', and the top risk factor was 'low birth weight'. Compared with data of 1990, the ranking of causes of deaths and DALYs in 2019 saw the most significant increase for 'HIV/AIDS and sexually transmitted infections' and 'skin and subcutaneous diseases' respectively. Conversely, the ranking of deaths/DALYs causes that dropped most significantly was 'nutritional deficiencies'. For children aged 5–14, in 2019, the leading deaths and DALYs causes were 'unintentional injuries' and 'mental disorders' respectively. The top risk factors were 'alcohol use' and 'short gestation', respectively. The ranking of deaths and DALYs causes rose most significantly were 'HIV/AIDS and sexually transmitted infections' and 'neonatal disorders', respectively. Conversely, the ranking of deaths causes that dropped most significantly were 'other infectious diseases', 'enteric infections' and 'nutritional deficiencies'. For DALYs, the causes that dropped most significantly in ranking were 'other infectious diseases'.

Conclusions The disease burden of children has significantly changed from 1990 to 2019, with notable differences between children aged <5 and 5–14 years. To optimise the allocation of health resources, it is necessary to adjust management strategies based on the latest disease burden.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study used data from the, Global Burden of Disease 2019 a comprehensive research project on the global population.
⇒ The impact of age on the results was minimised by dividing the children into two groups of <5 and 5–14 years.
⇒ However, our study only considered two outcomes, namely DALYs and deaths, which could potentially constrain the findings.

INTRODUCTION

Children's health is a matter of global concern due to its significance for sustainable economic development.[1] China has made remarkable advancements in health reform and development over the past three decades, leading to improved overall physical fitness and health among its people,[2 3] consequently, there have been notable changes in the disease burden among children. The plan known as 'Healthy China 2030' was a critical component of China's population health policy. Its primary goal was to advance the development of a healthy China and improve the overall health of Chinese population.[4] The specific objectives of 'Healthy China 2030' were to continuously improve people's health, control the main health risk factors, enhance the capability of health services, and expand the scale of the health industry. This proposal suggested that by 2030, the mortality rate for infants should be controlled at 5.0‰, while the rate for children under 5 years of age should be controlled at 6.0‰.

Understanding the current situation and risk factors of children's diseases in China is crucial for identifying key areas of concern in children's health. This information is essential for the successful implementation of 'Healthy China 2030' plan. However, few studies had systematically analysed the current status, risk factors and changes of disease burden of Chinese children. The Global Burden of Diseases, Injuries and Risk Factors Study (GBD) was the

only comprehensive assessment providing time trends for a collectively exhaustive list of diseases and injuries. GBD 2019 systematically analysed the disease burden and risk factors of the disease burden experienced by individuals of all ages in various countries and regions worldwide, this study provided the most up-to-date assessment of the descriptive epidemiology of a mutually exclusive and collectively exhaustive list of diseases and injuries for 204 countries and territories from 1990 to 2019, which provided policy-relevant information on the trends of major causes of burden globally, regionally and by country or territory.[5] The aim of our study was to analyse the current status, risk factors and trends of disease burden among Chinese children from 1990 to 2019, using GBD 2019 data.

MATERIALS AND METHODS

Data sources

Data from GBD 2019 were used in our study.[5 6] In, GBD 2019 the disease burden of 204 countries and regions was estimated for 23 age groups. Disease burden causes (diseases/injuries) were classified into four levels. Level 1 categories comprised the three broadest causes, which were further classified into 22 causes at level 2. Overall, a total of 369 causes were included in this study. Disease burden causes were measured by deaths, disability-adjusted life years (DALYs), years lived with disability (YLDs) and years of life lost (YLLs). To construct the disease profile, GBD 2019 mapped International Classification of Diseases (ICD) codes, including both ICD-9 and ICD-10 codes, to the list of causes.

The data sources used for GBD 2019 were varied and included published systematic reviews and reports, as well as government and international organisation websites. In addition, GBD collaborators contributed their own datasets to the project.

In our study, we analysed data on Chinese children aged 5–14 years old and those under 5 years old, which included information regarding DALYs and deaths resulting from causes (level 2) in 1990 and 2019 as well as risk factors. If some causes in level 2 classification were not detailed enough, or causes from adults were also included, we included and analysed only those causes falling under the level 3 subordinate classification for children. Data can be accessed by setting specific filtering criteria. For instance, researchers can download detailed information on DALYs for specific causes or age groups. (online supplemental figure 1).

Definitions

In our study, we analysed the main disease burden causes in 2019, main risk factors of disease burden in 2019, changes in disease burden from 1990 to 2019 among Chinese children. We measured the disease burden by using two outcomes including DALYs and deaths. We employed two units to express the results: number and constituent ratio (%).

The term 'disease burden causes' or 'causes' referred to the specific diseases/injuries that contribute to the disease burden. The Pareto principle (also known as the 80/20 rule) stated that for many events, roughly 80% of the effects comes from 20% of the causes. According to Pareto principle, the causes which caused the 80% of disease burden were 'main disease burden causes'.[7]

Risk factors were defined as attributes or exposures that are causally associated with an increased incidence or prevalence of causes. GBD 2019 has established a hierarchy of risk factors, the level 1 includes behavioural, environmental/occupational and metabolic risks, level 2 includes 20 risks, level 3 includes 52 risks and level 4 includes 69 risks. Overall, it integrated 87 detailed risks or clusters of risks. Risk factors in GBD 2019 were estimated based on published systematic reviews and meta-regression.[8] In our study, the main risk factors were defined as those that were associated with 80% of the disease burden.

The term 'changes in disease burden' pertained to two aspects: The first aspect was the change in the ranking of disease burden for various causes. The second aspect was the change in the disease burden for each cause and overall, which were estimated by the annual change rate.

DALYs were also defined as years of healthy life lost, it was the sum of YLLs and YLDs. YLDs were years lived with any short-term or long-term health loss weighted for severity by the disability weights, YLLs were years of life lost due to premature mortality.[6] Although DALYs were calculated as the sum of YLLs and YLDs, we did not separately include or analyse these two outcomes in our study. 95% uncertainty intervals were the 2.5th and 97.5th percentile of the distribution for each estimate.[5]

The annual change rate represented the extent of change in disease burden. It was calculated by subtracting the number of deaths/DALYs in 1990 from the number of deaths/DALYs in 2019 and dividing it by the number of deaths in 1990.

Data analysis

Microsoft Office Excel was used to rank disease burden for various causes by their constituent ratio (%), and the GBD results query tool was used to analyse the annual change rate of disease burden for each cause.[6]

Main causes and main risk factors of disease burden were confirmed by the Pareto analysis.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

RESULTS

Main disease burden and changes of disease burden from 1990 to 2019 in Chinese children

Children aged <5 years

Main deaths causes in 2019

According to the Pareto analysis, there were four main deaths causes, these were neonatal disorders, congenital birth defects, unintentional injuries, respiratory infections and tuberculosis (online supplemental figure 2).

Figure 1 Changes of main deaths causes of children aged <5 years from 1990 to 2019. Deaths causes were ranked by the constituent ratio of deaths.

Changes in deaths from 1990 to 2019

The ranking of deaths causes underwent significant changes between 1990 and 2019. The ranking of respiratory infections and tuberculosis, enteric infections, nutritional deficiencies significantly decreased (from 1st to 4th, 6th to 11th, 7th to 13th, respectively), while neoplasms, HIV/AIDS and sexually transmitted infections significantly increased (form 9th to 5th, 14th to 8th, respectively) (figure 1, online supplemental table 1).

Both overall deaths and deaths attributed to each cause had significantly decreased. The annual change rate of deaths attributed to both individual causes and all causes were negative. In 2019, the total number of deaths was 130 703.47 (113 985.45–148 954.47), which was a 90% decrease compared with 1990. Among all causes, both nutritional deficiencies and enteric infections had the highest annual change rate of deaths, reducing up to 98% (figure 1).

Main DALYs causes in 2019

According to the Pareto analysis, there were five main DALYs causes, these were neonatal disorders, congenital birth defects, respiratory infections and tuberculosis, unintentional injuries, neoplasms (online supplemental figure 3).

Changes in DALYs from 1990 to 2019

The ranking of DALYs causes underwent obvious changes between 1990 and 2019. The ranking of self-harm and interpersonal violence significantly decreased (from 7th to 12th, 14th to 18th, respectively), while skin and subcutaneous diseases, neoplasms, HIV/AIDS and sexually transmitted infections significantly increased (from 12th to 7th, 9th to 5th, 15th to 11th, respectively) (figure 2, online supplemental table 2).

Both overall deaths and deaths attributed to each cause significantly decreased, the annual change rate of deaths attributed to both individual causes and all causes were negative. In 2019, the total number of DALYs was 13 428 890.22 (11 870 936.47–15 217 799.05), indicating a significant decrease of 89% compared with 1990. Among all causes, respiratory infections and tuberculosis, other infectious diseases, enteric infections had the highest annual change rate of deaths, reducing up to 96% (figure 2).

Children aged 5–14 years

Main deaths causes in 2019

According to the Pareto analysis, there were four main deaths causes, these were unintentional injuries, neoplasms, transport injuries and congenital birth defects (online supplemental figure 4).

Changes in deaths from 1990 to 2019

The ranking of deaths causes underwent significant changes between 1990 and 2019. The ranking of other infectious diseases, enteric infections, nutritional deficiencies significantly decreased (from 5th to 8th, 9th to 12th, 14th to 17th, respectively), while HIV/AIDS and sexually transmitted infections significantly increased (from 19th to 13th) (figure 3, online supplemental table 3).

Both overall deaths and deaths attributed to most causes have significantly decreased, so the annual change rate of deaths attributed to them was negative.

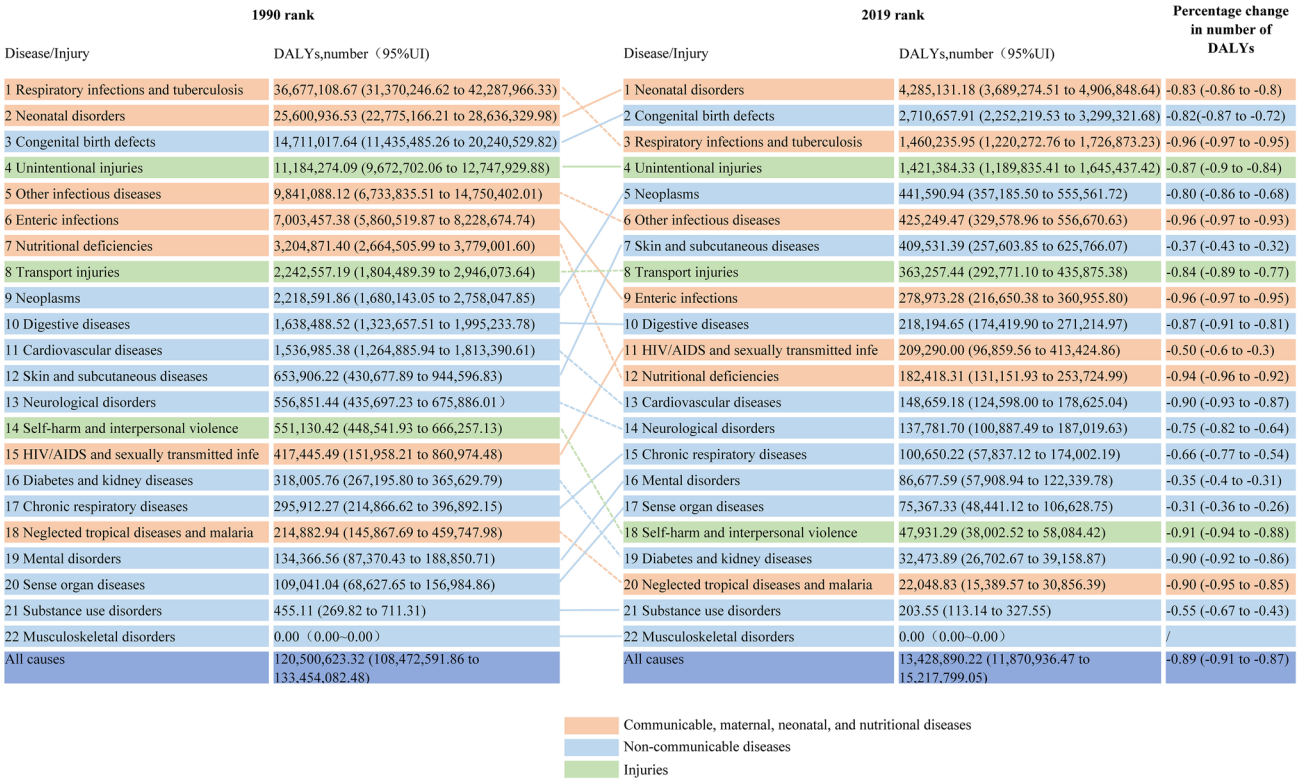

Figure 2 Changes of main DALYs causes of children aged <5 years from 1990 to 2019. DALYs causes were ranked by the constituent ratio of DALYs. DALYs, Disability-Adjusted Life Years.

In 2019, the total number of deaths was 33 742.94 (30 828.42–36 795.95), indicating a significant decrease of 78% compared with 1990. Among all causes, both other infectious diseases and nutritional deficiencies had the highest annual change rate of deaths, reducing up to 92%. However, HIV/AIDS and sexually transmitted

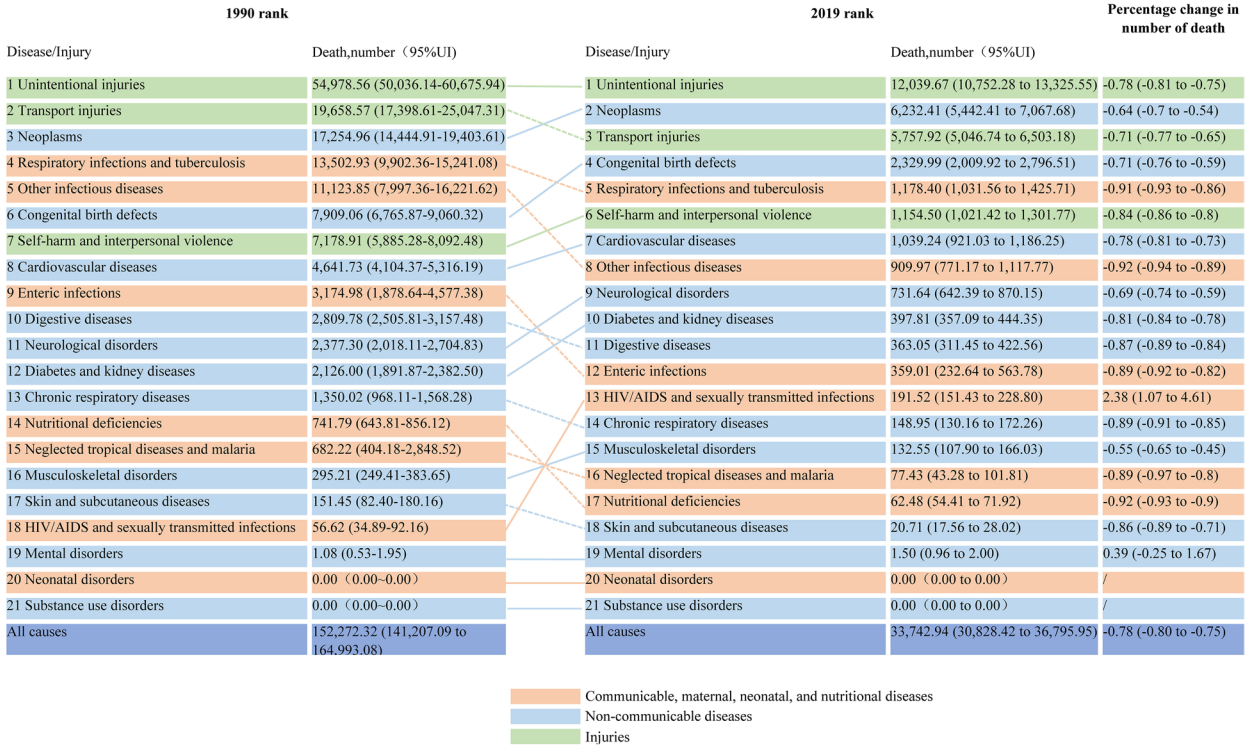

Figure 3 Changes of main deaths causes of children aged 5–14 years from 1990 to 2019. Deaths causes were ranked by the constituent ratio of deaths.

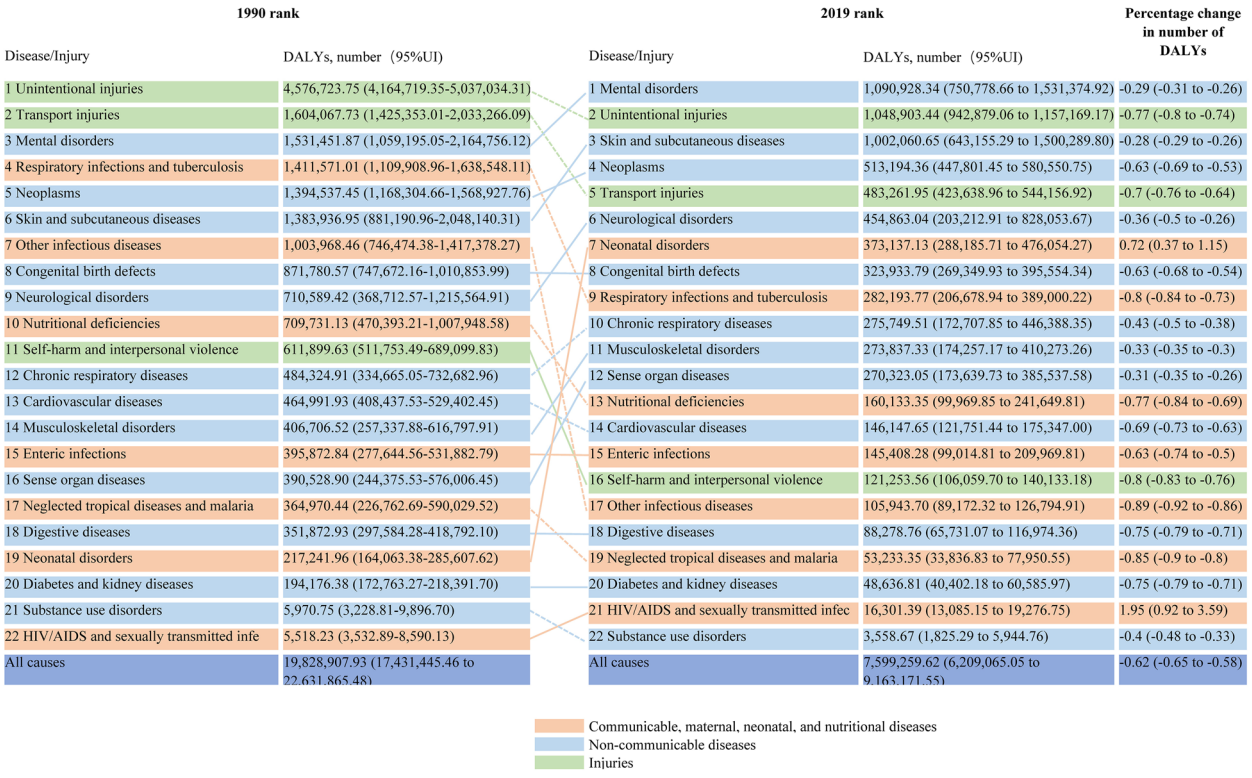

Figure 4 Changes of main DALYs causes of children aged 5–14 years from 1990 to 2019. DALYs causes were ranked by the constituent ratio of DALYs. DALYs, Disability-Adjusted Life Years.

infections experienced an increase in deaths (2.38%) (figure 3).

Main DALYs causes in 2019

According to the Pareto analysis, there were 10 main DALYs causes, these were mental disorders, unintentional injuries, skin and subcutaneous diseases, neoplasms, transport injuries, neurological disorders, neonatal disorders, congenital birth defects, respiratory infections and tuberculosis, chronic respiratory diseases (online supplemental figure 5).

Changes in DALYs from 1990 to 2019

The ranking of respiratory infections and tuberculosis, other infectious diseases, self-harm and interpersonal violence significantly decreased (from 4th to 9th, 7th to 17th, 11th to 16th, respectively), while mental disorders, neonatal disorders significantly increased (from 3th to 1st, 19th to 7th, respectively) (figure 4, online supplemental table 4).

Both overall DALYs and DALYs attributed to most causes have significantly decreased, so the annual change rate of deaths attributed to them was negative. In 2019, the total number of DALYs was 7 599 259.62 (6 209 065.05–9 163 171.55), indicating a significant decrease of 62% compared with 1990. Among all causes, other infectious diseases had the highest annual change rate of DALYs, reducing up to 89%, however, 2 causes including HIV/AIDS and sexually transmitted infections, and neonatal disorders experienced an increase in DALYs (1.95% and 0.72%, respectively) (figure 4).

Main risk factors of the disease burden of Chinese children in 2019

For children aged <5 years, there were three and four main risk factors of deaths and DALYs, respectively (online supplemental figures 6 and 7). The top three risk factors for both deaths and DALYs were found to be low birth weight, short gestation and child wasting (online supplemental tables 5 and 6).

For children aged 5–14 years, there were six and nine main risk factors of deaths and DALYs, respectively (online supplemental figures 8 and 9). The top three risk factors of deaths were alcohol use, kidney dysfunction and secondhand smoke. On the other hand, the top three risk factors of DALYs were short gestation, low birth weight and iron deficiency (online supplemental tables 7 and 8).

DISCUSSION

According to our study, disease burden among children underwent significant changes in the past 29 years, additionally, differences in disease burden exist between children aged <5 years and those aged 5–14 years.

For children aged <5 years, neonatal disorders have been an important disease burden cause since 1990, and it emerged as the leading cause of both deaths and DALYs in 2019. In addition, the ranking of two causes (neoplasms, HIV/AIDS and sexually transmitted infections) significantly increased. Although the main causes for disease burden changed, fortunately, both overall deaths/DALYs and deaths/DALYs attributed to each cause significantly decreased from 1990 to 2019. Among

them, ranking of deaths/DALYs for nutritional deficiencies in children aged <5 years also significantly decreased during this time period, indicating that China has made significant progress in efforts to combat poverty. For children aged 5–14 years, unintentional injuries and mental disorders have been important disease burden causes since 1990, and they were the leading deaths and DALYs cause, respectively, in 2019. In addition, the ranking of two causes (HIV/AIDS and sexually transmitted infections, neonatal disorders) significantly increased. Fortunately, the overall disease burden, encompassing both the number of deaths and DALYs decreased obviously from 1990 to 2019. Furthermore, a majority of individual causes also decreased during this time period. For example, the number of deaths/DALYs for other infectious diseases (such as encephalitis, meningitis, acute hepatitis, measles and whooping cough, online supplemental table 9) decreased up to 92%/89%, indicating that China has made significant progress in improving children's health, and the national immunisation programme has been successful.[9] In short, efforts to strengthen prevention and treatment of neonatal disorders, HIV/AIDS and sexually transmitted infections, unintentional injuries, mental disorders of children still should be emphasised.

While there was a decrease in disease burden for most diseases among children aged 5–14 years, it was important to note that the disease burden of three specific causes—HIV/AIDS and sexually transmitted infections, neonatal disorders, and mental disorders—did not decrease, but instead increased. This highlighted the critical need for urgent prevention and treatment of these diseases. Vertical transmission was the leading cause of HIV/AIDS infection in children worldwide, accounting for over 90% of cases.[10] Other modes of transmission, such as sexual contact, blood transfusions or injection drug use, also increased the risk for HIV transmission in children.[11 12] To prevent mother-to-child transmission of HIV, stricter measures were needed, these included universal screening for HIV before pregnancy, administering proper antiretroviral therapy for HIV-infected women before and during pregnancy periods,[13–15] performing a caesarean section if necessary, providing prophylactic treatment for neonates and avoiding breast feeding.[16] For a significant period, sex education in both family and school settings was insufficient,[17] therefore, it was imperative to develop comprehensive sex education programmes for teenagers, while strictly controlling the spread of sexually transmitted infections.[4 18] In addition, for neonatal disorders, both the ranking and the number of DALYs also increased. So, it was crucial to improve health services and treatment capabilities for emergency and critical illnesses in neonates. Additionally, advocating for eugenics and constructing a comprehensive prevention and control system for birth defects was necessary. The prevention and treatment of key diseases in children should also be given high priority. In regard to mental disorders, while there was a 39% increase in deaths related to mental disorders since 1990, it was important to note that the actual number of deaths in both 1990 and 2019 were relatively low. However, mental disorders remained the leading DALYs cause for children aged 5–14 years, causing up to 1 090 928.34 DALYs in 2019. Thus, more efforts should be made to improve the construction and management of mental health service systems, with a particular focus on intervening in common mental disorders among Chinese children.[4 19] Additionally, parents should prioritise the psychological well-being of their children and pay more attention to their mental health needs.

The prevention of disease burden relied heavily on modifying risk factors.[8] This study highlighted the significance of low birth weight, short gestation and child wasting as the main risk factors for disease burden in children aged <5 years. This underscored the importance of healthcare during pregnancy and nutritional supplementation during childhood. Based on our study, it was discovered that alcohol use, secondhand smoke, short gestation, ambient particulate matter pollution and bullying victimisation were main risk factors of disease burden for children aged 5–14 years. Adolescent drinking and secondhand smoke were significant public health issues.[20 21] Exposure to tobacco during pregnancy or infancy could impair the lung function of children at different stages of development,[22–26] however, antismoking laws could help reduce the harm of secondhand smoke.[27–29] Therefore, we strongly recommend strengthening and strictly enforcing no-smoking policies and alcohol restrictions. In recent years, ambient particulate matter pollution had emerged as a significant risk factor that poses a threat to human health,[30 31] the depletion of green vegetation, emission of industrial waste gases, automobile exhaust and thermal power generation were some of the common causes. Therefore, it is imperative to sustain and strengthen sustainable development policies.[32] In addition, bullying victimisation was also identified as a significant risk factor for DALYs in children aged 5–14 years in 2019 and was found to be associated with mental disorders. Researches indicated that teenagers who had experienced bullying at school were at a higher risk of developing adverse psychiatric symptoms, including anxiety, depression and in severe cases, even suicide.[33 34] Therefore, it is imperative to take measures to prevent bullying in schools and prioritise the mental health of students.

This study is the first to systematically analyse the current status, trends and risk factors of disease burden among Chinese children from 1990 to 2019. However, our study has some limitations. First, we only analysed two outcomes, namely DALYs and deaths, and did not consider other outcomes such as YLLs and YLDs. This limitation may restrict the comprehensiveness of our findings. Second, we classified children into two age groups, namely <5 and 5–14 years. Therefore, the generalisability

of our results to neonates and infants may be limited, and further studies focusing on these age groups are needed.

CONCLUSIONS

In conclusion, significant changes existed in the disease burden of children between 1990 and 2019, with notable differences between children aged <5 and those aged 5–14 years. From 1990 to 2019, there was a clear decrease in the total disease burden and the disease burden of individual causes, with the exceptions of HIV/AIDS and sexually transmitted infections, mental disorders and neonatal disorders in children aged 5–14 years. In 2019, among children aged <5 years, neonatal disorders were the leading deaths/DALYs cause, the ranking of deaths and DALYs causes rose most significant were HIV/AIDS and sexually transmitted infections, skin and subcutaneous diseases, respectively. Among children aged 5–14 years, unintentional injuries were the leading deaths cause, and mental disorders were the leading DALYs cause, the ranking of deaths and DALYs causes rose most significant were HIV/AIDS and sexually transmitted infections, neonatal disorders, respectively. In our opinion, it is important to prioritise the diseases/injuries that are causing the highest disease burden, have experienced an increase in disease burden and have significantly increased in ranking. Additionally, management measures should be improved based on the latest disease burden and risk factors.

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Contributors JC analysed and interpreted the data regarding the DALYs and deaths, DL analysed and interpreted the data regarding the risk factors, LZeng, Z-JJ and GC made all figures and tables, JC and DL wrote the manuscript, XX and LZhang reviewed the manuscript. LZhang is responsible for the overall content as the guarantor. All authors read and approved the final manuscript.

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Competing interests None declared.

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Patient consent for publication Not applicable.

Ethics approval Because the GBD data are anonymous and publicly available, we waived ethical approval for this study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. The datasets analysed in the current study are available in the Global Burden of Disease Collaborative Network, http://ghdx.healthdata.org/gbd-results-tool. This is a public database, data is publicly available and can be downloaded after registration and login.

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