Causes of death in children younger than five years in China in 2015: an updated analysis

Author: Peige Song

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PLAGIARISM STATEMENT

I, Peige Song, declare that all the work in this thesis was performed personally unless stated otherwise. No part of this work has not been submitted for any other degree or profession qualification.

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ABBREVIATIONS

1-4MR	1-4 Years Mortality Rate
AFR	African Region
AMR	Region of the Americas
CDC	Chinese Center for Disease Control and Prevention
CHERG	Child Health Epidemiology Reference Group
CNKI	China National Knowledge Infrastructure
COD	Causes of Death / Cause of Death
CRVS	Civil Registration and Vital Statistics
DHS	Demographic and Health Surveys
DSP	Disease Surveillance Points
EMR	Eastern Mediterranean Region
EUR	European Region
GDP	Gross Domestic Product
ICD	International Classification of Diseases and Related Health Problems
ICD-10	International Classification of Diseases and Related Health Problems 10th version
IHME	Institute for Health Metrics and Evaluation
IQR	Inter–Quartile Range
LMIC	Low- and Middle-Income Countries
MCEE	Maternal and Child Epidemiology Estimation
MCH	Maternal and Child Health
MCHARS	National Maternal and Child Health Annual Reporting System
MCMS	National Maternal and Child Mortality Surveillance
MDGs	Millennium Development Goals
MICS	Multiple Indicator Cluster Surveys

NBS	National Bureau of Statistics
NHFPC	Chinese National Health and Family Planning Commission
NMR	Neonatal Mortality Rate
NMSS	National Mortality Surveillance System
NRSCD	National Retrospective Survey on Causes of Death
NSSPC	National Sample Survey on Population Changes
NTDs	Neural Tube Defects
OLS	Ordinary Least Squares
PIMR	Post-neonatal Infant Mortality Rate
SDGs	Sustainable Development Goals
SEAR	South-East Asia Region
SIDS	Sudden Infant Death Syndrome
U5MR	Under-five Mortality Rate
UN	United Nations
UN IGME	United Nation's Inter-agency Group for Child Mortality Estimation
UNICEF	United Nations Children's Fund
UNPD	United Nations Population Division
USAID	United States Agency for International Development
VAMCM	Verbal-Autopsy-Data-Based Multi-Cause Model
VIP	VIP Database for Chinese Technical Periodical
VRMCM	Vital-Registration-Data-Based Multi-Cause Model
WHO	World Health Organization
WPR	Western Pacific Region

ABSTRACT

Introduction

Since the adoption of the Millennium Development Goals (MDGs) in 2000, substantial progress in improving child health and reducing child mortality rate has been made in the last one and half decades. Despite the achievements, for a populous county like China, there are still 181,574 children under five years old who died in 2015, most of them were preventable. Under the new Sustainable Development Goals (SDGs), information about the distribution of causes of death and time trend for child mortality should be updated to inform policy and research. In this study, I aim to estimate the causes of death in children younger than five years old in recent seven years from 2009 to 2015 with a focus on the year of 2015 and provide an update causes of death predicting model for China.

Methods

Updated data of under-five mortality rates and number of live births at national and provincial levels were obtained from the National Maternal and Child Mortality Surveillance System, the National Maternal and Child Health Annual Reporting System and the Chinese Bureau of Statistics by systematically searching, and then adjusted by United Nation's Inter-agency Group for Child Mortality Estimation. A systematic review was also conducted from high-quality community based longitudinal studies of different causes of death in three Chinese and one English bibliographic databases, a single proportionate cause-of-death modelling based on the Child Health Epidemiology Reference Group method was developed to estimate the number of child death according to proportional causes in different age group at both national and provincial levels.

Results

Of all children died before five years old in 2015 in China, 51.5% occurred during the first month, 21.6% occurred during 1-12months, and 27.6% were from 1-4 years old. The leading causes of death in 2015 were preterm birth complications, birth asphyxia, congenital abnormalities and pneumonia for children under five years old. Different models were constructed for different age group which can be applied to predict the proportional distribution of causes of death for the following years. The causes of death spectrum changed dramatically among different provinces with different development levels, especially for the proportions of infectious diseases and congenital abnormalities.

Conclusions

As an update analysis, this study validates the accuracy of the previous study and proposes a new statistical modelling method to predict the proportions of most common causes of child death in China which can be adopted in further related studies. Furthermore, this study offers the most up-to-date estimates of causes of child death in China from 2009 to 2015, with these estimates, targeting strategies on reducing child mortality, especially for neonates, should be made toward the top causes of neonatal diseases, congenital abnormalities, and infectious diseases, with special attentions on the difference between different regions with uneven development levels.

1 INTRODUCTION

1.1 Background

Child health is widely regarded as a priority issue of every nation (Currie & Reichman, 2015; Stein, 2005). Under-five mortality rate (U5MR), which estimates the probability of dying between birth and the fifth birthday, is typically expressed as the number of deaths per 1,000 live births (UNICEF). It is a useful indicator that measures not only the level of child health, but also overall development of a society (Haroun, Mahfouz, & Ibrahim, 2007; Reidpath & Allotey, 2003). Since the adoption of the Millennium Development Goals (MDGs) by 189 member states of United Nations (UN) organization in September 2000 (Gaffey, Das, & Bhutta, 2015; You et al., 2015), global and national estimates of U5MR have been routinely reported to track the progress towards MDG 4, which calls for a reduction in child mortality by two-thirds from 1990 to 2015 (Wardlaw, You, Hug, Amouzou, & Newby, 2014; Way, 2015). In this study, I will explore the progress in reaching the MDG4 in the largest developing country - China. It is widely regarded that China has made the most impressive progress in reducing its child mortality in the 21st century and it could therefore serve as a model to many other low- and middle-income countries (LMIC). I will study the changes in child mortality levels and focus on establishing the causes of death (COD) in different under-five age groups. I will attempt to determine the cause structure among neonates (<1 month), post-neonatal infants (1-12 months) and children aged 1-4 years (12-59 months). Ultimately, I will summarise the COD for all children in the age group 0-4 (0-59 months), as shown in **Figure 1.1**.

This chapter will provide an overview of the current child mortality and its historical changes in China in the past two decades.

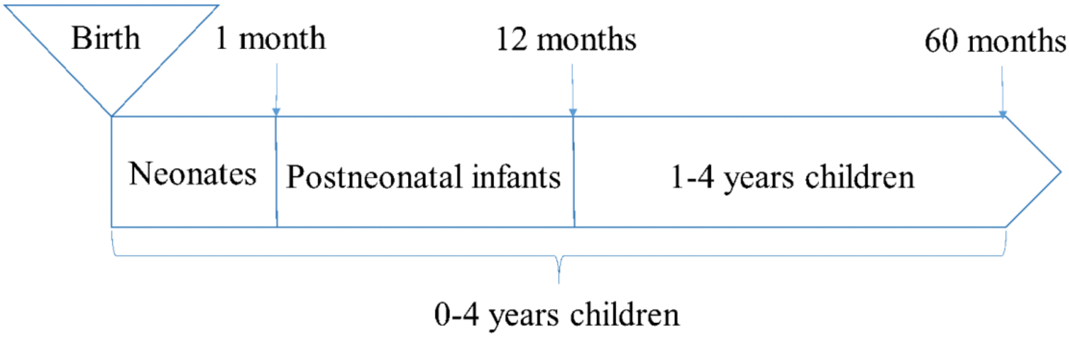


Figure 1.1 Definition of important age groups in children under 5 years

1.2 Civil registration and vital statistics

Civil registration and vital statistics (CRVS) system is an administrative legal registration of civil events (Abouzahr et al., 2014; World Health Organization, 2013a, 2014a), such as births, deaths, marriages, divorces and fetal deaths. Vital statistics is based on information generated from civil registration systems. Universal CRVS with a complete coverage in the population is the best way for tracking all births and deaths (World Health Organization, 2013b, 2015a).

CRVS provides information on life events and it records all births and deaths at the national level. CRVS is fundamental for providing rigorous data on mortality and COD, and for generating demographic and health statistics for the population. The information obtained from CRVS can usually be used to produce timely and reliable population estimates to guide policy and programs (Mathers, Ma Fat, Inoue, Rao, & Lopez, 2005; Moriyama et al., 2010; World Health Organization, 2013c). The demand for complete, accurate and timely CRVS has been increasing over the past two decades to track progress towards public health related goals and targets (AbouZahr et al., 2015; World Health Organization, 2015a).

Internationally, the UN collects, compiles and compares national vital statistics data and uses this information for regional and national comparisons (Mahapatra et al., 2007). The coverage of vital registration varies widely between countries - from almost 100% in the European region, to less than 10% in the African region (Mathers et al., 2005). Moreover, in some countries where the vital coverage is high, the data on COD are still far from satisfactory (World Health Organization, 2014b). It is estimated that among all 115 countries that report mortality data routinely to the World Health Organization (WHO), only 64 have good quality mortality data coupled with COD (Jha, 2012). Globally, there are still more than 100 countries without functional death registration system. As a result, up to 80% of deaths that occur outside of health facilities are not counted, and nearly 230 million children under five years are not covered with a vital registration system (World Health Organization, 2014a).

1.3 Death classification

Correct classification of COD is an important component of CRVS. Data on COD provides valuable information that influences public health decision making, which can then improve the survival of children and adults (World Health Organization, 2014a). Internationally, the most widely used tool for recording COD is the International Classification of Diseases and Related Health Problems (ICD), which adopts triple alphanumeric digit codes to unify the diagnoses. The international standard classification is currently in its 10th version (ICD-10). The adoption of ICD-10 allows comparisons among different countries, areas and time periods (World Health Organization, 2004). In China, ICD-10 is widely used as the reference system for medical diagnosis of diseases and deaths (G. Yang et al., 2008).

1.4 Main mortality data sources in China

In China, the most populous country in the world (Population Pyramids of the World from 1950 to 2100, 2015), a complete and universal CRVS coverage has not been achieved until recently. However, sample-based longitudinal registration systems, based on representative surveillance sites, have been in use for some time and they became the most valuable sources for national mortality statistics (Setel et al., 2005; World Health Organization, 2014b), other relevant sources include surveillance systems, household surveys, census, etc. They can also be used in addition to sample-based surveys to provide reasonably reliable data for the entire Chinese population (Mathers et al., 2005; Setel et al., 2007).

1.4.1 Mortality data for the population of China

1.4.1.1 National Mortality Surveillance System

Before 2013, the Chinese CRVS included two systems: the vital registration system of the Chinese National Health and Family Planning Commission (NHFPC) (the former Ministry of Health) and the sample-based disease surveillance points (DSP) system of the Chinese Center for Disease Control and Prevention (CDC). The vital registration system was established in 1973 and started to collect data of vital events. By 2012, this system covered around 230 million people in 22 provinces, helping to provide valuable information on both mortality and COD patterns, although the data were not truly representative for the whole China (Beaglehole & Bonita, 2009). DSP was established in 1978 to collect data on individual births, deaths and 35 notifiable infectious diseases in surveillance areas (Zeng, Poston Jr, Vlosky, & Gu, 2008). By 2004, there were 161 sites included in the surveillance system, covering 73 million persons in 31 provinces. The sites were selected from different areas based on a multistage cluster sampling method, leading to a very good national representativeness of the DSP (S. Liu et al.; Yu et al., 2015). From 2013, the above two systems were merged together to generate a new "National Mortality Surveillance System" (NMSS), which currently covers 605 surveillance points in 31 provinces and 24% of the whole Chinese population. The selection of surveillance points was based on a national multistage cluster sampling method, after stratifying for different socioeconomic status to ensure the representativeness (S. Liu et al.; Setel et al., 2005). However, because of its high underreporting rate among children under five years (as high as 35.0 % according to under-reporting field survey) (K. Guo et al., 2015) and the poor performance of linking birth registration (McNicoll, 2015; G. Yang et al., 2005), this system is not presently used as the official data source on child mortality (Rao, Lopez, Yang, Begg, & Ma, 2005; G. Yang et al., 2005).

1.4.1.2 National Retrospective Survey on Causes of Death

Another main source of information on COD structure in China is the National Retrospective Survey on Causes of Death (NRSCD), which is also called the "Cancer Epidemiology Survey". There have been three NRSCD in China, which were conducted to collect death information for 1973-1975, 1990-1992, and 2004-2005 respectively. In these surveys, the age, sex and COD were recorded for each death (Banister & Hill, 2004). The first survey was conducted at the national level between 1973-1975, covering about 850 million persons and identifying about 20 million deaths (Zou, Wan, Dai, & Yang, 2012). The two subsequent surveys were both sample-based surveys that used random cluster sampling design. The most recent, third NRSCD, covered 73 million persons in 160 counties and 53 areas with high cancer incidence (J.-B. Wang et al., 2010; Ling Yang, Parkin, Li, & Chen, 2003). It retrospectively investigated all deaths reported by DSP in the study areas. The high-quality data on mortality and COD made NRSCD one of the most reliable sources on COD in China, especially on the issue of cancer prevention and control (Ling Yang et al., 2003; J. Zhao, Jow-Ching Tu, McMurray, & Sleigh, 2012).

1.4.1.3 National census and inter-census surveys

Reliable and complete data on population-level mortality can also be derived from direct or indirect estimates based on censuses (World Bank Group, 2015). In China, the National Bureau of Statistics (NBS) has conducted six national censuses: in 1953, 1964, 1982, 1990, 2000 and 2010. The aim was to collect accurate information on the national demographic features. The overall quality of these censuses was regarded as very high, with net under-enumeration rates of only 0.116%, 0.0014%, 0.04%, 0.06%, 1.81% and 0.12% for the years 1953, 1964, 1982, 1990, 2000 and 2010, respectively (Basten, 2012; G. Zhang & Zhao, 2005; Z. Zhao & Chen, 2011). Since 1982, NBS regularised the census, so that it is held once in every ten years, each time in the year ending with '0'. During the inter-census periods, national sample surveys based on 1% of population and a stratified multi-stage sampling were also conducted every ten years, each time in the year ending with '5'. As these sample surveys were similar to the formal censuses, they are also referred to as "mini-censuses". The national 1% population surveys have already been conducted in 1987, 1995, 2005 and 2015 respectively (Cao, Yuan, Wang, Mao, & Zhu, 2009; National Bureau of Statistics of the People's Republic of China, 2014). In addition, National Sample Survey on Population Changes (NSSPC) was also being conducted by NBS annually from 1983 during the years when there was no census or mini-census (McNicoll, 2015), using a similar design as the censuses and mini-censuses.

Based on the above censuses and surveys, NBS publishes demographic data with a wide coverage of the whole population. The reports are published annually in the NBS statistical yearbooks. Mortality data can also be obtained from these yearbooks. However, the use of the mortality data is limited because of the lack of COD details (McNicoll, 2015).

1.4.2 Mortality data for children

1.4.2.1 National Maternal and Child Mortality Surveillance system

National Maternal and Child Mortality Surveillance (MCMS) system was established in 1996 based on three independent surveillance systems, which were: (i) population-based maternal mortality surveillance system; (ii) population-based child mortality surveillance system; and (iii) hospital-based birth defect surveillance system (Du et al., 2012; Liang et al., 2011). In 2007, the number of surveillance sites expanded from 116 (37 urban and 79 rural) to 336 counties/districts (126 urban and 210 rural) in 31 provinces (autonomous regions and municipalities) in Mainland China (He et al., 2015; Rudan et al., 2010). Based on their geography and economic development, these sites can be further categorised into three regions: East, Central and West, with the East region being the most developed and the West region the least. The East region includes Beijing, Tianjin, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, and Guangdong; the Central includes Hebei, Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan and Hainan, the West includes Inner Mongolia, Guangxi, Sichuan, Chongqing, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang (Department of Maternal and Child Health, 2013).

A stratified cluster sampling method was used for the selection of surveillance sites to ensure the sites were distributed evenly across the 31 provinces (autonomous regions and municipalities), and that the sites are nationally and regionally representative. Data from this system can thus be used to provide national and regional estimates, but not estimates at a provincial level.

The surveillance contents, case definitions, reporting methods, and quality control are unified across all surveillance sites within MCMS. The basic contents include:

1) The number of live births, the number of children aged 1-4 years and the number of overall population;

2) The number of deaths for children younger than five years of age and their corresponding COD;

3) The timing, locations and distribution of deaths for of children younger than five years of age;

4) The basic situation of health care services for children younger than five years (Department of Maternal and Child Health, 2013; Du et al., 2012; Liang et al., 2011).

For each community/village, one doctor is responsible for recording every newborn child,

child death, or inbound/outbound migration of a child during the surveillance period. Once a death occurs, the community/village doctor is responsible for reporting it to the community health center/township hospital within ten days. Upon receiving this report, a specialist in charge of maternal and child health (MCH) organises a home visit to verify the death within seven days. A national unified “death report card” is used to record the death related information. When a child dies at home or on the way to a hospital, a “Questionnaire of Child Death Outside of Medical Institutions” is used to conduct a verbal autopsy. The established COD is then recorded in the “Death Report Card” (see **Appendix Table 1**). When a child dies in a hospital, the “Death Report Card” would be completed based on the diagnosis from the hospital. All death causes are recorded as the primary COD and coded based on 35 causes categorised by MCMS specifically for children (see **Appendix Table 2** for the causes used for classifying child deaths). ICD-10 would be assigned automatically in the electric reporting system after the causes set by MCMS are entered in the computer system.

Quality control of the MCMS consists of two parts: the attention is firstly focused on a possible under-reporting of either live births or deaths, and then the focus is placed on a possible COD misclassification. For the part of quality control process relevant to under-reporting, different methods are used to conduct cross-checking, e.g. checking original records and various registrations (such as birth registration, maternal registration, registration of family planning, public security registration, vaccination cards, etc.). For COD misclassification, a team of specialists is invited to review all the reported deaths and their causes every 3, 6 or 12 months at the different levels of surveillance units, aiming to minimise the misclassification error. The provincial MCMS administrative office annually checks the MCMS death list against all the child deaths recorded in NMSS, which also helps to guarantee the completeness and accuracy of the deaths and causes.

1.4.2.2 National Maternal and Child Health Annual Reporting System

The National Maternal and Child Health Annual Reporting System (MCHARS) was established in the beginning of 1980s. This is another registration system that specifically records the births and deaths of mothers and children. It is therefore another important source that could illuminate women and children's health situation. MCHARS should theoretically cover the whole population of China. Its information is obtained from the county level in rural areas, and from the level of districts in urban areas (Feng, Theodoratou, et al., 2012; Gan et al., 2014; Kuruvilla et al., 2014; Yanqiu, Ronsmans, & Lin, 2009). All data are collected based on ten report forms (Department of Maternal and Child Health, 2013):

1) "Maternal health annual report form";
2) "Hospital delivery monthly report form";
3) "The health situation of children under seven years old report form";
4) "Non-resident maternal and children's health situation annual report form";
5) "Common gynecological disease screening annual report form";
6) "Contraception operation annual report form";
7) "Intermediate induction annual report form";
8) "Family planning counseling and follow-up services annual report form";
9) "Disabled children and contraception operation complications annual report form";
10) "Pre-marital health care annual report form"

All data in the above forms are collected by community/village doctor and reported to higher level Bureaus of Health before the total number of live births from all administrative areas in one province is collated and reported to the central MCHARS office (Cao et al., 2009; Feng, Theodoratou, et al., 2012; Y. Wang et al., 2015). As a national statutory vital registration system, MCHARS collects routine information on births and maternal and child deaths in both rural and urban areas across the whole country (Feng, Theodoratou, et al., 2012). Despite its nationwide coverage, MCHARS suffers from possible underreporting and lacks details on COD in children. For these reasons, data from MCHARS are of limited use for estimating the COD in children and MCMS should be preferred (Gan et al., 2014).

1.5 Child mortality

1.5.1 Global profile

Globally, the child mortality estimates for 194 countries are reported annually by the United Nation's Inter-agency Group for Child Mortality Estimation (UN IGME). UN IGME includes the United Nations Children's Fund (UNICEF), WHO, the World Bank, and the United Nations Population Division (UNPD). In its estimates, it relies on multiple sources of data. For countries with complete and timely CRVS which continuously record births and deaths, this is the best source. For large countries, like India and China, well-functioning sample surveillance systems can be an alternative option. In other developing countries, large-scale household surveys and even censuses (summary birth histories), such as the UNICEF-supported Multiple Indicator Cluster Surveys (MICS) and the United States Agency for International Development (USAID)-supported Demographic and Health Surveys (DHS) are the main sources (WHO, 2013). Based on the different data sources and quality, different modelling methods are applied to produce comparable country-specific estimates of U5MR (Alkema, New, Pedersen, & You, 2014; World Health Organization, 2011; You et al., 2015).

After more than 15 years of global efforts and collaboration, substantial progress has been made towards improving children's survival in the world (**Figure 1.2**). The U5MR has halved from 91 (Boy-89, Girl-92) deaths per 1,000 live births in 1990 to 43 (Boy-41, Girl-46) deaths per 1,000 live births in 2015, and the number of under-five deaths has also dropped from 12.7 (Boy-12.6, Girl-13.0) million in 1990 to 5.9 (Boy-5.7, Girl-6.4) million in 2015 (UNICEF, 2015c).

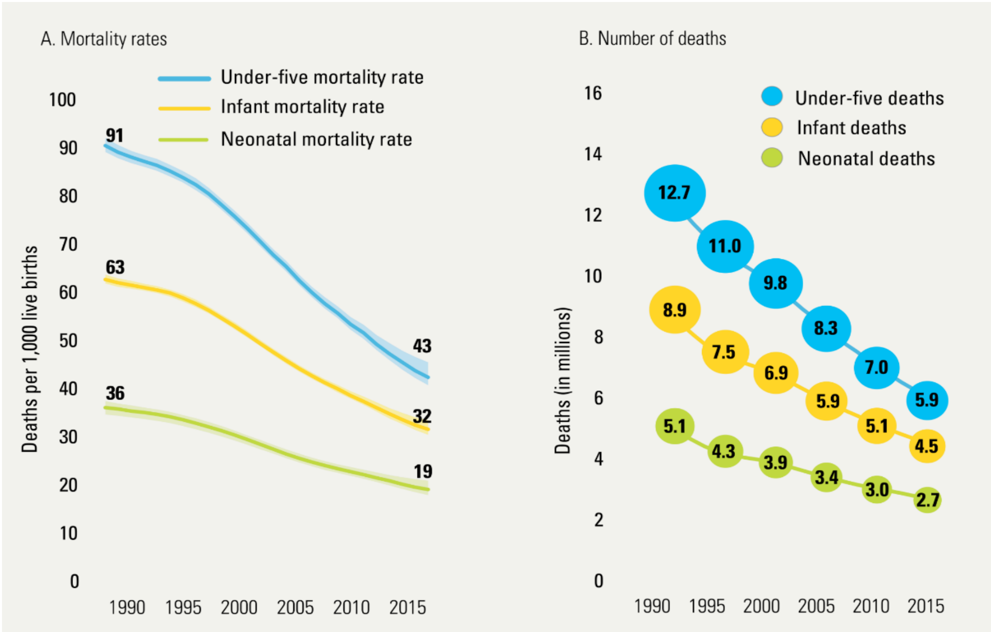


Figure 1.2 Global under-five, infant and neonatal mortality rates and the number of deaths from 1990 to 2015 (source:(UNICEF, 2015a))

*Note: the shaded bands in Figure A are the 90 percent uncertainty intervals around the estimates of mortality rates.

Despite the above advances, there are still 16,000 children younger than five years who die from preventable causes every day (United Nations, 2015a). Moreover, a considerable equity gap between different socioeconomic strata still exists in most countries (UNICEF, 2015b) (**Figure 1.3**). Children from rural, poor or low-maternal-education households are much more vulnerable: on average, children in rural areas are 1.7 times as likely to die before reaching five years old as children in urban areas. The risk is 1.9 times greater for poor children in comparison to the wealthier groups, 1.5 times greater for children whose mothers have no education in comparison to primary education, and 2.8 times greater for children whose mothers have no education in comparison to a secondary or higher education (UNICEF, 2015a) (**Figure 1.3**).

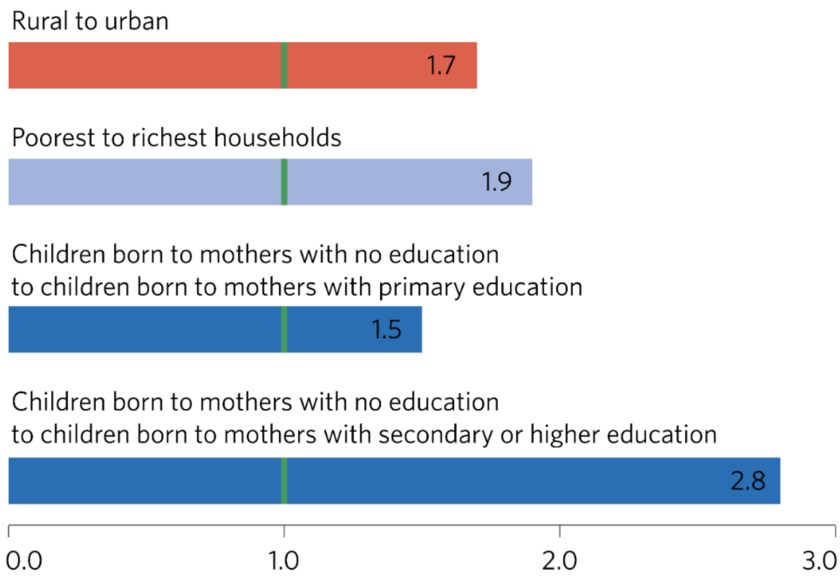


Figure 1.3 Ratio of U5MRs for children by residence, wealth quintile and mother's education, 2005-2013 (source: (Way, 2015))

*Note: data are based on the MICS and DHS survey that took place between 2005 and July 2013. Data from most recent survey in that period are used for countries with multiple surveys. Data by wealth quintile are based on 55 surveys, data on education are based on 59 surveys, and data on residence are based on 60 surveys.

In addition, although a considerable progress has been made in most regions in the world, achievements differ between countries (see **Figure 1.4**). Some 50 countries (**Table 1.1**) will fail to achieve the MDG 4 according to "Countdown to 2015" (a review system to measure progress in maternal, newborn and child health worldwide) final report (Victora et al., 2015; World Health Organization, 2015b), most of which are LMIC.

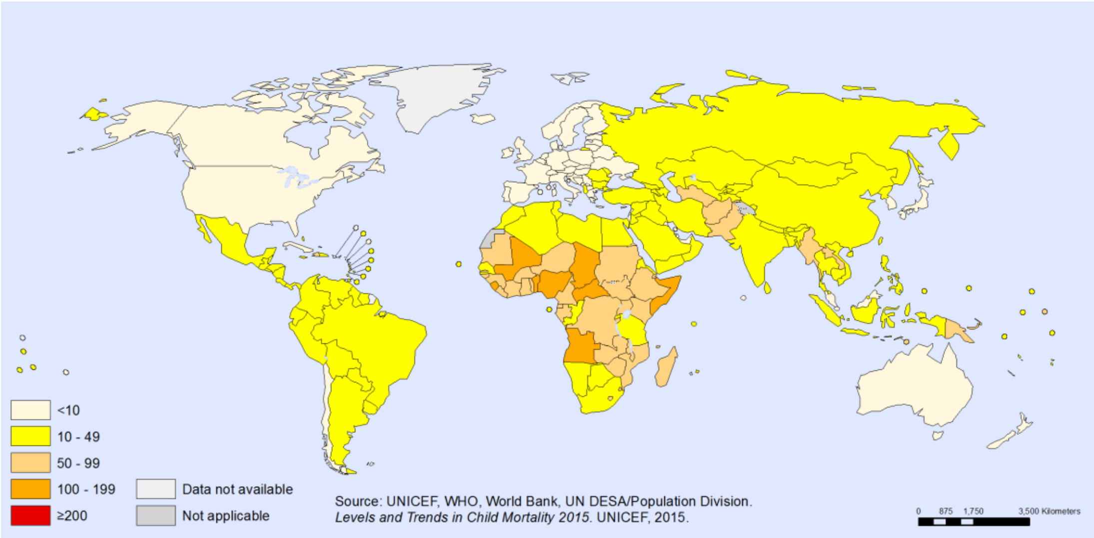


Figure 1.4 Global distribution of U5MRs, 2015 (source: (World Health Organization))

Table 1.1 Number of countries according to MDG target 4.A Achievement status, by WHO region, 2013 (source: (World Health Organization, 2015b))

WHO region	**MDG Target 4.A-achievement status**				**Total**
	Achieved	On track	At least halfway	Less than halfway	
African Region (AFR)	6	2	25	14	47
Region of the Americas (AMR)	5	3	24	3	35
South-East Asia Region (SEAR)	5	2	4	0	11
European Region (EUR)	23	4	26	0	53
Eastern Mediterranean Region (EMR)	6	2	12	1	21
Western Pacific Region (WPR)	3	0	18	6	27
Global	**48 (25%)**	**13 (7%)**	**109 (56%)**	**24 (12%)**	**194 (100%)**

1.5.2 China profile

The estimates of UN IGME revealed that the U5MR in China had declined from 53.8 per 1,000 live births in 1990 to 10.7 per 1,000 live births in 2015 (**Figure 1.5**) (CMEInfo).

MCMS also reported that the U5MR in China has dropped dramatically - from 61 per 1,000 live births to 12 per 1,000 live births between 1991 and 2013 (**Figure 1.6**) (National Health and Family Planning Commission of the People's Republic of China, 2014). This progress made China one of the most successful countries in achieving MDG 4: not only did China manage to reduce the mortality of children under five years of age by two thirds, but also it reached this target eight years in advance of the year 2015 (National Health and Family Planning Commission, 2014; You et al., 2015). The newly launched 17 UN Sustainable Development Goals (SDGs) framework proposed a new measureable target for child health: it requires that the overall U5MR drops to at least 25 per 1,000 live births for all countries (United Nations, 2015b). In China, this has already been achieved at the national level, according to the above data.

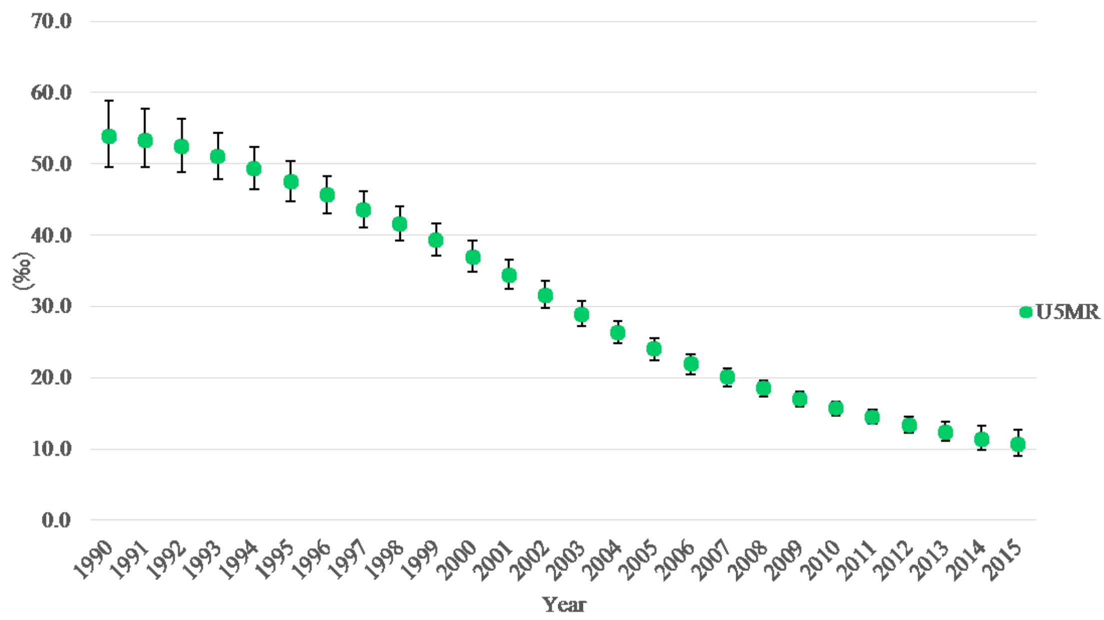


Figure 1.5 The estimates of U5MR in China from 1990 to 2014 (data source: UN IGME)

*Note: Lower, median and upper of the data dots refer to the lower bound, median and upper bound of 90% uncertainty intervals.

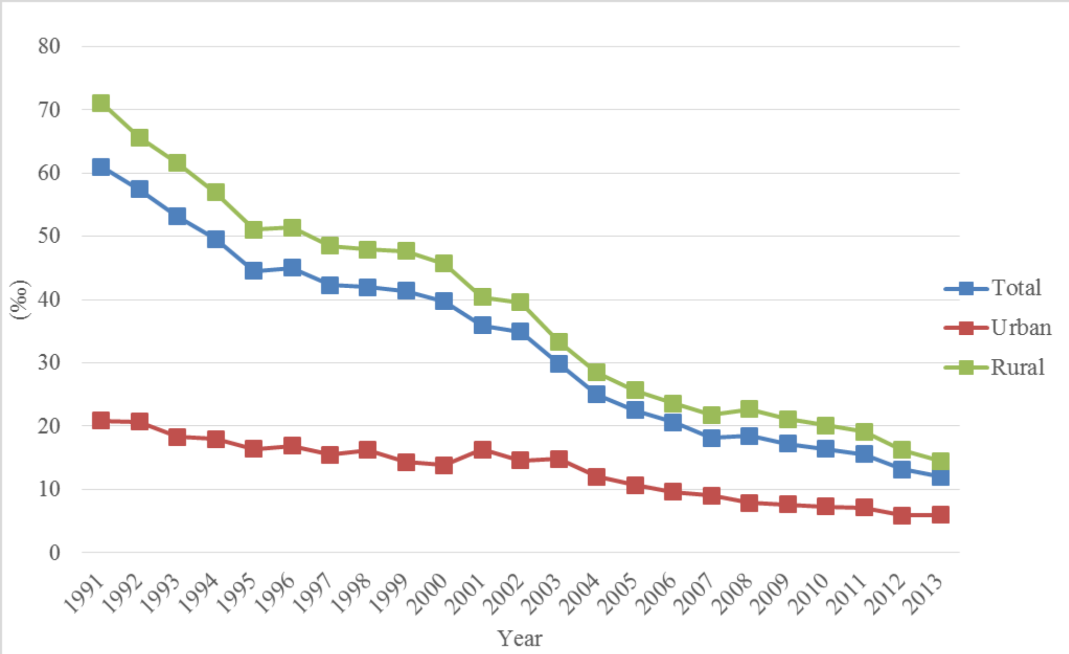


Figure 1.6 The trend of U5MR in China from 1991 to 2013 (data source: MCMS)

However, another requirement in the SDG 3 which calls for an end to preventable deaths of newborns and children under 5 years of age remains unrealised. Despite the current positive factors, such as the rapid economic growth, the development targeted central government and China's special and demographic circumstances (declining fertility rates, etc.) (Ministry of Foreign Affairs, 2015; United Nations Development Programme China, 2015), for a populous and diverse country like China, this goal is still challenging: the total number of children who died before their fifth birthdays is still huge (UNICEF, 2015c), especially in rural areas. The number of under-five deaths occurring in China (about 236,000) in 2013 accounted for 4% of all under-five deaths globally (UNICEF, 2014a). In addition, there are also large disparities in child mortality rates between the rich and the poor, as well as between the urban and the rural regions of the country (Ministry of Foreign Affairs, 2015; UNICEF, 2014b; Yi et al., 2011). According to the latest estimates of U5MR for 2851 Chinese counties, there were still 345 counties (12% of all Chinese counties) lagging behind in achieving the MDG 4 pace of decline from 1996 to 2012, which represented a total population of 149.8 million in which 1.5 million live births were recorded in 2012 (Y. Wang et al., 2015). The vulnerable groups cannot always be served effectively by the current MCH programs. This is especially true for the fast growing migrant population coming from rural areas and inhabiting the big cities (E. Y. Chan, Griffiths, Gao, Chan, & Fok, 2008). Targeted efforts are required immediately to end the growing inequalities by the year 2030 (Thomsen et al., 2011; United Nations, 2015b).

1.6 Causes of death in children

The leading COD in children are very different from the causes among adults (Field & Behrman, 2003) and they vary among different regions (UNICEF, 2015a). Information on COD is important for health policy development and continuous monitoring of the progress in reducing child mortality (França, de Abreu, Rao, & Lopez, 2008).

1.6.1 Global profile

Lack of reliable cause-specific information on child mortality has been a long-standing major obstacle to producing consistent and internationally comparable estimates of COD in children, and thus for tracking progress in achieving the MDG4 (World Health Organization, 2005).

To improve the estimates of the cause-specific proportional distribution of deaths in children under five years, the WHO established the external Child Health Epidemiology Reference Group (CHERG) in 2001 (Bryce, Boschi-Pinto, Shibuya, & Black, 2005). Funded by the Gates Foundation, this group of technical experts developed a standard set of procedures to estimate the major causes of child deaths globally, regionally and nationally. The total number of deaths of children under five years old was set as the "envelope", based on U5MR estimated by UN IGME. Then, according to the COD data availability and accuracy, different models were applied in different countries to produce comparable country-specific estimates of COD (Black et al., 2010; Bryce et al., 2005; L. Liu et al., 2015). In countries with complete and high-quality CRVS, COD were estimated directly from the CRVS data by grouping causes into standard ICD groups, or by reassigning causes that didn't seem comparable to ICD classification. In countries with low U5MRs (≤35 deaths per 1,000 live births) but incomplete CRVS, a vital-registration-data-based multi-cause model (VRMCM) was applied to estimate the proportion of each cause. In countries with high U5MRs (>35 per 1,000 live births), a verbal-autopsy-data-based multi-cause model (VAMCM) was applied (Bryce et al., 2005). In India, as a special case, a state-level multi-cause model was developed based on 45 study data points. It was derived from the "Million Deaths Study" and all-India sub-national verbal autopsy studies. In China, as another special case, a set of single-cause models based on a systematic review of 206 independent local studies into causes of child mortality was developed (L. Liu et al., 2012; Rudan et al., 2010).

According to the latest WHO statistics report, the main COD in children under five years has changes in the last decade from 2000 to 2012, with large reduction occurring among infectious diseases, such as pneumonia, diarrhea, measles and malaria (**Figure 1.7**). The progress was slower among congenital causes, preterm birth complications and accidents. In 2013, the leading causes were preterm birth complications (15%), pneumonia (15%) and intrapartum-related complications (11%), and almost half (44%) of the causes occurred in the neonatal period (**Figure 1.8**) (L. Liu et al., 2015).

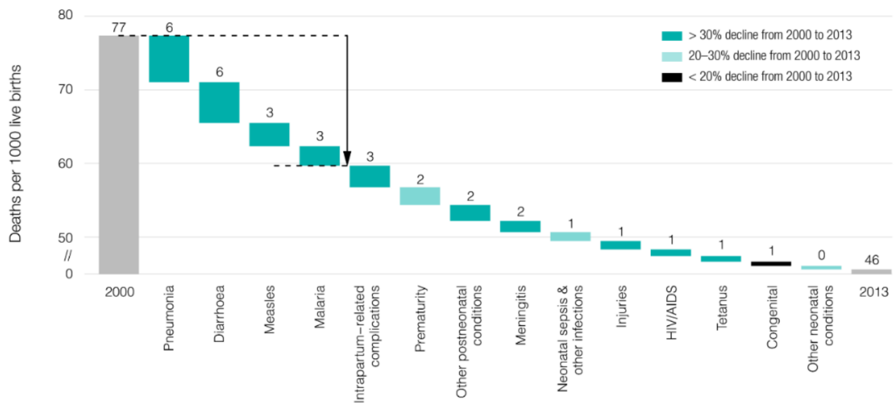


Figure 1.7 Global trends in COD in children under five years, 2000 to 2013 (source:

(World Health Organization, 2015b))

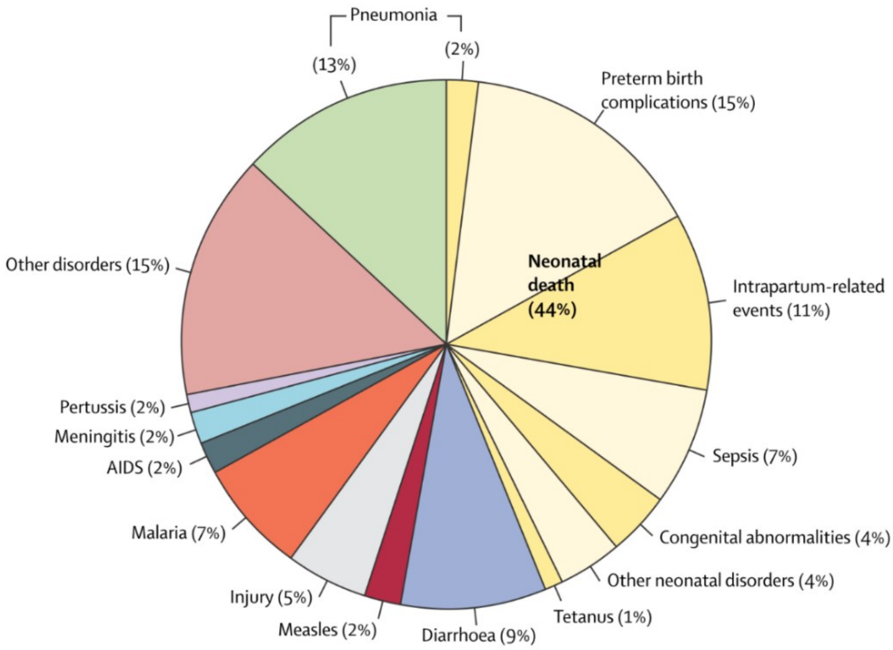


Figure 1.8 Global COD in children under five years in 2013 (source: (L. Liu et al., 2015))

Although massive progress has been achieved in infectious disease reduction, infectious and other preventable diseases still claim a large number of child lives around the world, especially in sub-Saharan Africa and South Asia. This calls for new targeted interventions - such as new vaccines - and better quality of maternal health care to reduce all preventable causes, especially for the top causes in the neonatal period (L. Liu et al., 2015; Requejo et al., 2015).

1.6.2 **China profile**

To address the underlying COD in children under five years in China, Rudan, Chan and colleagues conducted a study on behalf of CHERG that estimated the COD in children under five in China in 2008. Their estimate was based on a systematic review of the Chinese literature, which has become digitalised only a couple of years earlier and made available in searchable databases such as China National Knowledge Infrastructure (CNKI) and WanFang data. Based on the information extracted from 206 studies, they proposed epidemiological models for estimating proportions of different causes based on the overall U5MR (Rudan et al., 2010). Since then, this study has been widely cited and adopted when addressing the issue of the causes of child mortality in China (Black et al., 2010; L. Liu et al., 2012), especially in the WHO datasets such as the Global Health Observatory data repository (L. Liu et al., 2012; World Health Organization).

According to the most recent estimates of the WHO and the Maternal and Child Epidemiology Estimation group (MCEE, former CHERG), more than half (61%) of the causes occurs in the neonatal period. In comparison to the global distribution, where the deaths in the neonatal period still contribute to less than 50% of all deaths, there is a clear need to focus the attention in China on neonatal deaths. This will require high quality health care provision for the entire period of pregnancy and newborn period (**Figure 1.9**) (NWCCW, 2014).

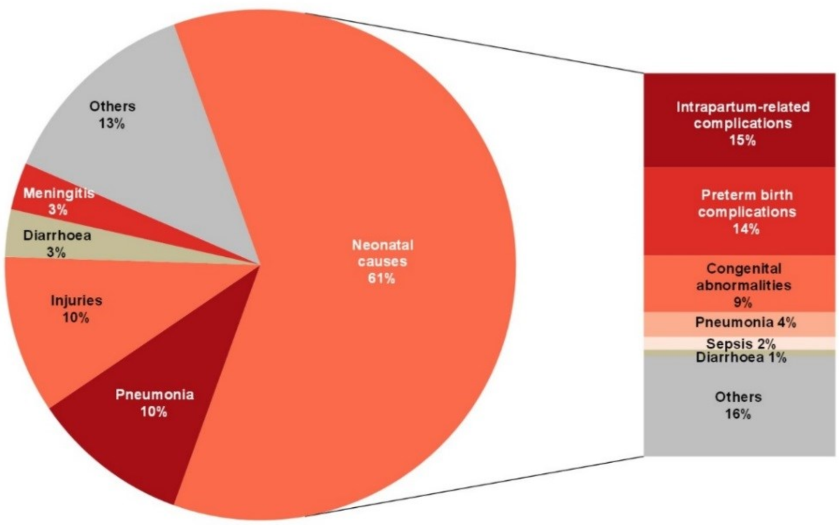


Figure 1.9 COD in children under five years in China in 2013 (source: (NWCCW, 2014))

Further improvements in child health in China will critically depend on new sources of data on the specific COD that will inform policy and practice and identify priorities (L. Liu et al., 2012; L. Liu et al., 2015; Stein, 2005). At the global and regional level, the CHERG cause-specific estimates have been updated regularly (Bryce et al., 2005; L. Liu et al., 2012). However, the estimation methods of COD in children under five years in China was established based on independent studies published between 2000 and 2008, which now represents a considerable time-lag and requires an update. The very point of the MDGs target - the year 2015 - marks a symbolic time for updating progress on child mortality and revising its COD predicting models for children under the age of five in China.

1.7 Research objectives

This study follows from the previous analysis by Rudan and Chan in 2008 (Rudan et al., 2010). The aim is to conduct an entirely new search of the literature to include all informative studies published in the Chinese literature and other sources between 2009 and 2014. It will then use the obtained information to revise and advance the methods used to estimate the causes of child deaths in China in the period 2009-2015. This study will not only explore whether the cause structure of child deaths has changed in comparison to the period 2000-2008, but also it will "validate" the previous estimate because the estimates for the year 2009 should closely resemble those for the year 2008, but they should be based on entirely new dataset and improved models. This resemblance, if demonstrated, would serve as a successful "replication" of the initial set of estimates and it would strengthen our confidence in the estimated cause structure for China throughout the entire period 2000-2015.

The objectives of this thesis are:

1. Acquiring the information on national-level and province-level U5MRs and the number of live births, to develop the "envelopes" for the total number of child deaths

in China in the years of 2009-2015;

2. Systematically reviewing the available Chinese literature, as well as all other sources, to develop a new dataset with COD in the years 2009-2014;

3. Developing epidemiological models that will predict the proportion of deaths in the period 2009-2015 that occur in the neonatal (<1 month), postneonatal infant (1-12 months), 1-4 years (12-59 months) and 0-4 years (0-59 months) period, to create the "envelopes" for these particular age groups;

4. Within each age group, developing epidemiological models that will assign COD to all deaths based on a province-level U5MR and epidemiological single-cause models that are based on information from independent studies acquired through systematic review;

5. Estimating the COD structure in children in China for each of the year 2009-2015 at both national and province levels.

1.8 Outline of the thesis

My thesis will be organised in four main sections: Introduction, Methods, Results and Discussion. In the Introduction part, I already presented the background and rationale for this research and I reviewed the relevant existing information on child mortality and COD structure, with a special focus on China. In the Methods section, I will present a detailed methodology description, including the overall approach, systematic review procedures, data sources used, the design of the study and statistical modelling methods. In the Results section, I will present the findings in a structured and systematic way. Finally, in the Discussion section, I plan to discuss the overall merits and limitations of the thesis and summarise the implication for future research and health-related policy.

2 METHODS

2.1 Data sources

In Chapter 1, I listed five available sources of information on child mortality in China: NMSS, NRSCD, NBS census, MCMS, and MCHARS (Mathers, Boerma, & Fat, 2009). They differ substantially in their reliability, validity and applicability to different problems. NMSS reports the mortality and COD covering the entire life period ranging from 0 to 100+ years, but its performance is questionable whenever there is a sole focus on child deaths. The issue with NRSCD is that they were conducted retrospectively and therefore suffer from a substantial recall bias and under-reporting. The NBS census provides the most reliable national-level demographic data, e.g. number of live births, but it doesn't provide information on COD (G. Yang et al., 2005). Because of these problems, MCMS was established especially for monitoring the COD in children under five years. Its aim was to be representative only for the entire nation, or the three large regions at best, but it is not representative of the provinces or counties. MCHARS has an advantage of covering the whole population of China with great density, so it can provide U5MR at the level of particular provinces, but it does not collect information of COD in children (Yanqiu et al., 2009).

2.1.1 Child mortality data

As mentioned above, the problems with under-reporting, recall bias and lack of information on COD limit the use of the data from NMSS, NRSCD and NBS census, respectively. NBS can still be used to obtain demographic parameters of interest, such as number of live births or population size. If the aim is to focus on child deaths, the two main sources in China are certainly MCMS and MCHARS (Mathers et al., 2009). In this study, I will use the national-level U5MR estimates from UN IGME, which are largely based on the data from

MCMS, as reported in the latest “China Health and Family Planning Statistical Yearbook 2014” (former China Health Statistics Yearbook before 2013), which is considered as the most reliable assessment for the estimates of national-level U5MR.

However, MCMS data is nationally representative, but does no offer U5MR estimates at the provincial level. Given that my approach to modelling will require province-level U5MRs, there are two possible sources: (i) MCHARS (as explained above); and (ii) provincial U5MR estimates published by Institute for Health Metrics and Evaluation (IHME) (Institute for Health Metrics and Evaluation (IHME), 2015). Data reported by MCHARS were collected by systematically searching provincial yearbooks and local government reports for the 31 provinces in Mainland China (except Hong Kong Special Administrative Region, Macao Special Administrative Region and Taiwan) in 2013. U5MR estimates by IHME was based on various modelling methods, including small area mortality estimation model, spatiotemporal smoothing, and Gaussian process regression (H. Wang et al., 2014; Y. Wang et al., 2015). The two sets of estimates have clearly been based on different data sources and the latter re-scaled the under-reporting by adjusting for completeness (Y. Wang et al., 2015). In **Figure 2.1**, I presented the province-level U5MRs from both MCHARS and IHME. The two sources show a very similar pattern of U5MR variation in different provinces, but the estimates by IHME are systematically higher than those from MCHARS. Given the known U5MR for the whole China (from MCMS and UN IGME), and the population of children (and the number of live births) in each province, it is easy to conclude that the estimates by IHME fit the national-level U5MR "envelope" very nicely when added together, while the estimates from MCHARS are implausibly low - which is consistent with the assumed under-reporting in MCHARS. Because of this, in my study, I used the estimates by IHME as the relevant province-level U5MRs for the year 2013.

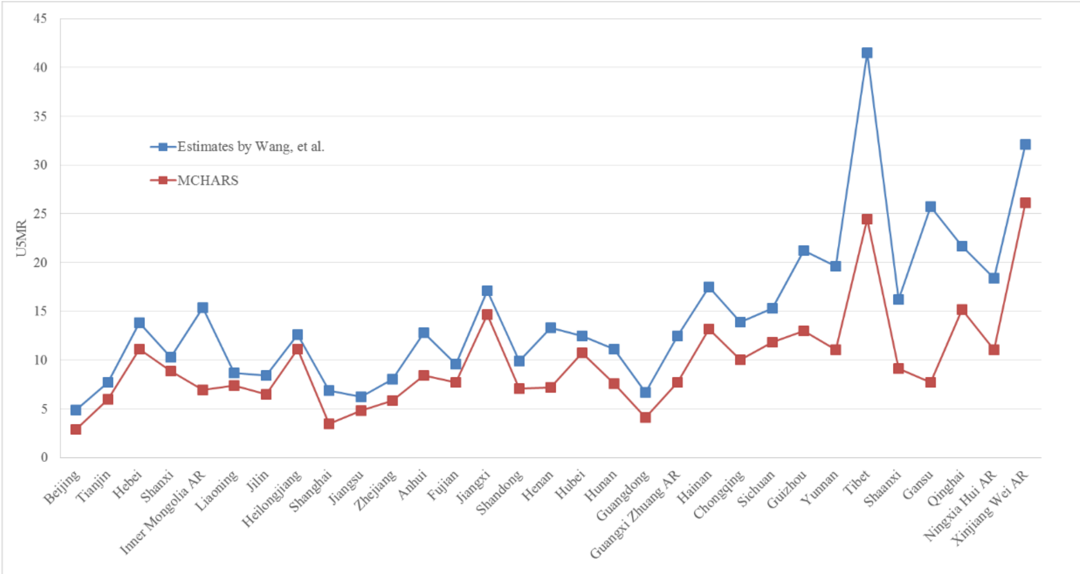


Figure 2.1 Comparison of U5MRs in 30 provinces of China in 2013 bases on data from MCHARS and estimates by IHME (data source: (Institute for Health Metrics and Evaluation (IHME), 2015; National Health and Family Planning Commission of the People's Republic of China, 2014))

2.1.2 Number of live births

There are also two main sources of data for the number of live births at both the national and provincial levels: MCHARS and the NBS estimates. The collection of live births data in MCHARS is the same as the counting of deaths: it is conducted by a local health worker and then reported to higher institutions. The provincial number of live births is then gathered by adding all live births in each county/district. Similarly as the counting of deaths, it is likely that the reporting of live births in MCHARS also suffers from under-reporting, at least to some extent.

The NBS estimates are based on national censuses, inter-censual surveys and NSSPC, the estimates of live births are not presented in the statistical yearbooks directly as absolute numbers, but they can be calculated through birth rates and population at year-end. NBS defines birth rate as "the ratio of the number of births to the average population (or mid-period population) during a certain period of time (usually a year)":

$$\text{Birth Rate} = \frac{Number\ of\ Births}{Annual\ Average\ Population} \times 1000‰$$

In the above formula, "number of births" refers to live births, and "annual average population" is the average of the number of population at the beginning of the year and at the end of the year.

Using the above reported birth rates and population at year-end, the provincial and national live births numbers are calculated using the following formula (Cao et al., 2009).

$$\begin{aligned}&\text{Number of live births}\\&\quad = \text{Birth Rate}\\&\quad \times \left(\frac{"population\ at\ year - end" + "population\ at\ last\ year - end"}{2}\right)\end{aligned}$$

Previous studies on China's child mortality have tended to use the estimates of live births from NBS because they are more robust than estimates from MCHARS (Cao et al., 2009; Rudan et al., 2010). In recent years, the UNPD's estimates of live births in China, as well as UN IGME's, are beginning to converge closely to NBS estimates from China. For this reason, my study will also be based on live births estimates from UNPD and UN IGME's, which closely resemble those reported by NBS.

2.2 Systematic review

2.2.1 Overview

As explained in Chapter 1, no information about COD patterns in children under five years at the province level can be obtained from the existing surveillance systems (or surveys). To estimate proportions of the most common COD, CHERG established a single cause model which bases the prediction of the proportional contribution of each major COD in each age group on the overall underlying U5MR. The models and relationships between the U5MR and the specific causes are based on relevant studies identified in the Chinese datasets through systematic review of the Chinese literature. To retrieve all independent and informative studies conducted in mainland China in the years that followed the last CHERG's estimate, a systematic review was conducted to derive related information form community-based longitudinal multi-cause studies. During the last decade, the amount and quality of Chinese medical research has increased substantially, which made it an important new source of information for the global health epidemiology (Cohen, Korevaar, Wang, Spijker, & Bossuyt, 2015; Xia, Wright, & Adams, 2008).

Three major Chinese literature databases and one English literature database were searched for the systematic review: CNKI, Wanfang Data, VIP Database for Chinese Technical Periodical (VIP) and PubMed. CNKI is an electronic platform created to integrate significant Chinese knowledge-based information resources. It includes searchable databases with full-text manuscripts from Chinese academic journals, statistical yearbooks, doctoral/masters dissertation theses and proceedings of conferences. It contains more than 73 million research articles, about 272,730 PhD Theses, 2,418,493 Masters Theses and more than 2.5 million conference papers in the Chinese language (CNKI). Wanfang data and VIP are similar literature databases which cover different amount of articles, theses and conference papers (Cohen et al., 2015; Y.-m. WANG & SHI, 2012). Another English database PubMed was also included to search English-language articles about COD in children in Mainland China.

2.2.2 **Search strategy**

In order to identify the most appropriate search strategy, I conducted a pilot systematic review in CNKI and Wanfang databases in April 2015 by applying the search strategy shown in **Table 2.1**, aiming to test the accuracy and coverage of the preset search terms.

To specify the children group, I applied Chinese language terms “ertong”, “xiaoer”, “youer” (all refer to “child”), “yinger” (refers to “infant”), “yingyouer” (refers to “infant and child”), and “xinshenger” (refers to “newborn/neonate”). These terms can cover different age groups for children under five years old. For death causes, the terms I applied were “siwang”, “shengcun” and “siyin”, which stands for “death”, “survival” and “causes of death” respectively.

Table 2.1 Pilot search strategy in CNKI and Wanfang

Database	Access date	Subject category	Sub-database	Search terms	Publication date	Search method
CNKI	19/04/2015	Medicine & Public Health	Journal, Featured journal, Doctoral dissertation, Master dissertation, Domestic conferences, International conferences	(“ertong” OR “xiaoer” OR “youer” OR “yinger” OR “yingyouer” OR “xinshenger”) AND (“siwang” OR “shengcun” OR “siyin”)	01/01/2009 -31/12/2014	Title search
Wanfang	20/04/2015	Not applicable	Journal articles, Dissertations, Conference articles	(“ertong” OR “xiaoer” OR “youer” OR “yinger” OR “yingyouer” OR “xinshenger”) AND (“siwang” OR “shengcun” OR “siyin”)	2009-2014	Title search

The pilot search captured all the relevant papers that were also being identified through much broader search terms, which confirmed the desired level of accuracy for my preset search terms and I applied them in the final search strategy. To ensure that all possible informative studies are included, I conducted the final literature search using comprehensive search, instead of "title only" search, in all four databases: CNKI, Wanfang, VIP and PubMed (Garg, Hackam, & Tonelli, 2008). The search was conducted in Aug 2015 and the final search strategy is presented in **Table 2.2**. Note that search strategies for each literature database are slightly different based on their specific search features. All source articles included publicly available publications, abstracts, and conference proceedings.

Table 2.2 Final search strategy in CNKI, Wanfang, VIP and PubMed

Database	Access date	Subject category	Sub-database	Search terms	Publication date	Search method
CNKI	26/08/2015	Medicine & Public Health	Journal, Featured journal, Doctoral dissertation, Master dissertation, Domestic conferences, International conferences	(SU % 'ertong' + 'xiaoer' + 'youer' + 'yinger' + 'yingyouer' + 'xinshenger' OR TI % 'ertong' + 'xiaoer' + 'youer' + 'yinger' + 'yingyouer' + 'xinshenger' OR KY % 'ertong' + 'xiaoer' + 'youer' + 'yinger' + 'yingyouer' + 'xinshenger' OR AB % 'ertong' + 'xiaoer' + 'youer' + 'yinger' + 'yingyouer' + 'xinshenger') AND (SU % 'siwang' + 'shengcun' + 'siyin' OR TI % 'siwang' + 'shengcun' + 'siyin' OR KY % 'siwang' + 'shengcun' + 'siyin' OR AB % 'siwang' + 'shengcun' + 'siyin')	01/01/2009 -31/12/2014	Comprehensive search: subject, title, keywords and abstract
Wanfang	26/08/2015	Not applicable	Journal articles, Dissertations, Conference articles	(subject: (ertong) + subject: (xiaoer) + subject: (youer) + subject: (yinger) + subject: (yingyouer) + subject: (xinshenger)) * (subject: (siwang) + subject: (shengcun) + subject: (siyin))	2009-2014	Comprehensive search: subject (including title, keywords and abstract)

VIP	26/08/2015	Medicine & Public Health	All journals	(M=(ertong+xiaoer+youer+yinger+yingyouer+xinshenger)+R=(ertong+xiaoer+youer+yinger+yingyouer+xinshenger))*(M=(siwang+shengcun+siyin)+R=(siwang+shengcun+siyin))	2009-2014	Comprehensive search: title, keywords and abstract
PubMed	06/09/2015	Not applicable	Not applicable	(((death* OR mortality or survival) AND (child* OR infant* OR neonat*) AND (China OR Chinese)))	01/01/2009 -31/12/2014	Comprehensive search: all fields

2.2.3 Study criteria

Based on standard CHERG methods, only independent, community-based, longitudinal, multi-cause studies were included in my study (Rudan et al., 2010). This is because studies conducted at hospital sites tend to have poor representativeness of the surrounding general population, especially for children in poor rural areas where the access to hospitals is not universal (Adams & Hannum, 2005; Lanata et al., 2004). Moreover, studies conducted retrospectively would introduce recall bias, so I only included longitudinal, prospective studies. I excluded the studies that only reported single cause, or that didn't give any breakdown by cause; single-cause studies tend to overestimate the reported cause, so only multi-cause studies were included. Furthermore, I applied some additional criteria to ensure the quality of included studies. The detailed inclusion and exclusion criteria are:

Inclusion criteria

1. Community-based study of the COD in children aged 0-4 years;
2. Multi-cause studies;
3. Studies with more than 100 observed deaths;

Exclusion criteria

1. Multiple publications of the same study;
2. Studies with no breakdown of deaths by cause or age;
3. Studies with no reported numerical estimates;
4. Unclear study design (prospective/retrospective) or unclear definitions;
5. Retrospective studies;
6. Studies where no overall U5MR was reported;
7. Studies with inconsistencies between reported methods and presented results;
8. Studies based on CDC death monitoring system;

9. Studies with clear calculation mistakes or logical mistakes.

2.2.4 Study selection and data extraction

All applicable Chinese citations from CNKI, Wanfang and VIP were imported into NoteExpress (version 3.0.4.6640) and all English citations from PubMed were imported into Endnote (version X7.2.1) before they were screened. Duplicate records were detected automatically in NoteExpress and Endnote by firstly conducting cross-record comparisons based on the variables "Author", "Year" and "Title", followed by "Year" and "Title" in the second iteration, and finally only the "Title" in the third iteration, using the criteria of "ignoring spacing and punctuation". All detected duplicate records were deleted manually. After deleting the duplicates, I conducted an initial screening of all titles and abstracts and deleted all records that were apparently irrelevant based on the preset criteria. Then, all full-text articles were retrieved and selected for final inclusion, according to pre-determined study criteria. I paid particular caution to exclude all duplicate publications that reported the same results based on the same data.

When conducting pilot data extraction, I drafted data extraction form by reviewing more than one thousand full-text articles, which I later modified through several rounds of revisions. The final standardised data abstraction form included three parts:

1) **Characteristics of the study**: authors, publication year, study setting, population type (urban or rural), surveillance period, quality control method and frequency;

2) **Mortality data**: there are three indicators in this part: the number of live births, overall number of deaths and overall mortality rates for neonates, post-neonatal infants, 1-4 years old children and all 0-4 years old children. For studies that only reported two of the three key indicators, the third one would be calculated based on the other two. For studies that only reported mortality-related indicators for two of the three age groups (e.g., infants, 1-4 years old children and under-five children), the third one would also be calculated based on the other two.

3) **COD data**: according to the pilot data extraction, most eligible studies that were identified through my search reported the COD data based on the national unified MCMS "child death report card". Therefore, I included all pre-set causes in the data extraction form. A detailed definition of the COD variables can be seen in **Appendix**

Table 3.

2.3 Statistical analysis

2.3.1 Procedures

The statistical procedures for estimating the proportional causes of child death in China for the years 2009-2015 included several steps (see **Table 2.3**).

Table 2.3 Statistical procedures of deriving the estimates of child death

Steps	Indicators	Methods	
		National level	Provincial level
1	Total number of child deaths (envelope)	Multiplying U5MR reported by MCMS by the number of live births reported by NBS and adjusted by UN IGME	Multiplying the provincial U5MRs reported by MCHARS (2010) or IHME-Chinese collaboration (2013) by the number of live births in each province reported by NBS and adjusting the total by an appropriate factor to fit the national envelope
2	Number of deaths in different age groups (neonates, post-neonatal infants, 1-4 years and 0-4 years) for each year in China	Modelling the proportion of all deaths in neonatal period (<1 month) and post-neonatal infant period (1-11 months) for each province using the province-level U5MR as a predictor; then, adding all the numbers of deaths and adjusting the total number of neonatal deaths by an appropriate factor to fit the national envelope for newborn deaths provided by UN IGME; and finally, computing the number of deaths of 1–4 years children (12-59 months) in each province by substracting neonatal	Three models to estimate the age group proportions for neonates (<1 month), postneonatal infants (1–11 months), 1–4 years children (12-59 months) were developed in the systematic review. Provincial U5MRs were applied to these models to split the total number of child deaths (from Step1) into appropriate age groups at provincial level; the least informative of the three models (for 1-4 years) was dropped and the number of deaths in that age group was calculated based on estimates for other age-groups (as

		and post-neonatal infant deaths from all 0-4 deaths in each province	a remainder)
3	Main cause proportions for each age group	Main cause proportions were estimated for neonates (<1 month), postneonatal infants (1–11 months), 1–4 years children (12-59 months) and 0-4 years children (0-59 months) separately by applying the national U5MRs (from 2009 to 2015) to the death cause proportional models developed in the systematic review	Main cause proportions at provincial level were estimated for neonates (<1 month), postneonatal infants (1–11 months), 1–4 years children (12-59 months) and 0-4 years children (0-59 months) separately by applying the provincial U5MRs in 2015 to the death cause proportional models developed in the systematic review

2.3.2 **Statistical modelling**

The single-cause model for the proportional contribution of each COD based on U5MR as a predictor variable was chosen to estimate COD in China by CHERG (Black et al., 2010; K. Y. Chan et al., 2015; Lawn, 2009; Organization, 2014; Rudan et al., 2010). In this study, an Ordinary Least Squares (OLS) regression model was developed using eligible study data. The predictor variables included U5MR and squared U5MR, and the criterion variable was specific proportion assigned to each cause.

Before choosing the most appropriate model, all the variables and three different weighting methods were tested in the pilot modelling to decide which model performs best in predicting the proportional cause based on U5MR. The three weighting methods were:

1) Giving equal weight to each study (no weight);

2) Giving equal weight to each death (weighting is proportional to the number of deaths);

3) Intermediate of 1) and 2) (weighting is proportional to the square root of the number of deaths).

The estimates of COD at both national and provincial levels were conducted based on the final chosen models, which typically included those where weighting is proportional to the number of deaths (for more details see later, in the Results section). The most commonly used model was:

$$\ln(\%\ Criterion\ variable) = \alpha + \beta * (\ln U5MR) + \gamma * (\ln U5MR)^2$$

All included studies that were used for constructing the predictive models were mapped by ArcGIS software (Version 10.1) to illustrate their geographic distribution. For each specific cause or age group, the median proportion, inter–quartile range (IQR) and maximum and minimum observed percentage were presented in box–and–whisker plots. Maps were then created to illustrate provincial U5MRs using ArcGIS. All statistical analyses were performed in R Studio (version 0.99.486) built on R (version 3.2.2) and with packages "gglopt2" (version 1.0.1), "reshape2" (version 1.4.1), "dplyr" (version 0.4.3), "knitr" (version 1.11) and "plyr" (version 1.8.3). All tests were two-sided and statistical significance was determined at P-value < 0.05 unless otherwise stated.

2.4 Ethical self-assessment

No ethical review committee approval was needed because all the estimates in this study were based on the analyses of publicly available and published information relevant to the population samples, rather than individuals. There were no ethical concerns regarding this study design. A level-one ethical self-assessment was carried out by my first supervisor Dr. Kit Yee Chan based on institutional policy (see **Appendix Table 4**), formal ethical approval was not required for this study.

3 RESULTS

3.1 Study characteristics

Based on the search strategy and criteria as stated in Chapter 2, a total of 81,079 citations were identified from the four databases. After removing 35,247 duplicates, 44,367 obviously irrelevant citations by title and abstract review, and 49 citations with no sufficient information on methods and results, a total of 1,416 articles with full-texts were reviewed to assess their eligibility (**Figure 3.1**). According to the study criteria, a total of 1,128 publications were excluded and 288 publications were included. All the single-cause models were based on those 288 studies.

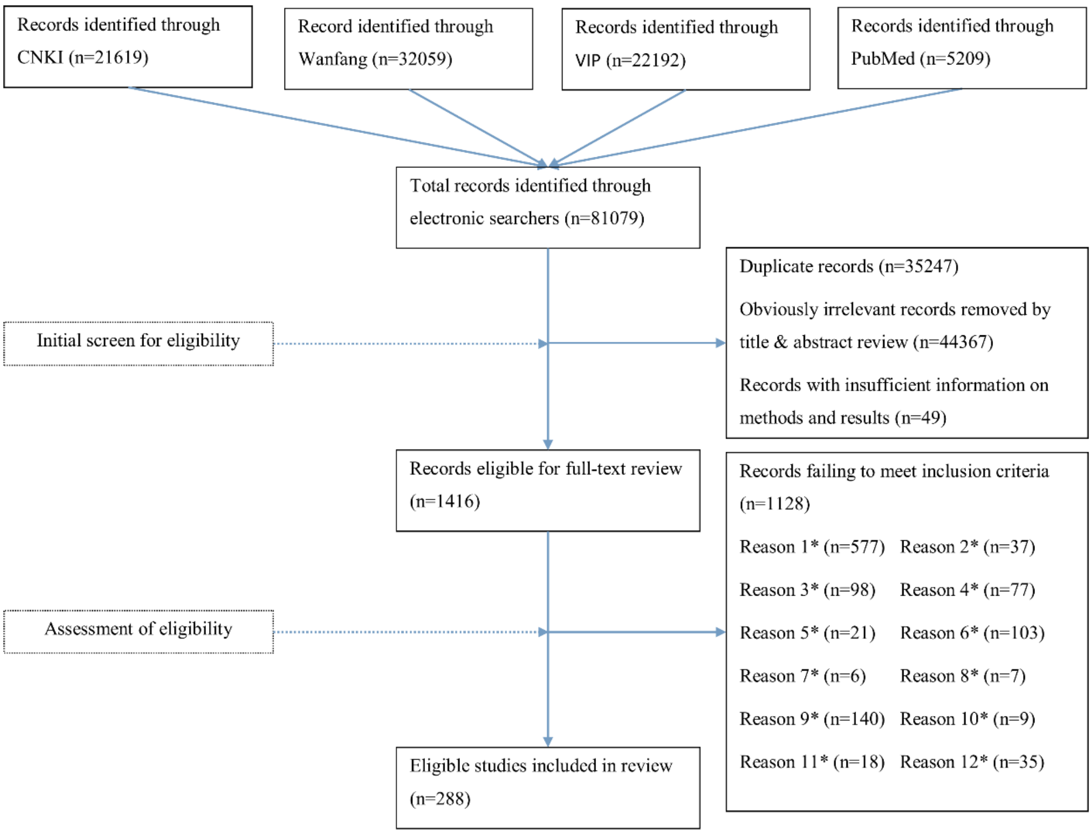


Figure 3.1 Systematic review flow diagram

* Note: Reason 1: Papers that were not community-based study of the COD in children aged 0-4 years; Reason 2: Papers that were not multi-cause studies; Reason 3: Papers with less than 100 deaths observed; Reason 4: Multiple publications of the same study; Reason 5: Papers with no breakdown of deaths by cause or age; Reason 6: Papers with no reported numerical estimates; Reason 7: Studies where design (prospective/retrospective) and definitions were not clear; Reason 8: Studies that were retrospective in design; Reason 9: Papers where no (overall) U5MR was reported for the study site; Reason 10: Papers with inconsistency between reported methods and presented results; Reason 11: Studies based on CDC death monitoring system; Reason 12: Papers with calculation mistakes or logical mistakes.

The full list of the 288 included studies and their characteristics can be found in **Appendix Table 5**. The summary of the main characteristics of the 288 included studies are shown in **Table 3.1**. The included publications were published relatively evenly from 2009 to 2014; most of them were conducted in both urban and rural areas (n=226, 78.5%). Overall, the total number of observed deaths across all the 288 studies was 363,134, and the total number of live births was 32,038,695, yielding an average U5MR of 11.3 per 1,000 live births. The distributions of the number of deaths and live births are listed in **Table 3.1**. More than half (n=146, 50.7%) of the studies reported 101-500 deaths, and most of the studies (n=168, 58.3%) observed 10,001-60,000 live births. The average surveillance period was 6.0 years with most (n=167, 58.0%) of the studies reporting a surveillance time between 5 and 9 years. Most (n=219, 76.0%) of the studies reported their quality control procedures, while the remaining studies (n=69, 24.0%) likely also introduced some quality control protocols, but these remained unreported. No studies clearly stated that they had no quality control protocols.

Table 3.1 Characteristics of the included studies

Characteristic of study (Total N=288)		Number of studies (%)
Year published		
	2009	51 (17.7)
	2010	36 (12.5)
	2011	48 (16.7)
	2012	61 (21.2)
	2013	47 (16.3)
	2014	45 (15.6)

Setting		
	Urban	45 (15.6)
	Rural	17 (5.9)
	Both	226 (78.5)
Number of observed deaths		
	101-500	146 (50.7)
	501-1,000	56 (19.4)
	1,001-2,000	38 (13.2)
	2,001-3,000	20 (6.9)
	3,001-4,000	11 (3.8)
	>4,000	17 (5.9)
Number of live births		
	<10,000	11 (3.8)
	10,001-30,000	95 (33.0)
	30,001-60,000	73 (25.3)
	60,001-100,000	38 (13.2)
	100,001-150,000	15 (5.2)
	>150,000	56 (19.4)
Reported U5MR (per 1,000 live births)		
	<5.0	15 (5.2)
	5.1-10.0	113 (39.2)
	10.1-15.0	84 (29.2)
	15.1-20.0	35 (12.2)
	>20.0	41 (14.2)
Surveillance time (year)		
	<5	69 (24.0)
	5-9	167 (58.0)
	10-14	50 (17.3)
	>15	2 (0.7)
Conducting quality control		
	Yes	219 (76.0)
	Unknown	69 (24.0)

Occasionally, more than one study would be based in the same geographic location, but I kept them all in my dataset if each research group presented their own independent and unique result. The geographic distribution of the 288 studies included 212 different locations in 30 provinces, municipalities and autonomous regions in China (except Tibet Autonomous Region, Hong Kong Special Administrative Region, Macao Special Administrative Region and Taiwan) (see **Figure 3.2**).

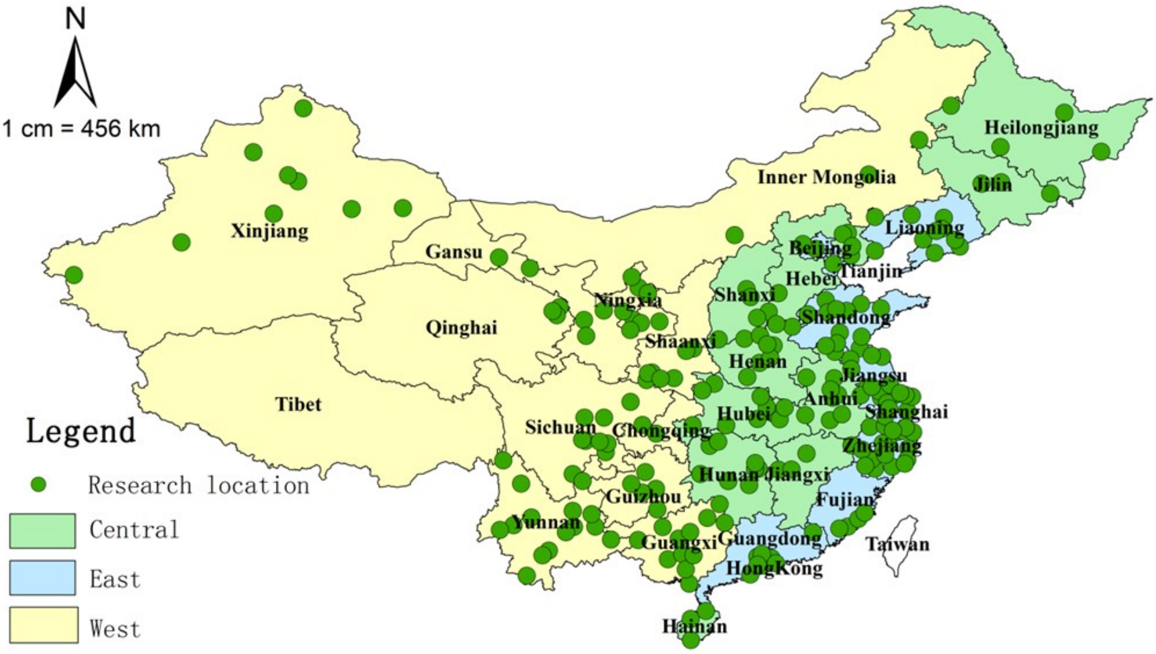


Figure 3.2 Geographic distribution of the included studies

*Note: The classification of East, Central and West was based on MCMS categories according to geography and economic development of each province (Department of Maternal and Child Health, 2013).

3.2 Modelling test and selection

In principle, I was interested in predicting the proportional distribution for all possible COD in each age group. However, this intention was limited by the availability of information for different causes in different age groups. The numbers of available studies that could serve as independent data points for constructing different models are listed in **Table 3.2**, by specific COD and age group of interest.

Table 3.2 The number of available study points of every death cause for different age group

Cause of death	Neonates (<1m)	Post-neonatal Infants (1-12m)	1-4 y (12-60m)	Under-5 (0-60m)
0l Dysentery (DYS)	0	0	1	2
02 Sepsis (SEP)	6	6	2	20
03 Measles (MES)	0	0	0	1
04 Tuberculosis (TB)	0	0	0	0
05 Other infectious and parasitic diseases (OT-inf)	0	0	1	2
All infectious and parasitic diseases (ALL-inf)	5	5	6	10
06 Leukemia(LKM)	0	0	11	7
07 Other tumor (OT-tm)	0	1	6	7
All tumor (ALL-tm)	1	4	11	11
08 Meningitis (MENI)	1	3	6	5
09 Other neurological disease (OT-neu)	2	2	8	9
All neurological disease (ALL-neu)	2	1	3	3
10 Pneumonia (PN)	61	49	54	190
11 Other respiratory diseases (OT-res)	4	2	3	10
All respiratory diseases (ALL-res)	3	3	4	4
12 Diarrhea (DI)	6	4	10	36
13 Other digestive diseases (OT-dig)	2	1	3	8
All digestive diseases (ALL-dig)	1	1	1	4
14 Congenital heart disease (CGH)	45	43	54	134
15 Neural tube defects (NTD)	4	3	0	13
16 Mongolism (MONG)	0	0	0	3
17 Other congenital abnormalities (OT-CA)	42	32	20	87
All congenital abnormalities (ALL-CA)	33	21	22	80
18 Preterm or low birth weight (PB)	86	33	4	228
19 Birth asphyxia (BA)	83	19	3	213
20 Neonatal tetanus (NT)	0	0	0	3
2l Neonatal scleredema (NS)	4	2	0	4

22 Intracranial haemorrhage (IH)	15	9	2	28
23 Other neonatal diseases (OT-neo)	16	5	2	20
All neonatal diseases (ALL-neo)	4	3	3	7
24 Drowning (DW)	0	0	31	47
25 Traffic accident (TA)	0	1	27	23
26 Accidental asphyxia (AA)	19	15	14	53
27 Accidental poisoning (AP)	0	0	3	6
28 Accidental fall (AF)	0	0	7	10
29 Other accidents (OT-acc)	2	1	13	22
All accidents (ALL-acc)	22	21	41	103
30 Endocrine, nutritional and metabolic diseases (ENM)	0	0	3	8
31 Hematopoietic and hematopoietic organ diseases (HHO)	3	3	6	12
32 Circulation system disease (CSD)	3	1	5	7
33 Urinary system disease (USD)	0	0	0	2
34 Other (OT)	26	21	23	54
35 Unclear diagnosis(UCD)	3	3	6	23

*Note: “All” in the database doesn’t imply all of the COD in the corresponding category, but rather to the entire category, as mentioned in the relevant article.

Based on the availability of information, the causes for which I developed the testing models were:

(i) Among the neonates, 7 causes were selected: 1) Pneumonia; 2) Congenital heart disease; 3) Congenital abnormalities; 4) Preterm birth or low birth weight; 5) Birth asphyxia; 6) Intracranial haemorrhage; 7) Accidents.

(ii) For postneonatal infants, 8 causes were selected: 1) Pneumonia; 2) Congenital heart disease; 3) Congenital abnormalities; 4) Preterm birth or low birth weight; 5) Birth asphyxia; 6) Intracranial haemorrhage; 7) Accidental asphyxia; 8) Accidents.

(iii) For children 1-4 years old, 8 causes were selected: 1) Leukemia; 2) Tumor; 3) Meningitis; 4) Pneumonia; 5) Diarrhea; 6) Congenital heart disease; 7) Congenital abnormalities; 8) Accidents.

(iv) Finally, for children 0-4 years old, 14 causes were selected: 1) Sepsis; 2) Leukemia; 3) Tumor; 4) Meningitis; 5) Pneumonia; 6) Diarrhea; 7) Congenital heart disease; 8) Neural tube defects; 9) Congenital abnormalities; 10) Preterm birth or low birth weight; 11) Birth asphyxia; 12) Intracranial haemorrhage; 13) Accidental asphyxia; 14) Accidents.

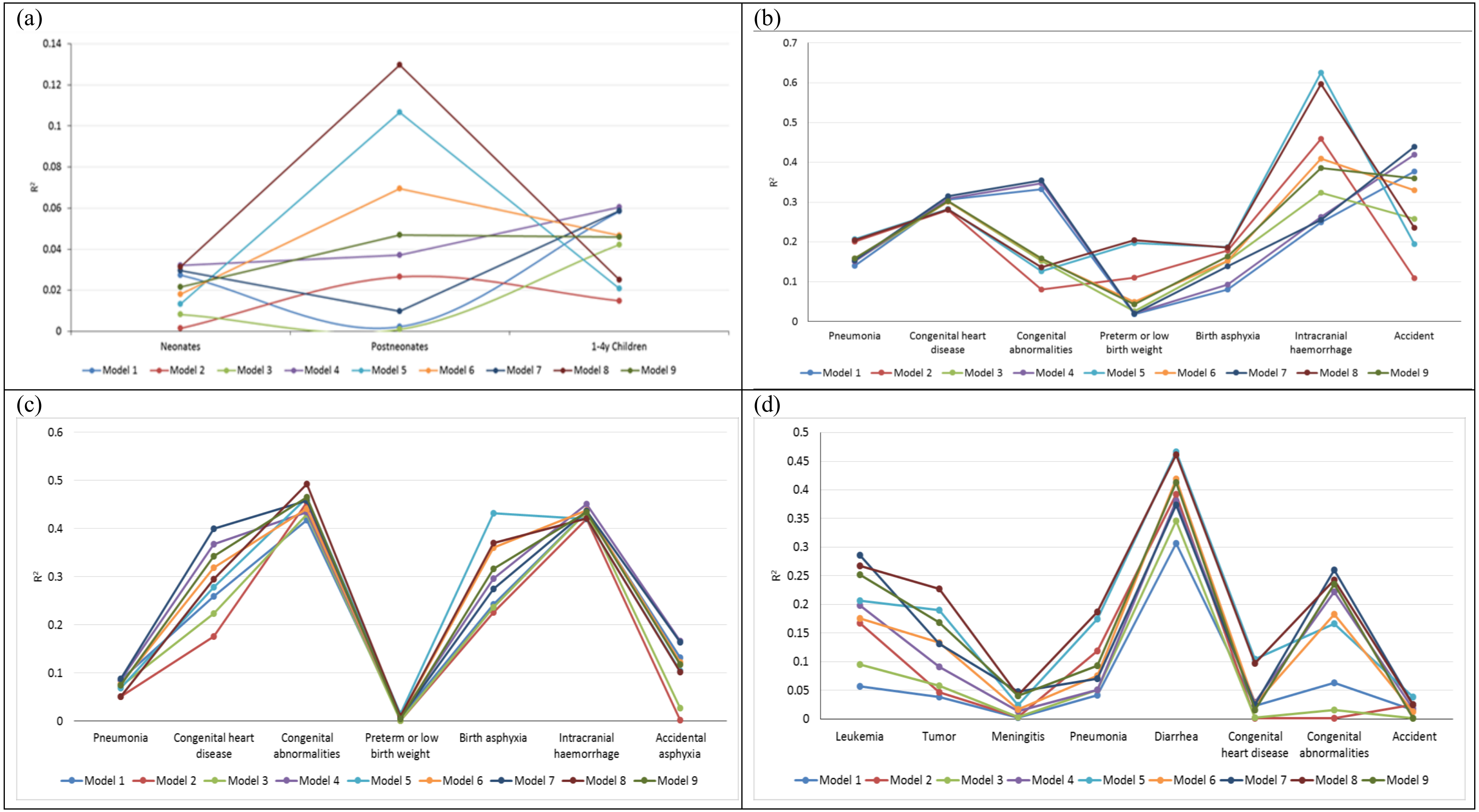
To identify the best-performing models, nine different testing models were constructed, as explained in Chapter 2. **Table 3.3** shows that the nine models were:

Table 3.3 The definitions of nine tested models

Model	Equation	Weighing method
Model 1	$\ln(\%\ Criterion\ variable) = \alpha + \beta * (\ln U5MR)$	no weighting
Model 2	$\ln(\%\ Criterion\ variable) = \alpha + \beta * (\ln U5MR)$	weighting proportional to the number of deaths
Model 3	$\ln(\%\ Criterion\ variable) = \alpha + \beta * (\ln U5MR)$	weight proportional to the square root of the number of deaths
Model 4	$\ln(\%\ Criterion\ variable) = \alpha + \beta * (\ln U5MR) + \gamma * (U5MR)^2$	no weighting
Model 5	$\ln(\%\ Criterion\ variable) = \alpha + \beta * (\ln U5MR) + \gamma * (U5MR)^2$	weighting proportional to the number of deaths
Model 6	$\ln(\%\ Criterion\ variable) = \alpha + \beta * (\ln U5MR) + \gamma * (U5MR)^2$	weight proportional to the square root of the number of deaths
Model 7	$\ln(\%\ Criterion\ variable) = \alpha + \beta * (\ln U5MR) + \gamma * (\ln U5MR)^2$	no weighting
Model 8	$\ln(\%\ Criterion\ variable) = \alpha + \beta * (\ln U5MR) + \gamma * (\ln U5MR)^2$	weighting proportional to the number of deaths
Model 9	$\ln(\%\ Criterion\ variable) = \alpha + \beta * (\ln U5MR) + \gamma * (\ln U5MR)^2$	weight proportional to the square root of the number of deaths

*Note: Where ln (U5MR) is the natural logarithm of U5MR, criterion variable refers to the proportion of each targeted age group (neonates, postneonatal infants, 1-4 years old children) or death cause.

All the results of the performance of these nine statistical models are shown in the **Appendix Figure 1-5**. All obvious outliers were removed, and the comparison of goodness-of-fit of the nine models is shown in **Figure 3.3** (based on explained proportion of total variance, R^2).


(a)
R²
Neonates
Postneonates
1-4y Children
Model 1 Model 2 Model 3 Model 4 Model 5 Model 6 Model 7 Model 8 Model 9
(b)
R²
Pneumonia
Congenital heart disease
Congenital abnormalities
Preterm or low birth weight
Birth asphyxia
Intracranial haemorrhage
Accident
Model 1 Model 2 Model 3 Model 4 Model 5 Model 6 Model 7 Model 8 Model 9
(c)
R²
Pneumonia
Congenital heart disease
Congenital abnormalities
Preterm or low birth weight
Birth asphyxia
Intracranial haemorrhage
Accidental asphyxia
Model 1 Model 2 Model 3 Model 4 Model 5 Model 6 Model 7 Model 8 Model 9
(d)
R²
Leukemia
Tumor
Meningitis
Pneumonia
Diarrhea
Congenital heart disease
Congenital abnormalities
Accident
Model 1 Model 2 Model 3 Model 4 Model 5 Model 6 Model 7 Model 8 Model 9

(e)

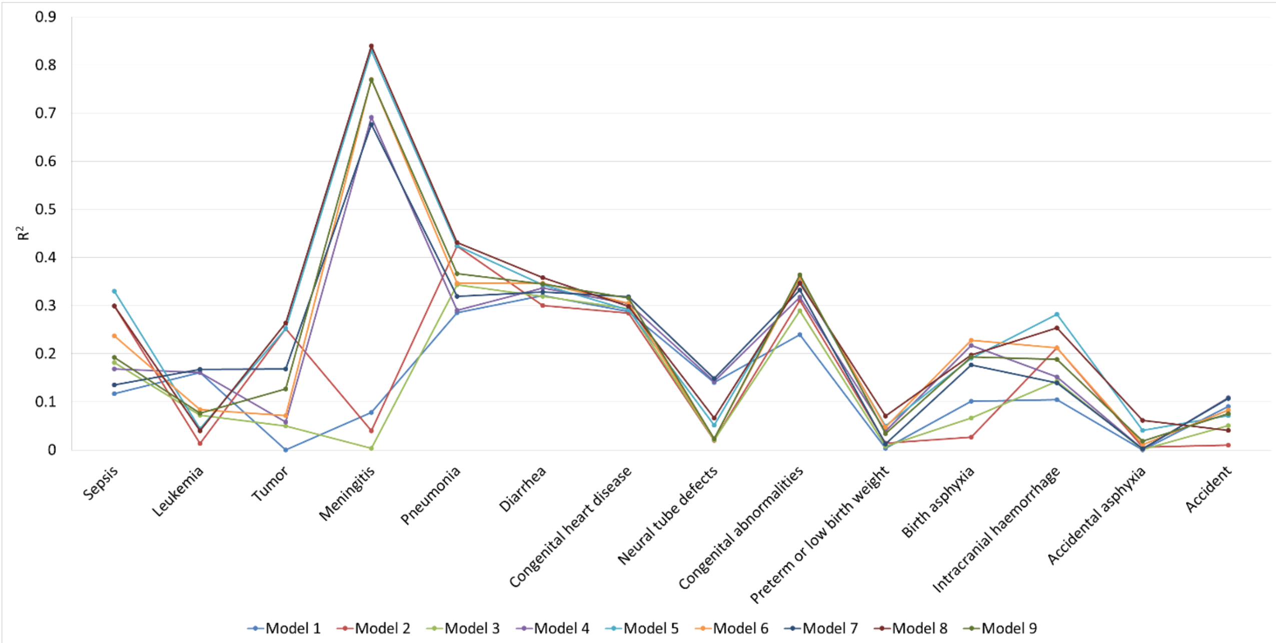


Figure 3.3 Comparison of the nine testing models

*Note: (a) predicting the proportions of all 0-4 years deaths that occur in 3 separate age-groups; (b) predicting the proportions of all neonatal deaths that are due to each selected cause for neonatal period; (c) predicting the proportions of all post-neonatal infant deaths that are due to each selected cause in post-neonatal infant period; (d) predicting the proportions of deaths that occur in 1-4 years old children that are due to each selected cause in 1-4 years period; (e) predicting the proportions of all under-five deaths that are due to each selected cause for 0-4 years period.

3.3 Final modelling methods

After the nine potential models were tested, model 8 (see **Table 3.3**) was chosen as the most useful for this study across a wide range of applications to different causes and in different age groups (see **Appendix Figure 1-5**, for the comprehensive overview of the results of model testing). The criterion variable was either the proportional contribution of the specific age group, or the specific COD, based on the studies that fulfilled the inclusion criteria. All calculations were then based on the chosen corresponding model and fitted to the national and provincial envelopes. The final model adopted weighting method proportional to the number of deaths:

$$\ln(\%\, Criterion\ variable) = \alpha + \beta * (\ln U5MR) + \gamma * (\ln U5MR)^2$$

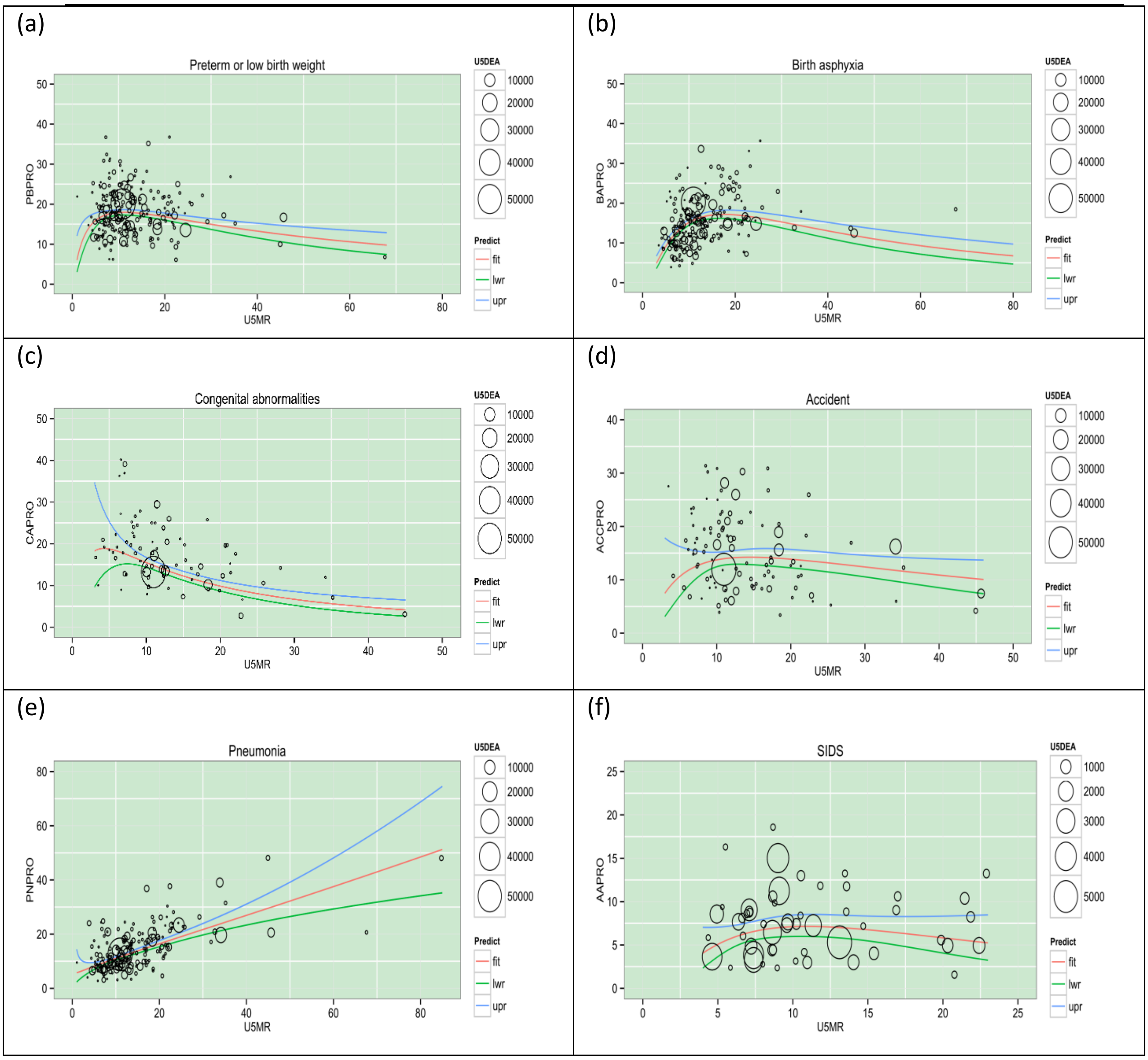
After the selection of the final model, eight derived statistical models were then developed to predict the relation between the proportion of the eight most common COD in children under 5 years and the corresponding U5MR (**Figure 3.4**; **Table 3.4**): birth asphyxia, preterm birth complications, neonatal sepsis, pneumonia, diarrhea, congenital abnormalities, accidents and sudden infant death syndrome (SIDS). For statistical modelling to estimate proportional COD in different age groups, 3 models were developed to predict the proportions of neonates, post-neonatal infants and 1-4 years deaths based on the corresponding U5MRs (**Figure 3.5**; **Table 3.4**). Then, further statistical models (**Figure 3.5**; **Table 3.4**) were established to attribute the deaths within provinces and within the 3 age groups to specific causes. When conducting the estimates at the province level, the "fit" to the "envelopes" for the total number of child deaths for each province was achieved by dropping the least predictive statistical model (based on R^2) and replacing it with the reminder of deaths within the "envelope" (**Table 3.4**).

Table 3.4 Detailed descriptions of the parameters in all statistical models

Predictor	Criterion variable	Relationship	R^2
Predicting the proportion of all 0-4 years deaths that are due to each of the 8 most common causes for 0-4 years period (in relation to overall U5MR)			
U5MR	% preterm or low birth weight	$\ln(PB)=0.90*\ln(U5MR)-0.19*(\ln(U5MR))^2+1.80$	0.07
U5MR	% birth asphyxia	$\ln(BA)=2.31*\ln(U5MR)-0.40*(\ln(U5MR))^2-0.47$	0.20

U5MR	% congenital abnormalities	$\ln(CA)=0.79*\ln(U5MR)-0.27*(\ln(U5MR))^2+2.36$	0.35
U5MR	% accident	$\ln(ACC)=1.39*\ln(U5MR)-0.26*(\ln(U5MR))^2+0.79$	0.04
U5MR	% pneumonia	$\ln(PN)=0.05*\ln(U5MR)+0.10*(\ln(U5MR))^2+1.75$	0.43
U5MR	% SIDS	$\ln(SIDS)=2.68*\ln(U5MR)-0.56*(\ln(U5MR))^2-1.23$	0.06
U5MR	% diarrhea	$\ln(DI)=3.49*\ln(U5MR)-0.42*(\ln(U5MR))^2-4.97$	0.36
U5MR	% neonatal sepsis	$\ln(SEP)=-0.98*\ln(U5MR)+0.05*(\ln(U5MR))^2+2.48$	0.30
Predicting the proportion of all 0-4 years deaths that occur in 3 separate age-groups: neonates, post-neonatal infants and 1-4 years children (in relation to overall U5MR)			
U5MR	% in neonates	$\ln(NEO)=0.41*\ln(U5MR)-0.08*(\ln(U5MR))^2+3.56$	0.03
U5MR	% in postneonatal infants	$\ln(PINF)=-1.12*\ln(U5MR)+0.23*(\ln(U5MR))^2+4.38$	0.13
U5MR	% in 1-4 years	$\ln(1\text{-}4y)=-0.61*\ln(U5MR)+0.10*(\ln(U5MR))^2+3.75$	0.03
Predicting the proportion of all neonatal deaths that are due to each of the 4 most common causes for neonatal period (in relation to overall U5MR)			
U5MR	% preterm or low birth weight	$\ln(PB)=0.72*\ln(U5MR)-0.16*(\ln(U5MR))^2+2.54$	0.21
U5MR	% birth asphyxia	$\ln(BA)=0.53*\ln(U5MR)-0.06*(\ln(U5MR))^2+2.31$	0.19
U5MR	% congenital abnormalities	$\ln(CA)=-4.17*\ln(U5MR)+0.75*(\ln(U5MR))^2+7.72$	0.14
U5MR	% pneumonia	$\ln(PN)=-0.27*\ln(U5MR)+0.12*(\ln(U5MR))^2+2.27$	0.20
Predicting the proportion of all postneonatal infant deaths that are due to each of the 4 most common causes for postneonatal period (in relation to overall U5MR)			
U5MR	% pneumonia	$\ln(PN)=0.26*\ln(U5MR)+0.00*(\ln(U5MR))^2+2.50$	0.05
U5MR	% congenital abnormalities	$\ln(CA)=0.91*\ln(U5MR)-0.37*(\ln(U5MR))^2+3.08$	0.49
U5MR	% SIDS	$\ln(SIDS)=-5.16*\ln(U5MR)+1.00*(\ln(U5MR))^2+8.93$	0.10
U5MR	% accident	$\ln(ACC)=-0.67*\ln(U5MR)+0.10*(\ln(U5MR))^2+3.21$	0.04
Predicting the proportion of all deaths that occur in 1-4 years children that are due to each of the			

4 most common causes for 1-4 years period (in relation to overall U5MR)			
U5MR	% accident	$\ln(ACC)=0.11*\ln(U5MR)-0.01*(\ln(U5MR))^2+3.53$	0.03
U5MR	% congenital abnormalities	$\ln(CA)=3.13*\ln(U5MR)-0.66*(\ln(U5MR))^2-0.99$	0.24
U5MR	% pneumonia	$\ln(PN)=-3.41*\ln(U5MR)+0.68*(\ln(U5MR))^2+6.15$	0.19
U5MR	% diarrhea	$\ln(DI)=3.35*\ln(U5MR)-0.48*(\ln(U5MR))^2-3.53$	0.46



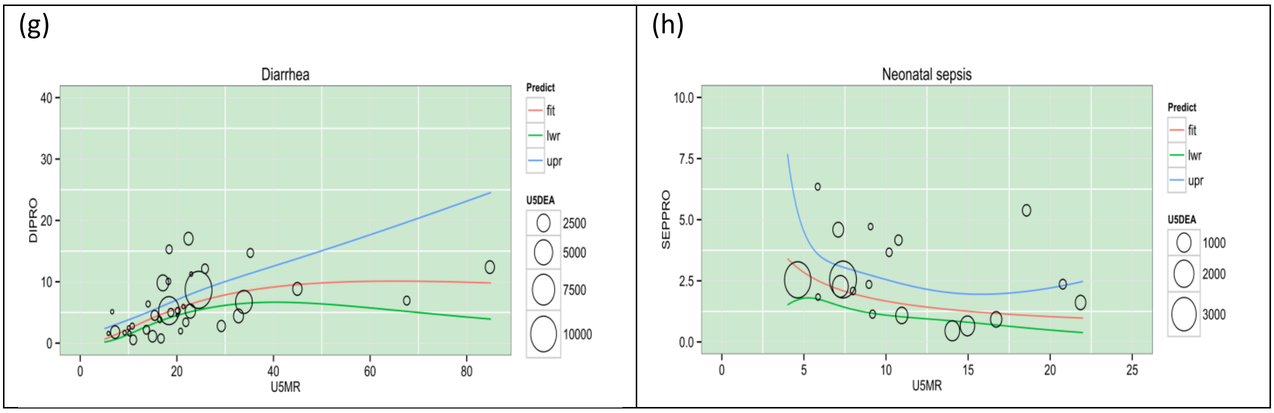


Figure 3.4 The relationship between U5MR and proportion of deaths in children under 5 years due to the most common 8 causes of death based on the best model

*Note: (a) Preterm birth and low birth weight; (b) Birth asphyxia; (c) Congenital abnormalities; (d) Accidents; (e) Pneumonia; (f) Sudden infant death syndrome; (g) Diarrhea; (h) Neonatal sepsis. Data points represent studies with available information and the size of the "bubbles" is proportional to the total number of child deaths observed in each study, 95% confidence interval is shown across the range of data with lower (lwr) and upper (upr) confidence bounds.

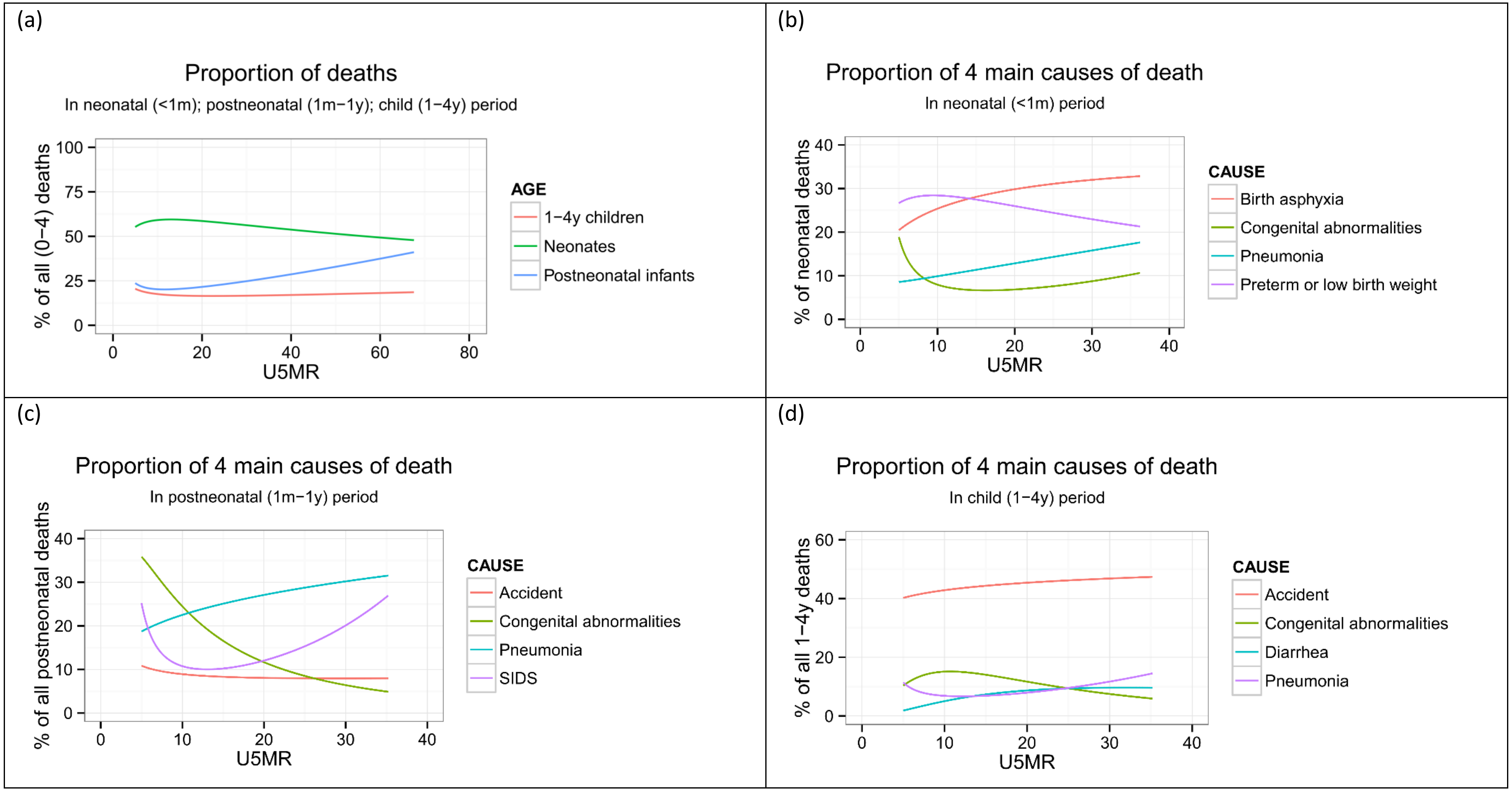

(a)
Proportion of deaths
In neonatal (<1m); postneonatal (1m−1y); child (1−4y) period
% of all (0−4) deaths
U5MR
AGE
1−4y children
Neonates
Postneonatal infants
(b)
Proportion of 4 main causes of death
In neonatal (<1m) period
% of neonatal deaths
U5MR
CAUSE
Birth asphyxia
Congenital abnormalities
Pneumonia
Preterm or low birth weight
(c)
Proportion of 4 main causes of death
In postneonatal (1m−1y) period
% of all postneonatal deaths
U5MR
CAUSE
Accident
Congenital abnormalities
Pneumonia
SIDS
(d)
Proportion of 4 main causes of death
In child (1−4y) period
% of all 1−4y deaths
U5MR
CAUSE
Accident
Congenital abnormalities
Diarrhea
Pneumonia

Figure 3.5 The relationship between U5MR and proportion of age group or deaths in children under 5 years based on the best model

*Note: (a) relationship between U5MR and proportion of all 0-4 year deaths observed in 3 in different age groups: neonates, postneonatal infants, and 1-4 years children; (b) relationship between U5MR and proportion of neonatal deaths due to each of the 4 most common causes: Birth asphyxia, Preterm birth, Pneumonia, Congenital abnormalities; (c) relationship between U5MR and proportion of post-neonatal infant deaths due to each of the 4 most common causes: Pneumonia, SIDS, Congenital abnormalities, Accidents; (d) relationship between U5MR and proportion of deaths in children aged 1-4 years due to each of the 4 most common causes: Accidents, Congenital abnormalities, Pneumonia, Diarrhea.

3.4 Generating national and provincial estimates

3.4.1 Main causes of child deaths from 2009 to 2015

From 2009 to 2015, the neonatal, postneonatal, 1-4 years and under-five mortality rates have declined by 39.6% (from 9.1 to 5.5 per 1,000 live births), 40.4% (from 3.8 to 2.2 per 1,000 live births), 28.5% (from 4.1 to 3.0 per 1,000 live births) and 37.1% (from 17.0 to 10.7 per 1,000 live births) respectively (**Figure 3.6**).

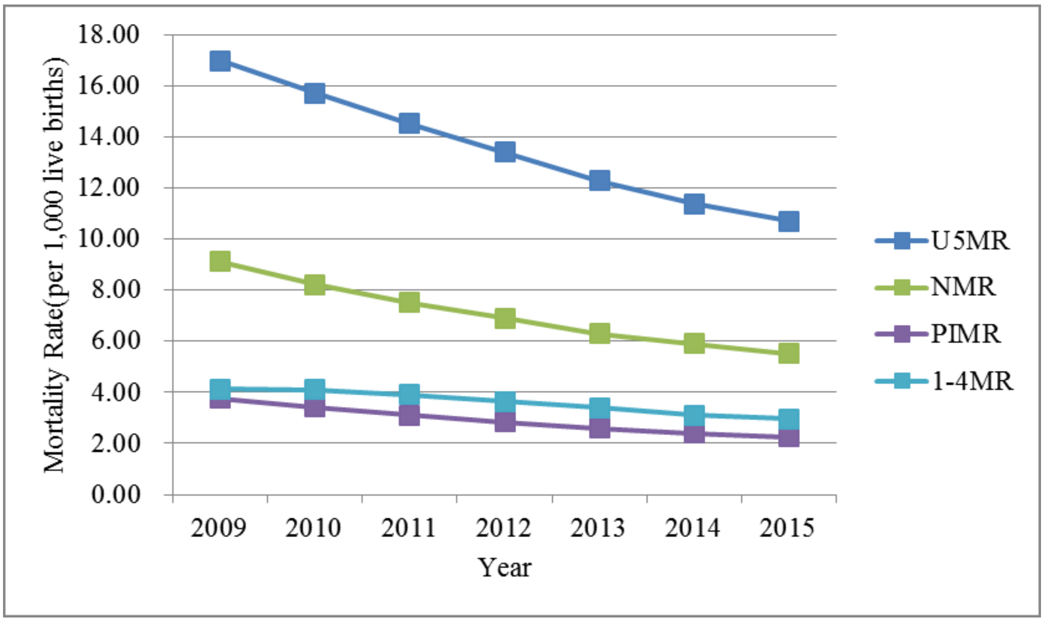


Figure 3.6 Trends in mortality rates (per 1,000 live births) in China during 2009–2015 in neonates, post-neonatal infants, 1-4 years children and children under 5 years

*Note: NMR refers to neonatal mortality rate, PIMR refers to post-neonatal infant mortality rate, 1-4MR refers to 1-4 years mortality rate, and U5MR refers to under 5 mortality rate.

Based on the final model that was derived from 288 independent studies, the changes in distribution of the leading COD occurring in different age groups from 2009 to 2015 are shown in **Figure 3.7**, detailed information can be found in **Appendix Table 6-12**. Neonatal deaths accounted for half of the deaths in children under 5 years, while the proportions of post-neonatal deaths and 1-4 years deaths were similar, which fluctuated around 21% and 27% respectively.

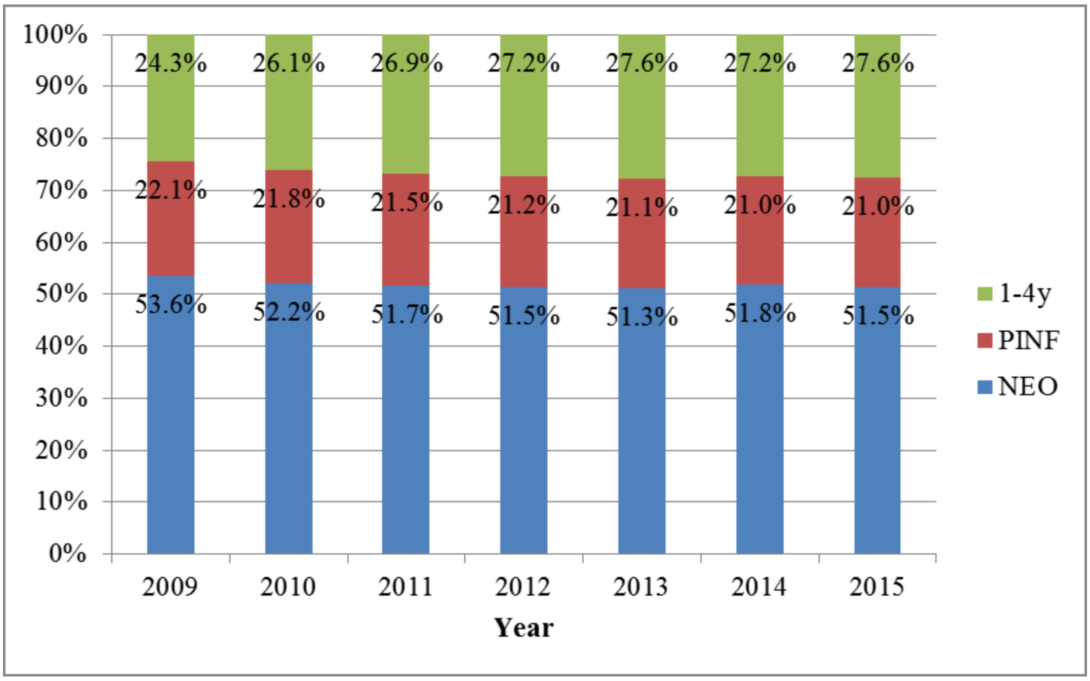


Figure 3.7 Distribution of deaths in children under 5 years in China by age group, 2009–2015

*Note: NEO: neonates, PINF: postneonatal infants, 1-4y: 1-4 years old children.

The main COD in children under 5 years of age are shown in **Figure 3.8a**: from 2009 to 2015, the proportions of deaths due to infectious causes – pneumonia and diarrhea - fell substantially with the overall reduction of U5MR: pneumonia from 16.4% to 12.4%, and diarrhea from 5.3% to 3.2%. In addition, the proportion of birth asphyxia also fell slightly (from 16.1% to 15.2%), while the proportion of preterm birth and low birth weight rose slightly (from 16.7% to 17.4%). The proportion of congenital abnormalities increased much faster as a proportional cause: from 10.6% to 14.1%. The proportions of neonatal sepsis and SIDS also showed an increase in this time period (from 1.1% to 1.6%, and 5.8% to 6.6% respectively). With the reduction of U5MR, the proportion of accidents fluctuated around 13.5% with no obvious tendency towards either increasing or declining.

The changes in the distribution of the main COD in neonates from 2009 to 2015 are shown in the **Figure 3.8b**. From 2009 to 2015, the proportions of deaths attributable to neonatal causes - birth asphyxia, preterm birth and low birth weight and neonatal sepsis - accounted for more than half of all the deaths. The proportional contribution of preterm birth and low birth weight and neonatal sepsis gradually increased from 30.3% to 33.0% and 1.9% to 2.8%, respectively. The proportion of birth asphyxia declined slightly during this period - from 29.2% to 28.6%. Infectious causes – pneumonia and diarrhea - continued to decrease, from 12.8% to 10.7%, and 1.5% to 0.9%, respectively. The proportion of congenital abnormalities increased from 9.0% to 11.3%, while the proportion of accidents decreased from 4.3% to 3.8%, and the proportion of SIDS was fairly constant around 3%.

The changes in the distribution of the main COD in post-neonatal infants from 2009 to 2015 are shown in **Figure 3.8c**: from 2009 to 2015, the proportions of infectious causes – pneumonia and diarrhea - declined substantially, from 33.7% to 23.1%, and from 11.6% to 5.2%, respectively. At the same time, the proportions of congenital abnormalities and SIDS increased from 13.2% to 21.6%, and 15.6% to 20.0%, respectively. The proportions of neonatal sepsis and accidents also rose slightly - from 0.5% to 0.8%, and from 8.2% to 8.8%, respectively. Other neonatal causes - birth asphyxia and preterm birth, and low birth weight, remained relatively low, contributing to about 2.0% of all deaths during this period.

The changes in the distribution of the main COD in the children 1-4 years of age from 2009 to 2015 is shown in **Figure 3.8d**. From 2009 to 2015, the proportions of congenital abnormalities kept on increasing from 11.9% to 13.7%, while the other main causes – accidents and diarrhea - both declined, from 38.4% to 35.2%, and from 8.7% to 7.6%, respectively. The proportion of pneumonia declined from 8.7% to 7.6% and then remained at this level. The proportion of SIDS was around 3%. This trend of predominant reduction in the main causes resulted in the proportion of other causes increasing from 30.1% to 34.7%.

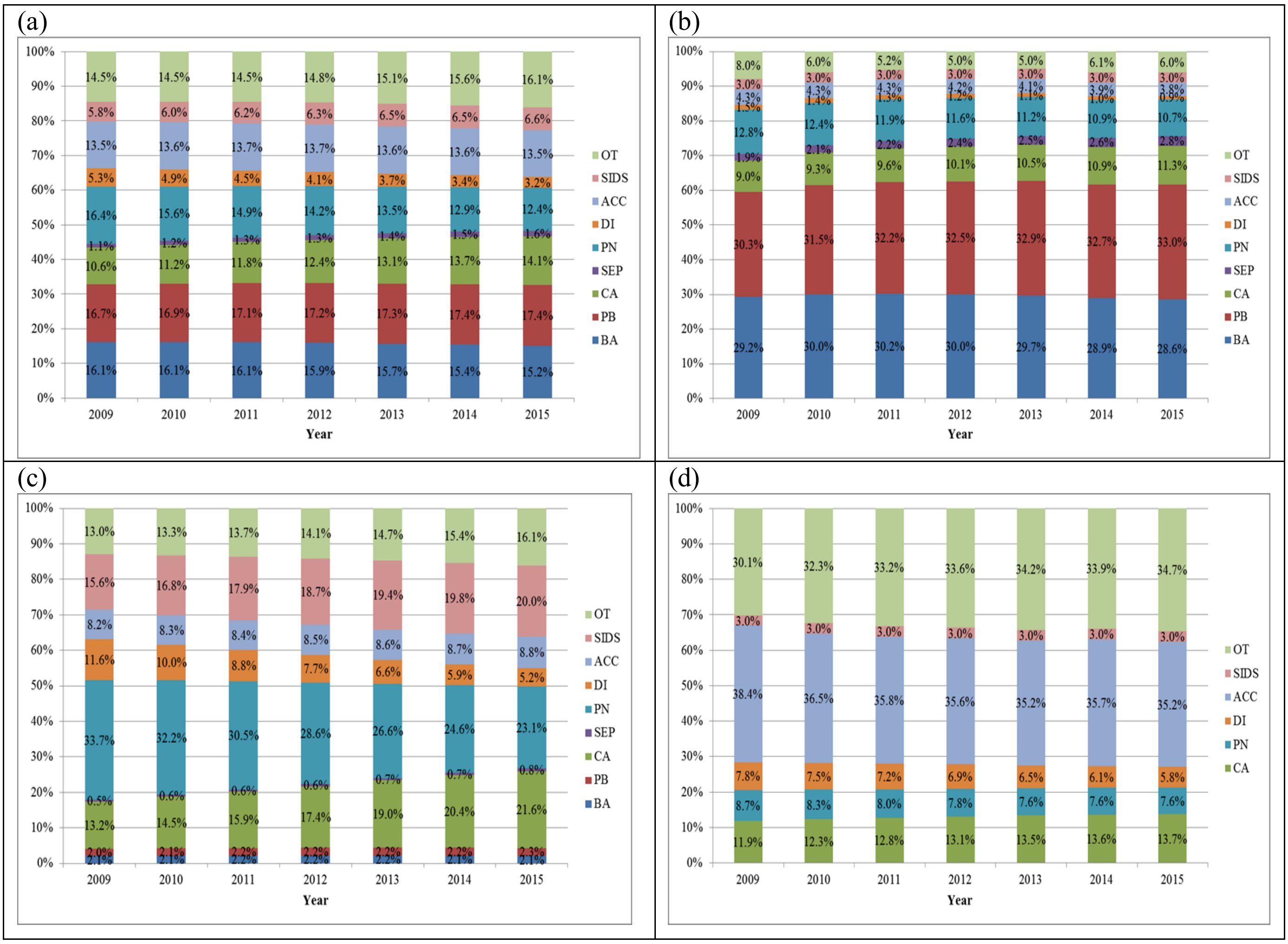


Figure 3.8 Causes of child deaths in China, 2009–2015

*Note: (a) Children under 5 years; (b) Neonates; (c) Post-neonatal infants; (d) 1-4 year old children; BA - Birth asphyxia, PB - Preterm birth and low birth weight, CA - Congenital abnormalities, SEP - Neonatal sepsis, PN - Pneumonia, DI - Diarrhea, ACC - Accidents, SIDS - Sudden infant death syndrome, OT - Other.

3.4.2 Main causes of child deaths in 2015

In 2015, the national U5MR was 10.7 per 1,000 live births, according to UN IGME's estimates. The national PIMR was estimated to be 2.2 per 1,000 live births, and NMR was 5.5 per 1,000 live births. The “envelope” for the year 2015 is shown in **Table 3.5**.

Table 3.5 The national estimates of mortality rates and numbers of deaths in 2015

Indicator	Estimate
Live births	16,988,246
U5MR (per 1,000 live births)	10.7
NMR (per 1,000 live births)	5.5
PIMR (per 1,000 live births)	2.2
1-4MR (per 1,000 live births)	3.0
Total deaths in children under 5 years	181,574
Neonatal deaths	93,435
1m-11m deaths	38,066
1yr-4yr deaths	50,073

*Note: U5MR refers to under-5 mortality rate, NMR refers to neonatal mortality rate, PIMR refers to post-neonatal infant mortality rate, 1-4MR refers to 1-4 years mortality rate.

The provincial estimates of U5MR, NMR, PIMR and 1-4MR are shown in **Table 3.6**. In 2015, U5MR was lowest in Beijing and highest in Tibet, NMR, PIMR and 1-4MR had the same trend as U5MR (**Figure 3.9**). U5MRs in China had an inverse relationship with economic development (based on Gross Domestic Product (GDP) per capita), provinces with high GDP per capita had lower U5MRs, such as Beijing and Shanghai, while provinces with lower GDP per capita had highest U5MRs, such as Xinjiang and Tibet (**Figure 3.10**). Based on geography, U5MRs were low in the East region with higher levels of economic development. U5MRs were higher in the Central region, and the highest in the West region, which is least developed (**Figure 3.11**).

Table 3.6 The provincial estimates of mortality rates in 2015

Province	Mortality Rate (per 1,000 live births)			
	NMR	PIMR	1-4MR	U5MR
Beijing	1.9	1.0	1.1	4.0
Jiangsu	2.5	1.2	1.4	5.1
Guangdong	2.7	1.3	1.5	5.5
Shanghai	2.8	1.3	1.6	5.7
Tianjin	3.2	1.4	1.8	6.3
Zhejiang	3.3	1.4	1.8	6.6

Jilin	3.5	1.5	1.9	6.9
Liaoning	3.6	1.5	2.0	7.1
Fujian	4.0	1.6	2.2	7.9
Shandong	4.2	1.7	2.3	8.1
Shanxi	4.4	1.7	2.4	8.5
Hunan	4.7	1.9	2.5	9.1
Guangxi Zhuang AR	5.3	2.1	2.9	10.3
Hubei	5.3	2.1	2.9	10.3
Heilongjiang	5.4	2.1	2.9	10.4
Anhui	5.5	2.1	2.9	10.5
Henan	5.7	2.2	3.0	10.9
Hebei	5.9	2.3	3.1	11.3
Chongqing	6.0	2.3	3.2	11.4
Sichuan	6.6	2.5	3.5	12.6
Inner Mongolia AR	6.6	2.6	3.5	12.7
Shaanxi	6.9	2.7	3.7	13.3
Jiangxi	7.3	2.9	3.9	14.1
Hainan	7.5	2.9	4.0	14.4
Ningxia Hui AR	7.9	3.1	4.1	15.1
Yunnan	8.4	3.3	4.4	16.1
Guizhou	9.0	3.6	4.7	17.4
Qinghai	9.2	3.8	4.8	17.8
Gansu	10.8	4.6	5.7	21.1
Xinjiang Wei AR	13.2	6.2	6.9	26.4
Tibet AR	16.5	9.0	8.6	34.1

*Note: NMR refers to neonatal mortality rate, PIMR refers to post-neonatal infant mortality rate, 1-4MR refers to 1-4 years mortality rate, U5MR refers to under 5 mortality rate.

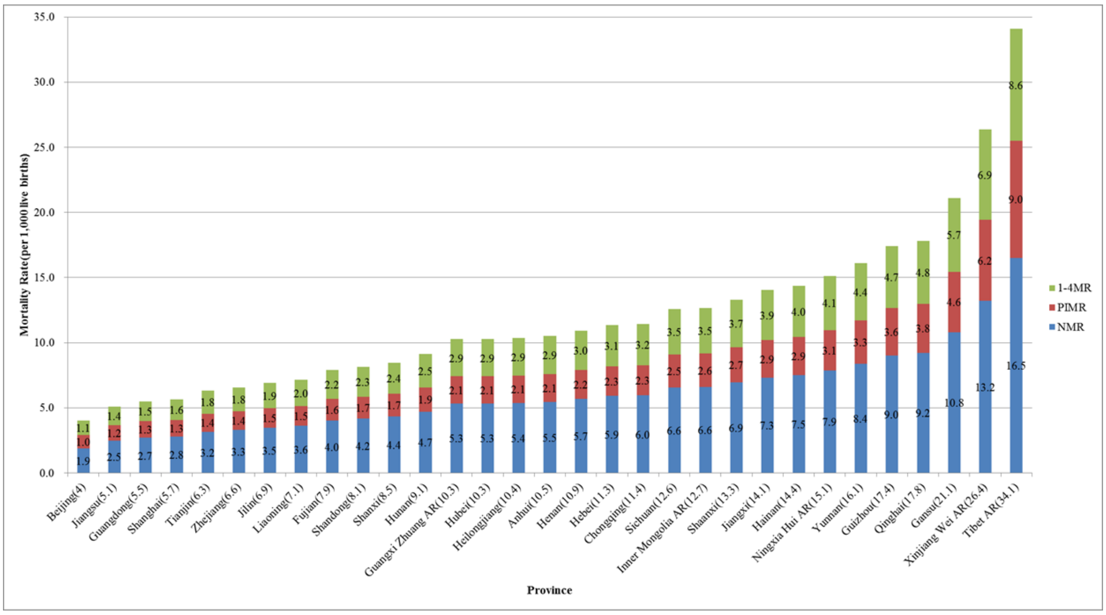


Figure 3.9 Child mortality rates in 31 provinces in China in 2015

*Note: Provinces are ranked according to under-5 mortality rates (recorded in x-axis label); NMR refers to neonatal mortality rate, PIMR refers to post-neonatal infant mortality rate, 1-4MR refers to 1-4 years mortality rate.

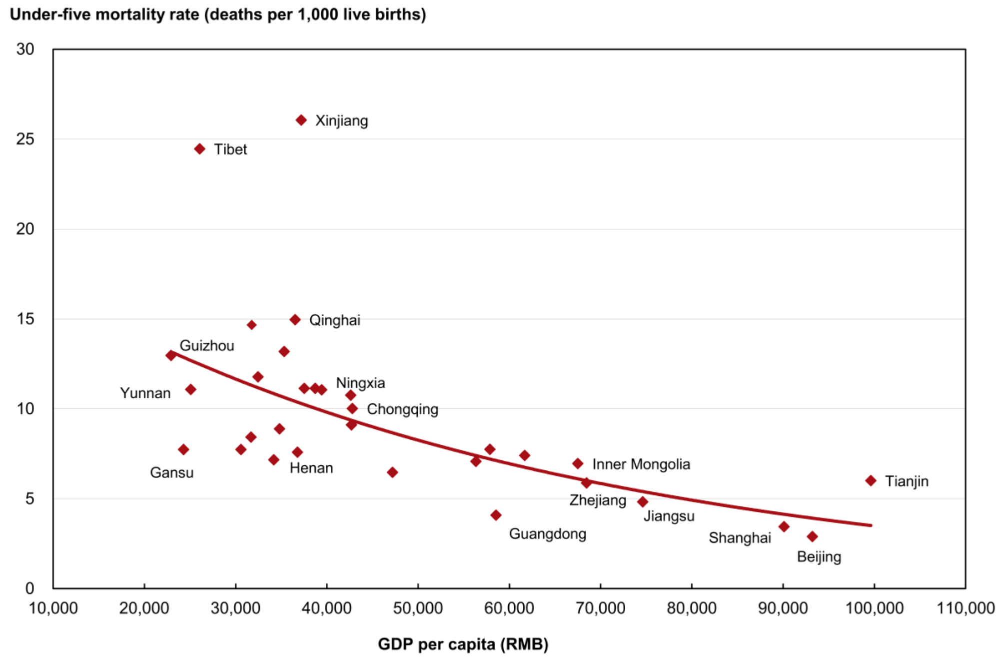


Figure 3.10 GDP per capita and under-five mortality rate in 31 provinces in 2013 (source: (NWCCW, 2014))

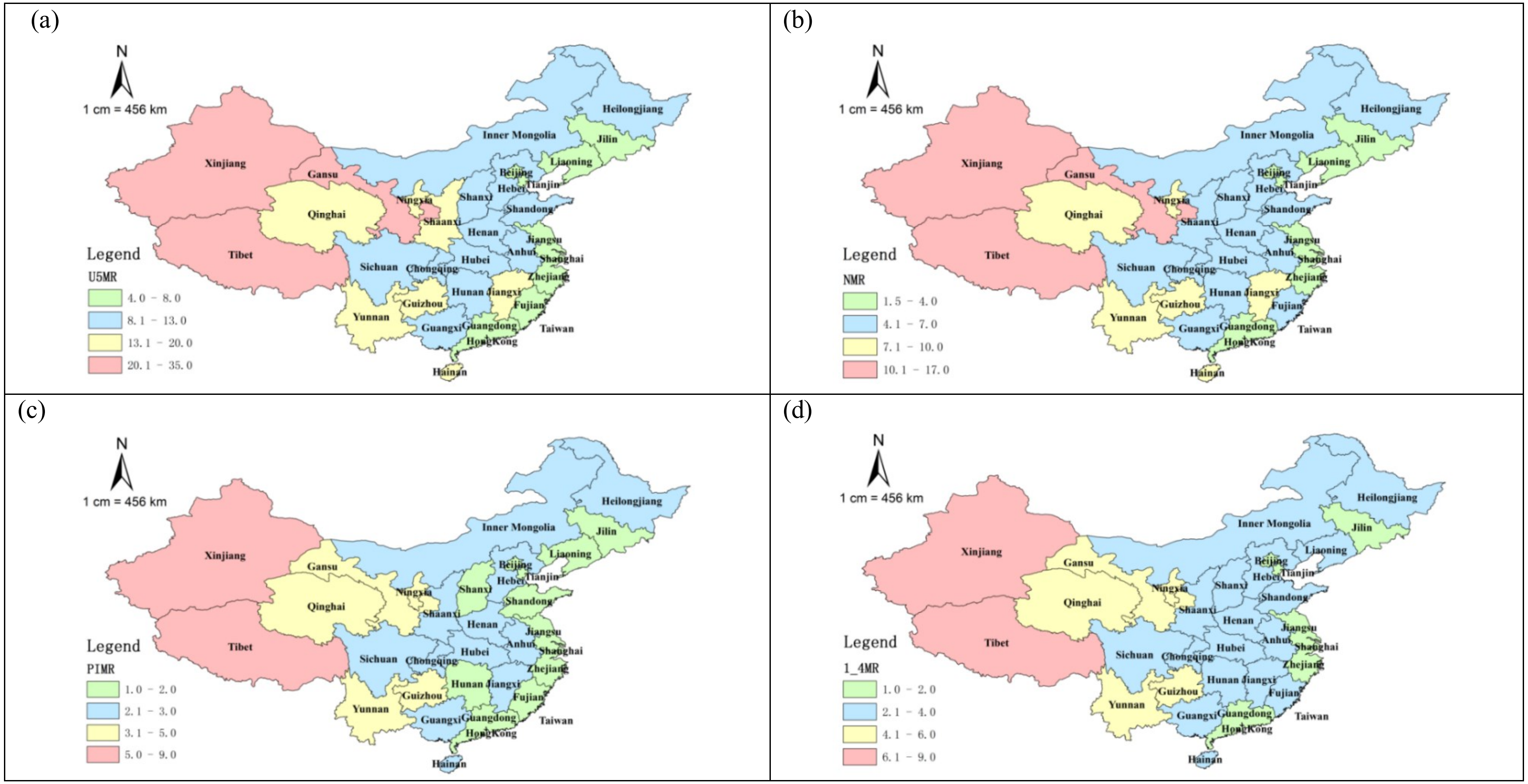


Figure 3.11 Geographic distribution of child mortality rates in 31 provinces in China in 2015

*Note: (a) Under-5 mortality rates; (b) Neonatal mortality rates; (c) Post-neonatal infant mortality rates; (d) 1-4 years mortality rates.

Figure 3.12 shows how the spectrum of the main causes of child deaths changed with the age group in 2015. Among the main COD in children under 5 years (**Figure 3.12a**), the leading causes were preterm birth and low birth weight and birth asphyxia, both responsible for more than 15% of all child deaths. In addition, congenital abnormalities (14.1%), accidents (13.5%) and pneumonia (12.4%) also contributed substantially, with SIDS adding further 6.6%. Among neonates (**Figure 3.12b**), preterm birth and low birth weight and birth asphyxia contributed more than half of the neonatal deaths, accounting for 33.0% and 28.6%, respectively. Congenital abnormalities (11.3%) and pneumonia (10.7%) were also the main causes which accounted for more than 10% of all neonatal deaths. Among post-neonatal infants (**Figure 3.12c**), most deaths were caused by pneumonia (23.1%), congenital abnormalities (21.6%) and SIDS (20.0%), followed by accidents (8.8%) and diarrhea (5.2%). Among the children aged 1-4 years (**Figure 3.12d**), accidental deaths (mainly drowning, asphyxia, falls, traffic accidents and poisoning) became the dominant COD (35.2%). Congenital abnormalities (13.7%), pneumonia (7.6%) and diarrhea (5.8%) also contributed a lot. Another dominant category was "other" (34.7%), accounting for more than one third of the deaths in 1-4 years children, which mainly included tumors and meningitis.

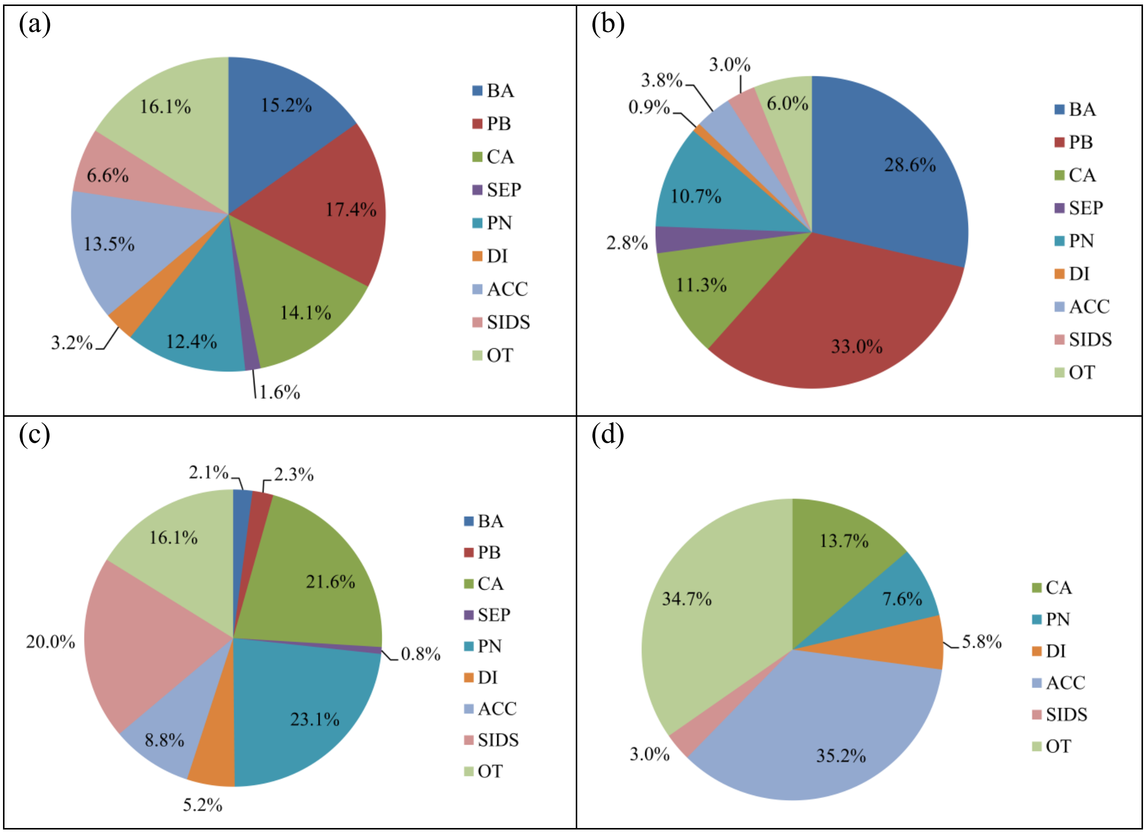
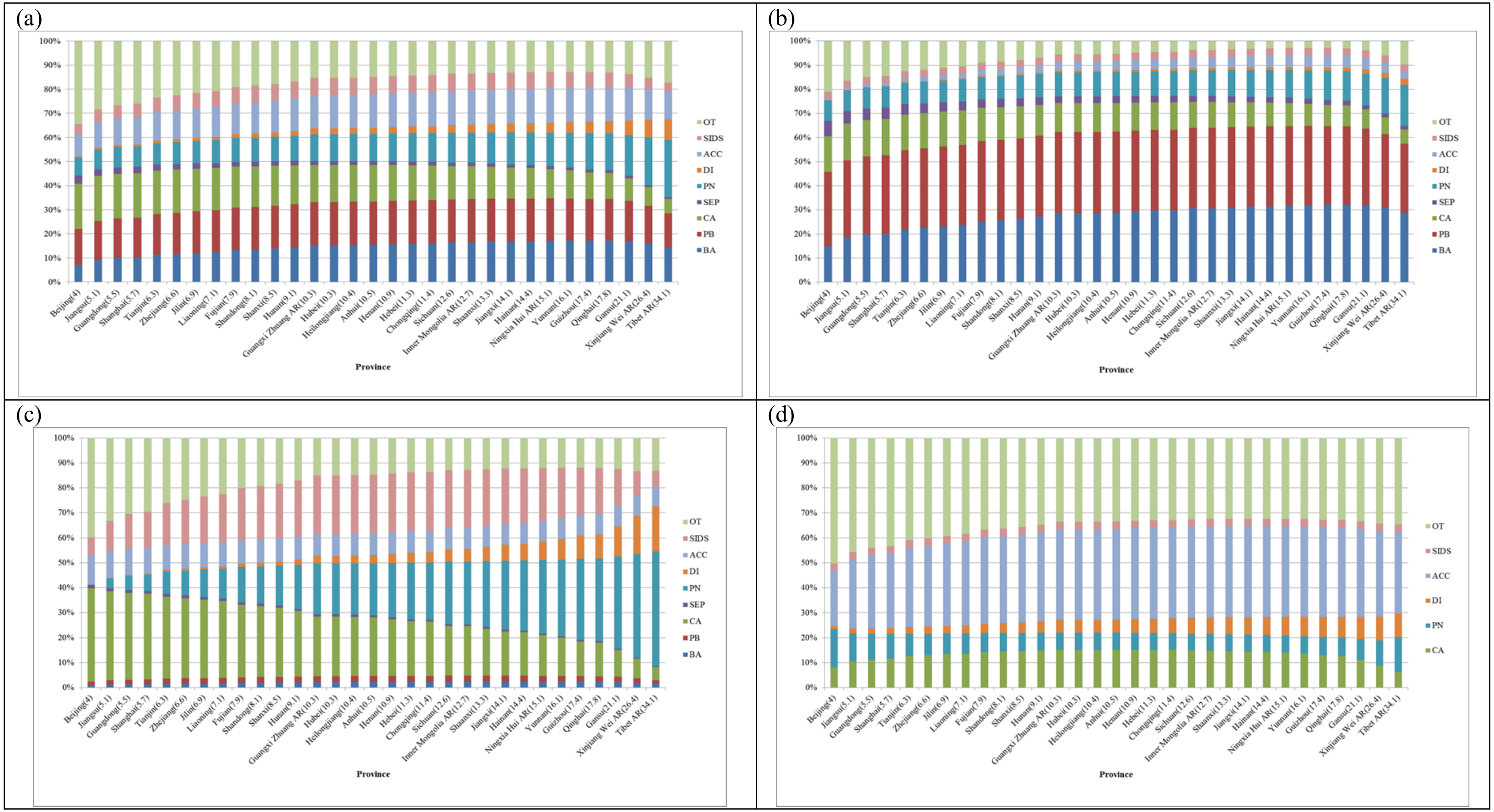


Figure 3.12 Proportional distributions of main COD in neonates, post-neonatal infants, 1-4 years children and children under 5 years in China in 2015

*Note: (a) Children under 5 years; (b) Neonates; (c) Post-neonatal infants; (d) 1-4 years children; BA - Birth asphyxia, PB - Preterm birth and low birth weight, CA - Congenital abnormalities, SEP - Neonatal sepsis, PN - Pneumonia, DI - Diarrhea, ACC - Accidents, SIDS - Sudden infant death syndrome, OT - Other.

The spectrum of causes of child deaths in 31 Chinese provinces (ranked by U5MRs) in 2015 is shown in **Figure 3.13**. In 2015, U5MR ranged from 4 per 1,000 live births in Beijing to 34.1 per 1,000 live births in Tibet. Correspondingly, the leading causes in children under 5 years (**Figure 3.13a**) in wealthier provinces (with lower U5MRs) were congenital abnormalities, preterm birth and low birth weight, and birth asphyxia, while in the poorer provinces (with higher U5MRs), the proportions of infectious diseases were still the dominant COD, especially for pneumonia. Among neonates (**Figure 3.13b**), the distributions in the COD between wealthier and poorer provinces were quite similar, with birth asphyxia and preterm birth and low birth weight being the top two causes. The proportions of congenital abnormalities were higher in the wealthier provinces than in the poorer provinces, where pneumonia was still one of the leading causes. Among post-neonatal infants (**Figure 3.13c**), the spectrum of causes changed dramatically: the leading cause changed from congenital abnormalities (in wealthier provinces) to pneumonia (in poorer provinces). Among the children aged 1-4 years (**Figure 3.13d**), accidents were the top COD in every province, while the poorer provinces were still observing a large burden of death from diarrhea.



(a)
(b)
(c)
(d)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
OT
SIDS
ACC
DI
PN
SEP
CA
PB
BA
Province
Beijing(4)
Jiangsu(5.1)
Guangdong(5.5)
Shanghai(5.7)
Tianjin(6.3)
Zhejiang(6.6)
Jilin(6.9)
Liaoning(7.1)
Fujian(7.9)
Shandong(8.1)
Shanxi(8.5)
Hunan(9.1)
Guangxi Zhuang AR(10.3)
Hubei(10.3)
Heilongjiang(10.4)
Anhui(10.5)
Henan(10.9)
Hebei(11.3)
Chongqing(11.4)
Sichuan(12.6)
Inner Mongolia AR(12.7)
Shaanxi(13.3)
Jiangxi(14.1)
Hainan(14.4)
Ningxia Hui AR(15.1)
Yunnan(16.1)
Guizhou(17.4)
Qinghai(17.8)
Gansu(21.1)
Xinjiang Wei AR(26.4)
Tibet AR(34.1)

Figure 3.13 Proportional contributions of common causes of child deaths in 31 provinces in China in 2015

*Note: Provinces are ranked according to under 5 mortality rates (recorded in x-axis label); (a) Children under 5 years; (b) Neonates; (c) Post-neonatal infants; (d) 1-4 years children; BA - Birth Asphyxia, PB - Preterm birth and low birth weight, CA - Congenital abnormalities, SEP - Neonatal sepsis, PN - Pneumonia, DI - Diarrhea, ACC - Accidents, SIDS - Sudden infant death syndrome, OT – Other.

4 DISCUSSION

The relationship between COD in children and overall U5MR has been well-recognised as a useful approach to predict the main COD based on overall mortality (Lopez, 2003; Salomon & Murray, 2001). Through the means of systematic reviewing of relevant local community-based epidemiological studies, the leading causes can be assessed. In China, although the number of MCMS surveillance sites has increased to 336 counties/districts covering 31 provinces of Mainland China, the data of MCMS only has national or regional representativeness, but it does not allow province-level estimates. Provincial spectrum of COD in children can only be understood through indirect estimates. This study is based on the most recent comprehensive review of independent studies of causes of child mortality in Mainland China. It provides an update to the previous estimates of COD in children in China, which is relevant both to understanding of the major COD in different stages of early life, and to understanding and mapping the considerable health inequities among different provinces in China. More importantly, although I based all my estimates on an entirely new database and a substantially revised statistical model, my study successfully validated and replicated the results of the previous analysis which was presented in the study by Rudan and Chan (Rudan et al., 2010). Given the level of resemblance of the key results, further analysis could be conducted to generate a complete time series of cause structure for China from the year 2000 to 2015.

4.1 Methods for predicting causes of child deaths

In the absence of reliable data on COD in CRVS, model estimates are the best alternative. In comparison to the previous study, this study also contained the search for additional studies in English to ensure the completeness of available information. In addition, I applied perhaps the most comprehensive search strategy and more stringent data collection criteria, which increased the yield of studies. Another obvious merit is the consistency of input data, because nearly all of the included studies were based on local MCMS data, implying a standardised approach to the data collection, quality control, definition and assignment of COD procedures, as explained in Chapter 1. Furthermore, only studies with high quality and considerable sample size were included in the analysis. When extracting data from included studies, I expanded the data extraction form against the MCMS death card to involve every possible COD. In this way, although some of the rare causes were not included in the final analysis because of the lack of sufficient amount of information, the proportions of the studied causes were not further skewed, or influenced by those rare causes. All of the above factors ensured the accuracy and robustness of the database with information upon the estimates were later based.

When defining the relationship between proportional COD and overall U5MR, I firstly tested several different statistical predictive models. I used different weighting methods and variables and then proposed the best-performing model, which was consistent with the previously used model in the CHERG's China estimates to great extent (Rudan et al., 2010). Testing several different models for optimal performance is an important new feature in this study that represents the advance over the previous approach. In addition, although the single-model method was adopted, in MCMS sites, only one primary COD should be assigned to one death according to the surveillance regulation (Department of Maternal and Child Health, 2013). The rigorous criterion of only choosing “multi-cause" studies in my analysis guaranteed that the reported sum of COD attributable to each cause was 100% in every included study. This avoided the potential problem of the sum of all single-cause estimates adding up to more than 100% of the known number of total deaths ("envelope"), which can occur when single-cause models are primarily relied upon (Black et al., 2010; Morris, Black, & Tomaskovic, 2003).

Generally, the relationships between the proportional of various COD and the overall U5MR were strong and internally consistent the models. Typically, the higher the U5MR, the higher the proportion of deaths due to infectious causes and the lower the proportion of deaths due to congenital abnormalities. This study shows that complex statistical models, although not the best solution, can still serve the purpose of developing estimates of cause-specific child mortality where the primary data on COD are not available, but there is universally available information of U5MR and its relationship to the proportion of each one of the main COD (defined by statistical models). My analyses produced internally consistent estimates that can now be used for local policy making and priority setting (Knippenberg et al., 2005). In the present context of China, the presented model-based analyses can be readily used to conduct national and provincial estimates in all cases where MCMS primary data are not available for analysis. Moreover, even when the MCMS data are available, the predictive models should still have merit as a supplementary - or even a dominant - information source, especially when estimating local (provincial) distributions of COD, where MCMS data are either absent or lack representativeness.

4.2 Summary of findings and recommendations

In the last two decades, China has made great progress toward reducing child mortality, which serves as an important result of many inputs into its rapid economic development (Feng, Theodoratou, et al., 2012). The year 2009 was one of the most important years in the history of China's health system development, with the announcement of the nation-wide full-scale "Health Care System Reform" (Guo, Bai, & Na, 2015; Yip et al., 2012). The reform was set to achieve comprehensive universal health coverage, which has then become the primary target of the new Chinese health care system. Better health services were also provided to vulnerable population, especially to children, women and elderly (Xiong et al., 2013). Since 2009, the reduction of U5MR has continuously been successful after the MDG 4 had already been achieved in 2007 (National Health and Family Planning Commission, 2014). With primary aim of this study being related to estimating proportions attributable to different COD, the spectrum of COD in children in China in the period 2009-2015 has been successfully defined in my analysis. The estimates in this study could now represent a basis for targeted interventions and policies that can be initiated.

4.2.1 Neonatal diseases

The estimated levels and trends in NMR, PIMR, 1-4MR and U5MR were similar relatively to each other during the period between 2009 to 2015. The proportions of deaths occurring in different age groups were reasonably steady, with more than half of all child deaths occurring in the first four weeks of life (the neonatal period). The burden of neonatal deaths was very high across the entire Chinese nation, regardless of the level of development of different provinces in the period 2009-2015. Although the knowledge, management procedures, interventions and technologies to avert deaths in the neonatal period exist and their coverage is expanding across China, my estimates show that there is still a large number of children who die each year because of the conditions that occur in neonatal period, and many of which are preventable (World Health Organization, 2012).

According to the model estimates, the proportion of deaths due to preterm birth complications keeps increasing in China. Preterm birth complications have been the leading

COD in children under 5 years in China over the past seven years continually. Complications of preterm births are also regarded as an important risk factor for other neonatal deaths, particularly for infectious diseases (Lawn, Gravett, Nunes, Rubens, & Stanton, 2010; Schrag et al., 2012). In my estimates, the increasing trend of neonatal sepsis was consistent with this proposed association, as the proportion of neonatal sepsis had an increasing trend that matched the rise in the proportion of complications of preterm birth. This temporal change could perhaps also be explained by the rising rate of caesarean sections in China (Hellerstein, Feldman, & Duan, 2015; Long et al., 2012), especially of the induction/elective caesarean sections (Gibbons et al., 2010; Lawn et al., 2010). Nevertheless, the increase of caesarean section rate can bring overall benefits and reduce neonatal mortality, as it reduces the occurrence of birth asphyxia (Coutinho, Cecatti, Surita, Costa, & Morais, 2011; Ramachandrappa & Jain, 2008). The outputs of my models are consistent with this, as they imply an overall reduction of deaths due to birth asphyxia during this period. Generally, birth asphyxia is a complex condition, influenced by many factors which include (but are not limited to) maternal health, antenatal care and birth attendance. As a result of the launch of national "safe motherhood" program - “the National Program to Reduce Maternal Mortality and Eliminate Neonatal Tetanus” (in 2000) and the Health Care System Reform (in 2009), the rates of hospital delivery and antenatal care were widely improved, even in the poorest rural areas (Feng et al., 2010). The Neonatal Resuscitation Program, adopted by the Chinese government nationally in 2004, also served to reduce the burden of deaths due to birth asphyxia (Lee et al., 2011; Xu et al., 2012). The efforts listed above have all served as the basis for improvement of maternal health and they also contributed to the reduction of NMR and deaths due to birth asphyxia (Feng et al., 2010; Feng, Xu, Guo, & Ronsmans, 2011; National Health and Family Planning Commission, 2014).

With the trend stated above, in 2015, the deaths due to neonatal diseases were still on the rise among all causes of child death, with preterm birth complications as the top cause and birth asphyxia as the second. Prematurity is well-recognised to represent a health risk which continues to have effects far beyond the early life. Some of the long-term implications of being born too soon include intellectual impairment, non-communicable diseases (such as diabetes and hypertension), mental health disorders and chronic respiratory diseases throughout the entire lifespan (Gravett & Rubens, 2012; World Health Organization, 2012). All this makes preterm birth a significant and long-term health problem. Although the mechanisms underlying preterm birth are considered to be very complex and they can be contributed to a number of risk factors - including maternal characteristics, nutritional status, psychological characteristics, infection, uterine contractions, and others (Goldenberg, Culhane, Iams, & Romero, 2008) - it should be possible to prevent more than three quarters of preterm births with cost-effective measures such as antenatal corticosteroids. The large share of deaths that still occur in the neonatal period highlights the importance of initiating health interventions at the start of life. When defining the policy to improve child survival, one priority should be set to enhancing the capacity for early recognition of neonatal diseases among both parents and postpartum care professionals, such as community nurses or village doctors, especially in rural poor areas, in order to reduce the mortality related to this particular age group.

4.2.2 **Infectious diseases**

Similarly to the trends previously observed in the period between 2000 to 2008 (Rudan et al., 2010), from 2009 to 2015 the overall decrease of U5MR could have mainly been contributed to a substantial decline in deaths attributable to infectious diseases, particularly childhood pneumonia and diarrhea. This is consistent with the trend observed in some previous studies - both in China and globally (He et al., 2015; L. Liu et al., 2012). The progress in reducing the proportional contribution of pneumonia and diarrhea is significant: in 2015, the proportion of deaths due to pneumonia has declined to 12.4%, with a reduction rate of 24.4% in comparison to the baseline contribution in the year 2009. Globally, China is still ranking as one of 15 countries with the highest burden of childhood pneumonia (Walker et al., 2013), while in China pneumonia still regularly features among the five leading COD in children under 5 years, especially in poor developing areas, such as Tibet and Xinjiang provinces.

Pneumonia typically develops as a combination of risk factors related to host, environment and infectious agent (Rudan, Boschi-Pinto, Biloglav, Mulholland, & Campbell, 2008). According to an analysis from National Surveillance System, the decline in pneumonia deaths in China can be largely explained by a rapid economic growth, increasing access to child health care and antibiotic treatment, improvement in child nutrition (such as breastfeeding and nutrients supplementation), and health promotion (He et al., 2015). These may also be important contributors to another infectious disease - diarrhea. From 2009 to 2015, the reduction in diarrhea has also been quite dramatic, declining from 5.3% to 3.2%, with a reduction rate of 39.6%. However, this analysis confirmed that in China diarrhea was not such a common COD among children under 5, in comparison to some other developing countries (Boschi-Pinto, 2008), this may be partly explained by the common Chinese cultural practice of eating cooked food and drinking boiled water and some other hygiene practices (J. Zhang, 2012).

Another feature is that infectious diseases were most relevant as the COD in post-neonatal infant period: pneumonia was the leading cause among children aged 1-11 months during the entire period between 2009 and 2015. Still, it also showed marked reduction during this period, which is in line with the results from several previous studies (Ma et al., 2014; Theodoratou et al., 2011; UNICEF, 2008; Van Look, Heggenhougen, & Quah, 2011). This implies that a special attention should be given to post-neonatal infants when expanding effective preventive and curative interventions among vulnerable children. Although the statistical modelling procedures in this study didn't take socioeconomic factors into consideration when determining the proportional COD in each year, indirect factors such as education, standard of living and household condition may have played important roles in this process. For policy making, interventions such as promoting breastfeeding practice, preventive zinc supplementation and expansion of vaccine coverage have been proven to be effective for both pneumonia and diarrhea (Bhutta et al., 2013). Introduction of health-promoting factors, as well as the focus on improved social determinants of health, are thought to have a large effect on improving the chances for survival among infants and young children (Sjursen, 2011; Zheng et al., 2013).

4.2.3 **Congenital abnormalities**

The burden of congenital abnormalities was growing during the period of 2009 to 2015, with a trend to replace birth asphyxia and become the second most significant cause of child deaths in China in the future years. In 2015, congenital abnormalities have become the third most common cause of death in children under 5 years. This cause was particularly important among post-neonatal infants, where congenital abnormalities have become the second leading cause, accounting for more than one fifth of total deaths and having a continuous increasing trend. Congenital abnormalities are set to become the leading cause of death in China in a not so distant future. According to the demographic distribution in 2015, congenital abnormalities have already become the leading cause of deaths in several economically highly developed provinces, such as Beijing and Jiangsu.

There is a number of possible reasons for the increasing proportion of congenital abnormalities, such as genetic factors, socioeconomic and demographic factors, maternal nutrition, environmental teratogens exposures, etc. (World Health Organization, 2010). However, for a broad cause of congenital abnormalities, primary prevention can only be effective when the understanding of causes is clear. As an example, neural tube defects (NTDs) can be effectively prevented with periconceptional folic acid supplementation (World Health Organization, 2007). Preventing congenital abnormalities has long been a policy priority in China (Dai et al., 2011). From 1980s, the Chinese central government began to establish the birth defects surveillance system nationally. Presently, this surveillance has already become a unique part of MCMS and it includes two independent systems: national and provincial hospital-based surveillance, and national and regional population-based surveillance. The magnitude of the problem can be assessed through this surveillance and data collection, but more detailed split of the causes of congenital abnormalities should be explored. Major factors affecting the prevalence and distribution of congenital abnormalities should also be understood, with more efforts diverted to revealing the situation of congenital abnormalities in detail, to provide the basis of targeted policy, especially for researches on etiology, prevention and treatment.

4.2.4 **Accidents**

The importance of accidents has drawn much attention worldwide, and also in China (K. Y. Chan et al., 2015; Holtz, 2013). Based on the estimates in this study, the proportion of child deaths due to accidents has remained comparatively stable in the last seven years from 2009 to 2015, and even across the whole nation geographically. However, the share of deaths due to accidents has been rising among post-neonatal infants and 1-4 year old children. The risk of accidental child death was the largest among the children aged 1-4 years, where this was the leading cause in the last seven years.

Among all types of accidents, drowning has long been recognised as a very important cause, based on both the surveillance data and modelling estimates (K. Y. Chan et al., 2015; Y. Wang et al., 2014). This suggests that prevention strategies focused on child drowning should be made as a national policy priority. However, for children under 5 years, the widely adopted drowning prevention - which is to teach children to swim - although proven to be beneficial, it probably will not contribute much to preventing drowning deaths among younger children (S. Wang et al., 2008; Li Yang, Nong, Li, Feng, & Lo, 2007). A more comprehensive and effective prevention program should be developed to reduce water hazards. Such programs should aim to enhance the infrastructure and provide sufficient and appropriate supervision of children through educating their parents, especially in the areas where the sea, rivers and lakes are in the close vicinity of the houses. In addition, other major accidental causes include traffic accidents, accidental asphyxia and falls. The national and even provincial estimates of breakdown of deaths due to accidents can increase the universal awareness of the harm of accidents and provide basis for policy-making on a large scale. This could include health development financing plan at the national level (K. Y. Chan et al., 2015), but more effective community-based interventions can only be successful when taking local environments into consideration.

4.2.5 Sudden infant death syndrome

The trend of SIDS resembled that of preterm birth complications (Goldstein, Trachtenberg, Sens, Harty, & Kinney, 2016) in the last seven years. According to my estimates, the burden of mortality due to SIDS has risen to 6.6% in children under 5 years in 2015. The situation was the worst among post-neonatal infants, where deaths due to SIDS accounted for one fifth of the total deaths. The regional burden of SIDS was the highest among post-neonatal infants in provinces with medium levels of under-five mortality, such as Anhui, Henan and Heilongjiang. The reasons for SIDS have long been regarded as unexplained, but some risk factors have been revealed over time, such as gender, smoking exposure, preterm birth, sleeping position and bed sharing (Gilbert, Salanti, Harden, & See, 2005; Task Force on Sudden Infant Death Syndrome, 2005; K. Zhang & Wang, 2013). Recommendations such as creating a safer sleeping environment, breastfeeding, or use of pacifiers (Mitchell, 2007) can all be adopted to reduce the burden of SIDS in specific circumstances.

However, it’s hard to distinguish between SIDS and accidental asphyxia as a direct cause of death (Kim, Shapiro - Mendoza, Chu, Camperlengo, & Anderson, 2012), especially in most cases of sleep-related infant deaths. The diagnosis used in death certificates (e.g., accidental suffocation, positional accidental asphyxia, and indeterminate cause) may influence the estimates of the true burden of SIDS and over- and under-estimate them (Kinney & Thach, 2009). In some cases, the definition of SIDS even includes mechanical asphyxia or suffocation (F Krous, 2010; Krous et al., 2004). In MCMS, there’s no preset category of SIDS for estimating the real burden. However, the high prevalence of preterm births and culturally highly prevalent practices of all-night bed sharing (particularly newborns and infants) make it persuasively acceptable that SIDS was generally classified into the preset category of accidental suffocation (Jiang et al., 2007; X. Liu, Liu, & Wang, 2003). The uncertainty about coding of SIDS makes it difficult to try to understand more about this important cause of death.

4.3 Limitations and future direction

Nonetheless, there are several important limitations to this study. For modelling method, although the applied model in this study was based on the best available information from high-quality studies, which were distributed reasonably evenly across all Chinese provinces, the model may still be biased because of unmeasured characteristics of the study population from each individual study. In order to specify the most comprehensive and robust association between the proportions of COD and overall U5MR, a number of additional covariates should be considered, such as the local socioeconomic development level, vaccination rate, etc. Therefore, the estimates in this study should only be considered to represent a rough approximation of the true picture of the spectrum of causes of child deaths in China. Future work will be needed to externally validate the estimates presented in this study. This can be achieved by comparing my results with the primary surveillance data from MCMS, which should also help to clarify the large and uncertain “other” cause. Moreover, internal validation should also be conducted to test the performance of the model. A better understanding of inherent limitations of the model-based estimates can be achieved by presenting all point estimates with their realistic uncertainty ranges. In future studies, uncertainty ranges should be added to the model and they could rely on "sampling-resampling" methods (Lawn, 2009).

For the purpose of defining the distribution of COD, this study only focused on a limited number of selected leading causes. This is especially true for a large category of causes such as “accidents” and “congenital abnormalities”, which comprises an entire set of complications, rather than a single, specific disease or cause. In this way, the estimates for diarrhea or sepsis, as an example, would seem to be less important when compared with the entire sets of causes. In a recent paper, all accidental causes have been partitioned into more specific categories (K. Y. Chan et al., 2015). Further comparisons among specific causes and a detailed analysis of accidental causes can better reveal the importance of different specific causes. For congenital abnormalities, an additional effort should be made to reveal the detailed spectrum. This could be realised through modeling based on the current birth defect surveillance system and provide an additional value to the study on causes of child deaths in China. Second, the estimates of SIDS in this study were based the contribution of accidental suffocation as recorded in the death card. Although efforts have been made to address this important issue properly, over-estimation may still exist and further research should be conducted to find out the real contributors to accidental suffocation. This should make it possible to split SIDS from other causes of accidental suffocation. Thirdly, misclassification may have occurred when there was no clinical diagnosis or treatment before death, even though a detailed interview with the parents or main guardians were conducted to identify the factors attributing to the child death. This is a routine data collection procedure in MCMS. We should be aware that the low specificity of verbal autopsies may lead to an underestimation of some specific causes, especially those relying on medical diagnosis (e.g. infectious diseases, tumor, and nervous system disease) (He et al., 2015; Rudan et al., 2008). Future research could focus on the difference between diagnosed and self-reported COD. Even the difference in diagnosis by different levels of health facilities can provide a glance on possible misclassification, which can be further adopted to adjust the model-based estimates or even primary-data based MCMS reports.

Additionally, despite all major advantages, constructing and improving statistical models of COD distribution should never become the ultimate focus of child death research. Substantial progress can only be made through collection of sufficient amount of informative data (L. Liu et al., 2012). More attention should be focused on improving the availability and quality of CRVS, MCMS and MCHARS data resources in China and their combining in order to estimate overall and cause-specific mortality rates, which can then provide improved picture of the causes of child deaths in China.

According to the information of the place of occurrence of child deaths as reported by the MCMS (**Figure 4.1**), there was still a large proportion of child deaths taking place at home or on the way to health care facility in rural areas in 2004, which was observed even in the most economically advanced rural places (UNICEF, Organization, & Activities, 2006). Future research on location of child deaths could potentially address the performance of the current health system, through using the relationship between the place of child death, the overall mortality rate and the spectrum of COD as an indicator of health system performance. If such indicator could be established, then the estimates of places of deaths or assessment of local health system performance could be conducted at province levels, or in areas where primary surveillance data are not available.

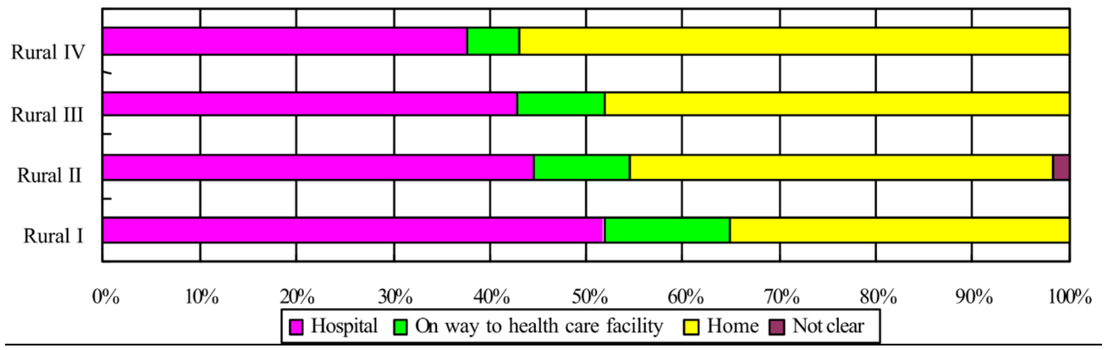


Figure 4.1 Places of child deaths by types of rural counties, 2004 (source: (UNICEF et al., 2006))

*Note: Rural areas type I, II, III or IV were categorised by socioeconomic development level, with type I being the richest and type IV being the poorest (Feng, Xu, Guo, & Ronsmans, 2012).

More importantly, complementary "social autopsy" data in MCMS child report card, which focus on the social, behavioral and health systems determinants of child deaths (Waiswa, Kalter, Jakob, & Black, 2012), should be analysed by using either the primary MCMS data or systematic review methods. They should aim to explore the underlying non-biological factors contributing to deaths where no treatment was administered, or care sought before dying. As a valuable complementary information of COD, social autopsy should be used to show how social, behavioral and health systems-related factors can combine in causing the deaths. This should inform us on the amount of preventable deaths whenever the access to (and use of) health care are universal in most areas. It should also provide more information to health sector policymakers and programmers to identify health priorities and develop effective targeted strategies (Kalter, Salgado, Babille, Koffi, & Black, 2011; Waiswa et al., 2012).

Furthermore, the differences in the distribution of COD between boys and girls can also shed a light on gender equity in child death, and the differences in mortality rates between migrant groups' children and resident groups' children can reflect the specific vulnerability of a large number of migrant children, who come from rural areas to contribute to a process of rapid urbanization (China Labour Bulletin, 2013; Tang et al., 2008; Y. Wang et al., 2015). For the leading cause of preterm birth complications, differentiating spontaneous and medically induced preterm birth is of policy importance because of the high rate of caesarean sections in China (Lawn et al., 2010). All these issues should be considered when designing the analyses of COD in future studies, where primary data are available and priorities should be set to eliminate the equity gap (L. Wang & Jacoby, 2004).

REFERENCES

AbouZahr, C., de Savigny, D., Mikkelsen, L., Setel, P. W., Lozano, R., Nichols, E., et al. (2015). Civil registration and vital statistics: progress in the data revolution for counting and accountability. *The Lancet*.

Abouzahr, C., Stein, C., Chapman, N., Toole, D., LeFranc, C., Joshi, K., et al. (2014). A development imperative: civil registration and vital statistics systems in the Asia-Pacific region. *Asia-Pacific Population Journal, 29*(1).

Adams, J., & Hannum, E. (2005). Children's social welfare in China, 1989–1997: Access to health insurance and education. *The China Quarterly, 181*, 100-121.

Alkema, L., New, J. R., Pedersen, J., & You, D. (2014). Child mortality estimation 2013: an overview of updates in estimation methods by the United Nations Inter-Agency Group for Child Mortality Estimation.

Banister, J., & Hill, K. (2004). Mortality in China 1964–2000. *Population studies, 58*(1), 55-75.

Basten, S. (2012). Family planning restrictions and a generation of excess males: analysis of national and provincial data from the 2010 Census of China. *University of Oxford, Department of Social Policy and Intervention Oxford Centre for Population Research: Working paper, 59*.

Beaglehole, R., & Bonita, R. (2009). *Global public health: a new era*: Oxford University Press.

Bhutta, Z. A., Das, J. K., Walker, N., Rizvi, A., Campbell, H., Rudan, I., et al. (2013). Interventions to address deaths from childhood pneumonia and diarrhoea equitably: what works and at what cost? *The Lancet, 381*(9875), 1417-1429.

Black, R. E., Cousens, S., Johnson, H. L., Lawn, J. E., Rudan, I., Bassani, D. G., et al. (2010). Global, regional, and national causes of child mortality in 2008: a systematic analysis. *The Lancet, 375*(9730), 1969-1987.

Boschi-Pinto, C. (2008). Estimating child mortality due to diarrhoea in developing countries. *Bulletin of the World Health Organization, 86*(9), 710-717.

Bryce, J., Boschi-Pinto, C., Shibuya, K., & Black, R. E. (2005). WHO estimates of the causes of death in children. *The Lancet, 365*(9465), 1147-1152.

Cao, Y., Yuan, P., Wang, Y., Mao, M., & Zhu, J. (2009). The profile of newborn screening coverage in China. *Journal of medical screening, 16*(4), 163-166.

Chan, E. Y., Griffiths, S., Gao, Y., Chan, C. W., & Fok, T. F. (2008). Addressing disparities in children's health in China. *Archives of disease in childhood, 93*(4), 346-352.

Chan, K. Y., Yu, X. W., Lu, J. P., Demaio, A. R., Bowman, K., & Theodoratou, E. (2015). Causes of accidental childhood deaths in China in 2010: A systematic review and analysis. *J Glob Health, 5*(1), 010412.

China Labour Bulletin. (2013). Migrant workers and their children. from http://www.clb.org.hk/en/content/migrant-workers-and-their-children

CMEInfo. UN Inter-agency Group for Child Mortality Estimation: China. Retrieved 03/12/2015, from http://www.childmortality.org/index.php?r=site/graph

CNKI. China National Knowledge Infrastructure from http://www.cnki.net/

Cohen, J. F., Korevaar, D. A., Wang, J., Spijker, R., & Bossuyt, P. M. (2015). Should we search Chinese biomedical databases when performing systematic reviews? *Systematic reviews, 4*(1), 23.

Coutinho, P. R., Cecatti, J. G., Surita, F. G., Costa, M. L., & Morais, S. S. (2011). Perinatal outcomes associated with low birth weight in a historical cohort. *Reproductive health, 8*(1), 18.

Currie, J., & Reichman, N. (2015). Policies to Promote Child Health: Introducing the Issue. *The Future of Children, 25*(1), 3.

Dai, L., Zhu, J., Liang, J., Wang, Y.-P., Wang, H., & Mao, M. (2011). Birth defects surveillance in China. *World Journal of Pediatrics, 7*(4), 302-310.

Department of Maternal and Child Health, N. H. a. F. P. C. o. C. (2013). *National Maternal and Child Health Surveillance work manual (in Chinese)*. Beijing, China.

Du, Q., Næss, Ø., Bjertness, E., Yang, G., Wang, L., & Kumar, B. N. (2012). Differences in reporting of maternal and child health indicators: A comparison between routine and survey data in Guizhou Province, China. *International journal of women's health, 4*, 295.

F Krous, H. (2010). Sudden unexpected death in infancy and the dilemma of defining the sudden infant death syndrome. *Current Pediatric Reviews, 6*(1), 5-12.

Feng, X. L., Shi, G., Wang, Y., Xu, L., Luo, H., Shen, J., et al. (2010). An impact evaluation of the Safe Motherhood Program in China. *Health economics, 19*(S1), 69-94.

Feng, X. L., Theodoratou, E., Liu, L., Chan, K. Y., Hipgrave, D., Scherpbier, R., et al. (2012). Social, economic, political and health system and program determinants of child mortality reduction in China between 1990 and 2006: a systematic analysis. *Journal of global health, 2*(1).

Feng, X. L., Xu, L., Guo, Y., & Ronsmans, C. (2011). Socioeconomic inequalities in hospital births in China between 1988 and 2008. *Bulletin of the World Health Organization, 89*(6), 432-441.

Feng, X. L., Xu, L., Guo, Y., & Ronsmans, C. (2012). Factors influencing rising caesarean section rates in China between 1988 and 2008. *Bulletin of the World Health Organization, 90*(1), 30-39A.

Field, M. J., & Behrman, R. E. (2003). *When Children Die:: Improving Palliative and End-of-Life Care for Children and Their Families*: National Academies Press.

França, E., de Abreu, D. X., Rao, C., & Lopez, A. D. (2008). Evaluation of cause-of-death statistics for Brazil, 2002–2004. *International journal of epidemiology, 37*(4), 891-901.

Gaffey, M. F., Das, J. K., & Bhutta, Z. A. (2015). *Millennium Development Goals 4 and 5: Past and future progress.* Paper presented at the Seminars in Fetal and Neonatal Medicine.

Gan, X.-L., Hao, C.-L., Dong, X.-J., Alexander, S., Dramaix, M. W., Hu, L.-N., et al. (2014). Provincial Maternal Mortality Surveillance Systems in China. *BioMed research international, 2014*.

Garg, A. X., Hackam, D., & Tonelli, M. (2008). Systematic review and meta-analysis: when one study is just not enough. *Clinical Journal of the American Society of Nephrology, 3*(1), 253-260.

Gibbons, L., Belizán, J. M., Lauer, J. A., Betrán, A. P., Merialdi, M., & Althabe, F. (2010). The global numbers and costs of additionally needed and unnecessary caesarean sections performed per year: overuse as a barrier to universal coverage. *World health report, 30*, 1-31.

Gilbert, R., Salanti, G., Harden, M., & See, S. (2005). Infant sleeping position and the sudden infant death syndrome: systematic review of observational studies and historical review of recommendations from 1940 to 2002. *International journal of epidemiology, 34*(4), 874-887.

Goldenberg, R. L., Culhane, J. F., Iams, J. D., & Romero, R. (2008). Epidemiology and causes of preterm birth. *The Lancet, 371*(9606), 75-84.

Goldstein, R. D., Trachtenberg, F. L., Sens, M. A., Harty, B. J., & Kinney, H. C. (2016). Overall Postneonatal Mortality and Rates of SIDS. *Pediatrics*, peds. 2015-2298.

Gravett, M. G., & Rubens, C. E. (2012). A framework for strategic investments in research to reduce the global burden of preterm birth. *American journal of obstetrics and gynecology, 207*(5), 368-373.

Guo, K., Yin, P., Wang, L., Ji, Y., Li, Q., Bishai, D., et al. (2015). Propensity score weighting for addressing under-reporting in mortality surveillance: a proof-of-concept study using the nationally representative mortality data in China. *Population health metrics, 13*(1), 1-11.

Guo, Y., Bai, J., & Na, H. (2015). *The history of China's maternal and child health care development.* Paper presented at the Seminars in Fetal and Neonatal Medicine.

Haroun, H. M., Mahfouz, M. S., & Ibrahim, K. H. (2007). Level and determinants of infant and under-five mortality in Wad-Medani Town, Sudan. *Journal of family & community medicine, 14*(2), 65.

He, C., Kang, L., Miao, L., Li, Q., Liang, J., Li, X., et al. (2015). Pneumonia Mortality among Children under 5 in China from 1996 to 2013: An Analysis from National Surveillance System. *PloS one, 10*(7), e0133620.

Hellerstein, S., Feldman, S., & Duan, T. (2015). China's 50% caesarean delivery rate: is it too high? *BJOG: An International Journal of Obstetrics & Gynaecology, 122*(2), 160-164.

Holtz, C. (2013). *Global health care: Issues and policies*: Jones & Bartlett Publishers.

Institute for Health Metrics and Evaluation (IHME). (2015). China subnational MDG 4. Retrieved 27/04/2016, from http://vizhub.healthdata.org/subnational/china

Jha, P. (2012). Counting the dead is one of the world's best investments to reduce premature mortality. *Hypothesis, 10*(1).

Jiang, F., Shen, X., Yan, C., Wu, S., Jin, X., Dyken, M., et al. (2007). Epidemiological study of sleep characteristics in Chinese children 1–23 months of age. *Pediatrics International, 49*(6), 811-816.

Kalter, H. D., Salgado, R., Babille, M., Koffi, A. K., & Black, R. E. (2011). Social autopsy for maternal and child deaths: a comprehensive literature review to examine the concept and the development of the method. *Popul Health Metr, 9*(45.10), 1186.

Kim, S. Y., Shapiro-Mendoza, C. K., Chu, S. Y., Camperlengo, L. T., & Anderson, R. N. (2012). Differentiating Cause-of-Death Terminology for Deaths Coded as Sudden Infant Death Syndrome, Accidental Suffocation, and Unknown Cause: An Investigation Using US Death Certificates, 2003–2004*. *Journal of forensic sciences, 57*(2), 364-369.

Kinney, H. C., & Thach, B. T. (2009). The sudden infant death syndrome. *New England Journal of Medicine, 361*(8), 795-805.

Knippenberg, R., Lawn, J. E., Darmstadt, G. L., Begkoyian, G., Fogstad, H., Walelign, N., et al. (2005). Systematic scaling up of neonatal care in countries. *The Lancet, 365*(9464), 1087-1098.

Krous, H. F., Beckwith, J. B., Byard, R. W., Rognum, T. O., Bajanowski, T., Corey, T., et al. (2004). Sudden infant death syndrome and unclassified sudden infant deaths: a definitional and diagnostic approach. *Pediatrics, 114*(1), 234-238.

Kuruvilla, S., Schweitzer, J., Bishai, D., Chowdhury, S., Caramani, D., Frost, L., et al. (2014). Success factors for reducing maternal and child mortality. *Bulletin of the World Health Organization, 92*(7), 533-544.

Lanata, C. F., Rudan, I., Boschi-Pinto, C., Tomaskovic, L., Cherian, T., Weber, M., et al. (2004). Methodological and quality issues in epidemiological studies of acute lower respiratory infections in children in developing countries. *International journal of epidemiology, 33*(6), 1362-1372.

Lawn, J. E. (2009). *4 million neonatal deaths: an analysis of available cause-of-death data and systematic country estimates with a focus on "birth asphyxia".* UCL (University College London).

Lawn, J. E., Gravett, M. G., Nunes, T. M., Rubens, C. E., & Stanton, C. (2010). Global report on preterm birth and stillbirth (1 of 7): definitions, description of the burden and opportunities to improve data. *BMC pregnancy and childbirth, 10*(Suppl 1), S1.

Lee, A. C., Cousens, S., Wall, S. N., Niermeyer, S., Darmstadt, G. L., Carlo, W. A., et al. (2011). Neonatal resuscitation and immediate newborn assessment and stimulation for the prevention of neonatal deaths: a systematic review, meta-analysis and Delphi estimation of mortality effect. *BMC Public Health, 11*(Suppl 3), S12.

Liang, J., Mao, M., Dai, L., Li, X., Miao, L., Li, Q., et al. (2011). Neonatal mortality due to preterm birth at 28–36 weeks' gestation in China, 2003–2008. *Paediatric and Perinatal epidemiology, 25*(6), 593-600.

Liu, L., Johnson, H. L., Cousens, S., Perin, J., Scott, S., Lawn, J. E., et al. (2012). Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *The Lancet, 379*(9832), 2151-2161.

Liu, L., Oza, S., Hogan, D., Perin, J., Rudan, I., Lawn, J. E., et al. (2015). Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis. *The Lancet, 385*(9966), 430-440.

Liu, S., Wu, X., Lopez, A. D., Wang, L., Cai, Y., Page, A., et al. (2016). An integrated national mortality surveillance system for death registration and mortality surveillance, China. *Bulletin of the World Health Organization, 94*(1), 46-57.

Liu, X., Liu, L., & Wang, R. (2003). Bed sharing, sleep habits, and sleep problems among Chinese school-aged children. *SLEEP-NEW YORK THEN WESTCHESTER-, 26*(7), 839-844.

Long, Q., Klemetti, R., Wang, Y., Tao, F., Yan, H., & Hemminki, E. (2012). High caesarean section rate in rural China: Is it related to health insurance (New co-operative medical scheme)? *Social Science & Medicine, 75*(4), 733-737.

Lopez, A. D. (2003). Commentary: Estimating the causes of child deaths. *International Journal of Epidemiology, 32*(6), 1052-1053.

Ma, Y., Guo, S., Wang, H., Xu, T., Huang, X., Zhao, C., et al. (2014). Cause of death among infants in rural western China: a community-based study using verbal autopsy. *The Journal of pediatrics, 165*(3), 577-584.

Mahapatra, P., Shibuya, K., Lopez, A. D., Coullare, F., Notzon, F. C., Rao, C., et al. (2007). Civil registration systems and vital statistics: successes and missed opportunities. *The Lancet, 370*(9599), 1653-1663.

Mathers, C. D., Boerma, T., & Fat, D. M. (2009). Global and regional causes of death. *British medical bulletin*, ldp028.

Mathers, C. D., Ma Fat, D., Inoue, M., Rao, C., & Lopez, A. D. (2005). Counting the dead and what they died from: an assessment of the global status of cause of death data. *Bulletin of the world health organization, 83*(3), 171-177c.

McNicoll, G. (2015). Analysing China's Population: Social Change in a New Demographic Era: WILEY-BLACKWELL 111 RIVER ST, HOBOKEN 07030-5774, NJ USA.

Ministry of Foreign Affairs, P. s. R. o. C. U. N. S. i. C. (2015). *Report on China's Implementation of the Millennium Development Goals (2000-2015)*.

Mitchell, E. (2007). Recommendations for sudden infant death syndrome prevention: a discussion document. *Archives of disease in childhood, 92*(2), 155-159.

Moriyama, I. M. M., Loy, R. M., Robb-Smith, A. H. T. R., Rosenberg, H. M. R., Hoyert, D. L., & Statistics, N. C. f. H. (2010). *History of the statistical classification of diseases and causes of death*: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

Morris, S. S., Black, R. E., & Tomaskovic, L. (2003). Predicting the distribution of under-five deaths by cause in countries without adequate vital registration systems. *International Journal of Epidemiology, 32*(6), 1041-1051.

National Bureau of Statistics of the People's Republic of China. (2014). *China Statistical Yearbook 2014 (Chinese-English Edition)*: China Statistics Press.

National Health and Family Planning Commission of the People's Republic of China. (2014).

China Health and Family Planning Statistical Yearbook 2014: China union medical university press.

National Health and Family Planning Commission, P. f. M., Newborn & Child Health, WHO, World Bank and Alliance for Health Policy and Systems Research. (2014). *Success factors for women's and children's health: China*. Geneva: World Health Organisation.

NWCCW, N., UNICEF. (2014). *Children in China: An Atlas of Social Indicators*.

Organization, W. H. (2014). CHERG-WHO methods and data sources for child causes of death 2000-2013. *Global Health Estimates Technical Paper WHO/HIS/HSI/GHE*.

Population Pyramids of the World from 1950 to 2100. (2015). Population Pyramid of China in 2015. Retrieved 02/12/2015, from http://populationpyramid.net/china/2015/

Ramachandrappa, A., & Jain, L. (2008). Elective cesarean section: its impact on neonatal respiratory outcome. *Clinics in perinatology, 35*(2), 373-393.

Rao, C., Lopez, A. D., Yang, G., Begg, S., & Ma, J. (2005). Evaluating national cause-of-death statistics: principles and application to the case of China. *Bulletin of the World Health Organization, 83*(8), 618-625.

Reidpath, D. D., & Allotey, P. (2003). Infant mortality rate as an indicator of population health. *Journal of epidemiology and community health, 57*(5), 344-346.

Requejo, J. H., Bryce, J., Barros, A. J., Berman, P., Bhutta, Z., Chopra, M., et al. (2015). Countdown to 2015 and beyond: fulfilling the health agenda for women and children. *The Lancet, 385*(9966), 466-476.

Rudan, I., Boschi-Pinto, C., Biloglav, Z., Mulholland, K., & Campbell, H. (2008). Epidemiology and etiology of childhood pneumonia. *Bulletin of the world health organization, 86*(5), 408-416B.

Rudan, I., Chan, K. Y., Zhang, J. S., Theodoratou, E., Feng, X. L., Salomon, J. A., et al. (2010). Causes of deaths in children younger than 5 years in China in 2008. *The Lancet, 375*(9720), 1083-1089.

Salomon, J. A., & Murray, C. J. (2001). Compositional Models for Mortality by Age, Sex, and Cause. *Global Program on Evidence for Health Policy Discussion Paper, 11*, 596-607.

Schrag, S. J., Cutland, C. L., Zell, E. R., Kuwanda, L., Buchmann, E. J., Velaphi, S. C., et al. (2012). Risk factors for neonatal sepsis and perinatal death among infants enrolled in the prevention of perinatal sepsis trial, Soweto, South Africa. *The Pediatric infectious disease journal, 31*(8), 821-826.

Setel, P. W., Macfarlane, S. B., Szreter, S., Mikkelsen, L., Jha, P., Stout, S., et al. (2007). A scandal of invisibility: making everyone count by counting everyone. *The Lancet, 370*(9598), 1569-1577.

Setel, P. W., Sankoh, O., Rao, C., Velkoff, V. A., Mathers, C., Gonghuan, Y., et al. (2005). Sample registration of vital events with verbal autopsy: a renewed commitment to measuring and monitoring vital statistics. *Bulletin of the World Health Organization, 83*(8), 611-617.

Sjursen, I. H. (2011). Determinants of child mortality in Angola: An econometric analysis.

Stein, R. E. (2005). Children's Health, the Nation's Wealth: Assessing and Improving Child Health. *Ambulatory Pediatrics, 5*(3), 131-133.

Tang, S., Meng, Q., Chen, L., Bekedam, H., Evans, T., & Whitehead, M. (2008). Tackling the challenges to health equity in China. *The Lancet, 372*(9648), 1493-1501.

Task Force on Sudden Infant Death Syndrome. (2005). The changing concept of sudden infant death syndrome: diagnostic coding shifts, controversies regarding the sleeping environment, and new variables to consider in reducing risk. *Pediatrics, 116*(5), 1245-1255.

Theodoratou, E., Zhang, J., Kolcic, I., Davis, A. M., Bhopal, S., Nair, H., et al. (2011). Estimating pneumonia deaths of post-neonatal children in countries of low or no death certification in 2008. *PloS one, 6*(9), 22.

Thomsen, S., Hoa, D. T. P., Målqvist, M., Sanneving, L., Saxena, D., Tana, S., et al. (2011). Promoting equity to achieve maternal and child health. *Reproductive health matters, 19*(38), 176-182.

UNICEF. Basic indicators. Retrieved 02/12/2015, from http://www.unicef.org/infobycountry/stats_popup1.html

UNICEF. (2008). *The State of Asia-Pacific's Children, 2008: Child Survival*: UNICEF.

UNICEF. (2014a). Committing to Child Survival: A Promise Renewed, Progress Report 2014.

UNICEF. (2014b). What census data can tell us about children in China–Facts and Figures 2013, Beijing: UNICEF China.

UNICEF. (2015a). *Committing to Child Survival: A Promise Renewed, Progress Report 2015*.

UNICEF. (2015b). *For every child, a fair chance: the promise of equity*.

UNICEF. (2015c). Levels & trends in child mortality. Estimates developed by the UN inter-agency group for child mortality estimation. New York: UNICEF.

UNICEF, Organization, W. H., & Activities, U. N. F. f. P. (2006). *Joint review of the maternal and child survival strategy in China*: UNICEF.

United Nations. (2015a). THE GLOBAL STRATEGY FOR WOMEN'S, CHILDREN'S AND ADOLESCENTS' HEALTH (2016-2030).

United Nations. (2015b). Sustainable Development Goals. Retrieved 29/11/2015, from https://sustainabledevelopment.un.org/topics

United Nations Development Programme China. (2015). *china, the millennium development goals, and the post-2015 development agenda: Discussion paper*.

Van Look, P., Heggenhougen, K., & Quah, S. R. (2011). *Sexual and reproductive health: a public health perspective*: Academic Press.

Victora, C. G., Requejo, J. H., Barros, A. J., Berman, P., Bhutta, Z., Boerma, T., et al. (2015). Countdown to 2015: a decade of tracking progress for maternal, newborn, and child survival. *The Lancet, 25*, 26.

Waiswa, P., Kalter, H. D., Jakob, R., & Black, R. E. (2012). Increased use of social autopsy is needed to improve maternal, neonatal and child health programmes in low-income countries. *Bulletin of the World Health Organization, 90*(6), 403-403A.

Walker, C. L. F., Rudan, I., Liu, L., Nair, H., Theodoratou, E., Bhutta, Z. A., et al. (2013). Global burden of childhood pneumonia and diarrhoea. *The Lancet, 381*(9875), 1405-1416.

Wang, H., Liddell, C. A., Coates, M. M., Mooney, M. D., Levitz, C. E., Schumacher, A. E., et al. (2014). Global, regional, and national levels of neonatal, infant, and under-5 mortality during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet, 384*(9947), 957-979.

Wang, J.-B., Jiang, Y., Wei, W.-Q., Yang, G.-H., Qiao, Y.-L., & Boffetta, P. (2010). Estimation of cancer incidence and mortality attributable to smoking in China. *Cancer Causes & Control, 21*(6), 959-965.

Wang, L., & Jacoby, H. (2004). *Environmental determinants of child mortality in Rural China: A competing risks approach* (Vol. 3241): World Bank Publications.

Wang, S., Li, Y., Chi, G., Xiao, S., Ozanne-Smith, J., Stevenson, M., et al. (2008). Injury-related fatalities in China: an under-recognised public-health problem. *The Lancet, 372*(9651), 1765-1773.

WANG, Y.-m., & SHI, L.-l. (2012). Comparison among the Search Platforms of Wanfang Database, CNKI Database and VIP Database [J]. *Shanxi Library Journal, 6*, 006.

Wang, Y., He, C., Li, X., Miao, L., Zhu, J., & Liang, J. (2014). Nationwide study of injury-related deaths among children aged 1–4 years in China, 2000–2008. *Journal of paediatrics and child health, 50*(10), E94-E101.

Wang, Y., Li, X., Zhou, M., Luo, S., Liang, J., Liddell, C. A., et al. (2015). Under-5 mortality in 2851 Chinese counties, 1996–2012: a subnational assessment of achieving MDG 4 goals in China. *The Lancet*.

Wardlaw, T., You, D., Hug, L., Amouzou, A., & Newby, H. (2014). UNICEF Report: enormous progress in child survival but greater focus on newborns urgently needed. *Reprod Health, 11*(1), 82.

Way, C. (2015). The Millennium Development Goals Report 2015. *New York: United Nations*.

WHO, U., UN Population Division, World Bank. (2013). *Estimation method for child mortality Used in: Level and Trends of Child mortality -Report 2013*.

World Bank Group. (2015). *World development indicators 2015*: World Bank Publications.

World Health Organization. Global Health Observatory data repository. Retrieved 26/11/2015, from http://apps.who.int/gho/data/node.main.ghe300-by-country?lang=en

World Health Organization. (2004). *International statistical classification of diseases and related health problems* (Vol. 1): World Health Organization.

World Health Organization. (2005). The World health report: 2005: make every mother and child count.

World Health Organization. (2007). Standards for maternal and neonatal care.

World Health Organization. (2010). Birth defects: report by the Secretariat. *Sixty-(2) Third World Health Assembly A, 63*.

World Health Organization. (2011). Monitoring maternal, newborn and child health; understanding key progress indicators. *A report prepared by Countdown for Maternal, Newborn and Child Health, Health Metrics Network and WHO. Geneva: WHO*.

World Health Organization. (2012). Born too soon: the global action report on preterm birth.

World Health Organization. (2013a). Civil registration and vital statistics 2013: challenges, best practice and design principles for modern systems. *WHO/HMN, December*.

World Health Organization. (2013b). Civil Registration: Why Counting Births and Deaths is Important. *Fact Sheet*(324).

World Health Organization. (2013c). Strengthening civil registration and vital statistics for births, deaths and causes of death: resource kit.

World Health Organization. (2014a). Global Civil Registration and Vital Statistics: A Scaling Up Investment Plan 2015-2024.

World Health Organization. (2014b). *Improving Mortality Statistics through Civil Registration and Vital Statistics Systems: Strategies for country and partner support*.

World Health Organization. (2015a). Covering every birth and death: Improving civil registration and vital statistics (CRVS): Report of the technical discussions, New Delhi, 16–17 June 2014.

World Health Organization. (2015b). World health statistics 2015.

Xia, J., Wright, J., & Adams, C. E. (2008). Five large Chinese biomedical bibliographic databases: accessibility and coverage. *Health Information & Libraries Journal, 25*(1), 55-61.

Xiong, J., Hipgrave, D., Myklebust, K., Guo, S., Scherpbier, R. W., Tong, X., et al. (2013). Child health security in China: a survey of child health insurance coverage in diverse areas of the country. *Social Science & Medicine, 97*, 15-19.

Xu, T., Wang, H., Ye, H., Yu, R., Huang, X., Wang, D., et al. (2012). Impact of a nationwide training program for neonatal resuscitation in China. *Chin Med J (Engl), 125*(8), 1448-1456.

Yang, G., Hu, J., Rao, K. Q., Ma, J., Rao, C., & Lopez, A. D. (2005). Mortality registration and surveillance in China: history, current situation and challenges. *Popul Health Metr, 3*(3).

Yang, G., Kong, L., Zhao, W., Wan, X., Zhai, Y., Chen, L. C., et al. (2008). Emergence of chronic non-communicable diseases in China. *The Lancet, 372*(9650), 1697-1705.

Yang, L., Nong, Q.-Q., Li, C.-L., Feng, Q.-M., & Lo, S. K. (2007). Risk factors for childhood drowning in rural regions of a developing country: a case–control study. *Injury Prevention, 13*(3), 178-182.

Yang, L., Parkin, D. M., Li, L., & Chen, Y. (2003). Sources of information on the burden of cancer in China. *Asian Pacific Journal of Cancer Prevention, 4*(1), 23-30.

Yanqiu, G., Ronsmans, C., & Lin, A. (2009). Time trends and regional differences in maternal mortality in China from 2000 to 2005. *Bulletin of the World Health Organization, 87*(12), 913-920.

Yi, B., Wu, L., Liu, H., Fang, W., Hu, Y., & Wang, Y. (2011). Rural-urban differences of neonatal mortality in a poorly developed province of China. *BMC public health, 11*(1), 477.

Yip, W. C.-M., Hsiao, W. C., Chen, W., Hu, S., Ma, J., & Maynard, A. (2012). Early appraisal of China's huge and complex health-care reforms. *The Lancet, 379*(9818), 833-842.

You, D., Hug, L., Ejdemyr, S., Idele, P., Hogan, D., Mathers, C., et al. (2015). Global, regional, and national levels and trends in under-5 mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN

Inter-agency Group for Child Mortality Estimation. *The Lancet*.

Yu, L., Lin, X., Liu, H., Shi, J., Nong, Q., Tang, H., et al. (2015). Sex and Age Differences in Mortality in Southern China, 2004–2010. *International journal of environmental research and public health, 12*(7), 7886-7898.

Zeng, Y., Poston Jr, D. L., Vlosky, D. A., & Gu, D. (2008). *Healthy longevity in China: Demographic, socioeconomic, and psychological dimensions* (Vol. 20): Springer Science & Business Media.

Zhang, G., & Zhao, Z. (2005). *Searching for the answer for Chinas fertility puzzle: data collection and data use in the last two decades*.

Zhang, J. (2012). The impact of water quality on health: Evidence from the drinking water infrastructure program in rural China. *Journal of health economics, 31*(1), 122-134.

Zhang, K., & Wang, X. (2013). Maternal smoking and increased risk of sudden infant death syndrome: a meta-analysis. *Legal medicine, 15*(3), 115-121.

Zhao, J., Jow-Ching Tu, E., McMurray, C., & Sleigh, A. (2012). Rising mortality from injury in urban China: demographic burden, underlying causes and policy implications. *Bulletin of the World Health Organization, 90*(6), 461-467.

Zhao, Z., & Chen, W. (2011). China's far below-replacement fertility and its long-term impact: Comments on the preliminary results of the 2010 census. *Demographic Research, 25*(26), 819-836.

Zheng, X., Qian, H., Zhao, Y., Shen, H., Zhao, Z., Sun, Y., et al. (2013). Home risk factors for childhood pneumonia in Nanjing, China. *Chinese Science Bulletin, 58*(34), 4230-4236.

Zou, X. N., Wan, X., Dai, Z., & Yang, G. H. (2012). Epidemiological characteristics of cancer in elderly Chinese. *ISRN oncology, 2012*.

APPENDICS

Appendix Table 1 Child Death Report Card

Year: 20___

Card No.：Health Statistics 49

Enact Authority：Ministry of Health

Approval Authority：National Bureau of Statistics

Approval No.：National Statistics [2012]184

Period of validity：12/2014

__________District/County□□□□□□

□Re-made Card

No. □□□□□□□□	(b) Disease or Situation directly led to (a)__________
Address______Town(Area)_____Street(Village)______	(c) Disease or Situation directly led to (b)__________
Father's Name_________________________Mother's Name_____________	(d) Disease or Situation directly led to (c)_________
Child's Name_________ Tel_____________	Primary Death Cause________________________________
Census Register：(1)Local (2)Non-local: living for less 1 year (3)Non-local: living for 1 year and above □	Death Cause Code □□
	ICD-10 Code □□□□
Gender：1.Male 2.Female 3. Sexual Ambiguity □	Death Location：(1) Hospitals (2) On the Way (3) Home □
Birth Date (Year | Month | Day: □□ □□ □□)	Treatment Before Death：(1) In Hospital (2) Outpatient (3) No Treatment □
Birth Weight _______g (1)Measured (2)Estimated □	
Gestational Age_______weeks	Diagnostic level：(1) Provincial (Municipal)

Birth Location：

Provincial (Municipal) Hospitals

District (County) Hospitals

Street (Town) Health Centres

Village Clinics

On the Way

Home □

Death Date

Year		Month		Day	

Death Age ________Years______Months______Days Hours

Death Diagnosis:

(a) Disease or Situation directly led to death___________

(2) District (County)

(3) Street (Town)

(4) Village Clinics

(5) No Treatment □

Main Reason of No Treatment：(Single Selection)

(1) Financial Difficulty

(2) Traffic Inconvenience

(3) Too Late to Hospital

(4) Parents Thought Disease was not Serious

(5) Custom

(6)Other(Please Specify） □

Death Diagnosis Basis: (1) Pathologic Autopsy

(2) Clinical

(3) Estimated □

Report Institution___________ Report Staff____________ Report Date__________

Appendix Table 2 Child Death Cause Code

0l Dysentery	19 Birth asphyxia
02 Sepsis	20 Neonatal tetanus
03 Measles	2l Neonatal scleredema
04 Tuberculosis	22 Intracranial hemorrhage
05 Other infectious and parasitic diseases	23 Other neonatal diseases
06 Leukemia	24 Drowning
07 Other tumor	25 Traffic accident
08 Meningitis	26 Accidental asphyxia
09 Other neurological disease	27 Accidental poisoning
10 Pneumonia	28 Accidental fall
11 Other respiratory diseases	29 Other accidents
12 Diarrhea	30 Endocrine, nutritional and metabolic diseases
13 Other digestive diseases	31 Hematopoietic and hematopoietic organ diseases
14 Congenital heart disease	32 Circulation system disease
15 Neural tube defects	33 Urinary system disease
16 Down syndrome	34 Other
17 Other congenital abnormalities	35 Unclear diagnosis
18 Preterm or low birth weight	

Appendix Table 3 Cause variables in the data abstraction form

Field	Abbreviative variable	Definition
Dysentery	DYS	Dysentery infections, common symptoms are high fever, convulsions, coma, shock and bloody and purulent stool in late stage.
Sepsis	SEP	Severe bacterial infections mostly come from umbilical or skin infection. Most common symptoms are high fever, rash, abdominal distension, hepatosplenomegaly for children, hypothermia, milk refusal, pale or grey complexion, jaundice, and convulsions for newborns. Children die of septic shock, disseminated intravascular coagulation (DIC) and cardiopulmonary failure.
Measles	MES	Children have measles exposure history, Koplik's spots and related characteristic skin rash and die of complications such as measles pneumonia.
Tuberculosis	TB	Most are primary complex. Children normally die of tuberculous meningitis or miliary tuberculosis, some die of tuberculous pleurisy, caseous pneumonia or tuberculosis peritonitis.
Other infectious and parasitic diseases	OT-inf	All other notifiable infectious diseases except dysentery, sepsis, measles and tuberculosis, such as diphtheria, epidemic cerebrospinal meningitis, whooping cough, scarlet fever, typhoid and paratyphoid fevers, viral hepatitis, poliomyelitis, Japanese encephalitis, typhus, relapsing fever, kala-azar, Tick-Borne encephalitis, rabies, scrub typhus, hemorrhagic fever, leptospirosis, brucellosis, anthrax, malaria and schistosomiasis, etc.
All infectious and parasitic diseases	ALL-inf	Total deaths because of the above infectious and parasitic diseases.
Leukemia	LKM	Malignant proliferation of white blood cells in bone marrow and other hematopoietic organs, resulting in a large number of immature white blood cells and released into the surrounding bloodstream. Most common symptoms are high fever, bleeding

		tendency, lymphadenectasis, hepatosplenomegaly, severe anemia. Children normally die of infections, intracranial bleeding, etc.
Other tumor	OT-tm	All other malignancies except leukemia, such as lymphosarcoma, Hodgkin's disease, brain tumors, etc.
All tumor	ALL-tm	Total deaths because of the above tumors.
Meningitis	MENI	Suppurative meningitis (not epidemic meningitis or tuberculous meningitis). Most common symptoms are fever, vomiting, convulsions, even coma, and infection lesions such as skin purulent lesions, otitis media, etc. Children normally die of cerebral hernia and systemic failure.
Other neurological disease	OT-neu	Acute infectious multiple nerve root inflammation (Guillain-Barre syndrome), status epilepticus, cerebral palsy, brain abscess, etc.
All neurological disease	ALL-neu	Total deaths because of the above neurological diseases.
Pneumonia	PN	Including bronchial pneumonia, bronchiolitis, lobar pneumonia and neonatal pneumonia. Most common symptoms are fever, cough, dyspnea, nasal ala flap, three concave sign, medium and fine bubbling rales in lung, and shadows on chest X-ray. For neonates, the symptoms are note very obvious, common symptoms are: foaming at the mouth, low response, milk refusal, hypothermia; fever, cough are not obvious, no moist rale in lung. Children normally die of heart failure, respiratory failure and toxic encephalopathy.
Other respiratory diseases	OT-res	Including asthma (mainly referring to status asthmaticus), empyema, pneumothorax, lung abscess, idiopathic fibrosing alveolitis and bronchiectasis.
All respiratory diseases	ALL-res	Total deaths because of the above respiratory diseases.
Diarrhea	DI	Including infectious and non- infectious diarrhea, common infectious diarrhea include bacterial diarrhea (escherichia coli and staphylococcus aureus) and viral enteritis (mainly rotavirus enteritis). Children with severe diarrhea normally die of

		dehydration, electrolyte imbalance and circulatory failure.
Other digestive diseases	OT-dig	Including gastric and duodenal ulcer, acute appendicitis, peritonitis, intestinal obstruction and intussusception.
All digestive diseases	ALL-dig	Total deaths because of the above respiratory diseases.
Congenital heart disease	CGH	Including a variety of congenital cardiovascular malformations, both cyanotic and non- cyanotic. Most common are patent ductus arteriosus, atrial septal defect, ventricular septal defect and tetralogy of fallot, etc.
Neural tube defects	NTD	Including spina bifida, encephalocele, anencephaly, etc.
Down syndrome	DS	Children with features of upward slanting eyes, wide eye span, flat nasal bridge, half-open mouth with a protruding tongue, mental deficiency and soft bending limbs.
Other congenital abnormalities	OT-CA	All other congenital abnormalities except congenital heart disease neural tube defects and Down syndrome, such as cleft lip and palate, aproctia, limb deformity, esophageal atresia, etc.
All congenital abnormalities	ALL-CA	Total deaths because of the above congenital abnormalities.
Preterm or low birth weight	PB	Preterm birth refers to the birth of a baby after 28 weeks but before 37 weeks (196-258 days) gestational age. Low birth weight is a birth weight of a liveborn infant of less than 2,500g measured within 1 hour after birth.
Birth asphyxia	BA	Including asphyxia during delivery or intrauterine asphyxia, the symptoms are dyspnea, cyanosis or pale, weak cry even groan, hypothermia or convulsions after rescue. It often occurs in situations where mothers with pregnancy-induced hypertension, prolong labour, umbilical cord around the neck, etc. Newborns born without the four main vital signs (body temperature, blood pressure, pulse/heart rate, and breathing rate) are stillborn, not birth asphyxia.
Neonatal tetanus	NT	Caused by traditional delivery methods or unstrict disinfection, incubation period is four to six days. Features are: lock-jaw, sardonic facies, opisthotonus, repeated convulsions, more severe

		convulsions after stimulation. Children normally die of asphyxia caused by convulsions or secondary infections.
Neonatal scleredema	NS	Often occur among preterm, low-birth weight and illness newborns in winter or cold season. Common symptoms are hypothermia, no eating, less move, less crying, slow shallow breathing, hard, cold, red, swollen and bright skin with locations of lower limbs→haunch→trunk→face. Children normally die of asphyxia caused by complicated with pneumonia, septicemia, pulmonary hemorrhage or systemic failure.
Intracranial haemorrhage	IH	Children have hypoxia history such as birth trauma, dystocia or birth asphyxia, and common neurological symptoms: straight eye expression or staring, sharp cry or np cry, cerebral cry vomiting, and even convulsions, coma. Physical signs are mainly bregmatic eminence, increased or reduced muscle tension, diminished or disappeared primitive reflexes. Children in late stage have respiratory failure symptoms such as apnea, superficial, uneven or double respiration, jaw breathing, etc.
Other neonatal diseases	OT-neo	Including neonatal hemolytic diseases (ABO hemolysis, Rh hemolytic), neonatal natural bleeding, hyaline membrane disease (neonatal respiratory distress syndrome), etc.
All neonatal diseases	ALL-neo	Total deaths because of the above neonatal diseases.
Drowning	DW	Swimming drowning or falling into the water.
Traffic accident	TA	Accidents by trains, cars, trucks, other vehicles and aircraft, ships etc.
Accidental asphyxia	AA	Smothered by quilt, accidentally crushed by mother when she turned over, suffocated with mother's nipple in mouth, or abnormal-objects in trachea, etc.
Accidental poisoning	AP	Poisoned from drugs, poisons (DDT, pesticides), gas and food.
Accidental fall	AF	Fall from a height (buildings, balconies, cliff and trees).
Other accidents	OT-acc	All other injuries or violence except drowning, Traffic accident, accidental asphyxia, accidental poisoning and accidental fall, such as electrocution, death by stoned, hacked, bited, burned, gun shot, infanticide by drowning, abandonment, etc.
All accidents	ALL-acc	Total deaths because of the above accidents.

Endocrine, nutritional and metabolic diseases	ENM	Such as diabetes mellitus, diabetes insipidus, galactosemia, phenylketonuria, malnutrition and severe nutritional deficiencies, etc.
Hematopoietic and hematopoietic organ diseases	HHO	Such as anemia, hemolytic disease, aplastic anemia, thrombocytopenic purpura and hemophilia, etc.
Circulation system disease	CSD	Such as rheumatic heart disease, myocarditis, pericarditis and Keshan disease, etc.
Urinary system disease	USD	Such as acute glomerulonephritis and nephrotic syndrome, etc.
Other	OT	All other causes with a clear diagnosis, but does not belong to the above 33 cause classifications.
Unclear diagnosis	UCD	Deaths without medical-seeking before death or a clear diagnosis, and couldn't be inferred by verbal autopsy.

*Note: death cause definitions come from the "National Maternal and Child Health Surveillance work manual"(Department of Maternal and Child Health, 2013).

Appendix Table 4 level-one ethical self-assessment

NEANERY OF MOLECULAR, GENETIC AND POPULATION HEALTH SCIENCES
ETHICS IN RESEARCH COMMITTEE
ETHICS (SELF) ASSESSMENT FORM: LEVEL ONE

Level One Ethics (Self) assessment is normally to be carried out by the Principal Investigator. For Honours and taught Masters students this is done by the dissertation supervisor on behalf of the programme manager. For MTh/MSC by research and PhD students the assessment is carried out by the first supervisor. For Post-doctoral Fellows this is done in collaboration with the mentor who is responsible for confirming that it has been carried out.

Title of Project: Causes of death in children younger than 5 years in China in 2015: an updated analysis

Funding Body (if applicable):

Principal Invest./ Supervisor/ Prog. Manager name: Kit Yee Chan

Student name and matriculation Number: Peige Song (s1427656)

Type of student:	**PhD**	**Masters by Research** √
	Taught Masters	**Honours**

Protection of research subject confidentiality

Are there any issues of confidentiality which are not adequately handled by the normal tenets of ethical academic research?

NO √ **YES**

If yes, Level Two Ethics review required

These include mutually understood agreements about:

- Non attribution of individual responses
- Individuals and organisations being anonymised in publications and presentations, if requested
- Feedback to collaborators, rights to edit responses, and intellectual property rights and publication

Data protection and Consent

Are issues of data handling and consent dealt with adequately and following procedures?

NO **YES** √

If No, Level Two Ethics review required

For example:

- Will respondents consent be sought regarding the collection of personal data?
- Are there special issues about informed consent or confidentiality in this case?
- Is the research compliant with UOE procedures (www.recordsmanagment.ed.ac.uk)

Moral Issues and Researcher/Institutional Conflicts of Interest

Do any special moral issues/conflicts of interest arise?

NO √ **YES**

If yes, Level Two Ethics review required

For example:

- Might the researcher compromise the research objectivity or independence in return for financial or non-financial benefit for her/himself or for a relative or friend?
- Are there particular moral issues or concerns that may arise, for example where the purposes of the research are concealed, where respondents are unable to provide informed consent or where research findings impinge negatively or differentially upon the interests of participants?
- Does the research involve vulnerable persons such as children, institutionalised persons or others entitled to protection and special procedures to protect their interests?

Potential physical or psychological harm, discomfort, or stress

Is there significant foreseeable potential for psychological harm or stress for those involved in your research? **YES** **NO** √

Is there significant foreseeable potential for physical harm or stress for those involved in your research? **YES** **NO** √

Is there significant foreseeable risk to the researcher? **YES** **NO** √

If YES to any section, Level Two Ethics Review required

OVERALL ASSESSMENT

SELF AUDIT HAS BEEN CONDUCTED?	**YES** √	**NO**
Were any risks identified?	**YES**	**NO** √
Is Level Two Ethics Assessment required?	**YES**	**NO** √

Signature of Applicant: Date: 8th October 2015

Appendix Table 5 Full list of publications that retained for model constructing

ID	Studies published in Chinese (N=286)
C1	Bu-Han Buer, Yu-Mei Sun, et al. 布尔布汗,孙玉梅,等 (2009). An analysis of deaths of children under 5 years old in Aletai area in 2006* (2006年阿勒泰地区5岁以下儿童死亡情况分析). Endemic Disease Bulletin (地方病通报). 24(2): 49-51
C2	Jun Chen, Hong Deng, et al. 陈军,邓虹,等 (2009). Death monitoring and countermeasures of children under 5 years old in Anqing city* (安庆市5岁以下儿童死亡监测与干预措施). Strait J Prev Med (海峡预防医学杂志). 15(5): 24-25
C3	Yan-Chun Chen, Cui-Ping Li, et al. 陈艳春,李翠平,等 (2009). The results of death monitoring of children under 5 years old in Chengde city from 2001 to 2007* (2001-2007年承德市5岁以下儿童死亡监测结果). Practical Preventive Medicine (实用预防医学). 16(1): 179-180
C4	Ming Fang 方明 (2009). Analysis and countermeasures of the results of monitoring death of children under 5 years old in Wujin district* (武进区5岁以下儿童死亡监测结果分析及干预措施). Jiangsu Health Care (江苏卫生保健). 11(3): 41-42
C5	Ju-Ai Gu, Zhi-Qin Wang, et al. 谷聚爱,王志芹,等 (2009). Analysis and interventions of death investigation on children under 5 years old in Zanhuang county from 2004 to 2008* (赞皇县2004～2008年5岁以下儿童死亡状况调查分析及干预措施). Clinical Misdiagnosis & Mistherapy (临床误诊误治). 22(10): 90-91
C6	Yu-Jing Gu 顾宇静 (2009). An analysis of monitoring deaths of floating children under 5 years old in Wuxi city, China from 2006 to 2008* (无锡市2006～2008年5岁以下流动家庭儿童死亡监测分析). China Prac Med (中国实用医药). 4(29): 258-259
C7	Rong-Rong Huang 黄容荣 (2009). An analysis of monitoring deaths of children under 5 years old in Guigang city, China from 2002 to 2007* (2002～2007年贵港市5岁以下儿童死亡监测结果分析). Maternal & Child Health Care of China (中国妇幼保健). 24(18): 2530-2531
C8	Su Huang 黄素 (2009). An analysis of monitoring deaths of children under 5 years old in Yuyao city, China from 2004 to 2008* (2004年～2008年余姚市五岁以下儿童死亡监测分析). Chinese Journal of Birth Health & Heredity (中国优生与遗传杂志). 17(12): 117-121
C9	Xiao-Li Huang 黄小利 (2009). Investigation on deaths of children under 5 years old in Mei county from 1999 to 2006* (梅县1999-2006年5岁以下儿童死亡情况的调查). IMHGN (国际医药卫生导报). 15(3): 103-104

C10	Chi-Xiao Jiang 姜赤晓 (2009). Analysis of death situation of children under five years old in Yingshan county during 2001-2005 (英山县 2001～2005 年五岁以下儿童死亡情况分析). Clinical Medical Engineering (临床医学工程). 16(5): 60-61
C11	Hua Jiang, Li-Na Ma 姜华,马丽娜 (2009). An analysis of deaths of children under 5 years old in Changchun city from 2006 to 2008* (长春市 2006-2008 年 5 岁以下儿童死亡分析). Practical Preventive Medicine (实用预防医学). 16(6): 1864-1865
C12	Ping Lei 雷平 (2009). An analysis of death causes of children under 5 years old in Haidong area from 2004 to 2007* (海东地区 2004 年—2007 年 5 岁以下儿童死亡原因分析). Qinghai Medical Journal (青海医药杂志). 39(3): 70-72
C13	Gang-Ling Li, Hui-Ping Li 李刚玲,李惠萍 (2009). An analysis of deaths of children under 5 years old in Yanqi county, Xinjiang province in last decade* (新疆巴州焉耆县 0～4 岁儿童 10 年死亡情况分析). Chinese Community Doctors (中国社区医师). 11(15): 250
C14	Jing-Jing Li, Jian-Ping Guo, et al. 李晶晶,郭建平,等 (2009). An analysis of monitoring deaths of children under 5 years old in Huailai county, Hebei province from 2000 to 2007* (2000～2007 年河北怀来县 5 岁以下儿童死亡监测分析). Maternal & Child Health Care of China (中国妇幼保健). 24(12): 1658-1659
C15	Zi-Mei Li, Yi Zhao 李自梅,赵一 (2009). An analysis of death monitoring result of children under 5 years old in Puer city, China from 2000 to 2006* (普洱市 2000～2006 年 5 岁以下儿童死亡监测结果分析). Maternal & Child Health Care of China (中国妇幼保健). 24(10): 1323-1324
C16	Yao Lin 林尧 (2009). Monitoring analysis of children death under 5 years old from 2000 to 2008 in Haikou (海口市 2000～2008 年 5 岁以下儿童死亡监测分析). Journal of Hainan Medical College (海南医学院学报). 15(11): 1462-1464
C17	Jin-Zhuang Liu 刘金庄 (2009). Analysis and interventions of death causes of children under 5 years old in Zhuanghe city, China* (庄河市 5 岁以下儿童死亡原因分析及干预措施). China Healthcare Frontiers (中国医疗前沿). 4(21): 124-125
C18	Yan Liu 刘燕 (2009). An analysis of deaths of children under 5 years old in Changsha city from 2005 to 2008* (长沙市 2005-2008 年度 5 岁以下儿童死亡分析). Practical Preventive Medicine (实用预防医学). 16(6): 1863-1864
C19	Yi-Xin Liu, Yan Lin, et al. 刘一心,林艳,等 (2009). Analysis of under 5 years old children mortality and leading death cause in Shenzhen from 2003 to 2007 (深圳市 2003～2007 年 5 岁以下儿童死亡监

	测结果分析). Morden Preventive Medicine (现代预防医学). 39(9): 1636-1638
C20	Yu-Hua Liu, Jian-Hong Yang 刘玉华,杨建红 (2009). An analysis of death causes of children under 5 years old in Yuanzhou district from 2003 to 2007* (袁州区 2003-2007 年 5 岁以下儿童死因分析). Journal of Yichun College (宜春学院学报). 31(4): 85-86
C21	Zheng-Mei Liu 刘正梅 (2009). An analysis of deaths of children under 5 years old in Linan city, China from 1999 to 2008* (临安市 1999-2008 年 5 岁以下儿童死亡情况分析). Chin Prev Med (中国预防医学杂志). 10(6): 509-511
C22	Li-Min Lu, Hong-Feng Liu, et al. 卢利民,刘洪峰,等 (2009). An analysis of deaths of children under 5 years old in Qinhuangdao city, China from 2004 to 2008* (秦皇岛市 2004～2008 年 5 岁以下儿童死亡结果分析). Maternal & Child Health Care of China (中国妇幼保健). 24(20): 2823-2824
C23	Sai-Mai-Ti Mayinuer 玛依努尔·赛买提 (2009). An analysis of death causes of children under 5 years old in Aketao county, China from 2004 to 2008* (阿克陶县 2004～2008 年 5 岁以下儿童死亡原因分析). China Morden Doctor (中国现代医生). 47(19): 126-128
C24	Qing-Mei Peng, Zhi Yang 彭青梅,杨智 (2009). An analysis of death causes of children under 5 years old in Binhai county from 2004 to 2008* (2004 年～2008 年滨海县 5 岁以下儿童死因分析). Jiangsu J Prev Med (江苏预防医学). 20(3): 66-67
C25	Qing-Ling Shi 石青玲 (2009). An analysis of death causes of children under 5 years old in Pingan county from 2001 to 2005* (平安县 2001 年～2005 年 5 岁以下儿童死因分析). Chinese Journal of Rural Medicine (中国农村医学杂志). 17(2): 60-61
C26	Xin-Yue Sun 孙新岳 (2009). An analysis and interventions of death causes of children under five years old in Donghai county from 2004 to 2008* (东海县 2004～2008 年 5 岁以下儿童死因分析及干预). Medical Information (医学信息（下旬刊）). 1(12): 277-278
C27	Dong-Hui Wang, Xi-Lian Mi, et al. 王东辉,密希连,等 (2009). Analysis and countermeasures of deaths of children under 5 years old in Akesu city from 2004 to 2008* (2004～2008 年阿克苏市 5 岁以下儿童死亡分析及对策). Endemic Disease Bulletin (地方病通报). 24(4): 39-40
C28	Gong-Liao Wang, Mei-Xin Pan, et al. 王功僚,潘美馨,等 (2009). An analysis of monitoring results of neonatal deaths in Baise city, Guangxi province from 2005 to2007* (广西省百色市 2005 年至 2007 年新生儿死亡监测结果分析). Chin J Perinat Med (中华围产医学杂志). 12(1): 53-54
C29	Hua Wang, Juan-Juan Wu 王华,吴娟娟 (2009). An analysis of deaths of children under 5 years old in Qidong city, China* (启东市 5 岁以下儿童死亡分析). Maternal & Child Health Care of China (中国

	妇幼保健). 24(18): 2534-2536
C30	Ling-Qin Wang 王玲勤 (2009). An analysis of deaths of children under 5 years old in Danzhou city in 2005 and 2006* (儋州市2005年与2006年5岁以下儿童死亡情况分析). Maternal & Child Health Care of China (中国妇幼保健). 24(24): 3382-3383
C31	Pei-Ying Wang, Hai-Ju Jin 王佩英,金海菊 (2009). An analysis of deaths of children under 5 years old in Jingning county, China from 2000 to 2007* (景宁县2000-2007年5岁以下儿童死亡分析). Chinese Rural Health Service Administration (中国农村卫生事业管理). 29(3): 235-236
C32	Yin-Xue Wang, Jin-Lian Huang, et al. 王银雪,黄金莲,等 (2009). An analysis of death causes of children under 5 years old in Yongkang city, China from 2003 to 2007* (永康市2003—2007年5岁以下儿童死亡原因分析). Chinese Rural Health Service Administration (中国农村卫生事业管理). 29(4): 314-316
C33	Zhu Wang, Cai-Hong Zhao 王铸,赵彩红 (2009). An analysis of death causes of children under 5 years old in Yongding district, Zhangjiajie city from 2000 and 2006* (张家界市永定区2000～2006年5岁以下儿童死亡原因分析). Maternal & Child Health Care of China (中国妇幼保健). 24(25): 3490-3491
C34	Zi-Heng Wang 王子恒 (2009). An analysis of the results of monitoring death causes of children under 5 years old in Changning county, Yunnan province from 2004 to 2008* (云南省昌宁县2004～2008年5岁以下儿童死因监测结果分析). Chin Pediatr Integr Tradit West Med (中国中西医结合儿科学). 1(6): 567-570
C35	Xiu-Ju Wei, Ying-Jie Wu, et al. 魏秀菊,武英杰,等 (2009). An analysis of deaths of children under 5 years old in Erqi diatrict, Zhengzhou city from 2005 to 2007* (2005至2007年郑州市二七区5岁以下儿童死亡分析). Journal of Zhengzhou University (Medical Sciences) (郑州大学学报). 44(5): 1065-1067
C36	Deng-Kang Wu 吴登康 (2009). An analysis of deaths of children under 5 years old in Jiangyin county, China from 2003 to 2006* (汉阴县2003～2006年5岁以下儿童死亡分析). Chinese Community Doctors (中国社区医师). 11(16): 250
C37	Chun-Liu Yang, Xiang-Hong Chen 杨春柳,陈湘红 (2009). An analysis of neonatal death in Zhuzhou area, China from 2004 to 2008* (株洲地区2004—2008年新生儿死亡情况分析). Chinese Journal of Neonatology (中国新生儿科杂志). 24(6): 362-364
C38	Chun-Liu Yang, Bo Liu 杨春柳,刘波 (2009). An analysis of deaths of children under 5 years old in

	Zhuzhou area from 2004 to 2008* (株洲地区 2004-2008 年 5 岁以下儿童死亡情况分析). Practical Preventive Medicine (实用预防医学). 16(4): 1170-1171
C39	Jun Yang 杨军 (2009). An analysis of neonatal deaths in Dongchuan district from 2001 to 2005* (东川区 2001 年～2005 年新生儿死亡情况分析). Soft Science of Health (卫生软科学). 23(1): 86-87
C40	Xiu-Hua Yu 于秀华 (2009). A longitudinal analysis and countermeasures of deaths of children under 5 years old* (5 岁以下儿童死亡纵向分析及对策). World Health Digest (中外健康文摘). 8(3): 35
C41	De-Jun Zhang 张德军 (2009). An analysis of death causes of children under 5 years old in Langzhong city, China from 2000 and 2006* (阆中市 2000～2006 年 5 岁以下儿童死亡原因分析). Maternal & Child Health Care of China (中国妇幼保健). 24(25): 3485-3487
C42	Li-Zhi Zhang, Jie Long, et al. 张利之,龙捷,等 (2009). An analysis of death tendency of children under 5 years old in Zhuzhou city, China from 2003 to 2007* (株洲市 2003～2007 年 5 岁以下儿童死亡趋势分析). China Morden Doctor (中国现代医生). 47(13): 56-57
C43	Su-Lan Zhang 张素兰 (2009). An analysis of monitoring deaths of children under 5 years old in urban areas of Changzhi city from 2001 and 2006* (长治市城区 2001～2006 年 5 岁以下儿童死亡监测分析). Maternal & Child Health Care of China (中国妇幼保健). 24(10): 1451-1452
C44	Zhu-Yun Zhang, Ju-Hua Chen 章珠云,陈菊花 (2009). An analysis of monitoring deaths of children under 5 years old in Songyang county, China from 1996 and 2007* (松阳县 1996～2007 年 5 岁以下儿童死亡监测分析). Maternal & Child Health Care of China (中国妇幼保健). 24(9): 1232-1233
C45	Jun-Ya Zhao, Jian-Yong Tong, et al. 赵俊雅,童建勇,等 (2009). An analysis of death causes of children under 5 years old in Haidian district, Beijing from 2005 to 2008* (2005～2008 年北京市海淀区 5 岁以下儿童死因分析). Captial Journal of Public Health (首都公共卫生). 3(6): 282-284
C46	Xin Zhao 赵昕 (2009). An analysis of the death causes of children under 5 years old in Liaoyang city, Liaoning province in 2007* (辽宁省辽阳市 2007 年 5 岁以下儿童死亡原因分析). Chin Pediatr Integr Tradit West Med (中国中西医结合儿科学). 1(3): 279-280
C47	Ying-Xia Zhu, Jie Chen, et al. 朱映霞,陈婕,等 (2009). An analysis of deaths of children under 5 years old in Wenzhou city, China* (温州市 5 岁以下儿童死亡情况分析). Zhejiang Prev Med (浙江预防医学). 21(10): 67-68
C48	Wu-Lian Cao 曹务莲 (2010). Analysis and interventions of monitoring deaths of children under 5 years old in Huaihua city in 2008* (怀化市 2008 年 0～4 岁儿童死亡监测分析及干预措施探讨). Maternal & Child Health Care of China (中国妇幼保健). 25(7): 932-934

C49	Jian-Wu Zeng, Yun Feng 曾建武,冯云 (2010). Current situation and outlook of deaths of children under five years old in Xiangtan city* (湘潭市 5 岁以下儿童死亡现状与思考). Medical Information (医学信息（下旬刊）). 23(11): 329-330
C50	Hong-Nan Qiu 仇红楠 (2010). An analysis of death causes of children under 5 years old in Tongzhou city, China* (通州市 5 岁以下儿童死因分析). Maternal & Child Health Care of China (中国妇幼保健). 25(8): 1111-1112
C51	Feng-Ming Deng 邓凤鸣 (2010). Rongxian 2007~2009 results of monitoring of child deaths (荣县 2007～2009 年儿童死亡监测结果分析). Journal of Clinical and Experimental Medicine (临床和实验医学杂志). 9(20): 1547-1548
C52	Xiao-Min Dou, Chao Zhang 豆筱敏,张超 (2010). Analysis of the mortality in children under 5 of puyang city from 2003~2007 (濮阳市 2003～2007 年 5 岁以下儿童死亡监测结果分析). China Clin Prac Med (中国临床实用医学). 4(8): 252-253
C53	Jian-Ping Gao, Wei-Na He 高建平,贺伟娜 (2010). Tendency analysis and countermeasures of monitoring deaths of children under 5 years old in Hami area from 2003 to 2008* (2003～2008 年哈密地区 5 岁以下儿童死亡监测变化趋势及干预措施分析). Xinjiang Medical Journal (新疆医学). 40(2): 134-135
C54	Qiong-Ying Guo, Yun-Fei Zhang, et al. 郭琼英,张云飞,等 (2010). An analysis of monitoring deaths of children under 5 years old in Chengjiang city from 1999 to 2008* (澂江县 1999 年～2008 年 5 岁以下儿童死亡监测分析). Soft Science of Health (卫生软科学). 24(1): 65-67
C55	Yan Guo, Li-Zhen Kuang, et al. 郭艳,邝丽贞,等 (2010). Analysis of mortality surveillance of children aged under 5 years during 2006~2008 in Nanhai district of Foshan city (2006 年至 2008 年佛山市南海区 5 岁以下儿童死亡监测分析). Journal of Zhengzhou University (Medical Sciences) (郑州大学学报). 45(4): 638-640
C56	Yan-Ning He, Yue-Xia Zhu, et al. 贺艳宁,朱月霞,等 (2010). An analysis of death causes of children under 5 years old in Jinfeng district from 2004 to 2008* (金凤区 2004-2008 年 5 岁以下儿童死亡原因分析). Ningxia Med J (宁夏医学杂志). 32(2): 190-191
C57	Run-Jiang Huang 黄润江 (2010). An analysis of monitoring deaths of children under 5 years old in Mojiang county, China from 1995 to 2005* (墨江县 1995～2005 年 5 岁以下儿童死亡监测结果分析). China Morden Doctor (中国现代医生). 48(4): 118-120
C58	Li-Qin Jia 贾丽琴 (2010). An analysis of deaths of children under 5 years old in Menghai county*

	(勐海县五岁以下儿童死亡情况分析). Medicine and Pharmacy of Yunnan (云南医药). 31(4): 477-479
C59	Wen Jing, Bao-Zhu Gao 敬雯, 高宝珠 (2010). To analyze the agents of the 334 death of neonatus from 2005 to 2009 in Xinjiang Formation corps (新疆生产建设兵团 2005—2009 年 334 例新生儿死亡原因分析). Chinese Primary Health Care (中国初级卫生保健). 24(9): 26-27
C60	Bing Liu, Liu Yang, et al. 刘冰,杨柳,等 (2010). An analysis of deaths of floating children under 5 years old in Shenyang city, China* (沈阳市流动人口 5 岁以下儿童死亡状况调查). Maternal & Child Health Care of China (中国妇幼保健). 25(9): 1231-1233
C61	Wen-Huang Liu 刘文煌 (2010). An analysis of deaths of children under 5 years old in Zhangzhou city, China from 2003 to 2007* (漳州市 2003～2007 年 5 岁以下儿童死亡分析). Maternal & Child Health Care of China (中国妇幼保健). 25(5): 642-643
C62	Xue-Li Liu, Jin-Shou Yang 刘学莉,杨进寿 (2010). Analysis of cause of death of children under 5 years in Qinghai (青海省 5 岁以下儿童死因分析). Morden Preventive Medicine (现代预防医学). 37(19): 3637-3638
C63	Ming-Lu Ma 马明录 (2010). An analysis of deaths of children under 5 years old in Longde county, China from 2000 to 2007* (2000～2007 年隆德县 5 岁以下儿童死亡情况分析). Maternal & Child Health Care of China (中国妇幼保健). 25(4): 503-504
C64	Bin Pu, Xiu-Lian Xu, et al. 蒲斌,徐秀莲,等 (2010). Analysis of mortality status of children under 5 years in Kunming from 2000 to 2007 (昆明市 2000—2007 年 5 岁以下儿童死亡状况分析). CJCHC (中国儿童保健杂志). 18(6): 521-524
C65	Jing-Hua Quan 全京花 (2010). An analysis of death review result of children under 5 years old in Yanbian monitoring points, China from 2005 to 2009* (延边州监测点 2005—2009 年 5 岁以下儿童死亡评审结果分析). CJCHC (中国儿童保健杂志). 18(7): 624-625
C66	Yu-Ying Shen 申玉英 (2010). An analysis of death causes of children under 5 years old in Huzhu county, China from 2000 to 2006* (互助县 2000～2006 年度 5 岁以下儿童死亡原因分析). Maternal & Child Health Care of China (中国妇幼保健). 25(22): 3131-3133
C67	Hua-Ming Shi 石华明 (2010). Analysis of the changes of 0-5 year-old children death in Tibetan Autonomous Prefecture of Gannan of Gansu province in the past 10 years (甘肃省甘南藏族自治州 0～5 岁儿童死亡近 10 年变化分析). Chinese Journal of Healthy Birth & Child Care (中国优生优育). 16(6): 291-293

C68	Ru-Xin Shu 舒如新 (2010). An analysis of deaths of children under 5 years old in Jinyun county, China in last decade* (缙云县 10 年 5 岁以下儿童死亡分析). Chinese Rural Health Service Administration (中国农村卫生事业管理). 30(6): 485-486
C69	Li-Ping Sun, Xiang-Mei Zhu 孙丽萍,祝香梅 (2010). Investigation on death results of children under 5 years old in Qibin district from 2000 to 2009* (2000-2009 年淇滨区 5 岁以下儿童死亡结果调查). Chronic Pathematology Journal (慢性病学杂志). 12(10): 1365-1366
C70	Su-Juan Sun 孙素娟 (2010). An analysis of death monitoring of children under 5 years old in Jianping county from 2005 to 2009* (2005-2009 年建平县 5 岁以下儿童死亡监测分析). Jiangsu Health Care (江苏卫生保健). 12(3): 39-40
C71	Chen-Fen Tang 唐晨芬 (2010). An analysis of the death monitoring results of children under 5 years old in Quanzhou county, China from 2001 to 2008* (全州县 2001～2008 年 5 岁以下儿童死亡监测结果分析). Medical Innovation of China (中国医学创新). 7(8): 49-50
C72	Mi-Zhen Wang 汪咪珍 (2010). An analysis of death causes of children under 5 years old in Cixi city, China from 1991 to 2008* (慈溪市 1991-2008 年 5 岁以下儿童死因分析). Zhejiang Prev Med (浙江预防医学). 122(2): 66-67
C73	En-Xia Wang, Xia Dong, et al. 王恩霞,董霞,等 (2010). An analysis of death causes of children under 5 years old in Zhangqiu city, China from 2000 to 2009* (章丘市 2000～2009 年 5 岁以下儿童死因分析). Chin J Mod Drug Appl (中国现代药物应用). 4(20): 260
C74	Li Wang 王莉 (2010). An analysis of deaths of children under 5 years old in Jiyuan city* (济源市 5 岁以下儿童死亡分析). J Med Theor & Prac (医学理论与实践). 23(3): 372
C75	Wei Wang, Xi-Lian Ni, et al. 王巍,倪锡莲,等 (2010). An analysis of death monitoring result of children under 5 years old in Jilin province, China from 1999 to 2008* (1999—2008 年吉林省 5 岁以下儿童死亡监测结果分析). CJCHC (中国儿童保健杂志). 18(3): 250-252
C76	Yi-Han Wang 王乙涵 (2010). An analysis of deaths of children under 5 years old in Chuanying district, Jilin city, China from 1999 to 2008* (吉林市船营区 1999 年至 2008 年 5 岁以下儿童死亡分析). China Foreign Medical Treatment (中外医疗). (28): 48-49
C77	Hong Xu 徐红 (2010). An analysis of deaths of children under 5 years old in Jilin city, China from 2001 to 2009* (2001～2009 年吉林市 5 岁以下儿童死亡分析). Chin J Mod Drug Appl (中国现代药物应用). 4(21): 245-246
C78	Mei-Fen Ye 叶美芬 (2010). An analysis of death causes of children under 5 years old in Longquan

	city from 2004 to 2008* (龙泉市 2004—2008 年 5 岁以下儿童死因分析). Shanghai Journal of Preventive Medicine (上海预防医学). 22(2): 117-118
C79	Jun-Lan Zhang, Kui-Shan Ma 张俊兰,马奎山 (2010). Analysis and countermeasures of death causes of children under 5 years old* (5 岁以下儿童死因分析及对策). Maternal & Child Health Care of China (中国妇幼保健). 25(28): 4064-4065
C80	Ling-Li Zhang 张伶俐 (2010). Analysis on Death Surveillanee for Children Under 5 Yeasr Old from 2004-2009 in Hunan province (湖南省 2004～2009 年 5 岁以下儿童死亡监测分析). Central South University (中南大学). ():
C81	Yu-Chi Zhang 张宇驰 (2010). Analysis of mortality trends of children under age of five in some country from 2006 to 2009 (某县 2006～2009 年 5 岁以下儿童死亡变化趋势分析). China Prac Med (中国实用医药). 5(34): 237-238
C82	Ya-Ping Zhao, Qin Li, et al. 赵亚萍,李勤,等 (2010). An analysis of deaths of children under 5 years old in Xingqing district, Yinchuan city from 1998 to 2007* (银川市兴庆区 1998～2007 年 5 岁以下儿童死亡分析). Maternal & Child Health Care of China (中国妇幼保健). 25(12): 1669-1670
C83	Xiao-Yun An, Hong Cui, et al. 安晓云,崔红,等 (2011). An analysis of death reviewing of children under 5 years old in Xuanwu district, Beijing city* (北京市宣武区 5 岁以下儿童死亡评审分析). Maternal & Child Health Care of China (中国妇幼保健). 26(32): 4972-4974
C84	Wen-Xia Cao, Xiao-Xia Zhao 曹文霞,赵晓霞 (2011). An analysis of monitoring deaths of children under 5 years old in Baiyin city,China from 2003 to 2008* (2003～2008 年白银市 5 岁以下儿童死亡监测情况). Maternal & Child Health Care of China (中国妇幼保健). 26(16): 2468-2469
C85	Da-Yong Zha, Dong-Ling Gu, et al. 查达永,古冬玲,等 (2011). The death cause analysis for children under 5 years old of Baiyun District in Guangzhou City (广州市白云区 2006～2010 年 5 岁以下儿童死因分析). China Modern Medicine (中国当代医药). 18(22): 154-155
C86	Lun-Neng Chen 陈伦能 (2011). Analysis and preventive measures for the death of children under 5 years old in panyu district (番禺区 5 岁以下儿童死亡情况分析与预防措施). CJCHC (中国儿童保健杂志). 19(6): 578-580
C87	Shu-Ying Dong 董淑英 (2011). An analysis of death monitoring of children under 5 years old in Quanshan district, Xuzhou from 2007 to 2010* (2007—2010 年徐州市泉山区 5 岁以下儿童死亡监测分析). Chin J School Doctor (中国校医). 25(8): 593-594
C88	Yue-Lian Dong, Li Zhou 董月莲,周丽 (2011). An analysis of deaths of children under 5 years old in

	Kelamayi city, China from 2003 to 2008* (克拉玛依市 2003～2008 年 5 岁以下儿童死亡分析). Maternal & Child Health Care of China (中国妇幼保健). 26(28): 4371-4372
C89	Chuan-Wei Duan 段传伟 (2011). An analysis of deaths of children under 5 years old in Pingdingshan city, China* (平顶山市 5 岁以下儿童死亡情况分析). Maternal & Child Health Care of China (中国妇幼保健). 26(28): 4358-4359
C90	Xiao-Yi Fu 傅小艺 (2011). Analysis of monitoring result on the death of children under five during the years from 2005 to 2008 in rural area of Yushui district of Xinyu city (新余市渝水区农村 2005～2008 年 5 岁以下儿童死亡监测结果). Maternal & Child Health Care of China (中国妇幼保健). 26(19): 2941-2943
C91	Zu-Kang Gong, Wu Jiang, et al. 龚祖康,蒋武,等 (2011). Death surveillance among children aged <5 years in Nanning, 2004-2009 (2004-2009 年南宁市 5 岁以下儿童死亡监测分析). J Prev Med Inf (预防医学情报杂志). 27(4): 290-293
C92	Feng Guo, Su-Lin Fu, et al. 郭锋,傅苏林,等 (2011). Mortality of children under 5 years old in Hefei city from 2003 to 2008 (合肥市 2003-2008 年<5 岁儿童死亡监测分析). Chin J Public Health (中国公共卫生). 27(6): 706-707
C93	Xiao-Yan Huang, Yu-E Lu 黄晓燕,吕玉娥 (2011). An analysis of monitoring deaths of children under 5 years old in Qujing city, China* (曲靖市 5 岁以下儿童死亡监测结果分析). Maternal & Child Health Care of China (中国妇幼保健). 26(22): 3430-3431
C94	Dong-Song Li, Zhu-Shan Qian 李冬松, 钱铸山 (2011). 2005-2009 below the big east area five years old the child died analysis (2005 年-2009 年大东区五岁以下儿童死亡分析). Chinese Manipopulation & Rehabilitation Medicine (按摩与康复医学（下旬刊）). 2(1): 238-239
C95	Ji-Cun Li 李积存 (2011). An analysis of death causes of children under five years old from 2001 to 2005* (2001-2005 年 5 岁以下儿童死亡原因分析). Chinese Journal of Rural Medicine (中国农村医学杂志). 9(1): 78-80
C96	Jie Liao, Jian-Xin Liu, et al. 廖捷,刘建新,等 (2011). An analysis of death causes of children under 5 years old in Dongguan xity, Guangdong province from 2004 to 2008* (广东省东莞市 2004～2008 年 5 岁以下儿童死亡原因分析). Maternal & Child Health Care of China (中国妇幼保健). 26(4): 572-573
C97	Dan Liu, Hong Yu 刘丹,余红 (2011). Analysis on monitoring result of death of children under 5 years in Shaoxing city from 2006 to 2008 (绍兴市 2006～2008 年 5 岁以下儿童死亡监测结果分析).

	Maternal & Child Health Care of China (中国妇幼保健). 26(35): 5533-5534
C98	Guo-Qin Liu 刘国琴 (2011). An analysis of deaths of children under 5 years old in one county, China from 2006 to 2010* (某县 2006 年至 2010 年 5 岁以下儿童死亡分析). Guide of China Medicine (中国医药指南). 9(13): 288-289
C99	Jing Liu 刘静 (2011). An analysis of monitoring deaths of children under 5 years old in Linyi county, China from 1999 to 2009* (1999～2009 年临邑县 5 岁以下儿童死亡监测分析). Maternal & Child Health Care of China (中国妇幼保健). 26(28): 4366-4367
C100	Jing Liu, Shu-Ping Li, et al. 刘静,李淑萍,等 (2011). An analysis of deaths of 305 neonates* (305 例新生儿死亡情况分析). Contemporary Medicine (当代医学). 17(19): 92-93
C101	Yan Liu 刘燕 (2011). An analysis of monitoring deaths of children under 5 years old in Liaocheng city, China from 2001 to 2008* (聊城市 2001～2008 年 5 岁以下儿童死亡监测分析). Maternal & Child Health Care of China (中国妇幼保健). 26(36): 5778-5780
C102	Yue-Fen Lu, Hong-Lian Zhu 陆月芬,朱红莲 (2011). Monitoring analysis of death of children under 5 in Yangzhong (扬中市 5 岁以下儿童死亡监测分析). CJCHC (中国儿童保健杂志). 19(9): 858-860
C103	Jin-Feng Ma, Li-Jun Ha, et al. 马金凤,哈丽君,等 (2011). An analysis of death factors of children under 5 years old in Yinchuan city in 2010* (银川市 2010 年 5 岁以下儿童死亡因素分析). Ningxia Med J (宁夏医学杂志). 33(12): 1250-1251
C104	Xiu-Zhen Ma 马秀珍 (2011). Analysis and corresponding suggestions of death causes of children under 5 years old in Kangle county, China from 2005 to 2010* (康乐县 2005～2010 年 5 岁以下儿童死亡原因分析与建议). Chin J Mod Drug Appl (中国现代药物应用). 5(11): 138-139
C105	Xiang-Ming Mao 毛向明 (2011). An analysis of death causes of children under 5 years old in Xifeng district, China from 2000 to 2009* (西峰区 2000～2009 年度 5 岁以下儿童死亡原因分析). Chinese Community Doctors (中国社区医师). 13(26): 307-309
C106	Zeng-Luan Mo 莫增銮 (2011). An retrospective analysis of deaths of children under 5 years old in Xincheng city, China* (忻城县 5 岁以下儿童死亡回顾性分析). Maternal & Child Health Care of China (中国妇幼保健). 26(32): 5013-5015
C107	Ying Qian, Pei-An Lou, et al. 钱颖,娄培安,等 (2011). An analysis of death causes of children under 5 years old in Xuzhou city, China from 2005 to 2009* (2005—2009 年徐州市 5 岁以下儿童死因分析). Chin J School Doctor (中国校医). 25(8): 592-594
C108	Hua Rong, Lei Zhu, et al. 荣华,朱蕾,等 (2011). Analysis of death causes of children under 5 years

	old from 2006 to 2009 in Zigong (2006-2009 年自贡市 5 岁以下儿童死亡变化趋势与分析). Journal of Luzhou Medical College (泸州医学院学报). 34(2): 181-183
C109	Guang-Yu Su 苏光玉 (2011). Investigation analysis of death cases of children under 5 years old in Butuo county from 2005 to 2008* (2005-2008 年布拖县 5 岁以下儿童死亡病例调查分析). Chin J of Clinical Rational Drug Use (临床合理用药杂志). 4(9A): 125-126
C110	Feng-Lan Sun, Yun-Ping Li, et al. 孙凤兰,李云平,等 (2011). An analysis of deaths of children under 5 years old in She county, China from 2001 to 2009* (涉县 2001～2009 年 5 岁以下儿童死亡分析). Maternal & Child Health Care of China (中国妇幼保健). 26(10): 1483-1485
C111	Zhen-Lai Tan 谭振来 (2011). An analysis of the survival and health conditions of children under 5 years old in Yingkou city, China in 2010s* (21 世纪 10 年代营口市 5 岁以下儿童生存和健康状况分析). Chin Pediatr Integr Tradit West Med (中国中西医结合儿科学). 3(2): 187-188
C112	Bing Wang 王冰 (2011). An analysis of death causes of children under 5 years old in Jiaozuo city, China from 2005 to 2009* (焦作市 2005-2009 年 5 岁以下儿童死亡原因分析). Chinese Journal of Coal Industry Medicine (中国煤炭工业医学杂志). 17(7): 1029-1030
C113	Xin Wang, Yuan-Ping Ding 王新,丁元萍 (2011). Analysis on result of under 5 mortality surveillance of Jilin city 2002-2010 (2002-2010 年吉林市 5 岁以下儿童死亡监测结果分析). Chin J Women Child Health (中国妇幼卫生杂志). 2(2): 77-79
C114	Xiu-Rong Wang 王秀荣 (2011). 2005 to 2009, deaths of children under age 5 Xinganmeng Analysis (2005-2009 年兴安盟 5 岁以下儿童死亡分析). National Medical Frontiers of China (中国医疗前沿). 6(18): 91-92
C115	Bao-Hua Wei, Zhi-Ru Xu, et al. 韦宝华,徐志茹,等 (2011). An analysis of deaths of children under 5 years old in Xinshi district, China from 2005 to 2009* (新市区 2005～2009 年 5 岁以下儿童死亡结果分析). Chinese Journal of Reproductive Health (中国生育健康杂志). 22(4): 220, 222
C116	Mei-Hua Wu, Jun-Li Du, et al. 武梅花,杜俊丽,等 (2011). Analysis on death causes of children under age 5 in Taigu county from 1990 to 2009 (1990 年至 2009 年太谷县 5 岁以下儿童死亡原因分析). Journal of Shanxi Medical College for Continuing Education (山西职工医学院学报). 21(1): 59-61
C117	Xiao-Mei Xiang 相晓妹 (2011). An analysis of death tendency of children under 5 years old in Xi'an city, China from 2000 to 2009* (西安市 2000～2009 年 5 岁以下儿童死亡趋势分析). Maternal & Child Health Care of China (中国妇幼保健). 26(7): 965-967
C118	Zuo-Ying Xiang 向左英 (2011). Observation and analysis of mortality status of children under 5

	years in Cili county from 2005 to 2009 (慈利县 2005—2009 年 5 岁以下儿童死亡监测分析). Chinese Primary Health Care (中国初级卫生保健). 25(2): 42-44
C119	Feng-Xian Xiao 肖凤仙 (2011). An analysis of monitoring deaths of children under 5 years old in Nanchang, China from 2000 to 2008* (2000～2008 年南昌市 5 岁以下儿童死亡监测资料分析). Maternal & Child Health Care of China (中国妇幼保健). 26(21): 3269-3270
C120	Ling Xu 徐灵 (2011). Analysis of death cause of children under the age of five in a district from 2006 to 2010 (城东区 2006 年-2010 年 5 岁以下儿童死因分析). Chinese Medical Record (中国病案). 12(11): 45-46
C121	Xiao-Fang Yang, Xiao-Ying Zhang, et al. 杨晓芳,张晓英,等 (2011). An analysis of deaths of children under 5 years old in Ganzhou district, Zhangye city from 2005 to 2009* (张掖市甘州区 2005～2009 年 5 岁以下儿童死亡分析). Chinese Community Doctors (中国社区医师). 13(8): 234-235
C122	Dan Zhang, Shao-Ping Yang 张丹,杨少萍 (2011). An analysis of deaths of children under 5 years old in Wuhan, China from 2001 to 2009* (武汉市 2001～2009 年 5 岁以下儿童死亡情况分析). Maternal & Child Health Care of China (中国妇幼保健). 26(8): 1132-1134
C123	Xiao-Ru Zhang 张晓茹 (2011). Analysis of death causes and study on the intervention measures in children under 5 years old (3677 例 5 岁以下儿童死亡原因分析). China Medicine (中国医药). 6(5): 610-612
C124	Xin-Lan Zhang, Jin-Yan Li, et al. 张新兰,李晋艳,等 (2011). An analysis of monitoring deaths of children under 5 years old in Changzhi city, China from 2000 to 2008* (2000～2008 年长治市 5 岁以下儿童死亡监测结果分析). Maternal & Child Health Care of China (中国妇幼保健). 26(26): 4041-4043
C125	Yi Zhang, Liao-Liao Wang 张奕,王嫽嫽 (2011). An analysis of death causes of children under 5 years old in Wenling city from 2006 to 2010* (2006～2010 年温岭市 5 岁以下儿童死因分析). China's health statistics annual conference in 2011 (2011 年中国卫生统计学年会). (3):
C126	Yu Zhang 张玉 (2011). Report of death monitoring analysis of children under 5 years old in Yuncheng city in 2009* (运城市 2009 年 5 岁以下儿童死亡监测分析报告). The Medical Forum (基层医学论坛). 15(11): 290-292
C127	Xiao-Xia Zhao, Wen-Xia Cao 赵晓霞,曹文霞 (2011). An analysis of monitoring deaths of children under 5 years old in Gansu province, China from 2001 to 2005* (2001～2005 年甘肃省 5 岁以下儿童

	死亡监测情况). Maternal & Child Health Care of China (中国妇幼保健). 26(28): 4354-4356
C128	Zhen-Zhang Zhuang, Li-Na Chen, et al. 庄镇漳,陈丽娜,等 (2011). Monitoring analysis of children death under 5 years old from 2006 - 2009 in Quanzhou (2006-2009 年泉州市 5 岁以下儿童死亡监测分析). Henan J Prev Med (河南预防医学杂志). 22(2): 84-85
C129	Miao-Ling Cai, Hong-Yan Zeng 蔡妙玲,曾红燕 (2012). Causes of death of children under five years old in Luohu district from 2006 to 2010 and the interventional measures (2006～2010 年罗湖区 5 岁以下儿童死亡原因与干预措施). Maternal & Child Health Care of China (中国妇幼保健). 27(21): 3224-3227
C130	Ruo-Zhu Cen 岑若珠 (2012). An analysis of neonatal deaths in Hechi city, China from 2009 to 2011* (河池市 2009～2011 年新生儿死亡情况分析). Maternal & Child Health Care of China (中国妇幼保健). 27(16): 2417-2418
C131	Lian-Zhi Chang 常连枝 (2012). An analysis of deaths of children under 5 years old in Xuchang city, China for a decade from 2001 to 2010* (许昌市 2001 年至 2010 年 5 岁以下儿童 10 年死亡情况分析). China Foreign Medical Treatment (中外医疗). (8): 126
C132	Feng-Ping Chen, Xiao-Ju Hu 陈凤萍,胡晓菊 (2012). An analysis of death causes of children under 5 years old in Nanzheng county, China from 2000 to 2010* (南郑县 2000～2010 年 5 岁以下儿童死亡原因分析). Maternal & Child Health Care of China (中国妇幼保健). 27(36): 5950-5952
C133	Yan Chen 陈艳 (2012). Analysis and interventions of death causes of children under 5 years old in Zhushan county* (竹山县 5 岁以下儿童死亡原因调查分析及干预). World Health Digest (中外健康文摘). 9(48): 377-378
C134	Zhong-Ping Chen 陈忠平 (2012). An analysis of death causes of children under 5 years old from 2004 to 2010* (2004～2010 年 5 岁以下儿童死因分析). Chinese Community Doctors (中国社区医师). 14(8): 380
C135	Ya-Li Qiu, Xi-Min Bai, et al. 仇亚丽,白希敏,等 (2012). An analysis of death causes of children under 5 years old in one city, China from 2001 to 2010* (2001 至 2010 年某市 5 岁以下儿童死亡原因分析). Guide of China Medicine (中国医药指南). 10(1): 88-90
C136	Wen-Xian Dai, Jin-Shuang Liu, et al. 戴文献,刘金双,等 (2012). An analysis of death tendency and causes of children under 5 years old in Sihong county, China from 2006 to 2011* (2006 年至 2011 年泗洪县 5 岁以下儿童死亡趋势与原因分析). Journal of Chinese Physician (中国医师杂志). 14(11): 1515-1517

C137	Hong Deng, Xiao-Fang Yuan, et al. 邓红,袁小芳,等 (2012). An analysis of death causes and mortality tendency of children under 5 years old in Xinyu city from 2007 to 2011* (新余市2007—2011 年 5 岁以下儿童各期死亡率变化趋势及死因分析). JCM (社区医学杂志). 10(17): 51-52
C138	Shi-Hua Deng, Ming-Gang Ban, et al. 邓仕华,班明刚,等 (2012). An analysis of deaths of children under 5 years old in Baise city, Guangxi province in 2010* (广西百色市2010年5岁以下儿童死亡分析). Maternal & Child Health Care of China (中国妇幼保健). 27(14): 2089-2091
C139	Yan-Qing Fu, Wei Wang 傅燕青,王维 (2012). Analysis and interventions of death causes of children under 5 years old in Xixiang street, China from 2007 to 2011* (西乡街道 2007—2011 年 5 岁以下儿童死亡原因分析与干预措施). China Health Industry (中国卫生产业). 9(34): 172-173
C140	Jian-Xia Gao 高建霞 (2012). An analysis of deaths of children under 5 years old in Pei county, China from 2002 to 2011* (沛县 2002～2011 年 5 岁以下儿童死亡分析). Chinese Community Doctors (中国社区医师). 14(28): 141
C141	Gai-Ling Ge 葛改玲 (2012). An analysis of death causes of children under five years old* (5 岁以下儿童死因分析). China Health Care & Nutrition (中国保健营养). 22(12): 5351
C142	Yu-Jing Gu 顾宇静 (2012). An analysis of deaths monitoring and revies of children under 5 years old in Wuxi city, China from 2001 to 2010* (2001～2011 年无锡市 5 岁以下儿童死亡监测和评审结果分析). Maternal & Child Health Care of China (中国妇幼保健). 27(13): 1990-1991
C143	Jie Gui 桂捷 (2012). An analysis of deaths of children under 5 years old in Yuhuatai district, Nanjing city from 2003 to 2009* (2003-2009 年南京市雨花台区 5 岁以下儿童死亡分析及干预措施). World Health Digest (中外健康文摘). 9(33): 56-58
C144	Gui-Mei He 和桂梅 (2012). An retrospective analysis of deaths of children under 5 years old in Deqin county, China from 2004 to 2010* (德钦县 2004 年-2010 年 5 岁以下儿童死亡回顾分析). Health Horizon•Medical Sciences (健康大视野：医学版). (1): 32-33
C145	Yu-Qiong He 和玉琼 (2012). An analysis of mornitoring deaths of children under 5 years old in Lijiang city, China from 2007 to 2011* (2007～2011 年丽江市 5 岁以下儿童死亡监测分析). Chinese Community Doctors (中国社区医师). 14(11): 414-415
C146	Hong Hou, Xin-Hua Liu, et al. 侯红,刘新华,等 (2012). An analysis of monitoring deaths of children under 5 years old in Wulumiqi city from 2006 to 2010* (乌鲁木齐市 2006～2010 年 5 岁以下儿童死亡监测分析). Xinjiang Medical Journal (新疆医学). 42(4): 113-115

C147	Ai-Fang Huang 黄爱芳 (2012). An analysis of deaths of children under 5 years old in Yuhuan county, China from 20003 to 2009* (2000-2009 年玉环县 5 岁以下儿童死亡状况分析). World Health Digest (中外健康文摘). 9(35): 53-54
C148	Fang Hui, Xia Hai 惠芳,海霞 (2012). Analysis on death of children under five years and interventional measures in Guyuan city from 2006 to 2009 (固原市 2006～2009 年度 5 岁以下儿童死亡分析及干预措施). Maternal & Child Health Care of China (中国妇幼保健). 27(3): 331-333
C149	Xiao-Mei Jiang, Wei-Tao Zhang, et al. 江晓梅,张渭桃,等 (2012). Death monitoring among children under five in Kaihua county from 2006 to 2010 (2006-2010 年开化县 5 岁以下儿童死亡监测分析). Chinese Rural Health Service Administration (中国农村卫生事业管理). 32(7): 748-751
C150	Cai-Xia Li 李彩霞 (2012). Retrospective analysis of deaths of children under 5 years old in Xinhui district, China from 2001 to 2010* (新会区 2001～2010 年 5 岁以下儿童死亡回顾性分析). Chinese Community Doctors (中国社区医师). 14(23): 319-320
C151	Dong-Mei Li, Dong-Dong Li 李冬梅,李冬东 (2012). An analysis of monitoring deaths of children under 5 years old in Changji Autonomous Prefecture* (昌吉州 5 岁以下儿童死亡监测分析). World Health Digest (中外健康文摘). 9(35): 56-57
C152	Hong-Hui Li, Zheng Nong, et al. 李红辉,农铮,等 (2012). Analysis of supervising result of death for the children under the age of 5 in Liuzhou from 2003 to 2011 (柳州市 2003-2011 年 5 岁以下儿童死亡监测结果分析). CJCHC (中国儿童保健杂志). 20(5): 476-477
C153	Hua Li, Hui Guo 李花,郭辉 (2012). An analysis of death causes of children under 5 years old in Chenggu county from 2005 to 2010* (城固县 2005 年～2010 年 5 岁以下儿童死亡原因分析). Jilin Medical Journal (吉林医学). 33(11): 2332-2333
C154	Li-Li Li 李丽丽 (2012). Death monitoring of children under 5 years old in Guannan county from 2006 to 2011* (2006—2011 年灌南县 5 岁以下儿童死亡监测). Jiangsu Health Care (江苏卫生保健). 14(5): 43-44
C155	Gui-Fang Lin, Xuan-Feng Zhong 林桂芳,钟旋风 (2012). Countermeasures of deaths of children under 5 years old* (五岁以下儿童死亡干预措施). Jiankang Bidu (健康必读（下旬刊）). (6): 424
C156	Ai-Yu Liu, Qi Li, et al. 刘爱宇,李琦,等 (2012). Epidemiological analysis on the death of children under 5 in Emeishan city, 2001-2011 (2001-2011 年峨眉山市 5 岁以下儿童死亡分析). Journal of Occupational Health and Damage (职业卫生与病伤). 27(3): 163-165
C157	Li-Yuan Liu 刘丽媛 (2012). Death analysis of 0~5 years old children from 2003 to 2010 in Ulanhot

	city (乌兰浩特市 2003～2010 年 0～5 岁儿童死亡情况分析). Journal of Inner Mongolia University for Nationalities (内蒙古民族大学学报). 27(4): 483-486
C158	Yin Liu, Chun-Xia Cang 刘银,仓春霞 (2012). Analysis and preventions of deaths of children under 5 years old in Zhongmou county, China* (中牟县 5 岁以下儿童死亡情况分析与预防措施). Chin J Mod Drug Appl (中国现代药物应用). 6(18): 135-136
C159	Xin-Mei Mao, Gang Li, et al. 毛新梅,李刚,等 (2012). An analysis of death tendency of children under 5 years old in Ningxia province from 2001 to 2010* (宁夏 2001-2010 年 5 岁以下儿童死亡趋势分析). Journal of Ningxia Medical University (宁夏医科大学学报). 34(12): 1286-1289
C160	Ji-Xiu Qin 秦吉秀 (2012). An analysis of death causes of children under 5 years old in Guilin city, China in 2011* (2011 年桂林市 5 岁以下儿童死亡原因分析). World Health Digest (中外健康文摘). 9(51): 417-418
C161	Wei-Xing Shen 沈卫星 (2012). An investigation on deaths of children under 5 years old in Tiexi district, Shenyang city from 2007 to 2011* (2007/2011 沈阳市铁西区 5 岁以下儿童死亡调查分析). Chin Pediatr Integr Tradit West Med (中国中西医结合儿科学). 4(5): 467-469
C162	Feng-Ling Song, Liang-Zheng Yang, et al. 宋风玲,杨良政,等 (2012). Dynamic analysis and preventive measures of deaths of children under 5 years old in Jinan city, China* (济南市 5 岁以下儿童死亡动态分析与干预措施研究). CJCHC (中国儿童保健杂志). 20(8): 758-760
C163	Min Tan 覃敏 (2012). An analysis of death tendency of children under 5 years old in Lincang city from 2006 to 2010* (临沧市 2006～2010 年 5 岁以下儿童死亡趋势分析). Journal of Military Surgeon in Southwest China (西南军医). 14(2): 247-248
C164	Li Wang 王丽 (2012). An analysis of death tendency of children under 5 years old in Shangyu city, China from 1999 to 2008* (1999～2008 年上虞市 5 岁以下儿童死亡变化趋势分析). Maternal & Child Health Care of China (中国妇幼保健). 27(4): 542-543
C165	Pei-Ying Wang 王佩英 (2012). An analysis of death causes of children under 5 years old in Jingning county, China* (景宁县 5 岁以下儿童死亡原因分析). Zhejiang Prev Med (浙江预防医学). 24(7): 70-72
C166	Qin Wang 王钦 (2012). An analysis of the results of monitoring deaths of children under 5 years old in Yiwu city from 2006 to 2011* (对 2006 年～2011 年义乌市 5 岁以下儿童死亡监测结果的分析). Seek Medical and Ask the Medicine (求医问药(下半月)). 10(11): 1029-1030
C167	Hong-Guang Wei, Bian-Fang Chen, et al. 魏红光,陈边防,等 (2012). An analysis of death causes of

	children under 5 years old in Suzhou district, Jiuquan city from 2001 to 2010* (酒泉市肃州区2001—2010年5岁以下儿童死亡原因分析). Health Vocational Education (卫生职业教育). 30(16): 103-104
C168	Sha-Dai-Ti-Han Wuyinla, Gui-Lan Yang 吾拉音•沙代提汗，扬挂兰 (2012). An analysis of mortalities of children under 5 years old from 2004 to 2008* (2004-2008年5岁以下儿童死亡率分析). Jiankang Bidu (健康必读（下旬刊）). (5): 455
C169	Ji Wu, Xue-Zhen Lu, et al. 吴奇,卢雪珍,等 (2012). An analysis of death infulencing factors of children under 5 years old in Haizhu district, China from 2001 to 2010* (海珠区2001～2010年5岁以下儿童死亡相关因素分析). Maternal & Child Health Care of China (中国妇幼保健). 27(25): 3935-3937
C170	Bing-Jie Xia, Chun-Ru Xia, et al. 夏冰杰,夏春茹,等 (2012). An analysis of deaths of children under 5 years old in Fengrun district, China from 2008 to 2011* (丰润区2008～2011年5岁以下儿童死亡情况分析). Chinese Journal of Reproductive Health (中国生育健康杂志). 23(6): 438-440
C171	Qin Xie, Ling Wei 谢琴,魏玲 (2012). An analysis of death causes of children under 5 years old in Yubei district, Chongqing city from 2007 to 2011* (2007—2011年重庆市渝北区5岁以下儿童死亡原因分析). J Mod Med Health (现代医药卫生). 28(16): 2553-2554
C172	Xiao-Hong Xu, Jin Lu 徐晓红,卢进 (2012). An analysis of monitoring deaths of children under 5 years old in Haian city, China from 2007 to 2011* (海安县2007～2011年5岁以下儿童死亡监测分析). Chinese Community Doctors (中国社区医师). 14(31): 363
C173	Kun-Li Yang 杨昆丽 (2012). An analysis of deaths and related influencing factors of child under 5 years old in Yulong county, Yunnan province* (云南省玉龙县5岁以下儿童死亡及相关影响因素分析). Chin J Women Child Health (中国妇幼卫生杂志). 3(6): 356-359
C174	Yan Yang, Hai-Ying Liu 杨彦,刘海英 (2012). An analysis of deaths of children under 5 years old in Lingwu city, China* (灵武市5岁以下儿童死亡分析). Maternal & Child Health Care of China (中国妇幼保健). 27(1): 73-74
C175	Shao-Jun Yao, Yi-Hong Wu, et al. 姚少军,吴艺红,等 (2012). An analysis of death investigation results of children under 5 years old in Hongan county from 2008 to 2011* (2008-2011年红安县5岁以下儿童死亡调查结果分析). Yiayao Qianyan (医药前沿). 2(17): 144-145
C176	Hong Yu, Dan Liu 余红,刘丹 (2012). Death surveillance in migrant children aged <5 years in Shaoxing, 2011 (2011年浙江省绍兴市5岁以下流动儿童死亡监测结果分析). Disease Surveillance

	(疾病监测). 27(11): 903-905
C177	Fei-Yan Yu, Dao-Liang Wang 俞飞燕,王道良 (2012). Longitudinal analysis and countermeasures of deaths of children under 5 years old in Xiaoshan district, China* (萧山区 5 岁以下儿童死亡纵向分析及对策). Chinese Rural Health Service Administration (中国农村卫生事业管理). 32(7): 746-747
C178	Hui-Ling Zhang, Li-Jun Xue 张惠玲, 薛丽君 (2012). Death analysis of children under 5 years of age in Xixiang county from 2005 to 2010 and intervention (西乡县 2005 至 2010 年 5 岁以下儿童死亡分析及干预). Chinese Journal of Women and Child Health Research (中国妇幼健康研究). 23(5): 655-657
C179	Shao-Qiang Zhang, Ling Zhang, et al. 张绍强, 张玲,等 (2012). Analysis of death of children under age 5 in Longgang district of Shenzhen (深圳市龙岗区 5 岁以下儿童死亡情况分析). Chinese Journal of Women and Child Health Research (中国妇幼健康研究). 23(2): 145-147
C180	Shu-Xian Zhang 张书先 (2012). An analysis of deaths of children under 5 years old in Anlu city, China from 2006 to 2010* (安陆市 2006-2010 年五岁以下儿童死亡分析). China Hwalth Care & nutrition (中国保健营养（中旬刊）). (8): 322
C181	Ya Zhang, Mei-Rong Wu 张娅,吴美荣 (2012). An analysis of death records of children under 5 years old in Tianqiao district, Jinan city from 2007 to 2010* (2007～2010 年济南市天桥区 5 岁以下儿童死亡资料分析). Prev Med Trib (预防医学论坛). 18(1): 62-63
C182	Ling-Ling Zhao 赵玲玲 (2012). An analysis of monitoring death causes of children under 5 years old in Dongyang city from 2009 to 2011* (2009 年～2011 年东阳市 5 岁以下儿童死亡原因监测分析). Seek Medical and Ask the Medicine (求医问药(下半月)). 10(11): 645
C183	Wen-Xiu Zhao 赵文秀 (2012). Investigation of children's mortality status under 5 years in Dandong from 2005 to 2011 (丹东市 2005-2011 年 5 岁以下儿童死亡状况调查). Jilin University (吉林大学). ():
C184	Ying Zhao, Chun-Yan Liu 赵莹,刘春艳 (2012). An analysis of the results of death monitoring of children under 5 years old in Hebei district, Tianjin city from 2006 to 2011* (2006-2011 年度天津市河北区 5 岁以下儿童死亡监测结果分析). Journal of Tianjin Medical University (天津医科大学学报). 18(2): 178-180
C185	Run Zhong, Ming-Gang Ban, et al. 钟润,班明刚,等 (2012). An investigation on neonatal deaths in Baise city from 2006 to 2010* (2006～2010 年百色市新生儿死亡情况调查). Youjiang Medical Journal (右江医学). 40(1): 107-108

C186	Li-Kun Zhou 周丽坤 (2012). Monitoring and analysis of death factors of children under 5 years old in Shizong county in recent 5 years* (师宗县近五年 5 岁以下儿童死亡因素监测与分析). Seek Medical and Ask the Medicine (求医问药(下半月)). 10(12): 3
C187	Yan-Fen Zhou 周艳芬 (2012). An analysis of death monitoring of children under 5 years old in Jiangdu district, Yangzhou city from 2007 to 2011* (扬州市江都区 2007～2011 年 5 岁以下儿童死亡监测情况分析). J Huaihai Med (淮海医药). 30(3): 248-250
C188	Xiao-Yan Zhu, Cheng-Yin Huang 朱晓燕,黄诚茵 (2012). An analysis of death monitoring result of children under 5 years old from 2006 to 2010* (2006～2010 年 5 岁以下儿童死亡监测结果分析). Maternal & Child Health Care of China (中国妇幼保健). 27(13): 1994-1995
C189	Xu-Wei Zhuang, Shu-Qin Ming 庄绪伟,明淑芹 (2012). Analysis of the monitoring data of the death of children under 5 years old in Ju'nan county in 2010 (莒南县 2010 年 5 岁以下儿童死亡监测分析). Journal of Shandong Medical College (山东医学高等专科学校学报). 34(4): 307-308
C190	Yong-Sheng Bai, Yan-Feng Liu, et al. 白永胜,刘雁峰,等 (2013). An analysis of death monitoring of children under 5 years old in Yanchi county from 2003 to 2012* (盐池县 2003-2012 年 5 岁以下儿童死亡监测分析). Journal of Ningxia Medical University (宁夏医科大学学报). 35(11): 1282-1284
C191	Ren-Zhi Cai, Hui-Ting Yu, et al. 蔡任之,虞慧婷,等 (2013). Analysis on death for children under 5 in Shanghai registered population and floating population in 2011 (上海市 2011 年户籍及非户籍人口 5 岁以下儿童死亡分析). Asia-Pacific Traditional Medicine (亚太传统医药). 9(9): 205-207
C192	Fang-Lan Cao 曹方兰 (2013). Death tendency of children under 5 years old in Yidu city, Hubei province from 2008 to 2012* (湖北宜都市 2008-2012 年 5 岁以下儿童死亡趋势). J of Pub Health and Prev Med (公共卫生与预防医学). 24(5): 120-121
C193	Su-Yun Chen, Xu Zhao 陈素云,赵旭 (2013). An analysis of deaths of children under 5 years old in Tongan district, Xiamen city from 2005 to 2009* (厦门市同安区 2005～2009 年 5 岁以下儿童死亡分析). Maternal & Child Health Care of China (中国妇幼保健). 28(4): 637-639
C194	Su-Hua Dong 董素华 (2013). Analysis on cause of death of children under 5 years old in Bengbu city from 2003 to 2011 (2003 年至 2011 年蚌埠市 5 岁以下儿童死亡率及死亡原因分析). Anhui Medical Journal (安徽医学). 34(8): 1233-1236
C195	Hong-Ying Fang, Li-Li Zhu, et al. 方红英,朱莉莉,等 (2013). Analysis of minotoring results of death for the children under 5 years old in Tongling (铜陵市 5 岁以下儿童死亡监测结果分析). CJCHC (中国儿童保健杂志). 21(8): 878-880

C196	Ming Fang 方明 (2013). Death monitoring of children under 5 years old in Wujin district, Changzhou city from 2010 to 2012* (常州市武进区 2010—2012 年 5 岁以下儿童死亡监测). Jiangsu Health Care (江苏卫生保健). 15(6): 48-49
C197	Hai-Xia Feng 冯海霞 (2013). An analysis of death monitoring results of children under 5 years old in Linzi district, Zibo city of Shandong province from 2000 to 2012* (山东省淄博市临淄区 2000-2012 年 5 岁以下儿童死亡监测结果分析). Chindren's Health Academic Exchange Conference (2013 山东省儿童保健学术交流会). (4):
C198	Han-Dong Fu, Min Lu, et al. 付汉东,陆敏,等 (2013). Analysis of the causes of death among children under 5 years old in Xiaogan city from 2007 to 2011 (孝感市 2007—2011 年 5 岁以下儿童死亡原因调查分析). Chinese General Practice (中国全科医学). 16(1C): 286-288
C199	Jin-Hua Gao, Ning Li, et al. 高进华,李宁,等 (2013). An analysis of deaths of children under 5 years old from 2008 to 2010* (2008～2010 年 5 岁以下儿童死亡情况分析). Maternal & Child Health Care of China (中国妇幼保健). 28(13): 2026-2028
C200	Yin-Xia Guo, Hui-Zhi Li, et al. 郭银霞,李惠芝,等 (2013). An analysis of death causes of children under 5 years old in Jinfeng district, Yinchuan city from 2005 to 2012* (银川市金凤区 2005-2012 年 5 岁以下儿童死亡原因分析). Ningxia Med J (宁夏医学杂志). 35(10): 984-985
C201	Xiu-Zhen Hu, Tao Jiang, et al. 胡秀珍,蒋涛,等 (2013). The analysis of death situation of children under five years in Zengdouqu district of Suizhou from 2008 to 2012 (随州市曾都区 2008—2012 年 5 岁以下儿童死亡情况分析). Chinese Primary Health Care (中国初级卫生保健). 27(8): 57-59
C202	Hai-Yu Jin, Jing-Hua Quan 金海玉,全京花 (2013). Death cause analysis of under five years old children from 2009-2012 in Yanbian area (2009～2012 年延边地区 5 岁以下儿童死亡原因分析). China Prac Med (中国实用医药). 8(7): 263-264
C203	Xiao-Juan Kou, Zhong-Jian Fu, et al. 寇晓娟,付中建,等 (2013). An analysis of deaths of children under 5 years old in Shouguang city from 2009 to 2011* (2009～2011 年寿光市 5 岁以下儿童死亡情况分析). Prev Med Trib (预防医学论坛). 19(10): 795-796
C204	Jun-Qin Li 李俊琴 (2013). Analysis of the death rate of children under 5 in Yingze district, Taiyuan during 2006~2010 (太原市迎泽区 2006~2010 年 5 岁以下儿童死亡情况分析). Journal of Shanxi Medical College for Continuing Education (山西职工医学院学报). 23(5): 42-44
C205	Li Liu, Chun-Hua Wang, et al. 刘丽,王春华,等 (2013). Trend analysis on infantile death in Harbin city from 2000 to 2010 (2000～2010 年哈尔滨市婴儿死亡趋势分析). Maternal & Child Health Care

	of China (中国妇幼保健). 28(5): 785-788
C206	Shi-Min Liu 刘世敏 (2013). An analysis of death causes of children under 5 years old in Fuchuan county, China from 2009-2013* (富川县 2009-2013 年五岁以下儿童死亡原因分析). World Health Digest (中外健康文摘). (51): 53-54
C207	Yuan-Zhu Long, Chu-Yan Long, et al. 龙元珠,龙楚彦,等 (2013). An analysis of the monitoring child death of children under 5 years old in Nanchang area, China from 2008 to 2012* (2008-2012 年南昌地区 5 岁以下儿童死亡监测分析). Chinese Journal of Women and Children Health (中国妇幼卫生杂志). 4(5): 35-36
C208	Kai-Min Luo, Yong-Zhong Wang 罗开敏,汪永忠 (2013). An analysis of death year report materials of children under 5 years old in Linxiang district, China from 2001 to 2010* (2001～2010 年临翔区 5 岁以下儿童死亡年报资料分析). Chinese Community Doctors (中国社区医师). 15(6): 374-375
C209	Tao Lu 吕涛 (2013). Monitoring results of children mortality under 5 years old in Anshan city from 2007 to 2011 (2007 至 2011 年鞍山市 5 岁以下儿童死亡监测结果分析). Chinese Journal of Women and Child Health Research (中国妇幼健康研究). 24(2): 149-151
C210	Ming Ma, Shu-Wen Zhang, et al. 马铭,张淑文,等 (2013). Analysis on death causes of children under 5 years old in Chengguan district of Lanzhou city from 2005 to 2010 (2005～2010 年兰州市城关区 5 岁以下儿童死因分析). Maternal & Child Health Care of China (中国妇幼保健). 28(3): 458-461
C211	Yu-Fei Ni, Ya-Bing Lu, et al. 倪钰飞,吕亚兵,等 (2013). An analysis of monitoring deaths of children under 5 years old in Nantong city, China from 2005 to 2011* (南通市 2005～2011 年 5 岁以下儿童死亡监测分析). Maternal & Child Health Care of China (中国妇幼保健). 28(27): 4511-4514
C212	Hai-Ling Peng, Qian Bai, et al. 彭海玲,白倩,等 (2013). Contrastive analysis of the death of children under 5 years old in urban and rural areas of Hanzhong (汉中市农村与城区 5 岁以下儿童死亡对比分析). Chinese Journal of Women and Child Health Research (中国妇幼健康研究). 24(3): 293-295
C213	Wei-Xia Qin, Han-Song Zhu, et al. 秦维霞,祝寒松,等 (2013). Epidemic feature analysis of children under-five mortality cause in Xiamen city (2007-2011 年厦门市 5 岁以下儿童死因流行特征分析). CJCHC (中国儿童保健杂志). 21(6): 654-657
C214	Wei-Xing Shi 施卫兴 (2013). An analysis of deaths of children under 5 years old in Fengxian district, Shanghai from 2008 to 2012* (2008-2012 年上海市奉贤区 5 岁以下儿童死亡分析). hanghai Medical & Pharmaceutical Journal (上海医药). 34(8): 52-54
C215	Shao-Qiu Tang 唐召秋 (2013). An analysis of deaths of children under 5 years old in Pingdu city of

	Shandong province from 2009 to 2012* (山东省平度市2009～2012年5岁以下儿童死亡情况分析). Capital Medicine (首都医药). (14): 37
C216	Chao-Xia Teng 滕朝霞 (2013). An analysis of death monitoring results of children under 5 years old in Huaying city from 2006 to 2010* (华蓥市2006年～2010年5岁以下儿童死亡监测结果分析). Jilin Medical Journal (吉林医学). 34(22): 4489-4490
C217	Yun-Xia Wang, Mei-Ling Liu, et al. 王云霞,刘美玲,等 (2013). An analysis of neonatal monitoring deaths in Yuxi city from 2008 to 2012* (玉溪市2008～2012年新生儿死亡监测情况分析). Medicine and Pharmacy of Yunnan (云南医药). 34(5): 432-433
C218	Zhen Wang, Yong-Hong Duan 王珍,段永红 (2013). Analysis of children under 5 years of age mortality of Hengyang city from 2006 to 2011 (衡阳市2006-2011年5岁以下儿童死亡情况分析). Chinese Journal of Women and Children Health (中国妇幼卫生杂志). 4(1): 10-11
C219	Zhong-De Wang, Qian-Yun Wang, et al. 王忠德,王茜云,等 (2013). Analysis on mortality surveillance among children aged under 5 years, Zibo city (2000～2010年淄博市5岁以下儿童死亡监测资料分析). Prev Med Trib (预防医学论坛). 19(2): 125-127
C220	Huang-Zhong Wei, Guang-Ying Zhao, et al. 魏煌忠,赵广英,等 (2013). An analysis of deaths of children under 5 years old in one street of Shenzhen city from 2007 to 2011* (深圳某街道2007-2011年5岁以下儿童死亡情况分析). J of Pub Health and Prev Med (公共卫生与预防医学). 24(1): 115-116
C221	Jin-Xi Wu, Su Huang 吴金曦,黄素 (2013). An analysis of death causes of children under 5 years old in Yuyao area, China from 2008 to 2012* (2008年～2012年余姚地区5岁以下儿童死亡原因分析). Chinese Journal of Birth Health & Heredity (中国优生与遗传杂志). 21(10): 124-125
C222	Min Wu 吴敏 (2013). Analysis of the causes of child death under five years of age in Leshan city from 2005 to 2010 (乐山市2005年-2010年5岁以下儿童死亡原因分析). West China Medical Journal (华西医学). 28(5): 761-763
C223	Wei-Shuang Wu 吴伟爽 (2013). An analysis of death causes of children under 5 years old in Sanmen county, China from 2007 to 2011* (三门县2007-2011年5岁以下儿童死因分析). Chinese Journal of Rural Medicine and Pharmacy (中国乡村医药). 20(16): 53-54
C224	Xiao-Wen Wu 武晓雯 (2013). An analysis of death causes of children under 5 years old in Zhengzhou city from 2010 to 2012* (2010~2012年郑州市5岁以下儿童死亡原因分析). Journal of Henan Medical College for Staff and Workers (河南职工医学院学报). 25(6): 715-716

C225	Xiao-Shu Xiang, Shui-Ping Zhang, et al. 相晓妹，张水平，等 (2013). Analysis of neonatal death review in Xi'an city from 2010 to 2012 (2010 至 2012 年西安市新生儿死亡评审分析). Chinese Journal of Women and Child Health Research (中国妇幼健康研究). 24(4): 478-481
C226	Xiao-Yan Xiong 熊晓妍 (2013). An analysis of death causes of children under 5 years old in Enshi county, China from 2010 to 2012* (恩施市 2010-2012 年 5 岁以下儿童死亡原因分析). Health Horizon (健康大视野：医学版). 21(9): 873-874
C227	Ze-Rong Yan 晏泽容 (2013). Investegation and analysis of death causes of children under 5 years old in Beibei district, China from 2006 to 2011* (2006～2011 年北碚区 5 岁以下儿童死因调查及分析). Chin J Mod Drug Appl (中国现代药物应用). 7(2): 130-132
C228	Hua-Feng Yang, Xu-Peng Chen, et al. 杨华凤,陈旭鹏,等 (2013). Analysis on the death situation of the children under 5 years in Nanjing from 2007 to 2011 (南京市 2007～2011 年 5 岁以下儿童死亡情况分析). Maternal & Child Health Care of China (中国妇幼保健). 28(3): 442-444
C229	Rong-Hui Yang 杨荣惠 (2013). Analysis of the monitoring results on children death under the age of five in Chongzhou city between 2001 and 2010 (崇州市 2001~2010 年 5 岁以下儿童死亡监测结果分析). Morden Preventive Medicine (现代预防医学). 40(20): 3768-3770
C230	Gang-Zhu Yin, Su-Lin Fu, et al. 殷刚柱,傅苏林,等 (2013). An analysis of monitoring deaths of children under 5 years old in Hefei city, China from 2006 to 2010* (2006～2010 年合肥市 5 岁以下儿童死亡监测分析). Maternal & Child Health Care of China (中国妇幼保健). 28(17): 2679-2681
C231	Chun-E Yu 余春娥 (2013). Analysis of the investigation result of death causes of children under 5 years old in Dushan county, China from 2008 to 2012* (独山县 2008-2012 年 5 岁以下儿童死亡原因调查结果分析). China Hwalth Care & nutrition (中国保健营养（中旬刊）). (12): 35-36
C232	Qiu-Xia Yu 俞秋霞 (2013). Analysis of the death cause of children less than 5 years old in Huishan district of Wuxi (江苏省无锡市惠山区 5 岁以下儿童十年死亡原因分析). Chin J Prim Med Pharm (中国基层医药). 20(21): 3269-3271
C233	Yu-Xia Zhan, Yi-Jun Ruan, et al. 詹玉霞,阮一君,等 (2013). Analysis and countermeasures of deaths of children under 5 years old in Putian city from 2007 to 2012* (莆田市 2007-2012 年 5 岁以下儿童死亡分析与对策). Strait J Prev Med (海峡预防医学杂志). 19(4): 76-77
C234	Min-Jie Zhang 张敏杰 (2013). An analysis of monitoring deaths of children under 5 years old in Balinzuoqi, China from 2008 to 2012* (巴林左旗 2008--2012 年 5 岁以下儿童死亡监测分析). China Health Care & Nutrition (中国保健营养（上旬刊）). (12): 7378-7379

C235	Li-Ping Zhao, Min-Hui Cao 赵丽萍, 曹敏辉 (2013). Analysis of death cause of children under age 5 from 2006 to 2010 in Weinan (渭南市 2006 至 2010 年 5 岁以下儿童死因分析). Chinese Journal of Women and Child Health Research (中国妇幼健康研究). 24(1): 10-12
C236	Jian-Ling Zhu, Zhan-Shun Cui 朱建玲,崔占顺 (2013). Tendency analysis of mortality rates of children under 5 years old in Jiuquan city, China from 2007 to 2011* (2007～2011 年酒泉市 5 岁以下儿童死亡率变化趋势探讨). Maternal & Child Health Care of China (中国妇幼保健). 28(12): 1906-1908
C237	Fan-Ling Bu 卜凡玲 (2014). Analysis and intervention countermeasures of death causes of perinatal infants and children under 5 years old in Pingyi county from 2006 to 2012* (平邑县 2006～2012 年围产儿和 5 岁以下儿童死亡原因分析及干预对策). Contemporary Medicine (当代医学). 20(19): 160-162
C238	Yan-Xia Chen, Chuan-Bi Chen, et al. 陈艳霞,陈川碧,等 (2014). Tendency analysis and preventive countermeasures of deaths of children under 5 years old in Sanya city, China from 2000 to 2012* (三亚市 2000～2012 年 5 岁以下儿童死亡变化趋势分析及防治对策). Maternal & Child Health Care of China (中国妇幼保健). 29(8): 1156-1158
C239	You-Ling Deng 邓佑玲 (2014). Analysis of the result of mornitoring neonatal deaths in one county, China from 2008 to 2012* (某县 2008 年~2012 年新生儿死亡监测的结果分析). Guide of China Medicine (中国医药指南). 12(5): 59-60
C240	Gui-Fen Feng, Bao-Shan Gan, et al. 冯桂芬,甘宝姗,等 (2014). Death cause analysis and corresponding intervention measures for children under 5 years old in Guangzhou city Liwan district (广州市荔湾区 5 岁以下儿童死因分析及相关干预对策). China Morden Doctor (中国现代医生). 52(9): 126-129
C241	Jian-Hui Gao, Yu-Shao Liu, et al. 高建慧,刘玉韶,等 (2014). Analysis of the causes and intervention strategy of neonatal death in Zhongshan city from 2003 to 2012 (中山市 2003-2012 年新生儿死亡分析及干预对策). CJCHC (中国儿童保健杂志). 22(10): 1101-1103
C242	Hui-Qin Kang 康慧琴 (2014). An analysis of death causes of children under 5 years old in Longde county from 2008 to 2012* (隆德县 2008-2012 年 5 岁以下儿童死因分析). Journal of Ningxia Medical University (宁夏医科大学学报). 36(11): 1284-1285
C243	Hai-Hua Li, Yan-Hong He, et al. 李海华,何艳宏,等 (2014). An analysis of death causes of children under 5 years old in Huzhou city, China from 2008 to 2012* (2008~2012 年湖州市 5 岁以下儿童死亡

	原因分析). Maternal & Child Health Care of China (中国妇幼保健). 29(34): 5610-5612
C244	Yan-Hui Li, Chun-Yan Niu 李艳辉,牛春艳 (2014). An analysis of 144 death cases of children under 5 years old in Chengde county, China* (承德县 144 例 5 岁以下儿童死亡分析). Chinese Journal of Ethnomedicine and ethnopharmacy (中国民族民间医药). 23(8): 110
C245	Ying Li, Yuan Lu 李莹,卢媛 (2014). Analysis of death causes and countermeasures of children under 5 years old in Wuchang district, Wuhan city from 2005 to 2011* (武汉市武昌区 2005~2011 年 5 岁以下儿童死因及干预措施分析). Maternal & Child Health Care of China (中国妇幼保健). 29(16): 2475-2478
C246	Xu-Hong Ling 凌序红 (2014). An analysis of deaths of children under five years old in Liuhe district from 2004 to 2013* (六合区 2004~2013 年 5 岁以下儿童死亡分析). Medical Information (医学信息). 27(12): 353
C247	Fang-Yu Liu, Juan Lu 刘芳妤,路娟 (2014). An analysis of death records of children under 5 years old in Dongling district, Shenyang* (沈阳市东陵区＜5 岁儿童死亡资料分析). hinese Practical Journal of Rural Doctor (中国实用乡村医生杂志). 21(4): 8-9
C248	Hong-Mei Liu 刘红梅 (2014). Discussion on multi death infulencing factors of children under 5 years old* (影响 5 岁以下儿童死亡多因素探讨). Chinese Baby (母婴世界). (14): 87-88
C249	Ming-Xing Liu, Xue Sun 刘明星,孙雪 (2014). An analysis of death causes of children under 5 years old in Xunxi county, China from 2004 to 2013* (郧西县 2004-2013 年 5 岁以下儿童死亡原因分析). China Medical Equipment (中国医学装备). 11(): 79-80
C250	Shi-Ying Liu 刘世英 (2014). An analysis of monitoring deaths of children under 5 years old* (5 岁以下儿童死因监测分析). Health Care Today (现代养生). (12): 56
C251	Hai-Chan Lu 陆海婵 (2014). An analysis of monitoring deaths of children under 5 years old in Lingshan county in 2013* (灵山县 2013 年 5 岁以下儿童死亡监测分析). Yiayao Qianyan (医药前沿). (22): 386-387
C252	Xiao-Fan Luo 罗晓帆 (2014). Review of death of children below 5 years old: an analysis of 191 cases (191 例 5 岁以下儿童死亡评审分析). Henan J Prev Med (河南预防医学杂志). 25(5): 341-343
C253	Guo-Qiang Lu 吕国强 (2014). An analysis of death records of children under five years old in Shaoyang city from 2008 to 2013* (邵阳市 2008 年～2013 年 0～4 岁儿童死亡资料分析). Medical Information (医学信息). 27(5): 126-127
C254	Shao-Ling Meng 孟召苓 (2014). An analysis of monitoring deaths of children under 5 years old in

	Wuqing district, China from 2010 to 2012* (武清区 2010~2012 年 5 岁以下儿童死亡监测分析). Chinese Journal of Urban and Rural Enterprise Hygiene (中国城乡企业卫生). (2): 144-146
C255	Bing-Yu Nong, Bin Yan, et al. 侬炳毓,严斌,等 (2014). An analysis of deaths of children under 5 years ofl in Guangnan County, China from 2008 to 2012* (2008-2012 年广南县 5 岁以下儿童死亡情况分析). Chinese-foreign Women's Health (中外女性健康（下半月）). (1): 90-91
C256	Yi-Ge Qiao, Rong Qu, et al. 乔艺阁,曲荣,等 (2014). Analysis of mortality and death causes of children under five years old in Shushan district of Hefei city from 2008 to 2012 (合肥市蜀山区 2008 至 2012 年 5 岁以下儿童死亡率及死亡原因分析). Anhui Medical Journal (安徽医学). 35(2): 226-229
C257	Zheng Rong 荣征 (2014). An analysis of death monitoring results of children under 5 years old in Yingdong district from 2011 to 2013* (颍东区 2011～2013 年 5 岁以下儿童死亡监测结果分析). Anhui J Prev Med (安徽预防医学杂志). 20(6): 477-478
C258	Xue-Zhen Shen, Chun-Yan Zhang 沈雪珍,章春燕 (2014). Analysis and preventive measure management of deaths of children under 5 years old in Yuhang district, China* (余杭区 5 岁以下儿童死亡情况分析与预防措施管理). Chinese Rural Health Service Administration (中国农村卫生事业管理). 34(4): 450-452
C259	Chun Tang 唐春 (2014). An analysis of monitoring deaths of children under 5 years old in Qianxi county, China from 2009 to 2013* (黔西县 2009--2013 年 5 岁以下儿童死亡监测分析). China Health Care & Nutrition (中国保健营养（下旬刊）). (5): 2895
C260	Chang-Yu Tao, Zhuo-Jian Ni, et al. 陶长余,倪倬健,等 (2014). Study on death of children under five years old and the trend in Haimen from 2003 to 2012 (海门市 2003~2012 年 5 岁以下儿童死亡状况及趋势研究). Maternal & Child Health Care of China (中国妇幼保健). 29(35): 5812-5816
C261	Hong-Lei Wang 王宏蕾 (2014). An analysis of death monitoring results of children under 5 years old in Chengde city from 2009 to 2013* (2009 年-2013 年承德市 5 岁以下儿童死亡监测结果分析). Medicine and Health Care (医药与保健). 22(5): 95-96
C262	Jin Wang 王瑾 (2014). An analysis of deaths of children under 5 years old in Fengcheng city, China from 2009 to 2013* (凤城市 2009-2013 年度 5 岁以下儿童死亡分析). World Health Digest (中外健康文摘). (7): 205
C263	Ying-Xiang Wang, Shu-Kun Zhang, et al. 王英翔,张淑琨,等 (2014). An analysis of monitoring death results and interventions of children under 5 years old in Jiangmen area, China from 2003 to 2013*

(2003 年～2013 年江门地区 5 岁以下儿童死亡监测结果及干预措施分析). Chinese Journal of Birth Health & Heredity (中国优生与遗传杂志). 22(12): 126-127

C264 Chang-Ping Wang 王长平 (2014). The analysis of the death rate of children under the 5 years old from 2009 to 2013, Changfeng county (合肥市长丰县 2009-2013 年 5 岁以下儿童死亡分析). Chinese Journal of Women and Children Health (中国妇幼卫生杂志). 5(6): 57-59

C265 Hong Wu 吴虹 (2014). An analysis of deaths of children under 5 years old in Cuiping district, Yibin city from 2001 to 2010* (宜宾市翠屏区 2001 年--2010 年 5 岁以下儿童死亡分析). China Health Care & Nutrition (中国保健营养（上旬刊）). (1): 479-480

C266 Ying-Hua Wu, Wei-Zhan Chen, et al. 伍颖华,陈伟湛,等 (2014). An analysis of deaths of children under 5 years old in Taishan city, Guangdong province from 2007 to 2012* (广东台山市 2007-2012 年 5 岁以下儿童死亡情况分析). J of Pub Health and Prev Med (公共卫生与预防医学). 25(1): 91-93

C267 Shu-Juan Yan, Xue-Na Zhu 闫淑娟,朱雪娜 (2014). Analysis of mortality rate and causes of death among children under 5 years old in Beijing from 2003 to 2012 (2003-2012 年北京市 5 岁以下儿童死亡率和死亡原因分析). Chin J Prev Med (中华预防医学杂志). 48(6): 484-490

C268 Li-Ping Yang, Li-Rong Tang 阳丽萍,唐丽蓉 (2014). Monitor and analysis of death in children under 5 years during 2009-2012 in Tianmen (天门市 2009-2012 年 5 岁以下儿童死亡监测分析). Morden Preventive Medicine (现代预防医学). 41(12): 2175-2176

C269 Gui-Yun Yang, Jin-Ling Shan, et al. 杨桂芸,单金玲,等 (2014). An analysis of deaths of children under 5 years old in Zhangqiu city, China from 2008 to 2013* (2008～2013 年章丘市 5 岁以下儿童死亡情况分析). China Prac Med (中国实用医药). 9(32): 253-254

C270 Yi Yao, Shu-Rong Kang, et al. 姚亦,康淑蓉,等 (2014). Analysis of mionitoring results in the death of children below 5 years old in Minhang district of Shanghai from 2010 to 2012 (2010—2012 年上海市闵行区 5 岁以下儿童死亡监测结果分析). Chinese Primary Health Care (中国初级卫生保健). 28(4): 40-42

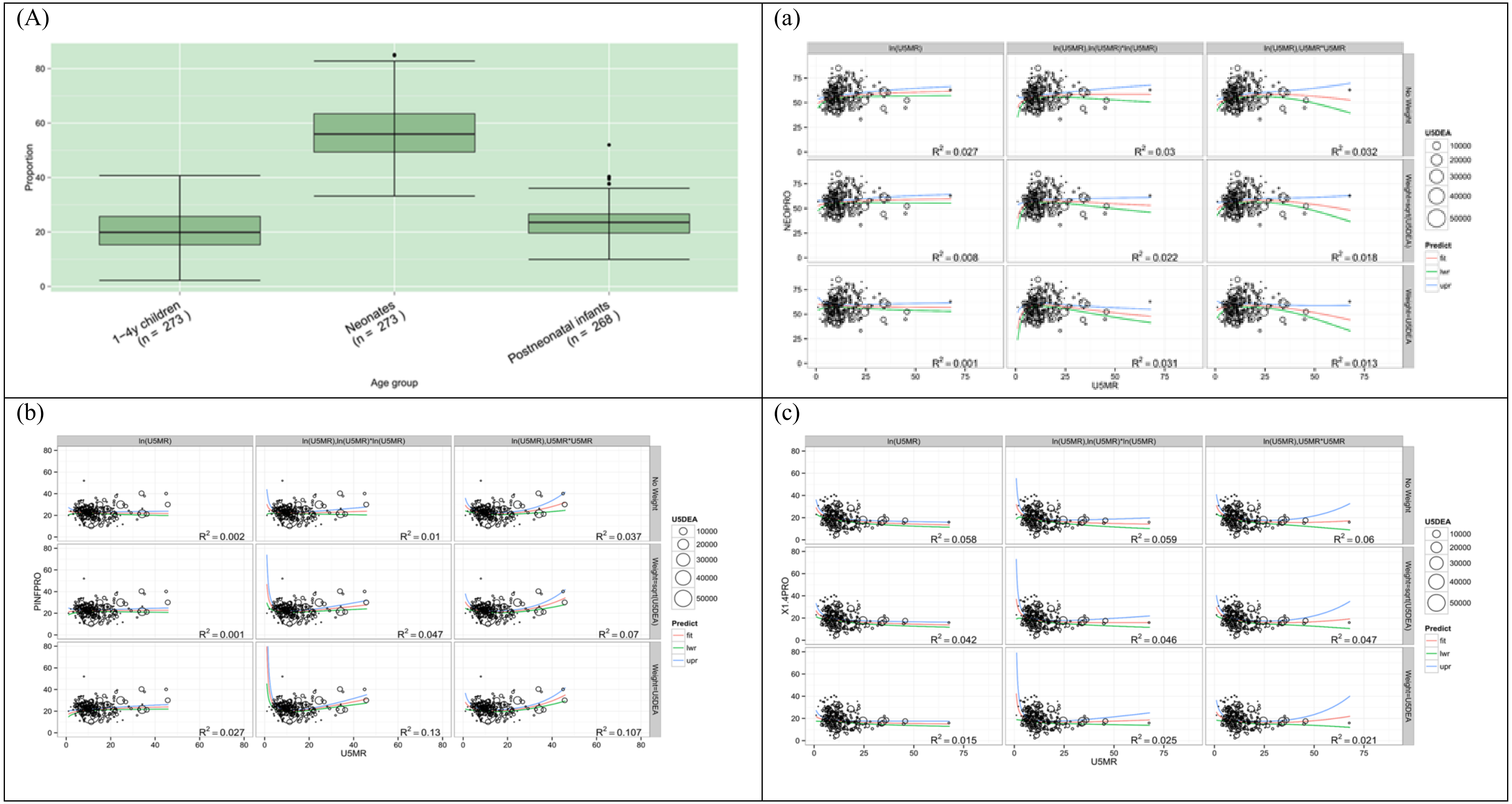
C271 Cheng Zhang, Yong Xu 张诚, 徐勇 (2014). An analysis of monitoring deaths of children under 5 years old in Taicang city from 2004 to 2013* (2004-2013 年太仓市<5 岁儿童死亡监测分析). Jiangsu J Prev Med (江苏预防医学). 25(6): 84-85

C272 Xiao-Mei Zhang 张晓媚 (2014). An analysis of deaths of children under 5 years old in Jiangning district, Nanjing city* (南京市江宁区 5 岁以下儿童死亡分析). Maternal & Child Health Care of China (中国妇幼保健). 29(1): 59-61

C273	Xue-Jiao Zhang, Li-Li Li, et al. 张雪娇,李荔荔,等 (2014). Trend analysis of mortality of children under 5 years in countryside of Shenyang from 2003 to 2012 (2003 至 2012 年沈阳市农村 5 岁以下儿童死亡趋势分析). Chinese Journal of Women and Child Health Research (中国妇幼健康研究). 25(2): 193-195
C274	Xue-Jiao Zhang, Li-Li Li, et al. 张雪娇,李荔荔,等 (2014). Analysis of monitoring mortality result on children under 5 years old in Shenyang from 2008 to 2012 (沈阳市 2008-2012 年 5 岁以下儿童死亡监测结果分析). CJCHC (中国儿童保健杂志). 22(2): 216-218
C275	Xin Zhao 赵昕 (2014). Analysis on death of children under 5 years old from 2008-2012 in Liaoyang city (辽阳市 2008～2012 年 5 岁以下儿童死亡情况分析). China Medicine and Pharmacy (中国医药科学). 4(4): 87-89
C276	Hui-Qin Zhou 周慧琴 (2014). An analysis of death causes of children under five years old in Midu county from 2006 to 2012* (弥渡县 2006~2012 年五岁以下儿童死亡原因分析). Medical Information (医学信息). 27(1): 135-136
C277	Jing Zhou 周晶 (2014). Analysis of the death rate and cause of death among children under 5 years old in Yizheng city from 2006 to 2013 (仪征市 2006-2013 年 5 岁以下儿童死亡率及死亡原因分析). Chinese Journal of Women and Children Health (中国妇幼卫生杂志). 5(6): 60-63
C278	Wen-Li Zhou, Li Chen, et al. 周文莉,陈莉,等 (2014). Analysis of the mortality of the children under five years old in Changning District from 2007-2013 (长宁区 2007-2013 年 5 岁以下儿童死亡状况分析). hanghai Medical & Pharmaceutical Journal (上海医药). 35(20): 43-45
C279	Han-Fei Zhu, Lu Liu, et al. 朱寒飞,刘璐,等 (2014). Analysis and countermeasures of deaths of children under 5 years old in Ningbo city from 2006 to 2011* (2006 至 2011 年宁波市 5 岁以下儿童死亡分析及对策). Zhejiang Clinical Medical Journal (浙江临床医学). 16(5): 768-769
C280	Shun-Li Zhu 朱顺利 (2014). An analysis of death monitoring situation of children under 5 years old in Ludian county, China from 2008 to 2013* (鲁甸县 2008--2013 年 5 岁以下儿童死亡监测情况分析). China Health Care & Nutrition (中国保健营养（上旬刊）). (6): 3519
C281	Yu-Qing Sun, Dong-Lei Geng 孙玉清，耿东磊 (2009) Relavent factors of life monitoring results of children under 5 years old in Mishan city from 2001 to 2008 * (密山市 2001 年-2008 年 5 岁以下儿童生命监测结果相关因素分析). World Health Digest Medical Periodical 中外健康文摘,6(02X):194-195.
C282	Hui-Lian Zhan 詹会莲 (2009) Tendency analysis of death causes of pre-term births in Lijiang city

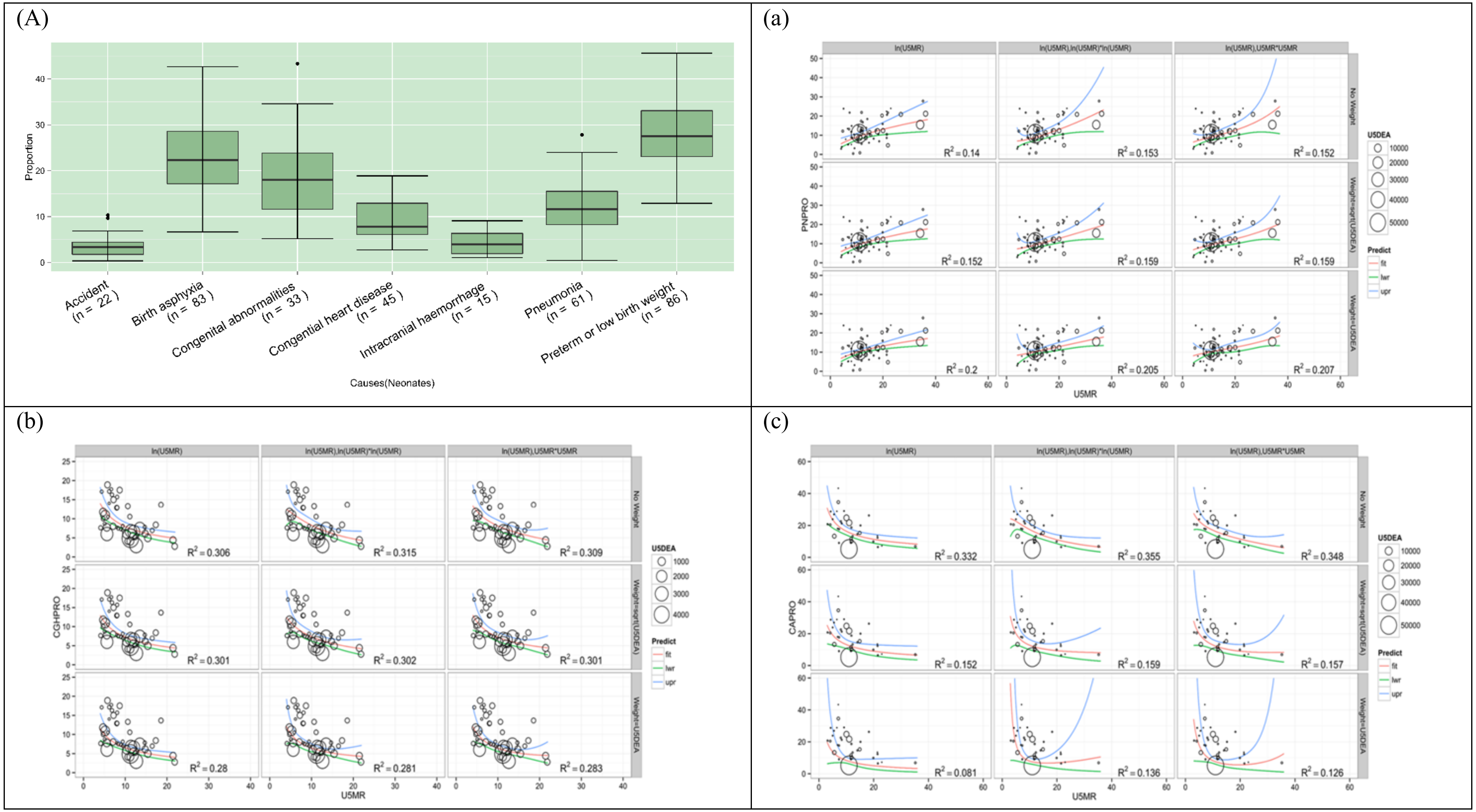
	from 1999 to 2008 * (丽江市 1999～2008 年早产儿死亡趋势及死因分析). CJCHC 中国儿童保健杂志,17(4):495-496.
C283	Hong Zhao, Zhen-Ju Jin 赵鸿，金真菊 (2009) Death factors of 1509 neonates * (1509 例新生儿死亡因素分析). Chinese Journal of Woman and Child Health Research 中国妇幼健康研究,20(6):686-688.
C284	Run Zhong, Jian-Wei Nong, et al. 钟润，农建伟，等 (2009). Result analysis of life monitoring of children under 5 years old in Baise city in recent 10 years * (百色市 5 岁以下儿童生命监测 10 年结果分析). CJCHC 中国儿童保健杂志,17(2):228-229.
C285	Zhi-Bin Chen 陈志斌 (2011) Result analysis of life monitoring of children under 5 years old in Pengyang county * (彭阳县 5 岁以下儿童生命监测结果分析).Maternal & Child Health Care of China 中国妇幼保健,26(28):4364-4365.
C286	Zi-Wei Wang 王子位 (2014) An analysis and countermeasures of death causes of children under 5 years old in Longling county from 2007 to 2011 (龙陵县 2007--2011 年 5 岁以下儿童死因分析及对策). China Health & Nutrition 中国保健营养（上旬刊）,(4):2283.
ID	Studies published in English (N=2)
E1	Huo K, Zhao Y, Feng H, Yao M, Savman K, Wang X, et al. Mortality rates of children aged under five in Henan province, China, 2004-2008. Paediatr Perinat Epidemiol. 2010 1990-07-01;24(4):343-8.
E2	Yi B, Wu L, Liu H, Fang W, Hu Y, Wang Y. Rural-urban differences of neonatal mortality in a poorly developed province of China. BMC PUBLIC HEALTH. 2011;11:477.

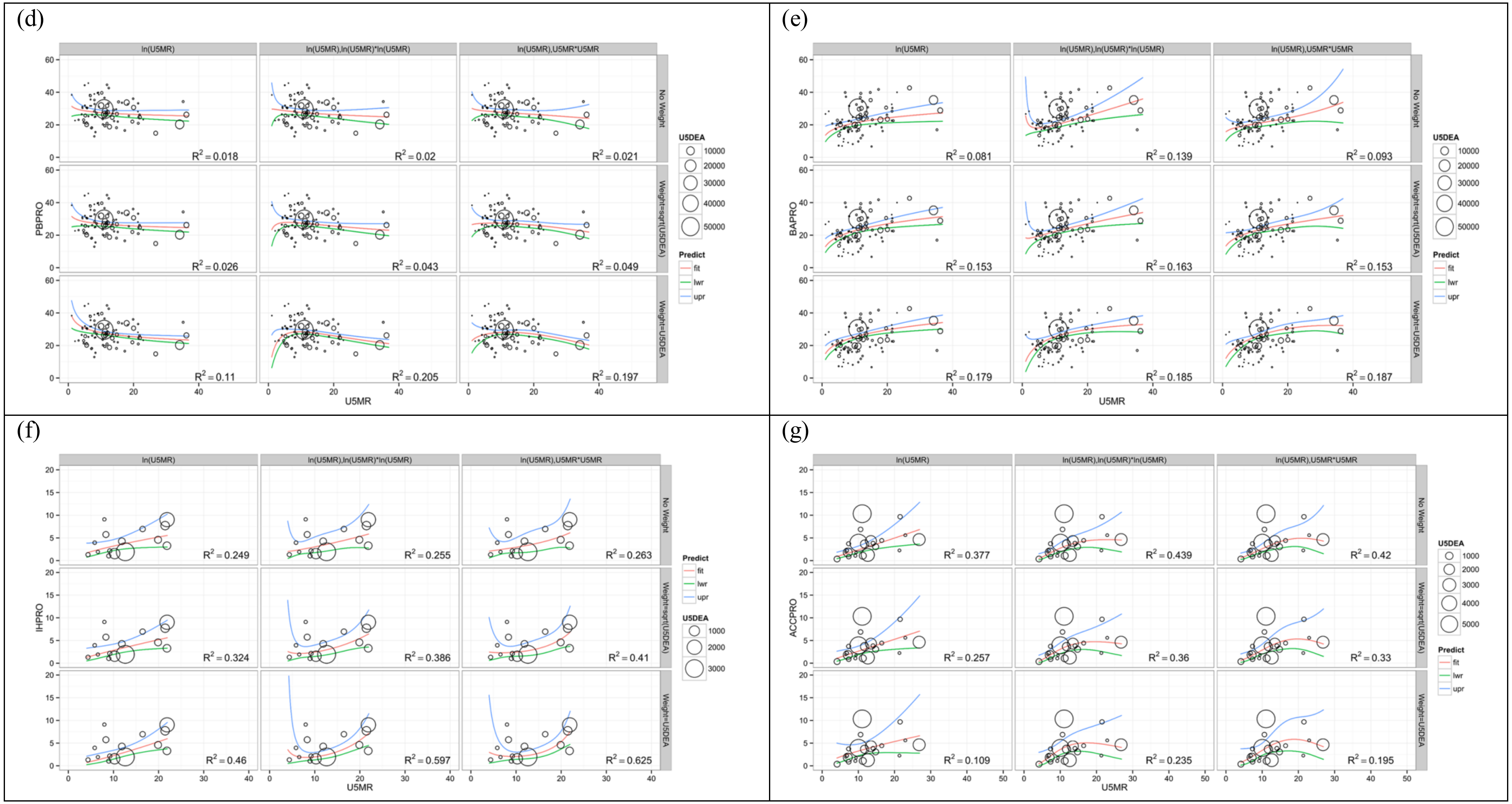
Note: The Chinese publication list employed the journals' official English names or abbreviations, English titles were obtained from journals or literature databases (CNKI, Wanfang and VIP). Where official English translation of journal names is not available, a pinyin title is adopted; where the Englishes translation of titles is not available, I translated the titles, lebelled with "" and marked as green.


(A)
Proportion
Age group
1–4y children (n = 273)
Neonates (n = 273)
Postneonatal infants (n = 268)
(a)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
NEOPRO
U5MR
U5DEA
Predict
fit
lwr
upr
R² = 0.027
R² = 0.03
R² = 0.032
R² = 0.008
R² = 0.022
R² = 0.018
R² = 0.001
R² = 0.031
R² = 0.013
(b)
PINFPRO
U5MR
R² = 0.002
R² = 0.01
R² = 0.037
R² = 0.001
R² = 0.047
R² = 0.07
R² = 0.027
R² = 0.13
R² = 0.107
(c)
X1.4PRO
U5MR
R² = 0.058
R² = 0.059
R² = 0.06
R² = 0.042
R² = 0.046
R² = 0.047
R² = 0.015
R² = 0.025
R² = 0.021

Appendix Figure 1 The association between U5MR and proportions of different age groups in children under five years based on the nine testing models

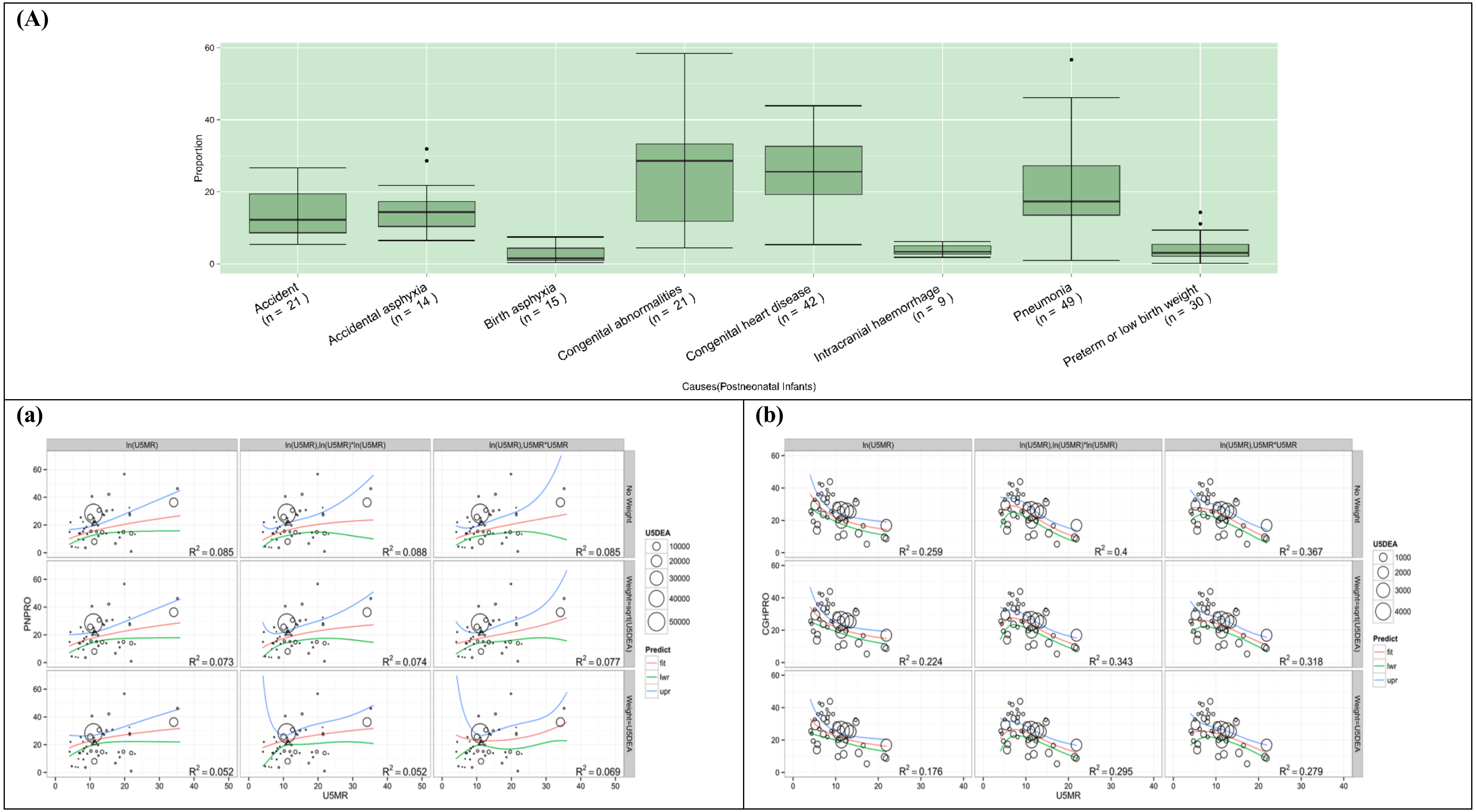
*Note: (A) Box–and–whisker plot of the proportions (Y-axis) of three separate age group: medians, inter–quartile ranges, maximum and minimum value observed in the studies that provided adequate information, the number of studies available for each age group is presented below X–axis; (a) The association between U5MR and proportions of neonates in children under five years based on the nine testing models; (b) The association between U5MR and proportions of postneonates in children under five years based on the nine testing models; (c) The association between U5MR and proportions of 1-4 years children in children under five years based on the nine testing models; Data points represent studies with available information and the size of the "bubbles" is proportional to the total number of child deaths observed in each study, 95% confidence interval is shown across the range of data with lower (lwr) and upper (upr) confidence bounds.


(A)
Proportion
Accident (n = 22)
Birth asphyxia (n = 83)
Congenital abnormalities (n = 33)
Congentital heart disease (n = 45)
Intracranial haemorrhage (n = 15)
Pneumonia (n = 61)
Preterm or low birth weight (n = 86)
Causes(Neonates)
(a)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
PNPRO
U5MR
U5DEA
Predict
fit
lwr
upr
$R^2 = 0.14$
$R^2 = 0.153$
$R^2 = 0.152$
$R^2 = 0.152$
$R^2 = 0.159$
$R^2 = 0.159$
$R^2 = 0.2$
$R^2 = 0.205$
$R^2 = 0.207$
(b)
CGHPRO
U5MR
$R^2 = 0.306$
$R^2 = 0.315$
$R^2 = 0.309$
$R^2 = 0.301$
$R^2 = 0.302$
$R^2 = 0.301$
$R^2 = 0.28$
$R^2 = 0.281$
$R^2 = 0.283$
(c)
CAPRO
U5MR
$R^2 = 0.332$
$R^2 = 0.355$
$R^2 = 0.348$
$R^2 = 0.152$
$R^2 = 0.159$
$R^2 = 0.157$
$R^2 = 0.081$
$R^2 = 0.136$
$R^2 = 0.126$

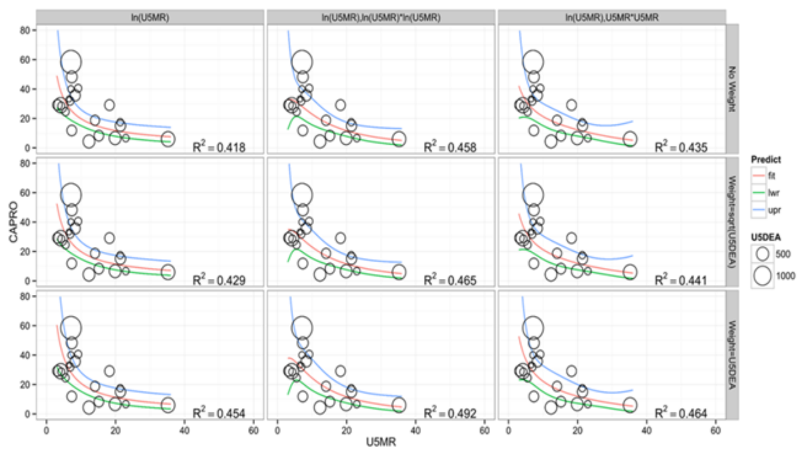

(d)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
PBPRO
U5MR
$R^2 = 0.018$
$R^2 = 0.02$
$R^2 = 0.021$
$R^2 = 0.026$
$R^2 = 0.043$
$R^2 = 0.049$
$R^2 = 0.11$
$R^2 = 0.205$
$R^2 = 0.197$
U5DEA
10000
20000
30000
40000
50000
Predict
fit
lwr
upr
(e)
BAPRO
$R^2 = 0.081$
$R^2 = 0.139$
$R^2 = 0.093$
$R^2 = 0.153$
$R^2 = 0.163$
$R^2 = 0.153$
$R^2 = 0.179$
$R^2 = 0.185$
$R^2 = 0.187$
(f)
IHPRO
$R^2 = 0.249$
$R^2 = 0.255$
$R^2 = 0.263$
$R^2 = 0.324$
$R^2 = 0.386$
$R^2 = 0.41$
$R^2 = 0.46$
$R^2 = 0.597$
$R^2 = 0.625$
U5DEA
1000
2000
3000
(g)
ACCPRO
$R^2 = 0.377$
$R^2 = 0.439$
$R^2 = 0.42$
$R^2 = 0.257$
$R^2 = 0.36$
$R^2 = 0.33$
$R^2 = 0.109$
$R^2 = 0.235$
$R^2 = 0.195$
U5DEA
1000
2000
3000
4000
5000

Appendix Figure 2 The association between U5MR and proportion of deaths in neonates due to the selected causes based on the nine testing models

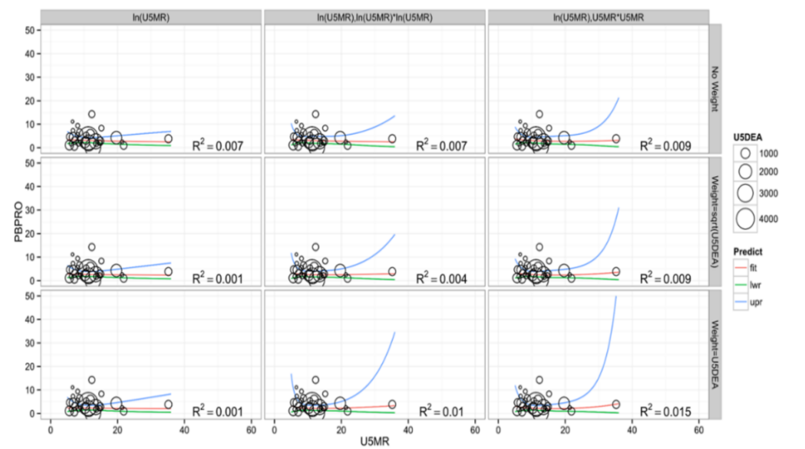
*Note: (A) Box–and–whisker plot of proportions (Y-axis) of different causes of death in neonates: medians, inter–quartile ranges, maximum and minimum value observed in the studies that provided adequate information, the number of studies available for each age group is presented below X–axis; (a) The association between U5MR and proportions of deaths due to pneumonia in neonates based on the nine testing models; (b) The association between U5MR and proportions of deaths due to congenital heart disease in neonates based on the nine testing models; (c) The association between U5MR and proportions of deaths due to congenital abnormalities in neonates based on the nine testing models; (d) The association between U5MR and proportions of deaths due to preterm or low birth weight in neonates based on the nine testing models; (e) The association between U5MR and proportions of deaths due to birth asphyxia in neonates based on the nine testing models; (f) The association between U5MR and proportions of deaths due to intracranial haemorrhage in neonates based on the nine testing models; (g) The association between U5MR and proportions of deaths due to accident in neonates based on the nine testing models; Data points represent studies with available information and the size of the “bubbles” is proportional to the total number of child deaths observed in each study, 95% confidence interval is shown across the range of data with lower (lwr) and upper (upr) confidence bounds.


(A)
Proportion
Accident (n = 21)
Accidental asphyxia (n = 14)
Birth asphyxia (n = 15)
Congenital abnormalities (n = 21)
Congenital heart disease (n = 42)
Intracranial haemorrhage (n = 9)
Pneumonia (n = 49)
Preterm or low birth weight (n = 30)
Causes(Postneonatal Infants)
(a)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
PNPRO
U5MR
U5DEA
Predict
fit
lwr
upr
(b)
CGHPRO
U5MR

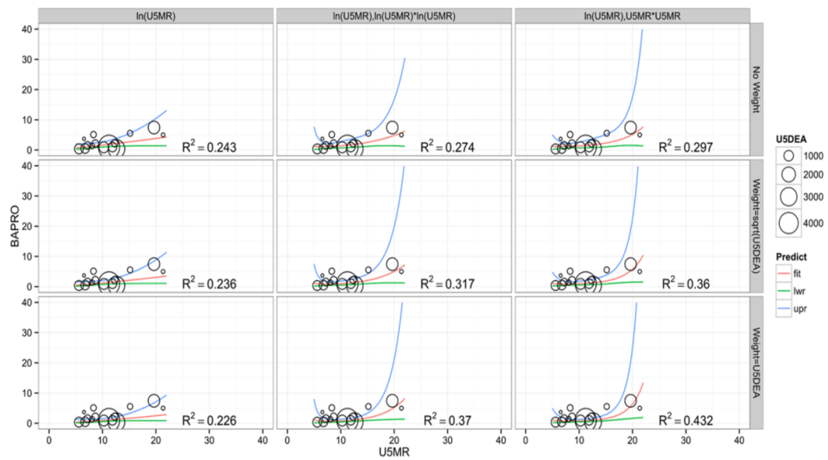
(c)


ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
CAPRO
U5MR
Predict
fit
lwr
upr
U5DEA
500
1000
$R^2 = 0.418$
$R^2 = 0.458$
$R^2 = 0.435$
$R^2 = 0.429$
$R^2 = 0.465$
$R^2 = 0.441$
$R^2 = 0.454$
$R^2 = 0.492$
$R^2 = 0.464$

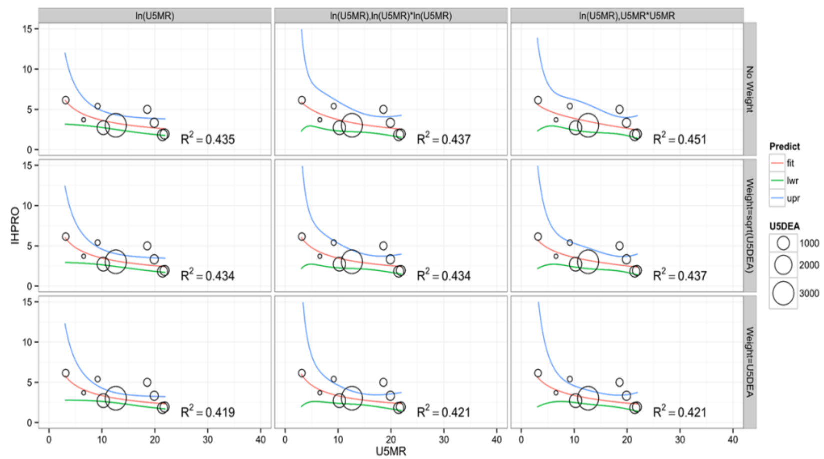
(d)


ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
PBPRO
U5MR
U5DEA
1000
2000
3000
4000
Predict
fit
lwr
upr
$R^2 = 0.007$
$R^2 = 0.007$
$R^2 = 0.009$
$R^2 = 0.001$
$R^2 = 0.004$
$R^2 = 0.009$
$R^2 = 0.001$
$R^2 = 0.01$
$R^2 = 0.015$

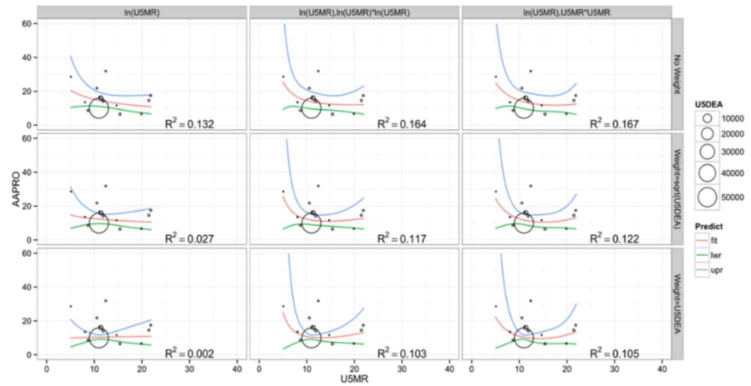
(e)


ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
BAPRO
U5MR
U5DEA
1000
2000
3000
4000
Predict
fit
lwr
upr
$R^2 = 0.243$
$R^2 = 0.274$
$R^2 = 0.297$
$R^2 = 0.236$
$R^2 = 0.317$
$R^2 = 0.36$
$R^2 = 0.226$
$R^2 = 0.37$
$R^2 = 0.432$

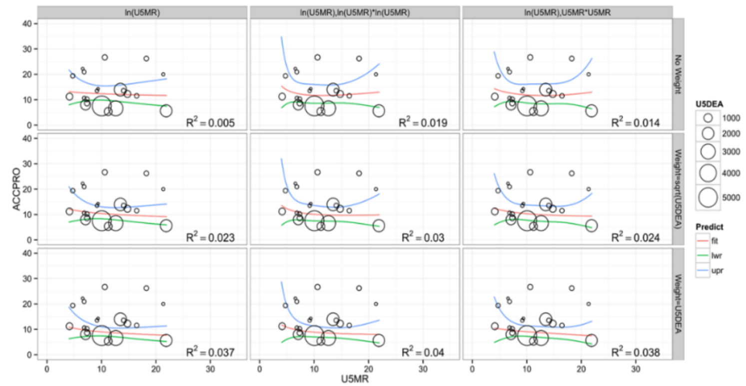
(f)


ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
IHPRO
U5MR
Predict
fit
lwr
upr
U5DEA
1000
2000
3000
$R^2 = 0.435$
$R^2 = 0.437$
$R^2 = 0.451$
$R^2 = 0.434$
$R^2 = 0.434$
$R^2 = 0.437$
$R^2 = 0.419$
$R^2 = 0.421$
$R^2 = 0.421$

(g)

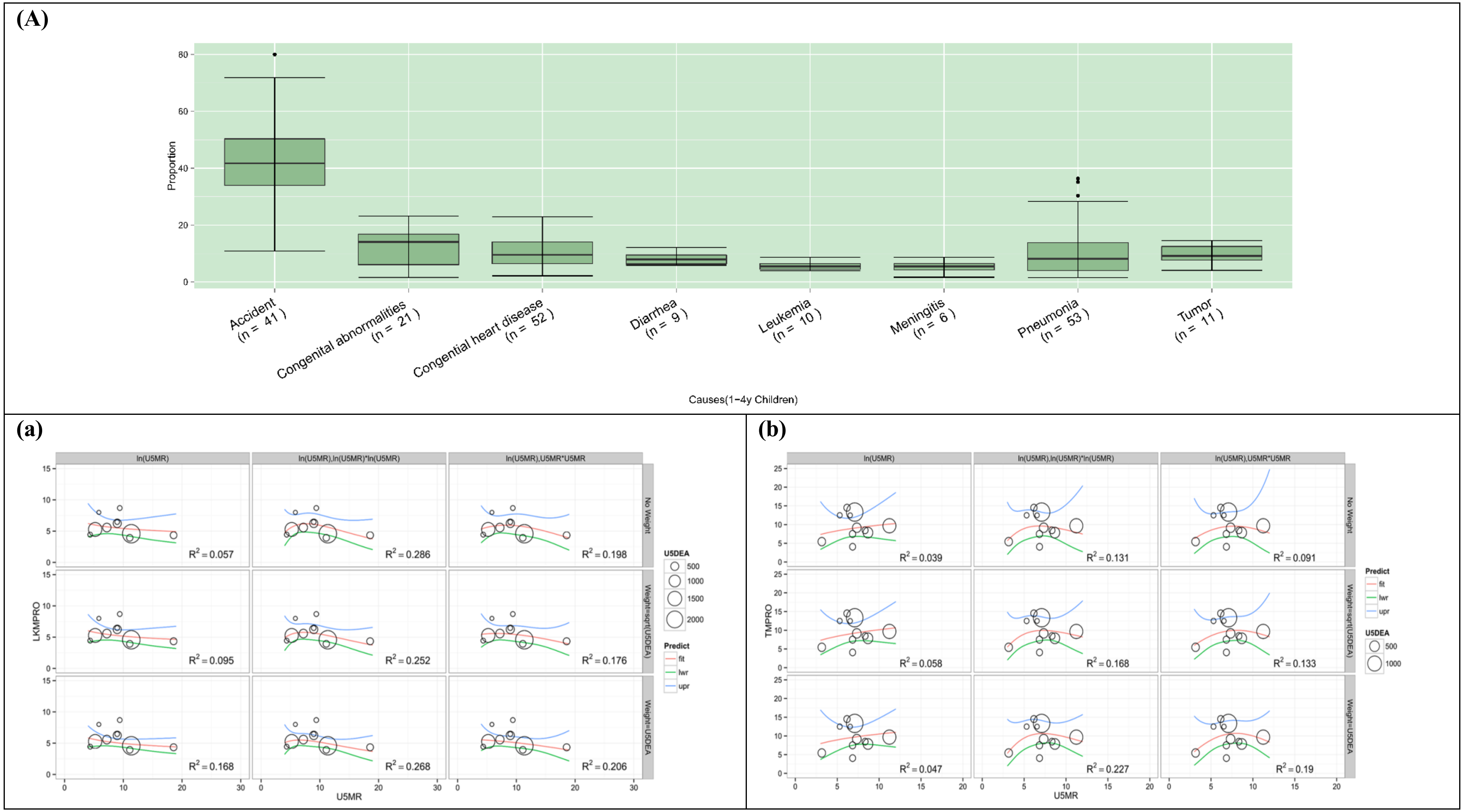


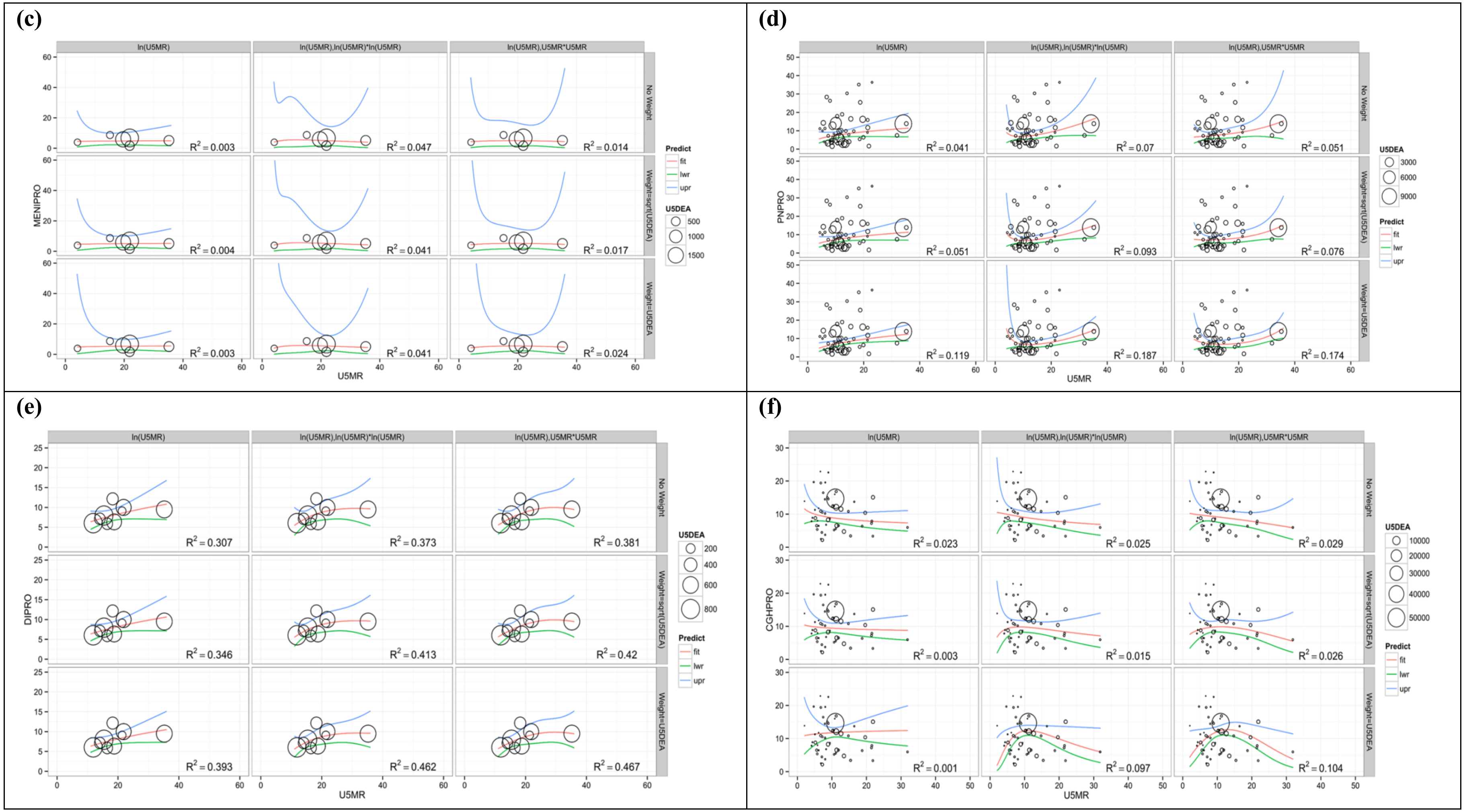
(h)

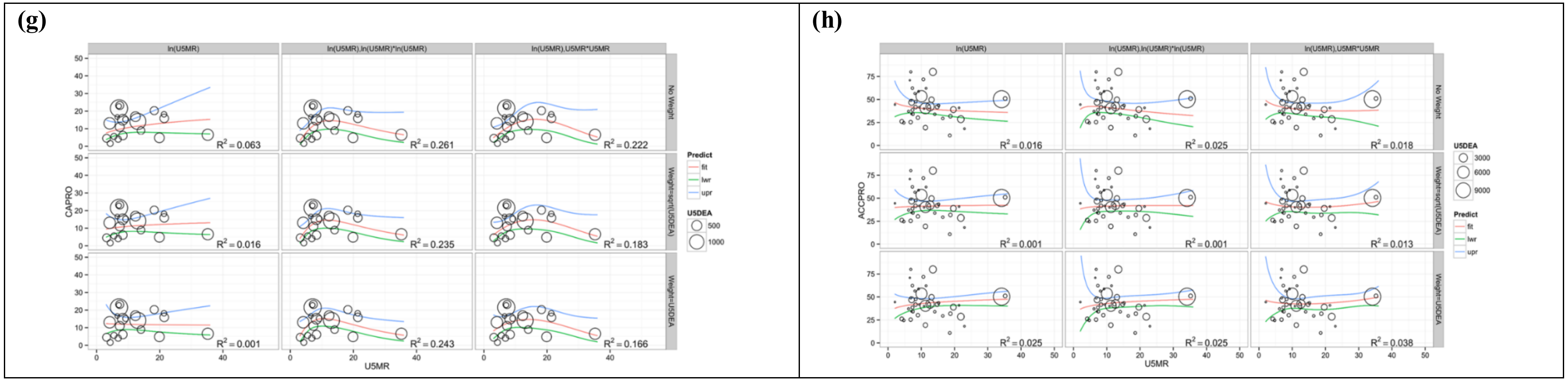


Appendix Figure 3 The association between U5MR and proportion of deaths in postneonatal infants due to the selected causes based on the nine testing models

*Note: (A) Box–and–whisker plot of the proportions (Y-axis) of different cause of death in postneonatal infant: medians, inter–quartile ranges, maximum and minimum value observed in the studies that provided adequate information. The number of studies available for each age group is presented below X–axis; (a) The association between U5MR and proportions of deaths due to pneumonia in postneonatal infants based on the nine testing models; (b) The association between U5MR and proportions of deaths due to congenital heart disease in postneonatal infants based on the nine testing models; (c) The association between U5MR and proportions of deaths due to congenital abnormalities in postneonatal infants based on the nine testing models; (d) The association between U5MR and proportions of deaths due to preterm or low birth weight in postneonatal infants based on the nine testing models; (e) The association between U5MR and proportions of deaths due to birth asphyxia in postneonatal infants based on the nine testing models; (f) The association between U5MR and proportions of deaths due to intracranial haemorrhage in postneonatal infants based on the nine testing models; (g) The association between U5MR and proportions of deaths due to accidental asphyxia in postneonatal infants based on the nine testing models; (h) The association between U5MR and proportions of deaths due to accident in postneonatal infants based on the nine testing models; Data points represent studies with available information and the size of the "bubbles" is proportional to the total number of child deaths observed in each study, 95% confidence interval is shown across the range of data with lower (lwr) and upper (upr) confidence bounds.

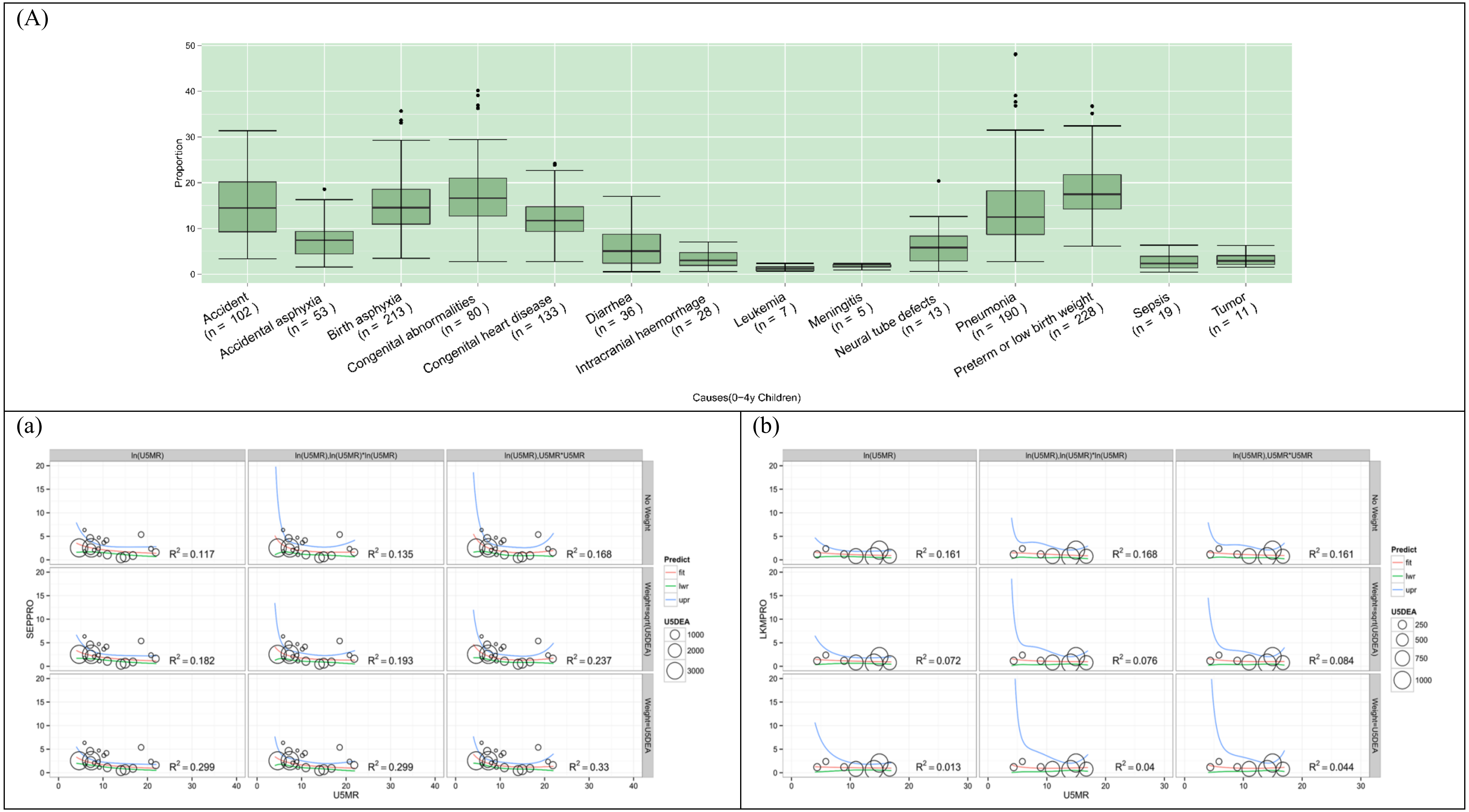

(A)
Proportion
Accident (n = 41)
Congenital abnormalities (n = 21)
Congenital heart disease (n = 52)
Diarrhea (n = 9)
Leukemia (n = 10)
Meningitis (n = 6)
Pneumonia (n = 53)
Tumor (n = 11)
Causes(1−4y Children)
(a)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
LKMPRO
U5MR
R² = 0.057
R² = 0.286
R² = 0.198
R² = 0.095
R² = 0.252
R² = 0.176
R² = 0.168
R² = 0.268
R² = 0.206
U5DEA
500
1000
1500
2000
Predict
fit
lwr
upr
(b)
TMPRO
U5MR
R² = 0.039
R² = 0.131
R² = 0.091
R² = 0.058
R² = 0.168
R² = 0.133
R² = 0.047
R² = 0.227
R² = 0.19

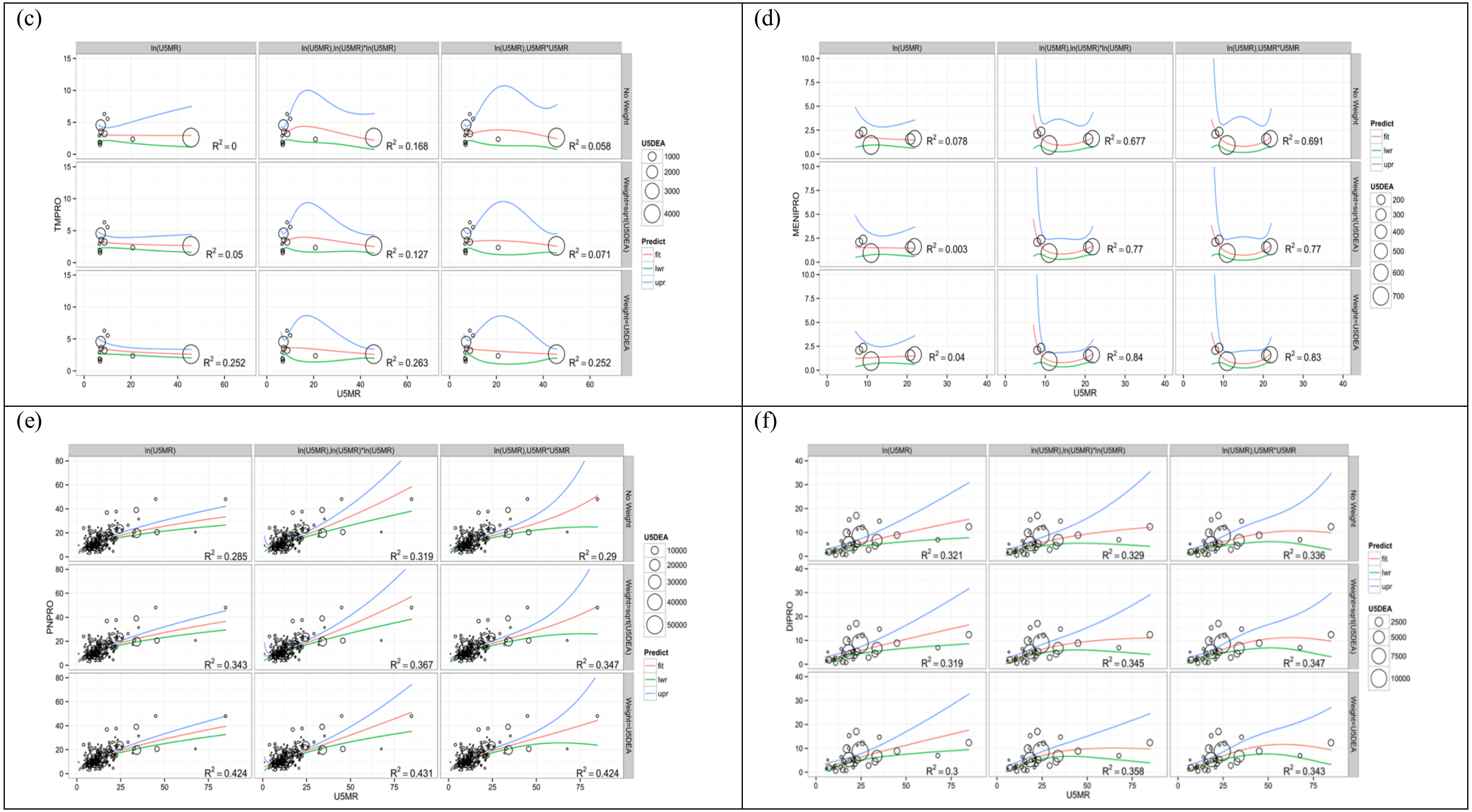

(c)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
MENIPRO
U5MR
R² = 0.003
R² = 0.047
R² = 0.014
R² = 0.004
R² = 0.041
R² = 0.017
R² = 0.003
R² = 0.041
R² = 0.024
Predict
fit
lwr
upr
U5DEA
500
1000
1500
(d)
PNPRO
U5MR
R² = 0.041
R² = 0.07
R² = 0.051
R² = 0.051
R² = 0.093
R² = 0.076
R² = 0.119
R² = 0.187
R² = 0.174
U5DEA
3000
6000
9000
(e)
DIPRO
U5MR
R² = 0.307
R² = 0.373
R² = 0.381
R² = 0.346
R² = 0.413
R² = 0.42
R² = 0.393
R² = 0.462
R² = 0.467
U5DEA
200
400
600
800
(f)
CGHPRO
U5MR
R² = 0.023
R² = 0.025
R² = 0.029
R² = 0.003
R² = 0.015
R² = 0.026
R² = 0.001
R² = 0.097
R² = 0.104
U5DEA
10000
20000
30000
40000
50000



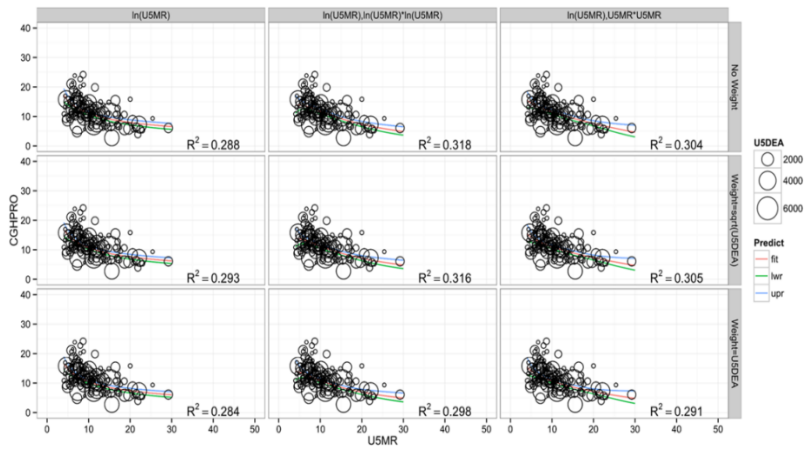
Appendix Figure 4 The association between U5MR and proportion of deaths in 1-4 years children due to the selected causes based on the nine tested models

*Note: (A) Box–and–whisker plot of the proportions (Y-axis) of different cause of death in 1-4 years children: medians, inter–quartile ranges, maximum and minimum value observed in the studies that provided adequate information, the number of studies available for each age group is presented below X–axis; (a) The association between U5MR and proportions of deaths due to leukemia in 1-4 years children based on the nine testing models; (b) The association between U5MR and proportions of deaths due to tumor in 1-4 years children based on the nine testing models; (c) The association between U5MR and proportions of deaths due to meningitis in 1-4 years children based on the nine testing models; (d) The association between U5MR and proportions of deaths due to pneumonia in 1-4 years children based on the nine testing models; (e) The association between U5MR and proportions of deaths due to diarrhea in 1-4 years children based on the nine testing models; (f) The association between U5MR and proportions of deaths due to congenital heart disease in 1-4 years children based on the nine testing models; (g) The association between U5MR and proportions of deaths due to congenital abnormalities in 1-4 years children based on the nine testing models; (h) The association between U5MR and proportions of deaths due to accident in 1-4 years children based on the nine testing models; Data points represent studies with available information and the size of the "bubbles" is proportional to the total number of child deaths observed in each study, 95% confidence interval is shown across the range of data with lower (lwr) and upper (upr) confidence bounds.

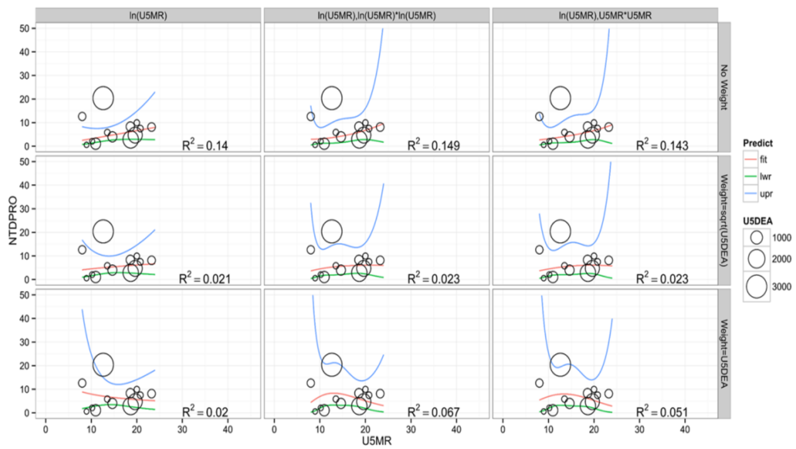

(A)
Proportion
Accident (n = 102)
Accidental asphyxia (n = 53)
Birth asphyxia (n = 213)
Congenital abnormalities (n = 80)
Congenital heart disease (n = 133)
Diarrhea (n = 36)
Intracranial haemorrhage (n = 28)
Leukemia (n = 7)
Meningitis (n = 5)
Neural tube defects (n = 13)
Pneumonia (n = 190)
Preterm or low birth weight (n = 228)
Sepsis (n = 19)
Tumor (n = 11)
Causes(0−4y Children)
(a)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
SEPPRO
U5MR
R² = 0.117
R² = 0.135
R² = 0.168
R² = 0.182
R² = 0.193
R² = 0.237
R² = 0.299
R² = 0.299
R² = 0.33
Predict
fit
lwr
upr
U5DEA
1000
2000
3000
(b)
LKMPRO
R² = 0.161
R² = 0.168
R² = 0.161
R² = 0.072
R² = 0.076
R² = 0.084
R² = 0.013
R² = 0.04
R² = 0.044
250
500
750
1000


(c)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
TMPRO
U5MR
$R^2 = 0$
$R^2 = 0.168$
$R^2 = 0.058$
$R^2 = 0.05$
$R^2 = 0.127$
$R^2 = 0.071$
$R^2 = 0.252$
$R^2 = 0.263$
$R^2 = 0.252$
U5DEA
1000
2000
3000
4000
Predict
fit
lwr
upr
(d)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
MENIPRO
U5MR
$R^2 = 0.078$
$R^2 = 0.677$
$R^2 = 0.691$
$R^2 = 0.003$
$R^2 = 0.77$
$R^2 = 0.77$
$R^2 = 0.04$
$R^2 = 0.84$
$R^2 = 0.83$
Predict
fit
lwr
upr
U5DEA
200
300
400
500
600
700
(e)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
PNPRO
U5MR
$R^2 = 0.285$
$R^2 = 0.319$
$R^2 = 0.29$
$R^2 = 0.343$
$R^2 = 0.367$
$R^2 = 0.347$
$R^2 = 0.424$
$R^2 = 0.431$
$R^2 = 0.424$
U5DEA
10000
20000
30000
40000
50000
Predict
fit
lwr
upr
(f)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
DIPRO
U5MR
$R^2 = 0.321$
$R^2 = 0.329$
$R^2 = 0.336$
$R^2 = 0.319$
$R^2 = 0.345$
$R^2 = 0.347$
$R^2 = 0.3$
$R^2 = 0.358$
$R^2 = 0.343$
Predict
fit
lwr
upr
U5DEA
2500
5000
7500
10000

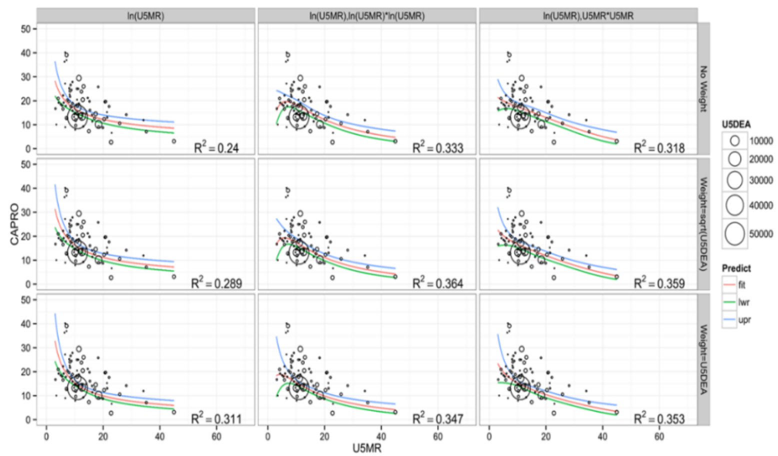
(g)


ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
CGHPRO
U5MR
U5DEA
2000
4000
6000
Predict
fit
lwr
upr
R² = 0.288
R² = 0.318
R² = 0.304
R² = 0.293
R² = 0.316
R² = 0.305
R² = 0.284
R² = 0.298
R² = 0.291

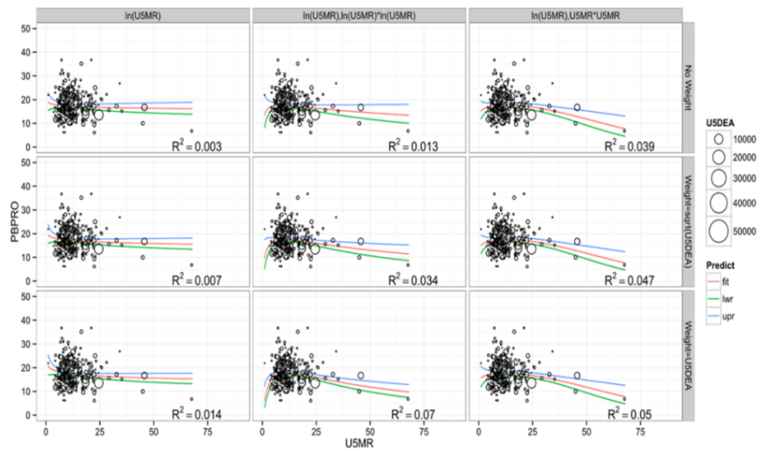
(h)

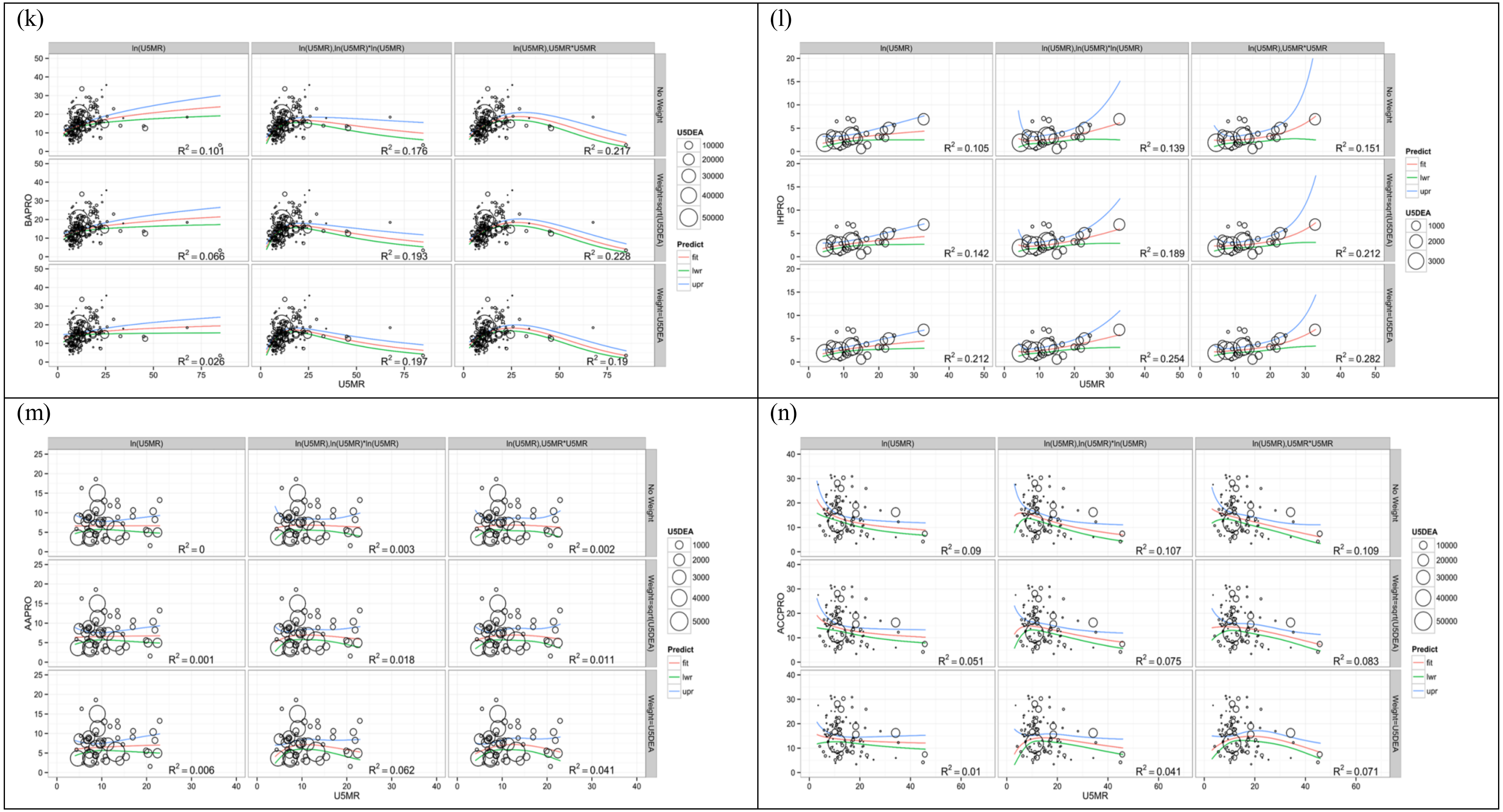

ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
NTDPRO
U5MR
Predict
fit
lwr
upr
U5DEA
1000
2000
3000
R² = 0.14
R² = 0.149
R² = 0.143
R² = 0.021
R² = 0.023
R² = 0.023
R² = 0.02
R² = 0.067
R² = 0.051

(i)


ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
CAPRO
U5MR
U5DEA
10000
20000
30000
40000
50000
Predict
fit
lwr
upr
R² = 0.24
R² = 0.333
R² = 0.318
R² = 0.289
R² = 0.364
R² = 0.359
R² = 0.311
R² = 0.347
R² = 0.353

(j)


ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
PBPRO
U5MR
U5DEA
10000
20000
30000
40000
50000
Predict
fit
lwr
upr
R² = 0.003
R² = 0.013
R² = 0.039
R² = 0.007
R² = 0.034
R² = 0.047
R² = 0.014
R² = 0.07
R² = 0.05


(k)
ln(U5MR)
ln(U5MR),ln(U5MR)*ln(U5MR)
ln(U5MR),U5MR*U5MR
No Weight
Weight=sqrt(U5DEA)
Weight=U5DEA
BAPRO
U5MR
U5DEA
Predict
fit
lwr
upr
R² = 0.101
R² = 0.176
R² = 0.217
R² = 0.066
R² = 0.193
R² = 0.228
R² = 0.026
R² = 0.197
R² = 0.19
(l)
IHPRO
R² = 0.105
R² = 0.139
R² = 0.151
R² = 0.142
R² = 0.189
R² = 0.212
R² = 0.212
R² = 0.254
R² = 0.282
(m)
AAPRO
R² = 0
R² = 0.003
R² = 0.002
R² = 0.001
R² = 0.018
R² = 0.011
R² = 0.006
R² = 0.062
R² = 0.041
(n)
ACCPRO
R² = 0.09
R² = 0.107
R² = 0.109
R² = 0.051
R² = 0.075
R² = 0.083
R² = 0.01
R² = 0.041
R² = 0.071

Appendix Figure 5 The association between U5MR and proportion of deaths in children under five years due to the selected causes based on the nine testing models

*Note: (A) Box–and–whisker plot of the proportions (Y-axis) of different cause of death in in children under five years: medians, inter–quartile ranges, maximum and minimum value observed in the studies that provided adequate information, the number of studies available for each age group is presented below X–axis; (a) The association between U5MR and proportions of deaths due to sepsis in children under five years based on the nine testing models; (b) The association between U5MR and proportions of deaths due to leukemia in children under five years based on the nine testing models; (c) The association between U5MR and proportions of deaths due to tumor in children under five years based on the nine testing models; (d) The association between U5MR and proportions of deaths due to meningitis in children under five years based on the nine testing models; (e) The association between U5MR and proportions of deaths due to pneumonia in children under five years based on the nine testing models; (f) The association between U5MR and proportions of deaths due to diarrhea in children under five years based on the nine testing models; (g) The association between U5MR and proportions of deaths due to congenital heart disease in children under five years based on the nine testing models; (h) The association between U5MR and proportions of deaths due to neural tube defects in children under five years based on the nine testing models; (i) The association between U5MR and proportions of deaths due to congenital abnormalities in children under five years based on the nine testing models; (j) The association between U5MR and proportions of deaths due to preterm or low birth weight in children under five years based on the nine testing models; (k) The association between U5MR and proportions of deaths due to birth asphyxia in children under five years based on the nine testing models; (l) The association between U5MR and proportions of deaths due to intracranial haemorrhage in children under five years based on the nine testing models; (m) The association between U5MR and proportions of deaths due to accidental asphyxia in children under five years based on the nine testing models; (n) The association between U5MR and proportions of deaths due to accident in children under five years based on the nine testing models; Data points represent studies with available information and the size of the "bubbles" is proportional to the total number of child deaths observed in each study, 95% confidence interval is shown across the range of data with lower (lwr) and upper (upr) confidence bounds.

Appendix Table 6 Detailed estimates for the year 2009

	PROVINCE (1-31)	LIVE BIRTHS (Ch.Bu.Stat. 2009)	LIVE BIRTHS (Fitted to UN 2009)	U5MR (IHME 2013)	TOTAL dths (UN+IHME)	U5MR (CHERG 2009)	Number of deaths in each province by age group			
							Neonatal	1m-1yr	1yr-4yr	Total
1	Anhui	801583	877798	12.8	11236	16.7	7981	3040	3612	14633
2	Beijing	146329	160242	4.9	785	6.4	538	224	261	1023
3	Chongqing	282051	308868	13.9	4293	18.1	3038	1180	1374	5591
4	Fujian	445605	487973	9.6	4685	12.5	3343	1231	1526	6101
5	Gansu	340060	372392	25.7	9570	33.5	6359	3251	2854	12464
6	Guangdong	1179355	1291488	6.7	8653	8.7	6097	2314	2858	11269
7	Guangxi Zhuang AR	685261	750416	12.5	9380	16.3	6669	2529	3019	12216
8	Guizhou	486827	533115	21.2	11302	27.6	7709	3526	3484	14719
9	Hainan	125929	137903	17.5	2413	22.8	1680	704	760	3143
10	Hebei	906587	992785	13.8	13700	18.0	9698	3759	4386	17843
11	Heilongjiang	286147	313354	12.6	3948	16.4	2806	1066	1270	5142
12	Henan	1082941	1185907	13.3	15773	17.3	11185	4297	5060	20541
13	Hubei	541829	593347	12.5	7417	16.3	5273	1999	2387	9659
14	Hunan	834287	913610	11.1	10141	14.5	7232	2692	3283	13207
15	Jiangsu	743563	814261	6.2	5048	8.1	3538	1366	1671	6575
16	Jiangxi	612499	670736	17.1	11470	22.3	8000	3320	3618	14937
17	Jilin	183105	200515	8.4	1684	10.9	1199	443	552	2194
18	Liaoning	262277	287214	8.7	2499	11.3	1781	656	817	3254
19	Neimenggu (Inner Mongolia) AR	234561	256863	15.4	3956	20.1	2782	1113	1258	5152
20	Ningxia Hui AR	89372	97869	18.4	1801	24.0	1248	534	564	2345
21	Qinghai	80603	88267	21.7	1915	28.3	1303	603	588	2495
22	Shaanxi (Qin)	381184	417427	16.2	6762	21.1	4737	1927	2142	8807
23	Shandong	1104890	1209942	9.9	11978	12.9	8550	3153	3897	15600
24	Shanghai	187963	205835	6.9	1420	9.0	1003	378	469	1850
25	Shanxi (Jin)	371645	406981	10.3	4192	13.4	2992	1106	1361	5459
26	Sichuan	746777	817781	15.3	12512	19.9	8802	3513	3980	16295
27	Tianjin	99766	109252	7.7	841	10.0	597	222	276	1096
28	Xinjiang Wei AR	342986	375597	32.1	12057	41.8	7714	4615	3373	15702
29	Xizang (Tibet) AR	45011	49291	41.5	2046	54.0	1241	925	499	2664
30	Yunnan	570992	625282	19.6	12256	25.5	8435	3712	3814	15961
31	Zhejiang	535937	586894	8.0	4695	10.4	3338	1236	1541	6115
	Total China (1)	14737923	16139204		210429		146867	60633	66552	274052

	PROVINCE	Birth Asphyxia				Preterm birth				Congenital disorders				Neonatal sepsis			
		Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total
1	Anhui	2438	73	0	2511	2482	69	0	2551	740	445	480	1666	154	17	0	171
2	Beijing	113	3	0	116	168	5	0	173	79	73	33	185	22	2	0	24
3	Chongqing	932	28	0	960	936	26	0	962	268	156	173	598	56	6	0	62
4	Fujian	972	29	0	1001	1063	30	0	1093	367	247	227	841	78	9	0	87
5	Gansu	1755	52	0	1807	1741	48	0	1789	385	173	183	741	84	9	0	94
6	Guangdong	1545	46	0	1591	1946	54	0	2000	802	627	421	1851	187	21	0	208
7	Guangxi Zhuang AR	2033	61	0	2094	2079	58	0	2137	628	381	407	1415	130	14	0	145
8	Guizhou	2258	67	0	2325	2209	61	0	2270	527	257	291	1075	112	12	0	124
9	Hainan	510	15	0	525	500	14	0	514	129	68	79	276	27	3	0	30
10	Hebei	2975	89	0	3064	2990	83	0	3073	860	502	556	1918	178	20	0	198
11	Heilongjiang	856	25	0	882	874	24	0	899	263	159	170	592	55	6	0	61
12	Henan	3426	102	0	3528	3464	96	0	3560	1014	601	657	2272	210	23	0	234
13	Hubei	1608	48	0	1655	1644	46	0	1690	496	301	322	1119	103	11	0	115
14	Hunan	2170	65	0	2235	2280	63	0	2343	730	464	468	1662	153	17	0	170
15	Jiangsu	861	26	0	886	1126	31	0	1157	481	390	240	1111	116	13	0	129
16	Jiangxi	2434	72	0	2506	2389	67	0	2456	623	334	384	1340	130	14	0	144
17	Jilin	335	10	0	345	383	11	0	394	142	100	84	325	31	3	0	34
18	Liaoning	503	15	0	518	569	16	0	584	206	144	124	474	45	5	0	50
19	Neimenggu (Inner Mongolia) AR	853	25	0	878	845	24	0	868	231	129	147	506	48	5	0	53
20	Ningxia Hui AR	376	11	0	387	368	10	0	378	93	48	56	197	19	2	0	22
21	Qinghai	379	11	0	391	371	10	0	382	88	42	48	178	19	2	0	21
22	Shaanxi (Qin)	1448	43	0	1492	1428	40	0	1467	381	209	239	829	79	9	0	88
23	Shandong	2505	75	0	2580	2715	76	0	2791	922	612	577	2111	196	22	0	217
24	Shanghai	258	8	0	265	320	9	0	329	130	100	70	300	30	3	0	33
25	Shanxi (Jin)	885	26	0	911	948	26	0	974	315	206	199	721	67	7	0	74
26	Sichuan	2700	80	0	2780	2676	74	0	2750	733	411	466	1611	152	17	0	169
27	Tianjin	161	5	0	166	191	5	0	196	74	54	42	170	16	2	0	18
28	Xinjiang Wei AR	1929	57	0	1987	1984	55	0	2039	403	164	149	717	93	10	0	103
29	Xizang (Tibet) AR	266	8	0	274	293	8	0	301	54	20	13	87	14	2	0	15
30	Yunnan	2514	75	0	2589	2457	68	0	2525	605	305	350	1260	127	14	0	141
31	Zhejiang	915	27	0	942	1067	30	0	1097	404	292	233	929	89	10	0	99
	Total China (1)	42913	1277	0	44190	44506	1239	0	45745	13172	8018	7886	29076	2820	313	0	3133

	PROVINCE	Pneumonia				Diarrhea				Accidents				SIDS			
		Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total
1	Anhui	946	943	259	2148	102	294	284	680	404	249	1420	2073	239	598	108	946
2	Beijing	48	21	23	92	2	2	7	11	9	22	91	122	16	38	8	62
3	Chongqing	373	388	103	864	43	128	114	285	154	96	536	786	91	214	41	346
4	Fujian	355	301	102	758	30	71	96	197	150	105	608	864	100	285	46	431
5	Gansu	1070	1476	386	2932	157	614	275	1046	196	258	1025	1479	191	165	86	442
6	Guangdong	581	377	206	1163	32	56	123	210	181	213	1107	1500	183	514	86	782
7	Guangxi Zhuang AR	783	771	214	1768	83	236	234	553	337	208	1189	1733	200	508	91	798
8	Guizhou	1164	1477	370	3011	164	596	333	1093	305	280	1297	1881	231	314	105	650
9	Hainan	230	267	67	563	30	101	69	200	78	56	290	424	50	93	23	166
10	Hebei	1187	1230	326	2743	135	405	361	901	491	305	1714	2510	291	687	132	1110
11	Heilongjiang	330	327	90	748	35	101	99	235	142	87	500	729	84	213	38	335
12	Henan	1347	1371	369	3087	150	440	408	997	567	351	1983	2900	336	816	152	1303
13	Hubei	619	610	169	1398	66	186	185	437	266	164	940	1370	158	401	72	631
14	Hunan	810	748	224	1782	78	206	234	518	353	225	1302	1880	217	587	98	903
15	Jiangsu	330	199	125	654	16	27	65	108	92	128	636	856	106	290	50	446
16	Jiangxi	1081	1244	311	2637	140	465	328	932	377	265	1384	2027	240	455	109	804
17	Jilin	122	95	37	254	9	19	31	59	48	39	219	306	36	104	17	157
18	Liaoning	183	146	55	383	14	31	47	92	73	57	326	456	53	154	25	232
19	Neimenggu (Inner Mongolia) AR	358	391	100	849	44	138	109	291	138	90	486	714	83	178	38	299
20	Ningxia Hui AR	175	208	52	435	23	80	52	156	56	42	214	313	37	64	17	119
21	Qinghai	199	255	64	519	28	104	56	188	50	48	218	316	39	51	18	108
22	Shaanxi (Qin)	624	700	177	1500	78	254	190	523	230	155	824	1209	142	287	64	494
23	Shandong	918	793	261	1972	79	195	253	527	392	268	1553	2213	257	724	117	1097
24	Shanghai	96	64	33	194	5	10	21	36	31	35	182	248	30	85	14	129
25	Shanxi (Jin)	326	288	92	706	29	74	91	194	141	93	542	776	90	250	41	381
26	Sichuan	1128	1231	315	2674	137	433	345	916	436	283	1540	2260	264	568	119	951
27	Tianjin	59	43	19	121	4	8	14	26	22	20	109	151	18	52	8	78
28	Xinjiang Wei AR	1488	2250	641	4380	219	928	314	1460	161	370	1138	1670	231	77	101	410
29	Xizang (Tibet) AR	285	478	153	916	40	183	42	265	14	76	151	242	14	17	15	46
30	Yunnan	1221	1497	372	3090	168	590	359	1117	360	295	1436	2091	253	395	114	762
31	Zhejiang	334	251	105	689	23	48	81	152	126	109	611	846	100	290	46	436
	Total China (1)	18770	20439	5819	45028	2161	7023	5221	14404	6378	4992	25574	36944	4382	9474	1997	15853

Appendix Table 7 Detailed estimates for the year 2010

PROVINCE (1-31)	LIVE BIRTHS (Ch.Bu.Stat. 2010)	LIVE BIRTHS (Fitted to UN 2010)	U5MR (IHME 2013)	TOTAL dths (UN+IHME)	U5MR (CHERG 2010)	Number of deaths in each province by age group: Neonatal	1m-1yr	1yr-4yr	Total	Birth Asphyxia: Neonatal	1m-1yr	1yr-4yr	Total	Preterm birth: Neonatal	1m-1yr	1yr-4yr	Total	Congenital disorders: Neonatal	1m-1yr	1yr-4yr	Total
Anhui	767588	832982	12.8	10662	15.4	6824	2643	3400	12866	2132	63	0	2196	2205	61	0	2266	654	423	471	1548
Beijing	142943	155121	4.9	760	5.9	464	205	248	917	95	3	0	98	148	4	0	153	69	69	30	168
Chongqing	263362	285799	13.9	3973	16.8	2535	997	1262	4794	799	24	0	823	812	23	0	835	231	145	167	543
Fujian	414680	450009	9.6	4320	11.6	2768	1051	1394	5213	812	24	0	836	911	25	0	936	314	226	210	750
Gansu	308179	334434	25.7	8595	31.0	5190	2610	2572	10372	1516	45	0	1561	1493	42	0	1535	329	158	184	670
Guangdong	1149919	1247886	6.7	8361	8.1	5266	2095	2728	10089	1322	39	0	1361	1728	48	0	1776	714	598	392	1704
Guangxi Zhuang AR	668773	725749	12.5	9072	15.1	5809	2242	2896	10947	1810	54	0	1863	1881	52	0	1934	564	369	406	1339
Guizhou	489717	531438	21.2	11266	25.6	6967	3164	3465	13595	2140	64	0	2204	2091	58	0	2149	494	260	317	1071
Hainan	127462	138321	17.5	2421	21.1	1524	639	758	2921	480	14	0	495	473	13	0	487	121	69	84	275
Hebei	940471	1020594	13.8	14084	16.7	8991	3531	4474	16996	2832	84	0	2916	2883	80	0	2964	823	518	595	1936
Heilongjiang	281468	305448	12.6	3849	15.2	2464	952	1228	4644	768	23	0	791	797	22	0	820	238	155	171	565
Henan	1088179	1180886	13.3	15706	16.0	10040	3914	4999	18952	3151	94	0	3245	3232	90	0	3322	940	600	679	2218
Hubei	593006	643527	12.5	8044	15.1	5151	1988	2568	9707	1605	48	0	1652	1668	46	0	1714	501	327	360	1187
Hunan	849928	922337	11.1	10238	13.4	6567	2502	3285	12354	2002	60	0	2061	2146	60	0	2205	685	467	481	1633
Jiangsu	762783	827768	6.2	5132	7.5	3212	1304	1677	6193	771	23	0	794	1049	29	0	1079	449	391	233	1073
Jiangxi	610128	662108	17.1	11322	20.6	7140	2972	3550	13663	2254	67	0	2321	2226	62	0	2288	575	332	404	1311
Jilin	217011	235499	8.4	1978	10.1	1263	483	641	2387	353	11	0	363	416	12	0	428	154	117	97	368
Liaoning	291114	315915	8.7	2748	10.5	1757	670	890	3317	498	15	0	512	579	16	0	595	210	157	135	502
Neimenggu (Inner Mongolia) AR	229245	248775	15.4	3831	18.6	2433	981	1210	4623	770	23	0	793	770	21	0	791	209	126	150	484
Ningxia Hui AR	88941	96518	18.4	1776	22.2	1113	476	554	2143	349	10	0	360	343	10	0	353	86	48	59	193
Qinghai	83664	90792	21.7	1970	26.2	1215	558	604	2377	371	11	0	383	363	10	0	373	85	44	54	183
Shaanxi (Qin)	363026	393954	16.2	6382	19.5	4040	1653	2009	7701	1278	38	0	1316	1270	35	0	1305	336	198	239	774
Shandong	1110129	1204706	9.9	11927	11.9	7646	2902	3844	14392	2263	67	0	2330	2512	70	0	2582	852	607	577	2036
Shanghai	159083	172636	6.9	1191	8.3	752	297	388	1437	192	6	0	197	247	7	0	254	101	83	56	240
Shanxi (Jin)	373853	405703	10.3	4179	12.4	2680	1018	1345	5043	802	24	0	826	879	24	0	904	292	205	201	697
Sichuan	724670	786408	15.3	12032	18.5	7643	3076	3800	14519	2419	72	0	2491	2421	67	0	2488	658	397	472	1528
Tianjin	103354	112159	7.7	864	9.3	549	212	281	1042	148	4	0	152	181	5	0	186	70	55	42	167
Xinjiang Wei AR	347303	376891	32.1	12098	38.7	7053	4108	3437	14599	1888	56	0	1944	1913	53	0	1967	389	169	174	732
Xizang (Tibet) AR	47084	51095	41.5	2120	50.1	1176	843	541	2559	273	8	0	281	294	8	0	302	54	21	17	93
Yunnan	600832	652020	19.6	12780	23.7	7966	3493	3962	15421	2480	74	0	2554	2427	68	0	2495	592	322	395	1309
Zhejiang	550626	597536	8.0	4780	9.7	3044	1172	1552	5768	834	25	0	859	1004	28	0	1032	380	295	233	908
Total China (1)	14748521	16005017		208461		131241	54753	65560	251554	39407	1173	0	40580	41365	1151	0	42516	12169	7950	8087	28206

PROVINCE (1-31)	Neonatal sepsis: Neonatal	1m-1yr	1yr-4yr	Total	Pneumonia: Neonatal	1m-1yr	1yr-4yr	Total	Diarrhea: Neonatal	1m-1yr	1yr-4yr	Total	Accidents: Neonatal	1m-1yr	1yr-4yr	Total	SIDS: Neonatal	1m-1yr	1yr-4yr	Total
Anhui	142	16	0	158	784	784	237	1804	82	211	254	547	341	219	1270	1830	205	553	102	859
Beijing	21	2	0	23	41	15	24	80	1	1	6	8	6	21	79	106	14	32	7	53
Chongqing	50	6	0	56	301	314	91	706	34	91	100	224	128	82	469	679	76	195	38	309
Fujian	70	8	0	78	286	242	93	621	23	47	82	152	117	91	525	732	83	247	42	372
Gansu	73	8	0	81	836	1157	314	2306	125	459	248	832	178	207	885	1270	156	170	77	403
Guangdong	178	20	0	197	492	308	204	1005	25	35	106	165	137	196	981	1314	158	445	82	685
Guangxi Zhuang AR	123	14	0	137	661	653	200	1514	68	171	213	452	288	186	1084	1558	174	477	87	738
Guizhou	108	12	0	120	1010	1288	339	2636	143	484	326	953	297	251	1232	1780	209	335	104	648
Hainan	26	3	0	29	201	235	63	498	26	80	67	174	74	51	276	401	46	95	23	164
Hebei	179	20	0	199	1065	1108	320	2493	118	319	352	789	455	289	1663	2408	270	695	134	1099
Heilongjiang	52	6	0	58	281	279	85	645	29	74	91	194	123	79	459	661	74	201	37	312
Henan	204	23	0	227	1172	1195	353	2719	126	333	384	843	506	322	1863	2691	301	795	150	1246
Hubei	109	12	0	121	586	579	177	1342	60	152	189	401	256	165	961	1381	155	423	77	654
Hunan	151	17	0	168	715	660	221	1595	66	153	220	439	309	211	1236	1756	197	567	99	862
Jiangsu	116	13	0	128	295	169	132	595	13	17	59	88	73	125	589	787	96	261	50	408
Jiangxi	125	14	0	139	930	1075	288	2294	119	363	312	794	349	239	1295	1883	214	458	107	778
Jilin	36	4	0	39	125	96	44	265	9	15	33	57	46	43	240	329	38	113	19	170
Liaoning	48	5	0	53	176	139	60	375	12	23	47	83	67	59	334	460	53	157	27	237
Neimenggu (Inner Mongolia) AR	45	5	0	50	302	332	92	726	36	104	101	242	123	79	446	648	73	173	36	282
Ningxia Hui AR	19	2	0	21	150	180	48	378	20	63	50	133	53	38	200	291	33	66	17	116
Qinghai	19	2	0	21	178	230	61	469	25	87	57	170	51	44	214	309	36	56	18	111
Shaanxi (Qin)	73	8	0	81	513	578	157	1249	64	188	173	425	201	133	737	1071	121	274	60	455
Shandong	190	21	0	212	799	688	257	1744	66	139	233	437	331	250	1448	2029	229	678	115	1023
Shanghai	25	3	0	27	71	46	29	145	4	5	16	25	21	28	141	189	23	64	12	98
Shanxi (Jin)	65	7	0	72	284	251	90	625	24	53	85	162	120	87	507	713	80	236	40	357
Sichuan	143	16	0	158	947	1037	287	2270	113	324	317	755	386	249	1401	2036	229	546	114	889
Tianjin	17	2	0	18	53	38	20	111	3	5	13	22	18	19	104	141	16	48	8	73
Xinjiang Wei AR	90	10	0	101	1297	1963	577	3837	198	794	325	1317	170	328	1118	1617	212	111	103	426
Xizang (Tibet) AR	14	2	0	15	256	427	143	826	38	166	47	251	16	69	159	244	15	19	16	50
Yunnan	129	14	0	143	1109	1366	359	2834	152	496	366	1014	361	278	1423	2063	239	431	119	789
Zhejiang	89	10	0	99	298	220	108	626	19	33	75	127	104	105	577	787	91	270	47	408
Total China (1)	2727	303	0	3030	16216	17649	5469	39334	1841	5486	4949	12276	5704	4544	23914	34162	3917	9191	1967	15075

Appendix Table 8 Detailed estimates for the year 2011

PROVINCE (1-31)	LIVE BIRTHS (Ch.Bu.Stat. 2011)	LIVE BIRTHS (Fitted to UN 2011)	U5MR (IHME 2013)	TOTAL dths (UN+IHME)	U5MR (CHERG 2011)	Number of deaths in each province by age group: Neonatal	1m-1yr	1yr-4yr	Total
Anhui	729214	806558	12.8	10324	14.3	6033	2341	3124	11497
Beijing	165012	182515	4.9	894	5.5	492	229	275	996
Chongqing	286718	317128	13.9	4408	15.5	2571	1009	1329	4909
Fujian	422912	467768	9.6	4491	10.7	2618	1010	1374	5001
Gansu	309490	342316	25.7	8798	28.6	4894	2382	2522	9797
Guangdong	1094429	1210510	6.7	8110	7.5	4626	1903	2503	9032
Guangxi Zhuang AR	634430	701721	12.5	8772	13.9	5127	1984	2657	9768
Guizhou	462389	511433	21.2	10842	23.6	6162	2733	3179	12075
Hainan	128506	142136	17.5	2487	19.5	1436	594	740	2770
Hebei	939719	1039390	13.8	14344	15.4	8369	3279	4326	15974
Heilongjiang	267962	296383	12.6	3734	14.0	2183	845	1131	4159
Henan	1086235	1201448	13.3	15979	14.8	9331	3637	4827	17795
Hubei	596698	659987	12.5	8250	13.9	4822	1866	2499	9187
Hunan	878831	972044	11.1	10790	12.4	6308	2424	3284	12016
Jiangsu	756076	836269	6.2	5185	6.9	2935	1238	1601	5774
Jiangxi	603230	667212	17.1	11409	19.0	6594	2710	3402	12706
Jilin	179444	198477	8.4	1667	9.4	966	378	512	1857
Liaoning	250041	276562	8.7	2406	9.7	1397	544	738	2680
Neimenggu (Inner Mongolia) AR	221444	244931	15.4	3772	17.2	2192	877	1131	4201
Ningxia Hui AR	86814	96022	18.4	1767	20.5	1016	427	524	1968
Qinghai	81602	90257	21.7	1959	24.2	1111	498	573	2181
Shaanxi (Qin)	364553	403219	16.2	6532	18.0	3787	1534	1954	7275
Shandong	1105438	1222686	9.9	12105	11.0	7062	2719	3699	13480
Shanghai	162053	179241	6.9	1237	7.7	707	289	382	1377
Shanxi (Jin)	375192	414987	10.3	4274	11.5	2496	960	1304	4760
Sichuan	787850	871414	15.3	13333	17.0	7751	3097	4000	14848
Tianjin	113857	125933	7.7	970	8.6	559	222	299	1080
Xinjiang Wei AR	329330	364261	32.1	11693	35.7	6299	3511	3212	13022
Xizang (Tibet) AR	46401	51322	41.5	2130	46.2	1095	741	536	2372
Yunnan	586757	648992	19.6	12720	21.8	7280	3130	3756	14166
Zhejiang	516589	571381	8.0	4571	8.9	2642	1043	1406	5091
Total China (1)	14569212	16114503		209952		120859	50153	62801	233813

PROVINCE (1-31)	Birth Asphyxia: Neonatal	1m-1yr	1yr-4yr	Total	Preterm birth: Neonatal	1m-1yr	1yr-4yr	Total	Congenital disorders: Neonatal	1m-1yr	1yr-4yr	Total	Neonatal sepsis: Neonatal	1m-1yr	1yr-4yr	Total
Anhui	1885	56	0	1941	1987	55	0	2042	603	409	448	1460	134	15	0	149
Beijing	96	3	0	99	158	4	0	162	74	80	31	185	24	3	0	26
Chongqing	814	24	0	838	841	23	0	864	245	161	184	590	54	6	0	60
Fujian	756	22	0	778	873	24	0	898	309	233	208	750	72	8	0	80
Gansu	1482	44	0	1527	1452	40	0	1493	324	164	201	689	73	8	0	81
Guangdong	1123	33	0	1156	1530	43	0	1573	647	571	348	1566	169	19	0	188
Guangxi Zhuang AR	1595	47	0	1642	1692	47	0	1739	520	356	384	1260	116	13	0	129
Guizhou	1943	58	0	2000	1902	53	0	1954	456	253	318	1027	101	11	0	112
Hainan	460	14	0	474	457	13	0	470	119	72	88	279	26	3	0	29
Hebei	2646	79	0	2725	2739	76	0	2815	800	528	600	1928	177	20	0	197
Heilongjiang	680	20	0	700	720	20	0	740	220	150	163	534	49	5	0	55
Henan	2935	87	0	3022	3064	85	0	3149	912	610	681	2203	203	23	0	225
Hubei	1500	45	0	1545	1591	44	0	1635	489	335	361	1185	109	12	0	121
Hunan	1908	57	0	1965	2095	58	0	2154	686	491	490	1667	155	17	0	172
Jiangsu	679	20	0	699	966	27	0	992	422	388	214	1024	115	13	0	127
Jiangxi	2113	63	0	2176	2106	59	0	2165	554	336	413	1304	122	14	0	136
Jilin	264	8	0	272	322	9	0	331	122	97	77	296	29	3	0	33
Liaoning	388	12	0	400	466	13	0	479	174	136	111	421	41	5	0	46
Neimenggu (Inner Mongolia) AR	701	21	0	721	709	20	0	729	196	124	148	468	43	5	0	48
Ningxia Hui AR	325	10	0	335	321	9	0	330	82	48	60	190	18	2	0	20
Qinghai	349	10	0	359	341	9	0	351	81	44	56	181	18	2	0	20
Shaanxi (Qin)	1213	36	0	1249	1218	34	0	1252	329	204	247	780	73	8	0	81
Shandong	2062	61	0	2124	2355	66	0	2420	819	612	560	1991	189	21	0	210
Shanghai	175	5	0	180	234	7	0	241	98	85	54	237	25	3	0	28
Shanxi (Jin)	739	22	0	761	832	23	0	855	283	208	197	689	65	7	0	72
Sichuan	2476	74	0	2549	2510	70	0	2580	696	442	525	1663	154	17	0	171
Tianjin	147	4	0	151	186	5	0	191	74	61	44	179	18	2	0	20
Xinjiang Wei AR	1768	53	0	1821	1769	49	0	1818	366	166	186	718	85	9	0	94
Xizang (Tibet) AR	270	8	0	279	285	8	0	293	54	22	20	95	13	1	0	15
Yunnan	2317	69	0	2386	2278	63	0	2341	565	323	406	1294	125	14	0	139
Zhejiang	706	21	0	727	881	25	0	905	342	279	208	829	83	9	0	93
Total China (1)	36514	1087	0	37600	38880	1082	0	39963	11661	7991	8032	27683	2678	298	0	2976

PROVINCE (1-31)	Pneumonia: Neonatal	1m-1yr	1yr-4yr	Total	Diarrhea: Neonatal	1m-1yr	1yr-4yr	Total	Accidents: Neonatal	1m-1yr	1yr-4yr	Total	SIDS: Neonatal	1m-1yr	1yr-4yr	Total
Anhui	672	654	213	1538	66	156	220	443	293	196	1148	1637	181	515	94	789
Beijing	43	13	28	84	1	1	6	8	5	24	81	111	15	31	8	54
Chongqing	296	301	93	689	31	78	100	209	129	83	486	698	77	211	40	328
Fujian	264	215	93	571	19	35	74	129	102	89	505	695	79	237	41	357
Gansu	753	1024	279	2056	112	392	242	746	186	189	862	1237	147	194	76	417
Guangdong	424	246	197	867	19	22	87	128	104	182	860	1146	139	381	75	594
Guangxi Zhuang AR	566	543	180	1289	55	126	184	365	246	166	977	1390	154	442	80	675
Guizhou	857	1071	288	2216	119	381	294	793	280	218	1118	1616	185	339	95	619
Hainan	182	208	58	448	23	66	64	152	72	48	266	385	43	99	22	164
Hebei	960	973	301	2233	101	251	323	675	417	271	1583	2272	251	688	130	1069
Heilongjiang	242	233	77	551	24	55	79	157	105	71	416	592	65	187	34	287
Henan	1055	1048	332	2435	108	260	351	719	460	302	1771	2533	280	782	145	1207
Hubei	532	511	169	1213	51	119	173	343	232	157	919	1307	145	415	75	635
Hunan	667	597	220	1484	57	120	205	383	281	207	1211	1699	189	563	99	851
Jiangsu	265	138	133	535	11	11	50	71	57	121	535	712	88	230	48	366
Jiangxi	828	936	261	2026	102	291	289	682	331	219	1224	1774	198	464	102	764
Jilin	94	69	36	198	6	9	24	39	32	34	185	251	29	86	15	131
Liaoning	137	103	51	291	9	15	36	59	48	49	269	366	42	126	22	190
Neimenggu (Inner Mongolia) AR	263	282	82	627	30	81	91	202	111	72	411	594	66	168	34	268
Ningxia Hui AR	132	155	42	329	17	51	46	114	50	34	187	272	30	66	16	113
Qinghai	156	197	53	407	22	71	53	146	50	40	201	290	33	59	17	110
Shaanxi (Qin)	464	511	146	1121	55	153	161	369	192	125	707	1023	114	279	59	451
Shandong	719	597	249	1565	55	103	207	364	284	237	1361	1882	212	640	111	963
Shanghai	65	39	29	134	3	4	14	21	17	27	132	177	21	59	11	92
Shanxi (Jin)	257	220	87	564	20	40	76	136	104	83	481	668	75	225	39	339
Sichuan	927	992	289	2209	106	282	319	707	393	253	1454	2100	233	597	120	950
Tianjin	53	36	22	111	3	4	13	20	16	21	106	143	17	49	9	75
Xinjiang Wei AR	1102	1639	477	3218	170	654	308	1131	175	279	1045	1500	189	139	96	424
Xizang (Tibet) AR	226	370	122	717	34	145	48	228	18	60	160	238	16	21	16	53
Yunnan	974	1175	318	2467	130	400	338	868	347	251	1333	1931	218	443	113	774
Zhejiang	253	177	100	531	15	22	62	98	81	95	505	681	79	234	42	355
Total China (1)	14429	15274	5024	34727	1576	4396	4534	10506	5215	4203	22501	31919	3609	8969	1884	14462

Appendix Table 9 Detailed estimates for the year 2012

PROVINCE (1-31)	LIVE BIRTHS (Ch.Bu.Stat. 2012)	LIVE BIRTHS (Fitted to UN 2012)	U5MR (IHME 2013)	TOTAL dths (UN+IHME)	U5MR (CHERG 2012)	Number of deaths in each province by age group: Neonatal	1m-1yr	1yr-4yr	Total
Anhui	777140	839795	12.8	10749	13.3	5819	2255	3066	11140
Beijing	184996	199910	4.9	980	5.1	494	239	282	1015
Chongqing	318415	344086	13.9	4783	14.4	2587	1010	1359	4957
Fujian	475712	514064	9.6	4935	9.9	2656	1036	1422	5114
Gansu	311321	336420	25.7	8646	26.6	4492	2117	2352	8960
Guangdong	1223742	1322403	6.7	8860	6.9	4647	1966	2570	9182
Guangxi Zhuang AR	662217	715606	12.5	8945	13.0	4843	1874	2554	9270
Guizhou	461336	498530	21.2	10569	22.0	5597	2425	2931	10953
Hainan	129268	139690	17.5	2445	18.1	1312	535	687	2533
Hebei	935636	1011069	13.8	13953	14.3	7548	2945	3967	14460
Heilongjiang	279883	302448	12.6	3811	13.1	2063	799	1088	3949
Henan	1115436	1205364	13.3	16031	13.8	8677	3372	4565	16614
Hubei	634535	685692	12.5	8571	13.0	4640	1796	2447	8883
Hunan	898652	971103	11.1	10779	11.5	5828	2252	3091	11171
Jiangsu	746656	806853	6.2	5002	6.4	2602	1132	1451	5184
Jiangxi	605157	653946	17.1	11182	17.7	6008	2435	3146	11589
Jilin	157558	170260	8.4	1430	8.7	764	304	413	1482
Liaoning	269739	291486	8.7	2536	9.0	1358	537	733	2628
Neimenggu (Inner Mongolia) AR	227959	246338	15.4	3794	16.0	2047	811	1073	3931
Ningxia Hui AR	85274	92149	18.4	1696	19.1	907	375	475	1757
Qinghai	81594	88172	21.7	1913	22.5	1011	442	530	1983
Shaanxi (Qin)	379298	409877	16.2	6640	16.8	3576	1432	1874	6881
Shandong	1149651	1242338	9.9	12299	10.3	6628	2578	3540	12746
Shanghai	225971	244189	6.9	1685	7.2	886	371	489	1746
Shanxi (Jin)	385405	416477	10.3	4290	10.7	2315	898	1233	4446
Sichuan	797441	861732	15.3	13184	15.9	7116	2817	3731	13664
Tianjin	121107	130870	7.7	1008	8.0	535	217	292	1044
Xinjiang Wei AR	340240	367671	32.1	11802	33.3	5953	3181	3097	12231
Xizang (Tibet) AR	47262	51072	41.5	2120	43.0	1023	657	517	2197
Yunnan	586664	633961	19.6	12426	20.3	6621	2790	3466	12877
Zhejiang	553564	598193	8.0	4786	8.3	2549	1026	1385	4959
Total China (1)	15168828	16391769		211849		113103	46623	59823	219549

PROVINCE (1-31)	Birth Asphyxia: Neonatal	1m-1yr	1yr-4yr	Total	Preterm birth: Neonatal	1m-1yr	1yr-4yr	Total	Congenital disorders: Neonatal	1m-1yr	1yr-4yr	Total	Neonatal sepsis: Neonatal	1m-1yr	1yr-4yr	Total
Anhui	1801	54	0	1855	1936	54	0	1990	606	425	450	1482	137	15	0	152
Beijing	91	3	0	94	158	4	0	162	75	85	30	190	26	3	0	28
Chongqing	814	24	0	838	856	24	0	880	256	175	194	625	58	6	0	64
Fujian	750	22	0	772	891	25	0	916	325	254	215	794	77	9	0	86
Gansu	1392	41	0	1434	1361	38	0	1399	310	163	205	678	70	8	0	77
Guangdong	1084	32	0	1116	1537	43	0	1580	667	615	344	1625	181	20	0	202
Guangxi Zhuang AR	1490	44	0	1535	1613	45	0	1658	511	362	377	1251	116	13	0	129
Guizhou	1789	53	0	1843	1758	49	0	1807	432	248	315	995	96	11	0	107
Hainan	422	13	0	435	424	12	0	436	113	71	86	270	25	3	0	28
Hebei	2372	71	0	2443	2498	70	0	2568	751	513	568	1833	169	19	0	187
Heilongjiang	636	19	0	655	687	19	0	706	217	153	160	530	49	5	0	55
Henan	2708	81	0	2788	2879	80	0	2959	883	611	662	2157	199	22	0	221
Hubei	1428	43	0	1471	1546	43	0	1589	490	347	362	1199	111	12	0	123
Hunan	1735	52	0	1787	1951	54	0	2006	659	488	466	1613	152	17	0	169
Jiangsu	576	17	0	593	855	24	0	879	382	368	185	935	109	12	0	121
Jiangxi	1933	58	0	1990	1947	54	0	2001	526	331	402	1259	117	13	0	130
Jilin	203	6	0	209	256	7	0	263	100	83	61	244	25	3	0	27
Liaoning	367	11	0	378	455	13	0	468	175	142	109	426	43	5	0	47
Neimenggu (Inner Mongolia) AR	653	19	0	673	671	19	0	690	191	125	146	462	43	5	0	47
Ningxia Hui AR	292	9	0	301	291	8	0	299	76	46	58	180	17	2	0	19
Qinghai	322	10	0	332	316	9	0	325	77	44	56	176	17	2	0	19
Shaanxi (Qin)	1147	34	0	1181	1166	32	0	1198	323	208	248	779	72	8	0	80
Shandong	1894	56	0	1951	2224	62	0	2285	799	617	536	1951	188	21	0	209
Shanghai	211	6	0	217	294	8	0	302	126	114	67	307	34	4	0	37
Shanxi (Jin)	672	20	0	692	776	22	0	798	273	208	187	668	64	7	0	71
Sichuan	2270	68	0	2337	2334	65	0	2399	666	438	510	1613	149	17	0	165
Tianjin	136	4	0	140	179	5	0	184	73	63	42	177	19	2	0	21
Xinjiang Wei AR	1728	51	0	1779	1713	48	0	1760	361	171	200	732	83	9	0	92
Xizang (Tibet) AR	264	8	0	272	274	8	0	281	53	22	22	97	13	1	0	14
Yunnan	2129	63	0	2192	2106	59	0	2164	535	318	400	1252	119	13	0	132
Zhejiang	660	20	0	680	852	24	0	876	341	288	201	830	86	10	0	95
Total China (1)	33970	1011	0	34981	36802	1024	0	37827	11372	8098	7864	27333	2659	295	0	2954

PROVINCE (1-31)	Pneumonia: Neonatal	1m-1yr	1yr-4yr	Total	Diarrhea: Neonatal	1m-1yr	1yr-4yr	Total	Accidents: Neonatal	1m-1yr	1yr-4yr	Total	SIDS: Neonatal	1m-1yr	1yr-4yr	Total
Anhui	631	593	206	1431	59	128	204	391	272	191	1120	1583	175	512	92	779
Beijing	42	9	32	83	1	0	5	7	4	26	78	108	15	29	8	52
Chongqing	289	285	93	667	29	68	97	193	126	84	495	706	78	221	41	339
Fujian	262	203	98	563	18	29	71	118	95	92	514	702	80	241	43	363
Gansu	665	882	240	1787	97	327	223	648	184	168	806	1159	135	205	71	411
Guangdong	420	221	213	854	17	16	81	114	91	192	853	1135	139	368	77	584
Guangxi Zhuang AR	521	483	171	1175	47	101	166	315	223	159	933	1315	145	430	77	651
Guizhou	752	915	249	1916	101	310	264	675	266	194	1031	1491	168	340	88	596
Hainan	161	179	51	392	19	53	57	129	66	43	246	356	39	97	21	157
Hebei	842	826	270	1938	84	195	281	559	367	246	1445	2058	226	646	119	992
Heilongjiang	222	207	73	503	20	44	71	136	95	68	397	561	62	183	33	277
Henan	954	918	309	2181	92	207	314	613	414	283	1666	2364	260	754	137	1151
Hubei	499	463	164	1126	45	97	160	302	214	152	894	1260	139	412	73	624
Hunan	602	518	207	1327	48	93	180	321	244	195	1129	1568	175	529	93	797
Jiangsu	231	107	128	466	8	7	41	56	43	113	465	621	78	195	44	316
Jiangxi	731	803	232	1766	86	233	257	577	304	198	1130	1633	180	452	94	726
Jilin	73	50	30	153	4	6	18	28	23	28	147	197	23	67	12	103
Liaoning	130	93	52	276	8	11	33	52	42	49	261	353	41	121	22	184
Neimenggu (Inner Mongolia) AR	238	248	76	562	26	66	82	174	103	67	389	558	61	166	32	259
Ningxia Hui AR	114	130	37	280	14	40	40	94	46	30	170	245	27	64	14	106
Qinghai	137	169	46	352	19	58	48	125	47	35	186	268	30	60	16	106
Shaanxi (Qin)	425	455	135	1015	48	126	148	322	181	117	676	974	107	280	56	443
Shandong	660	524	241	1426	46	79	184	309	246	228	1285	1759	199	603	106	908
Shanghai	81	44	40	164	3	4	16	23	18	36	164	218	27	72	15	113
Shanxi (Jin)	233	191	83	508	17	31	67	115	90	79	449	618	69	211	37	317
Sichuan	826	858	262	1946	90	225	284	599	358	232	1352	1941	213	578	112	903
Tianjin	50	32	22	103	3	3	11	17	14	20	101	135	16	46	9	71
Xinjiang Wei AR	998	1451	415	2864	153	571	298	1023	185	253	1017	1455	179	165	93	437
Xizang (Tibet) AR	201	322	103	627	31	128	48	206	20	53	157	230	16	23	16	55
Yunnan	856	1006	278	2140	111	324	303	737	326	224	1230	1780	199	439	104	742
Zhejiang	240	158	102	500	13	17	56	85	69	95	486	651	76	221	42	339
Total China (1)	13088	13345	4657	31089	1359	3596	4107	9063	4777	3953	21274	30003	3379	8727	1795	13901

Appendix Table 10 Detailed estimates for the year 2013

PROVINCE (1-31)	LIVE BIRTHS (Ch.Bu.Stat. 2013)	LIVE BIRTHS (Fitted to UN 2013)	U5MR (IHME 2013)	TOTAL dths (UN+IHME)	U5MR (CHERG 2013)	Number of deaths in each province by age group			
						Neonatal	1m-1yr	1yr-4yr	Total
Anhui	773946	861221	12.8	11024	12.1	5407	2099	2904	10411
Beijing	186820	207887	4.9	1019	4.6	459	235	268	962
Chongqing	306693	341277	13.9	4744	13.1	2328	906	1246	4480
Fujian	458842	510583	9.6	4902	9.1	2380	946	1303	4629
Gansu	313712	349087	25.7	8972	24.3	4267	1936	2270	8473
Guangdong	1137295	1265542	6.7	8479	6.3	3990	1755	2262	8008
Guangxi Zhuang AR	671231	746923	12.5	9337	11.8	4578	1778	2462	8817
Guizhou	455855	507260	21.2	10754	20.0	5199	2192	2765	10156
Hainan	129984	144642	17.5	2531	16.5	1236	496	658	2390
Hebei	953232	1060723	13.8	14638	13.0	7183	2795	3846	13824
Heilongjiang	263049	292712	12.6	3688	11.9	1809	702	972	3483
Henan	1154579	1284776	13.3	17088	12.6	8384	3258	4496	16137
Hubei	641421	713751	12.5	8922	11.8	4374	1699	2353	8426
Hunan	899743	1001203	11.1	11113	10.5	5433	2121	2942	10495
Jiangsu	748567	832979	6.2	5164	5.9	2407	1094	1376	4877
Jiangxi	595270	662396	17.1	11327	16.1	5537	2211	2948	10697
Jilin	147445	164072	8.4	1378	7.9	663	271	367	1302
Liaoning	267321	297465	8.7	2588	8.2	1248	506	689	2444
Neimenggu (Inner Mongolia) AR	223937	249189	15.4	3838	14.5	1881	739	1004	3624
Ningxia Hui AR	85371	94997	18.4	1748	17.4	852	346	453	1651
Qinghai	81488	90677	21.7	1968	20.5	950	404	505	1858
Shaanxi (Qin)	376226	418651	16.2	6782	15.3	3321	1314	1770	6405
Shandong	1107812	1232734	9.9	12204	9.3	5936	2348	3242	11525
Shanghai	196139	218257	6.9	1506	6.5	711	309	402	1422
Shanxi (Jin)	391356	435487	10.3	4486	9.7	2186	860	1190	4236
Sichuan	801068	891401	15.3	13638	14.4	6686	2625	3568	12880
Tianjin	119454	132924	7.7	1024	7.3	489	205	273	967
Xinjiang Wei AR	356169	396332	32.1	12722	30.3	5894	2993	3127	12015
Xizang (Tibet) AR	48860	54370	41.5	2256	39.2	1004	604	523	2131
Yunnan	588773	655166	19.6	12841	18.5	6239	2571	3318	12127
Zhejiang	549299	611241	8.0	4890	7.6	2343	971	1304	4618
Total China (1)	15030957	16725928		217569		105373	43290	56807	205470

PROVINCE (1-31)	Birth Asphyxia				Preterm birth				Congenital disorders				Neonatal sepsis			
	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total
Anhui	1643	49	0	1692	1817	51	0	1867	593	434	436	1463	137	15	0	152
Beijing	78	2	0	81	145	4	0	149	70	86	26	181	26	3	0	29
Chongqing	723	22	0	744	779	22	0	801	243	173	184	600	55	6	0	62
Fujian	648	19	0	667	802	22	0	824	305	250	194	749	75	8	0	83
Gansu	1354	40	0	1394	1324	37	0	1361	310	172	220	702	70	8	0	77
Guangdong	879	26	0	905	1316	37	0	1353	589	575	286	1449	170	19	0	189
Guangxi Zhuang AR	1381	41	0	1422	1540	43	0	1582	509	376	370	1256	118	13	0	131
Guizhou	1682	50	0	1732	1666	46	0	1712	422	255	323	1000	95	11	0	105
Hainan	398	12	0	410	406	11	0	417	113	73	88	274	25	3	0	28
Hebei	2226	66	0	2292	2405	67	0	2472	754	537	568	1859	172	19	0	191
Heilongjiang	547	16	0	563	608	17	0	625	200	147	146	494	46	5	0	51
Henan	2574	77	0	2651	2812	78	0	2891	899	649	669	2218	206	23	0	229
Hubei	1320	39	0	1359	1471	41	0	1512	487	359	354	1200	112	12	0	125
Hunan	1574	47	0	1621	1832	51	0	1883	646	499	445	1590	152	17	0	169
Jiangsu	501	15	0	516	788	22	0	810	361	371	164	896	110	12	0	122
Jiangxi	1779	53	0	1832	1823	51	0	1873	511	336	399	1246	115	13	0	128
Jilin	169	5	0	174	222	6	0	229	90	78	52	221	23	3	0	26
Liaoning	323	10	0	333	419	12	0	431	168	143	100	411	42	5	0	47
Neimenggu (Inner Mongolia) AR	596	18	0	614	625	17	0	643	185	127	143	454	42	5	0	46
Ningxia Hui AR	275	8	0	284	278	8	0	286	75	48	59	182	17	2	0	19
Qinghai	307	9	0	316	303	8	0	312	76	45	58	179	17	2	0	19
Shaanxi (Qin)	1060	32	0	1092	1099	31	0	1129	317	213	246	776	71	8	0	79
Shandong	1640	49	0	1688	2001	56	0	2057	750	605	485	1840	182	20	0	202
Shanghai	160	5	0	165	235	7	0	242	104	100	52	256	30	3	0	33
Shanxi (Jin)	614	18	0	633	737	21	0	758	271	215	179	665	65	7	0	72
Sichuan	2116	63	0	2179	2223	62	0	2285	660	453	509	1621	149	17	0	166
Tianjin	118	4	0	122	163	5	0	168	69	62	37	169	18	2	0	20
Xinjiang Wei AR	1775	53	0	1827	1744	49	0	1793	377	188	231	796	86	10	0	96
Xizang (Tibet) AR	273	8	0	282	278	8	0	285	55	24	26	105	13	1	0	15
Yunnan	2020	60	0	2080	2021	56	0	2077	531	331	412	1273	119	13	0	132
Zhejiang	579	17	0	596	784	22	0	806	326	289	182	798	86	10	0	95
Total China (1)	31333	932	0	32265	34668	965	0	35633	11067	8214	7642	26924	2645	294	0	2938

PROVINCE (1-31)	Pneumonia				Diarrhea				Accidents				SIDS			
	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total
Anhui	568	508	194	1270	48	95	178	321	236	180	1053	1469	162	490	87	739
Beijing	39	3	34	76	1	0	4	5	3	26	68	98	14	24	8	45
Chongqing	251	237	84	572	23	50	82	155	108	77	451	636	70	207	37	314
Fujian	229	166	92	487	14	20	59	92	75	86	461	622	71	214	39	324
Gansu	602	772	211	1585	85	273	211	569	190	154	782	1126	128	228	68	424
Guangdong	354	160	202	716	13	9	62	84	63	176	714	953	120	296	68	484
Guangxi Zhuang AR	477	420	165	1062	39	76	147	263	196	153	892	1242	137	416	74	628
Guizhou	668	785	219	1672	86	247	240	573	257	176	973	1407	156	352	83	591
Hainan	146	156	47	349	17	42	52	110	63	41	236	339	37	98	20	155
Hebei	774	726	258	1758	71	150	252	473	332	237	1393	1962	215	639	115	970
Heilongjiang	189	167	65	421	16	31	59	105	78	60	352	491	54	164	29	248
Henan	892	818	301	2010	79	162	285	526	378	278	1630	2285	252	754	135	1140
Hubei	456	402	157	1015	38	73	141	252	187	146	852	1186	131	398	71	600
Hunan	545	443	200	1187	39	67	156	263	206	187	1060	1454	163	497	88	749
Jiangsu	211	79	132	422	7	4	33	44	32	112	416	560	72	167	41	280
Jiangxi	648	684	209	1541	72	180	227	479	279	182	1057	1518	166	447	88	701
Jilin	62	39	28	128	3	4	14	21	17	26	126	169	20	57	11	88
Liaoning	117	77	51	245	6	8	27	41	33	47	239	320	37	109	21	167
Neimenggu (Inner Mongolia) AR	211	211	69	491	21	50	72	143	92	62	362	516	56	161	30	247
Ningxia Hui AR	103	113	33	249	12	32	37	80	43	28	162	233	26	65	14	105
Qinghai	123	146	41	311	16	47	44	107	47	32	177	256	28	63	15	106
Shaanxi (Qin)	380	390	123	893	40	97	132	269	165	109	637	911	100	277	53	429
Shandong	576	428	227	1230	36	54	151	241	195	212	1153	1561	178	537	97	812
Shanghai	63	30	35	129	2	2	11	16	12	31	129	171	21	54	12	87
Shanxi (Jin)	214	165	82	461	14	22	58	94	76	77	426	579	66	199	36	300
Sichuan	749	745	244	1737	76	174	254	504	327	219	1288	1834	201	573	107	881
Tianjin	45	25	22	92	2	2	9	13	10	20	91	122	15	40	8	63
Xinjiang Wei AR	937	1320	371	2628	143	507	301	950	209	237	1039	1485	177	209	94	479
Xizang (Tibet) AR	186	290	89	565	29	115	49	193	24	48	163	235	18	27	16	61
Yunnan	774	875	251	1899	95	260	277	632	315	208	1177	1700	187	455	100	742
Zhejiang	215	129	102	446	10	11	46	67	54	93	442	589	70	196	39	306
Total China (1)	11801	11507	4336	27645	1153	2863	3673	7689	4302	3722	20002	28027	3149	8411	1704	13265

Appendix Table 11 Detailed estimates for the year 2014

PROVINCE (1-31)	LIVE BIRTHS (Ch.Bu.Stat. 2013)	LIVE BIRTHS (Fitted to UN 2014)	U5MR (IHME 2013)	TOTAL dths (UN+IHME)	U5MR (CHERG 2014)	Number of deaths in each province by age group: Neonatal	1m-1yr	1yr-4yr	Total	Birth Asphyxia: Neonatal	1m-1yr	1yr-4yr	Total	Preterm birth: Neonatal	1m-1yr	1yr-4yr	Total	Congenital disorders: Neonatal	1m-1yr	1yr-4yr	Total	Neonatal sepsis: Neonatal	1m-1yr	1yr-4yr	Total
Anhui	773946	873371	12.8	11179	11.2	5129	1972	2680	9781	1505	45	0	1550	1709	48	0	1756	590	438	405	1433	135	15	0	151
Beijing	186820	210820	4.9	1033	4.3	430	229	245	904	68	2	0	70	133	4	0	137	64	85	21	171	26	3	0	29
Chongqing	306693	346092	13.9	4811	12.2	2210	849	1150	4209	665	20	0	685	734	20	0	755	243	175	172	589	55	6	0	61
Fujian	458842	517787	9.6	4971	8.4	2250	898	1202	4349	583	17	0	601	748	21	0	769	300	250	175	725	74	8	0	83
Gansu	313712	354013	25.7	9098	22.5	4083	1775	2103	7960	1295	39	0	1333	1270	35	0	1306	311	176	221	708	69	8	0	76
Guangdong	1137295	1283398	6.7	8599	5.9	3755	1687	2082	7523	774	23	0	797	1215	34	0	1249	562	572	248	1382	170	19	0	188
Guangxi Zhuang AR	671231	757461	12.5	9468	10.9	4341	1671	2272	8284	1263	38	0	1301	1447	40	0	1487	506	379	344	1229	117	13	0	130
Guizhou	455855	514417	21.2	10906	18.5	4962	2023	2556	9542	1589	47	0	1637	1590	44	0	1634	424	260	317	1000	93	10	0	104
Hainan	129984	146683	17.5	2567	15.3	1177	461	608	2246	372	11	0	383	385	11	0	396	113	75	85	272	25	3	0	28
Hebei	953232	1075689	13.8	14845	12.1	6820	2619	3549	12988	2049	61	0	2110	2267	63	0	2330	752	542	532	1826	171	19	0	189
Heilongjiang	263049	296841	12.6	3740	11.0	1715	660	897	3272	501	15	0	515	572	16	0	588	199	149	136	483	46	5	0	51
Henan	1154579	1302903	13.3	17329	11.6	7957	3056	4149	15162	2364	70	0	2434	2648	74	0	2722	896	655	625	2176	204	23	0	227
Hubei	641421	723822	12.5	9048	10.9	4148	1597	2171	7916	1207	36	0	1243	1383	38	0	1421	484	362	329	1174	112	12	0	124
Hunan	899743	1015329	11.1	11270	9.7	5144	2002	2714	9861	1429	43	0	1472	1716	48	0	1764	639	501	409	1549	151	17	0	168
Jiangsu	748567	844732	6.2	5237	5.4	2263	1054	1265	4582	439	13	0	452	726	20	0	746	343	368	141	852	110	12	0	122
Jiangxi	595270	671742	17.1	11487	15.0	5271	2056	2722	10050	1660	49	0	1709	1729	48	0	1777	512	341	383	1236	114	13	0	126
Jilin	147445	166387	8.4	1398	7.3	626	259	339	1223	150	4	0	155	207	6	0	212	88	78	47	213	23	3	0	26
Liaoning	267321	301662	8.7	2624	7.6	1179	482	636	2296	289	9	0	298	390	11	0	401	164	143	89	396	42	5	0	47
Neimenggu (Inner Mongolia) AR	223937	252705	15.4	3892	13.5	1789	690	927	3405	552	16	0	569	591	16	0	608	185	128	135	448	41	5	0	46
Ningxia Hui AR	85371	96338	18.4	1773	16.1	812	320	419	1551	258	8	0	266	264	7	0	272	75	49	57	181	17	2	0	19
Qinghai	81488	91956	21.7	1995	19.0	907	372	467	1746	290	9	0	299	290	8	0	298	76	46	57	180	17	2	0	19
Shaanxi (Qin)	376226	424558	16.2	6878	14.2	3159	1224	1634	6018	986	29	0	1015	1041	29	0	1069	317	216	235	767	71	8	0	78
Shandong	1107812	1250127	9.9	12376	8.7	5613	2226	2990	10829	1479	44	0	1523	1869	52	0	1921	737	607	440	1784	181	20	0	201
Shanghai	196139	221336	6.9	1527	6.0	669	297	370	1336	141	4	0	145	217	6	0	223	100	99	45	244	29	3	0	33
Shanxi (Jin)	391356	441632	10.3	4549	9.0	2068	814	1098	3980	555	17	0	572	689	19	0	708	267	216	163	645	65	7	0	72
Sichuan	801068	903978	15.3	13831	13.4	6357	2451	3294	12101	1960	58	0	2019	2102	59	0	2160	660	458	482	1600	148	16	0	164
Tianjin	119454	134800	7.7	1038	6.7	461	196	252	908	105	3	0	108	151	4	0	155	67	62	33	162	18	2	0	20
Xinjiang Wei AR	356169	401924	32.1	12902	28.1	5655	2723	2911	11288	1721	51	0	1772	1684	47	0	1731	379	193	238	810	85	9	0	94
Xizang (Tibet) AR	48860	55137	41.5	2288	36.3	966	544	491	2002	269	8	0	277	270	8	0	278	56	25	28	108	13	1	0	14
Yunnan	588773	664410	19.6	13022	17.1	5949	2379	3066	11394	1900	57	0	1957	1924	54	0	1978	532	337	401	1270	117	13	0	131
Zhejiang	549299	619865	8.0	4959	7.0	2210	927	1202	4339	515	15	0	531	727	20	0	748	316	289	162	766	85	9	0	95
Total China (1)	15030957	16961912		220639		100075	40514	52459	193048	28935	861	0	29796	32688	910	0	33598	10955	8272	7154	26381	2624	292	0	2916

PROVINCE (1-31)	Pneumonia: Neonatal	1m-1yr	1yr-4yr	Total	Diarrhea: Neonatal	1m-1yr	1yr-4yr	Total	Accidents: Neonatal	1m-1yr	1yr-4yr	Total	SIDS: Neonatal	1m-1yr	1yr-4yr	Total
Anhui	525	440	180	1145	41	78	152	271	209	172	988	1368	154	464	80	698
Beijing	36	-1	34	70	1	0	3	4	2	26	59	87	13	19	7	40
Chongqing	232	206	77	515	20	41	71	131	97	73	424	594	66	198	34	299
Fujian	212	141	88	441	11	16	49	76	63	83	427	573	67	195	36	299
Gansu	554	677	182	1414	75	235	191	501	191	142	745	1078	122	239	63	425
Guangdong	329	123	200	652	10	7	50	67	50	173	642	865	113	257	62	432
Guangxi Zhuang AR	441	364	153	958	33	62	126	221	173	146	836	1155	130	393	68	592
Guizhou	616	687	193	1496	75	210	214	499	250	164	923	1337	149	357	77	583
Hainan	135	136	42	313	14	35	45	94	59	38	223	320	35	97	18	151
Hebei	716	630	237	1583	60	123	217	400	298	225	1310	1833	205	611	106	922
Heilongjiang	175	145	60	380	13	25	50	88	69	58	330	457	51	155	27	234
Henan	825	709	278	1812	67	132	245	444	337	264	1531	2131	239	717	124	1080
Hubei	421	348	146	915	32	59	120	211	165	140	799	1104	124	376	65	565
Hunan	504	381	188	1073	33	54	132	219	178	179	989	1346	154	463	81	699
Jiangsu	196	57	132	385	5	3	27	35	25	111	372	507	68	143	38	249
Jiangxi	598	597	188	1383	62	150	199	411	261	171	999	1430	158	439	82	679
Jilin	57	33	27	117	3	3	12	17	14	25	116	154	19	51	10	80
Liaoning	109	65	49	222	5	6	23	34	28	46	220	293	35	98	19	152
Neimenggu (Inner Mongolia) AR	195	184	62	441	18	41	62	122	84	58	342	484	54	156	28	237
Ningxia Hui AR	95	99	30	223	10	27	32	69	41	26	153	220	24	65	13	102
Qinghai	114	128	36	278	14	40	40	93	46	30	168	244	27	64	14	105
Shaanxi (Qin)	351	340	111	803	35	81	115	230	153	102	601	857	95	270	49	414
Shandong	533	364	216	1114	30	43	127	200	164	205	1069	1439	168	492	90	750
Shanghai	59	24	34	117	2	1	9	13	10	30	116	156	20	47	11	78
Shanxi (Jin)	199	141	78	417	12	18	49	78	64	74	396	534	62	183	33	278
Sichuan	692	649	222	1562	64	144	221	430	299	207	1214	1720	191	555	99	845
Tianjin	41	21	21	83	2	2	8	11	8	19	83	111	14	36	8	57
Xinjiang Wei AR	862	1161	315	2337	127	442	278	848	219	216	999	1434	170	233	87	490
Xizang (Tibet) AR	171	255	75	501	26	102	47	175	26	43	159	229	19	30	15	64
Yunnan	714	766	223	1702	82	219	246	547	302	194	1114	1610	178	456	92	726
Zhejiang	200	106	99	405	8	8	38	55	44	90	404	538	66	175	36	277
Total China (1)	10906	9975	3976	24857	989	2407	3200	6596	3927	3532	18751	26210	2992	8035	1574	12602

Appendix Table 12 Detailed estimates for the year 2015

PROVINCE	LIVE BIRTHS	LIVE BIRTHS	U5MR	TOTAL dths	U5MR	Number of deaths in each province by age group				Birth Asphyxia				Preterm birth				Congenital disorders				Neonatal sepsis				Pneumonia				Diarrhea				Accidents				SIDS			
(1-31)	(Ch.Bu.Stat. 2013)	(Fitted to UN 2015)	(IHME 2013)	(UN+IHME)	(CHERG 2015)	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total	Neonatal	1m-1yr	1yr-4yr	Total
Anhui	773946	874727	12.8	11197	10.5	4784	1859	2558	9200	1382	41	0	1423	1606	45	0	1651	569	436	387	1392	133	15	0	148	480	389	173	1042	35	61	136	232	182	164	929	1275	144	436	77	656
Beijing	186820	211147	4.9	1035	4.0	397	221	232	850	59	2	0	61	122	3	0	126	59	83	19	160	26	3	0	29	33	-5	36	64	1	0	3	3	2	26	51	79	12	16	7	35
Chongqing	306693	346629	13.9	4818	11.4	2063	798	1098	3959	613	18	0	632	692	19	0	711	234	174	166	574	54	6	0	60	213	182	74	468	17	32	64	113	86	69	400	555	62	188	33	282
Fujian	458842	518591	9.6	4978	7.9	2092	853	1145	4091	528	16	0	543	698	19	0	718	286	248	163	697	73	8	0	81	194	121	87	403	10	12	43	64	52	80	396	529	63	178	34	275
Gansu	313712	354562	25.7	9112	21.1	3835	1639	2013	7487	1231	37	0	1268	1213	34	0	1247	302	177	224	704	67	7	0	75	505	605	166	1276	67	199	179	445	186	131	710	1027	115	244	60	420
Guangdong	1137295	1285390	6.7	8612	5.5	3480	1619	1977	7076	687	20	0	708	1125	31	0	1156	527	562	224	1313	168	19	0	186	302	94	202	598	8	4	43	56	39	170	580	789	104	225	59	388
Guangxi Zhuang AR	671231	758637	12.5	9483	10.3	4048	1576	2168	7792	1158	34	0	1193	1359	38	0	1397	487	377	328	1192	115	13	0	128	403	321	148	872	28	48	113	189	150	140	786	1075	121	369	65	555
Guizhou	455855	515216	21.2	10923	17.4	4652	1879	2443	8975	1497	45	0	1541	1512	42	0	1554	411	261	316	988	92	10	0	102	562	613	179	1353	66	175	198	438	236	153	878	1267	140	355	73	568
Hainan	129984	146911	17.5	2571	14.4	1102	430	580	2112	347	10	0	357	365	10	0	375	109	75	83	267	25	3	0	27	123	121	40	284	12	29	41	82	54	36	211	301	33	94	17	145
Hebei	953232	1077359	13.8	14868	11.3	6366	2463	3388	12216	1888	56	0	1944	2134	59	0	2194	726	541	512	1778	168	19	0	186	654	558	227	1440	52	98	195	344	263	214	1235	1712	191	579	102	872
Heilongjiang	263049	297302	12.6	3746	10.4	1600	622	856	3078	459	14	0	473	537	15	0	552	192	148	130	469	45	5	0	50	160	128	58	346	11	19	45	76	60	55	310	425	48	146	26	219
Henan	1154579	1304925	13.3	17356	10.9	7424	2877	3959	14261	2174	65	0	2239	2491	69	0	2560	864	653	599	2116	201	22	0	223	754	627	267	1648	57	104	220	380	295	252	1441	1988	223	677	119	1018
Hubei	641421	724945	12.5	9062	10.3	3868	1506	2071	7446	1107	33	0	1140	1299	36	0	1335	466	360	313	1139	110	12	0	122	385	307	141	833	27	46	108	181	144	133	751	1028	116	352	62	531
Hunan	899743	1016905	11.1	11288	9.1	4791	1894	2589	9275	1303	39	0	1341	1608	45	0	1652	613	497	386	1497	149	17	0	166	462	333	183	978	28	41	117	186	152	172	924	1248	144	429	78	650
Jiangsu	748567	846043	6.2	5245	5.1	2096	1014	1200	4310	388	12	0	400	670	19	0	689	319	361	126	807	109	12	0	121	180	40	134	353	4	2	23	29	19	109	333	461	63	123	36	222
Jiangxi	595270	672785	17.1	11505	14.1	4931	1922	2600	9453	1546	46	0	1592	1636	46	0	1681	496	341	375	1212	112	12	0	124	546	532	176	1254	54	122	181	357	238	161	947	1345	148	426	78	652
Jilin	147445	166645	8.4	1400	6.9	581	247	322	1150	135	4	0	139	192	5	0	198	84	77	43	204	23	3	0	25	52	27	27	107	2	2	10	14	11	24	107	142	17	46	10	73
Liaoning	267321	302130	8.7	2629	7.1	1095	459	605	2160	260	8	0	268	363	10	0	373	156	141	82	379	42	5	0	46	99	55	49	203	4	4	20	28	23	44	203	270	33	88	18	139
Neimenggu (Inner Mongolia) AR	223937	253097	15.4	3898	12.7	1671	647	885	3203	512	15	0	527	558	16	0	573	179	128	131	438	41	5	0	45	178	163	59	401	16	33	56	105	76	55	323	454	50	149	27	226
Ningxia Hui AR	85371	96487	18.4	1775	15.1	760	299	400	1459	241	7	0	248	251	7	0	258	73	49	56	178	16	2	0	18	87	88	28	202	9	22	29	60	38	25	145	208	23	63	12	98
Qinghai	81488	92099	21.7	1999	17.8	850	345	446	1642	274	8	0	282	276	8	0	283	74	47	57	178	16	2	0	18	104	114	33	251	12	33	37	82	43	28	160	231	26	64	13	103
Shaanxi (Qin)	376226	425217	16.2	6889	13.3	2954	1146	1560	5660	916	27	0	943	983	27	0	1011	307	215	229	751	69	8	0	77	321	303	105	728	30	65	104	199	138	97	569	804	89	260	47	396
Shandong	1107812	1252068	9.9	12385	8.1	5222	2113	2850	10185	1340	40	0	1380	1746	49	0	1794	705	601	411	1717	178	20	0	198	489	316	213	1017	25	32	112	169	138	198	994	1329	157	450	86	693
Shanghai	196139	221680	6.9	1530	5.7	620	285	352	1257	125	4	0	129	201	6	0	207	94	98	41	232	29	3	0	32	54	18	35	107	2	1	8	11	8	30	105	142	19	41	11	71
Shanxi (Jin)	391366	442317	10.3	4556	8.5	1925	772	1047	3743	504	15	0	519	644	18	0	662	255	214	153	622	64	7	0	71	182	122	76	381	10	13	43	66	54	71	368	494	58	169	31	258
Sichuan	801068	905381	15.3	13852	12.6	5940	2298	3144	11382	1816	54	0	1870	1984	55	0	2039	638	458	468	1564	145	16	0	161	632	576	210	1419	56	116	200	371	268	196	1148	1612	178	531	94	804
Tianjin	119454	135009	7.7	1040	6.3	428	187	239	854	94	3	0	97	140	4	0	144	63	61	30	155	18	2	0	20	38	17	21	76	1	1	7	9	7	19	76	102	13	32	7	52
Xinjiang Wei AR	356169	402548	32.1	12922	26.4	5324	2499	2795	10617	1655	49	0	1704	1618	45	0	1663	369	196	247	812	83	9	0	92	784	1037	282	2103	114	383	265	762	220	198	958	1377	160	248	84	491
Xizang (Tibet) AR	48860	55223	41.5	2292	34.1	912	496	475	1883	263	8	0	270	261	7	0	268	54	26	30	110	13	1	0	14	155	228	66	449	24	90	46	160	27	39	155	222	20	31	14	65
Yunnan	588773	665441	19.6	13043	16.1	5573	2215	2929	10717	1782	53	0	1835	1827	51	0	1878	516	338	397	1251	115	13	0	128	651	683	207	1541	72	181	226	479	281	182	1058	1521	167	449	88	704
Zhejiang	549299	620827	8.0	4967	6.6	2051	886	1144	4081	462	14	0	476	676	19	0	695	299	285	148	732	84	9	0	93	183	88	99	371	7	6	33	46	36	88	370	494	62	156	34	252
Total China (1)	15030057	16988245		220981		93435	38066	50073	181574	26748	796	0	27544	30788	857	0	31645	10527	8227	6874	25628	2582	287	0	2869	9966	8803	3801	22570	861	1976	2902	5738	3524	3360	17623	24507	2795	7614	1502	11912