

Disease spectrum analysis of hospitalized children in China: A study of 18 tertiary children's hospitals

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ABSTRACT

Importance: Morbidity and mortality of children are important indicators of the performance of the public health system in any country. In China, the children's disease spectrum has gradually changed in recent years. However, the gender- and age-specific disease spectrum for hospitalized children under 15 years old is still unclear.

Objective: To explore the gender- and age-based distribution of diseases in hospitalized children under 15 years in China.

Methods: Medical records home page data for 2016 to 2018 were collected from 18 tertiary children's hospitals in China. The gender- and age-specific disease spectrum was analyzed, using the tenth revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10).

Results: The most common diseases were those of the respiratory system (25.7% of all 2 232 142 hospitalized children). The top three diseases for boys were diseases of the respiratory system (25.6%), diseases of the digestive system (11.4%) and certain conditions originating in the perinatal period (8.6%). The top three diseases for girls were diseases of the respiratory system (25.9%), certain conditions originating in the perinatal period (10.1%), and factors influencing health status and contact with health services (9.4%). The most common diseases for children under 1 year old were certain conditions originating in the perinatal period (38.1%). For all other age groups, the most common conditions were respiratory diseases (33.8% for those aged 1–3 years, 25.2% for those aged 4–6 years, and 12.2% for those aged 7–14 years).

Interpretation: This study analyzed the medical records home pages of 18 children's hospitals to provide the first overview of the disease spectrum and its gender- and age-specific distribution among children in China.

KEYWORDS

Disease spectrum, Hospitalized children, China

INTRODUCTION

Measurement of children's morbidity and mortality has always been crucial, and is particularly important among children under 5 years of age, who are most sensitive to stimulation and nurture. The United Nations (UN) Millennium Development Goals are largely focused on reducing mortality in this age group. However, the death toll for children aged 5–14 years, as estimated by the UN World Population Prospects, UN Inter-Agency Group for Child Mortality Estimation, and the model-based Global Burden of Diseases, was about 0.7–1.2 million in 2017.^{1–4} Several global health targets, including the 2030 UN Sustainable Development Goals, have therefore been proposed to cover all children under 15 years of age.

China accounts for one-fifth of the world's population. Improvements in economic and health conditions in recent years mean that the disease spectrum of children in China has probably changed. This study analyzed the disease spectrum among children who have been hospitalized, using medical records home page data from 18 tertiary children's hospitals in China covering the period from 2016 to 2018.

METHODS

Data source

We conducted a retrospective analysis using information extracted from the medical records home

page of 18 tertiary children's hospitals including Anhui, Beijing, Dalian, Hunan, Gansu, Guiyang, Hangzhou, Jinan, Liaocheng, Liuzhou, Kunming, Nanjing, Inner Mongolia, Qinghai, Shanxi, Shenzhen, Wuhan, and Urumqi. All the information was reported to the medical records department of Beijing Children's Hospital, with following personal identifying information masked before reporting: patient name, ID, birth address, phone number of current address, postal code of current address, contact name, contact address, contact phone number, et al.

Study variables

We selected medical records home pages dated from January 1, 2016 to December 31, 2018, and extracted information including the characteristics of the medical institute (name, type, and level), the characteristics of the patient (primary diagnosis name and code, secondary diagnosis name and code, gender, age, and length of stay), and cost information (total cost, material cost, pharmacy cost, and nursing cost). Medical records were excluded if any of the following conditions applied: (a) age at diagnosis was older than 14 years; (b) total cost was lower than 5 CNY; (c) length of stay was zero; (d) some key variables were missing or unclear, including age, sex, and primary diagnosis; (e) there were obvious errors, such as admission date after the discharge date.

Classification of Diseases

National clinical coding database of the classification of diseases version 2.0 was used as the standard code for disease classification. Diseases were classified into 22 categories using the tenth revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10), represented by I to XXII. The codes are shown in Table 1.

TABLE 1 ICD-10 disease classification and corresponding code

Code	ICD-10Code	Disease classification
I	A00-B99	Certain infectious and parasitic diseases
II	C00-D48	Neoplasms
III	D50-D89	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
IV	E00-E90	Endocrine, nutritional and metabolic diseases
V	F00-F99	Mental and behavioral disorders
VI	G00-G99	Diseases of the nervous system
VII	H00-H59	Diseases of the eye and adnexa
VIII	H60-H95	Diseases of the ear and mastoid process
IX	I00-I99	Diseases of the circulatory system
X	J00-J99	Diseases of the respiratory system
XI	K00-K93	Diseases of the digestive system
XII	L00-L99	Diseases of the skin and subcutaneous tissue
XIII	M00-M99	Diseases of the musculoskeletal system and connective tissue
XIV	N00-N99	Diseases of the genitourinary system
XV	O00-O99	Pregnancy, childbirth and the puerperium
XVI	P00-P96	Certain conditions originating in the perinatal period
XVII	Q00-Q99	Congenital malformations, deformations, and chromosomal abnormalities
XVIII	R00-R99	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
XIX	S00-T98	Injury, poisoning and certain other consequences of external causes
XX	V01-Y98	External causes of morbidity and mortality
XXI	Z00-Z99	Factors influencing health status and contact with health services
XXII	U00-U99	Codes for special purposes

Statistical analysis

The study population was divided into four groups by age (<1, 1–3, 4–6, and 7–14 years old). A Pareto graph was used to show the order of all hospitalized cases, and a population pyramid to show gender- and age-specific distribution. All analyses and graphs used SAS JMP Pro version 14.1.

RESULTS

A total of 2 484 177 cases from 18 hospitals were identified. After data cleaning, 2 232 142 cases were

included in the analysis. The disease order for these 2 232 142 cases is shown in Figure 1. The top five conditions were diseases of the respiratory system (25.7%), diseases of the digestive system (10.1%), certain conditions originating in the perinatal period (9.2%), factors influencing health status and contact with health services (8.5%), congenital malformations, deformations and chromosomal abnormalities (7.2%).

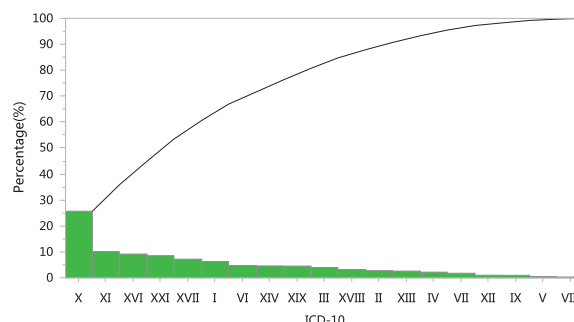


FIGURE 1 Pareto graph for disease order of hospitalized cases.

More boys than girls were hospitalized (62.2% vs. 37.8%). The most common condition was diseases of the respiratory system among both boys and girls (25.6% and 25.9%). For boys, the next most common conditions were diseases of the digestive system (11.4%), certain conditions originating in the perinatal period (8.6%), factors influencing health status and contact with health services (8.0%), and congenital malformations, deformations and chromosomal abnormalities (7.8%). For girls, the next most common conditions were certain conditions originating in the perinatal period (10.1%), factors influencing health status and contact with health services (9.4%), diseases of the digestive system (8.1%), and certain infectious and parasitic diseases (6.4%) (Figure 2).

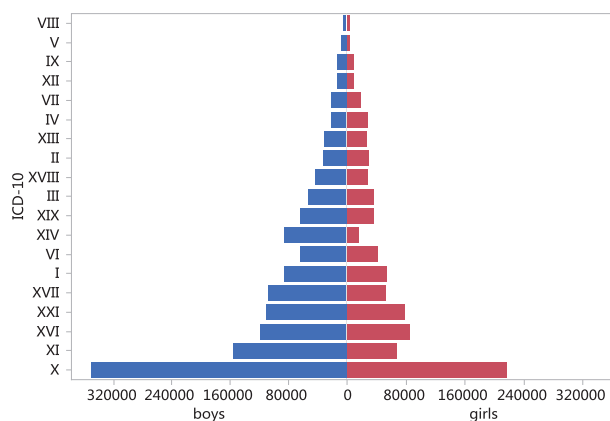


FIGURE 2 Population pyramid graph for gender distribution of hospitalized cases

In total, 512 288 (23.0%) hospitalized children were under 1 year old, 866 810 (38.8%) were between 1 and 3 years old, 414 836 (18.6%) were between 4 and 6

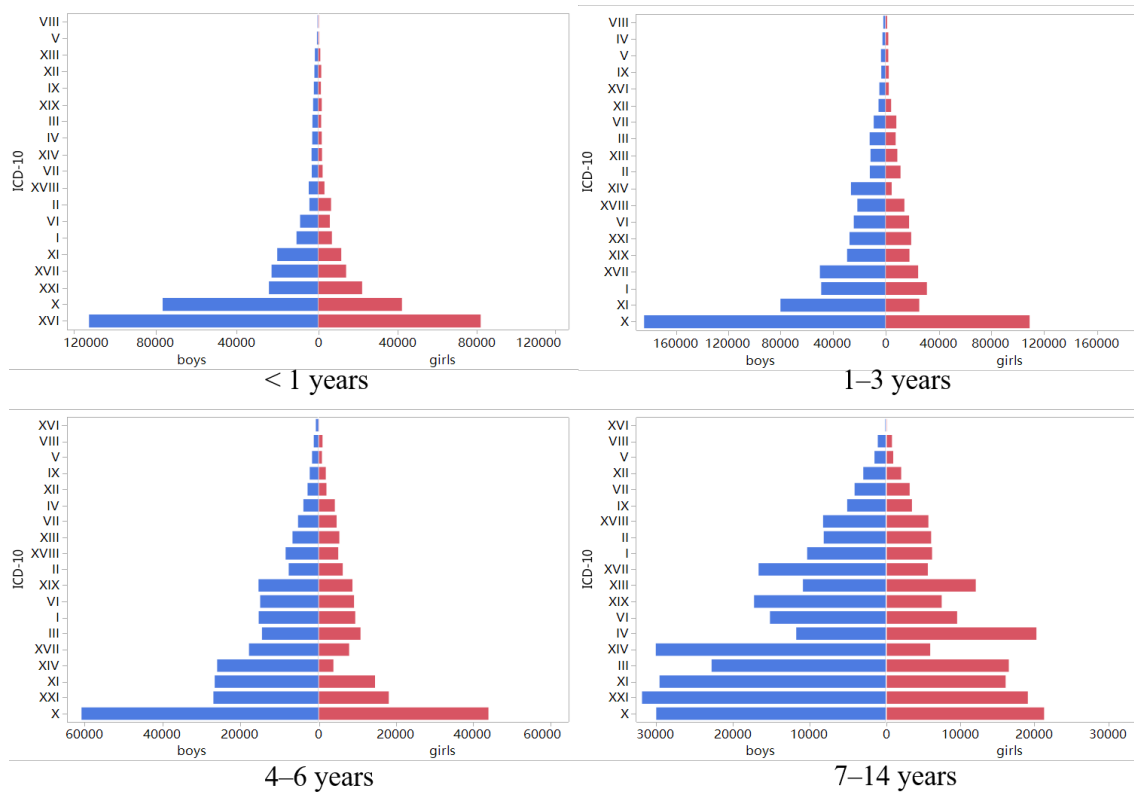


FIGURE 3 Population pyramid graph for the age-gender specific distribution of hospitalized cases.

TABLE 2 Most common conditions among the four age groups, by percentage

Age (yr)	Disease order				
	1	2	3	4	5
<1	Certain conditions originating in the perinatal period (38.1%)	Diseases of the respiratory system (23.2%)	Factors influencing health status and contact with health services (9.0%)	Congenital malformations, deformations, and chromosomal abnormalities (7.2%)	Diseases of the digestive system (6.2%)
1-3	Diseases of the respiratory system (33.8%)	Diseases of the digestive system (12.2%)	Certain infectious and parasitic diseases (9.2%)	Congenital malformations, deformations, and chromosomal abnormalities (8.6%)	Injury, poisoning and certain other consequences of external causes (5.4%)
4-6	Diseases of the respiratory system (25.2%)	Factors influencing health status and contact with health services (10.9%)	Diseases of the digestive system (9.9%)	Diseases of the genitourinary system (7.2%)	Congenital malformations, deformations, and chromosomal abnormalities (6.2%)
7-14	Diseases of the respiratory system (12.2%)	Factors influencing health status and contact with health services (12.1%)	Diseases of the digestive system (10.9%)	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (9.4%)	Diseases of the genitourinary system (8.5%)

years old, and 438 208 (19.6%) were over 7 years old. The most common diseases in the four groups were different. The top five diseases in each age group are shown in Table 2, and Figure 3 shows the population pyramids for different conditions by gender and age group.

DISCUSSION

Previous disease spectrum studies of children were mostly based on a single center or department,⁵⁻⁷ and the data were therefore less nationally representative. This study included 18 tertiary children’s hospitals,

nearly one-third of all tertiary children's hospitals in China, and covered main cities in both the north and south of the country, so the data can be considered more comprehensive and the results more representative.

The children's disease spectrum varied greatly with age and gender. In general, respiratory diseases were the most common. This may be mainly because of two reasons: first, children's low immune function makes them more susceptible to respiratory infections, and second, previous studies have shown that air pollution may lead to increased respiratory diseases in children.⁸⁻¹⁰ The Global Burden of Disease 2013 study found that lower respiratory tract infections were the leading cause of hospitalization for children aged 0–19 years in most developing countries, and particularly among children younger than 5 years.¹¹ Many of the risk factors for respiratory diseases, such as household air pollution and low immunity, are avoidable through proper prevention and management. More attention should therefore be paid to reducing hospitalization and death from these diseases.

Boys had a higher proportion than girls of most diseases except endocrine, nutritional and metabolic diseases. Among children aged 7–14 years in particular, a significantly higher proportion of girls than boys were hospitalized with endocrine, nutritional and metabolic diseases. This observation may be related to the beginning of puberty in girls and an associated increase in endocrine-related diseases.

The disease spectrum of children in different age groups reflects the different characteristics of these groups. Children under 1 year old were mainly hospitalized for certain conditions originating in the perinatal period, but diseases of the respiratory system were the most common conditions among all the other age groups. However, the proportion with these conditions was lower in the older age groups, showing that there was a greater range of diseases among older children.

The trends in the proportion of children hospitalized for particular diseases varied with age. The proportion of several diseases showed a relatively obvious upward trend, including diseases of the blood and blood-forming organs, and certain disorders involving the immune system, diseases of the musculoskeletal system and connective tissue, and diseases of the genitourinary system. The increase in the proportion of these diseases may highlight characteristics of children's growth and development and indicate the need for medical attention to focus on different issues across age groups.

By analyzing medical records home pages from 18 children's hospitals, this study has been able to provide the first reasonably comprehensive description of the disease spectrum and its gender- and age-specific distribution

among children in China. Hospitalization cannot fully reflect trends in morbidity, but this study's findings provide an overview of the disease spectrum among Chinese children, and a reference for changes in causes of hospitalization among children.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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