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Cover Photo: Working group members from China CDC guiding the disposal of silt, debris, floating objects after the flood disaster in Xiawo Township, Zhengzhou City, July 23, 2021.

Preplanned Studies

# Cooking Oil and Salt Intakes Among Children Aged 6–17 Years — China, 2016–2017

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**Summary**

**What is already known on this topic?**

High-level intakes of both cooking oil and salt are issues of concern in China as they can lead to an increased risk of chronic diseases later in life. Reducing intakes of cooking oil and salt should be prioritized in children.

**What is added by this report?**

Among children aged 6–17 years in China in 2016–2017, the median intake of cooking oil and salt were 27.7 and 6.1 g/d, respectively. The percentages of children with intake of cooking oil and salt that exceeded the recommended guidelines were 50.4% and 67.8%, respectively.

**What are the implications for public health practice?**

Understanding the consumption levels of cooking oil and salt among children aged 6–17 years in China is vital for reducing associated health effects later in life. This study provided scientific evidence to recommend policymakers formulate effective policies to reduce intake of cooking oil and salt for the target population.

Currently, the intake of cooking salt and oil of Chinese residents are still at a high level. The results of the China Nutrition and Health Surveillance 2010–2013 showed that the average cooking oil and cooking salt intakes of Chinese residents overall were 42.1 and 10.5 g/d, respectively (*1*). A high intake of cooking oil may lead to an increased risk of chronic diseases such as obesity, cardiovascular disease, fatty liver, etc. (*2*–*3*). In addition, a high intake of cooking salt may also lead to an increased risk of other chronic diseases such as hypertension, stroke, gastric cancer, etc. (*4*–*5*). This study aimed to estimate the intake of cooking oil and salt among children aged 6–17 years old in China using data from the China Nutrition and Health Surveillance of Children and Lactating Mothers (CNHSCLM) in 2016–2017, to provide scientific evidence for policymakers to formulate effective policies to reduce intake of cooking oil and salt.

The CNHSCLM was a cross-sectional study, and data from 2016–2017 were used. A multistage stratified random sampling method was used to collect data in 275 monitoring sites in 31 provincial-level administrative divisions (PLADs) (*6*). The intake data on cooking oil and salt were extracted from the CNHSCLM in this study and assessed over three consecutive days of recording the weight of cooking oil and salt in the family kitchens or school cafeterias, and the total number of diners was recorded. The individual intake of cooking oil and salt was calculated according to the dietary energy ratio of the number of diners and according to the recommended intake of cooking oil and salt in the Dietary Guidelines for Chinese Residents (2016). The recommended intake of cooking oil for children aged 4–10 and 11–17 years were 20–25 and 25–30 g/d, respectively, and participants in the surveillance were placed into groups of low, adequate, and high consumption. The recommended intake of cooking salt for children aged 4–6, 7–10, and 11–17 years were <3, <4, and <5 g/d, respectively, and the participants were divided into adequate and high groups (*7*). SAS (version 9.4, SAS Institute Inc., Cary, NC, USA) was used to conduct all the analyses. All data were non-normally distributed. The measurement data were described by median and quartile distance. The intake of cooking oil and salt among different age groups, sex, area types, regions (*8*), and sources were analyzed by Wilcoxon rank-sum test. The data were described by constituent ratio, and the constituent ratio was compared using chi-squared tests. The level of statistical significance was set at $P<0.05$. The protocol of this study was evaluated and approved by the ethical committee of China CDC (201614).

A total of 16,042 participants were included in this report, including 3,996 participants aged 6–8 years, 4,781 participants aged 9–11 years, 3,802 participants aged 12–14 years, and 3,463 participants aged 15–17 years. These 16,042 participants were distributed as follows: 7,982 males and 8,060 females; 7,524 in

urban areas and 8,518 in rural areas; 5,576 in eastern regions, 4,910 in central regions, and 5,556 in western regions; and 10,865 were evaluated in family kitchens and 5,177 in school cafeterias. The study's population distribution was fully described in Table 1.

As presented in Table 1, the median intake of cooking oil among children aged 6–17 years in China overall in 2016–2017 was 27.7 g/d, and that of children aged 6–8, 9–11, 12–14, and 15–17 years were 24.1, 26.3, 29.6, and 33.3 g/d, respectively. The intake of cooking oil showed differences based on the following factors: males had higher intake than females (29.4 g/d *vs.* 26.3 g/d, $P<0.01$); urban residents had lower intake than rural residents (25.9 g/d *vs.* 29.4 g/d, $P<0.01$); residents in eastern regions had lower intakes than residents in central and western regions (24.3 g/d *vs.* 29.0 g/d *vs.* 30.7 g/d, $P<0.01$); and participants in family kitchens had lower intake than those in school cafeterias (27.0 g/d *vs.* 29.4 g/d, $P<0.05$). The median intake of cooking salt overall was 6.1 g/d, and that of children aged 6–8, 9–11, 12–14, and 15–17 years were 5.2, 6.2, 6.6, and 6.6 g/d, respectively. Intake of cooking salt showed differences based on the following factors: males had higher intake than females (6.4 g/d *vs.* 5.8 g/d, $P<0.01$); urban residents had lower intake than rural residents (5.6 g/d *vs.* 6.4 g/d, $P<0.01$); residents in eastern regions had lower intakes than residents in central and western regions (5.7 g/d *vs.* 6.3 g/d *vs.* 6.3 g/d, $P<0.01$); and participants in family kitchens had lower intake than those in school cafeterias (5.8 g/d *vs.* 6.6 g/d, $P<0.05$).

The results of evaluating intake of cooking oil and salt based on the distributions were illustrated in Table 2. Among children aged 6–17 years in China in 2016–2017, only 10.5% of the children had the recommended intake of cooking oil, with 39.2% of children having lower than the recommended intake and 50.4% of children having higher than recommended intake. The proportions of children aged 6–8, 9–11, 12–14, and 15–17 years having higher than the recommended intake of cooking oil were 47.6%, 50.0%, 49.3%, and 55.2%, respectively.

TABLE 1. The median of intake of cooking oil and salt among children aged 6–17 years in China, 2016—2017 (g/d) [M ($P_{25}$, $P_{75}$)].

| Variable | N | Cooking oil | Cooking salt |
|---|---|---|---|
| Total | 16,042 | 27.7(15.5, 44.8) | 6.1(3.8, 9.3) |
| Age groups (years) | | | |
| 6–8 | 3,996 | 24.1(14.1, 38.0)* | 5.2(3.2, 8.1)* |
| 9–11 | 4,781 | 26.3(14.7, 42.2)* | 6.2(3.9, 9.1)* |
| 12–14 | 3,802 | 29.6(16.8, 47.2)* | 6.6(4.2, 9.7)* |
| 15–17 | 3,463 | 33.3(18.3, 53.5)* | 6.6(4.0, 10.0)* |
| Sex | | | |
| Male | 7,982 | 29.4(16.3, 47.5)† | 6.4(3.9, 9.8)† |
| Female | 8,060 | 26.3(14.8, 42.1)† | 5.8(3.6, 8.7)† |
| Area type | | | |
| Urban | 7,524 | 25.9(14.5, 42.5)§ | 5.6(3.4, 8.9)§ |
| Rural | 8,518 | 29.4(16.5, 47.6)§ | 6.4(4.1, 9.5)§ |
| Region | | | |
| Eastern regions | 5,576 | 24.3(13.6, 38.7)¶ | 5.7(3.5, 8.6)¶ |
| Central regions | 4,910 | 29.0(17.3, 46.1)¶ | 6.3(3.9, 9.5)¶ |
| Western regions | 5,556 | 30.7(16.1, 50.6)¶ | 6.3(3.9, 9.8)¶ |
| Source | | | |
| Family kitchen | 10,865 | 27.0(15.7, 44.1)** | 5.8(3.6, 9.0)** |
| School cafeteria | 5,177 | 29.4(14.8, 46.6)** | 6.6(4.2, 9.8)** |

* *P*-value <0.01 for differences among children aged 6–8, 9–11, 12–14, and 15–17 years.
† *P*-value <0.01 for differences between male and female.
§ *P*-value <0.01 for differences between urban and rural areas.
¶ *P*-value <0.01 for differences among eastern, central, and western regions.
** *P*-value <0.05 for differences between family kitchen and school cafeteria.

TABLE 2. Distributions of cooking oil and salt intakes among children aged 6–17 years in China, 2016—2017 (%).

| Variable | Recommended intake of cooking oil | | | Recommended intake of cooking salt | |
|---|---|---|---|---|---|
| | Low[N(%)] | Adequate[N(%)] | High[N(%)] | Adequate[N(%)] | High[N(%)] |
| Total | 6,286(39.2) | 1,678(10.5) | 8,078(50.4) | 5,174(32.3) | 10,868(67.8) |
| Age groups (years) | | | | | |
| 6–8 | 1,555(38.9)* | 539(13.5)* | 1,902(47.6)* | 1,316(32.9)* | 2,680(67.1)* |
| 9–11 | 1,934(40.5)* | 457(9.6)* | 2,390(50.0)* | 1,415(29.6)* | 3,366(70.4)* |
| 12–14 | 1,552(40.8)* | 375(9.9)* | 1,875(49.3)* | 1,277(33.6)* | 2,525(66.4)* |
| 15–17 | 1,245(36.0)* | 307(8.9)* | 1,911(55.2)* | 1,166(33.7)* | 2,297(66.3)* |
| Sex | | | | | |
| Male | 2,907(36.4)† | 825(10.3)† | 4,250(53.2)† | 2,337(29.3)† | 5,645(70.7)† |
| Female | 3,379(41.9)† | 853(10.6)† | 3,828(47.5)† | 2,837(35.2)† | 5,223(64.8)† |
| Area type | | | | | |
| Urban | 3,186(42.3)§ | 791(10.5)§ | 3,547(47.1)§ | 2,769(36.8)§ | 4,755(63.2)§ |
| Rural | 3,100(36.4)§ | 887(10.4)§ | 4,531(53.2)§ | 2,405(28.2)§ | 6,113(71.8)§ |
| Region | | | | | |
| Eastern regions | 2,552(45.8)¶ | 655(11.8)¶ | 2,369(42.5)¶ | 1,985(35.6)¶ | 3,591(64.4)¶ |
| Central regions | 1,764(35.9)¶ | 533(10.9)¶ | 2,613(53.2)¶ | 1,445(29.4)¶ | 3,465(70.6)¶ |
| Western regions | 1,970(35.5)¶ | 490(8.8)¶ | 3,096(55.7)¶ | 1,744(31.4)¶ | 3,812(68.6)¶ |
| Source | | | | | |
| Family kitchen | 4,226(38.9)** | 1,188(10.9)** | 5,451(50.2)** | 3,625(33.4)** | 7,240(66.6)** |
| School cafeteria | 2,060(39.8)** | 490(9.5)** | 2,627(50.7)** | 1,549(29.9)** | 3,628(70.1)** |

* *P*-value <0.01 for differences among children aged 6–8, 9–11, and 12–14 years.
† *P*-value <0.01 for differences between male and female.
§ *P*-value <0.01 for differences between urban and rural areas.
¶ *P*-value <0.01 for differences among eastern, central, and western regions.
** *P*-value <0.05 for differences between family kitchen and school cafeteria.

Differences in higher than the recommended intake of cooking oil existed for the following factors: males had a higher proportion than females (53.2% *vs.* 47.5%, *P*<0.01); urban residents had a lower proportion than rural residents (47.1% *vs.* 53.2%, *P*<0.01); residents of the eastern regions had lower proportion than those residing in central and western regions (42.5% *vs.* 53.2% *vs.* 55.7%, *P*<0.01); and participants in family kitchens had a lower proportion than those in school canteens (50.2% *vs.* 50.7%, *P*<0.05). The proportion of children overall having intake of cooking salt higher than recommended was 67.8%, and that of children aged 6–8, 9–11, 12–14, and 15–17 years were 67.1%, 70.4%, 66.4%, and 66.3%, respectively. Differences in higher than recommended intake of cooking salt existed for the following factors: males had a higher proportion than females (70.7% *vs.* 64.8%, *P*<0.01); urban residents had a lower proportion than rural residents (63.2% *vs.* 71.8%, *P*<0.01); residents of the eastern regions had lower proportion than those residing in central and western regions (64.4% *vs.* 70.6% *vs.* 68.6%, *P*<0.01); and participants in family kitchens had a lower proportion than those in school cafeterias (66.6% *vs.* 70.1%, *P*<0.01).

## DISCUSSION

High intake of cooking oil and salt is closely associated with increased risk of chronic diseases such as obesity, hypertension, cardiovascular disease, etc. (*2*–*5*). Therefore, reducing cooking oil and salt is one of the core recommendations in the Dietary Guidelines for Chinese Residents (2016). The National Health Commission (NHC) has launched a special campaign to encourage residents to reduce intake of cooking oil and salt (*9*). In this study among children aged 6–17 years in China in 2016–2017, the median intake of cooking oil was 27.7 g/d, and the median intake typically increased with age as children aged 6–8, 9–11, 12–14, and 15–17 years had intakes of 24.1, 26.3, 29.3, and 33.3 g/d, respectively. Overall, 50.4% of the children had an intake of cooking oil that

exceeded recommended intake levels. The median intake of cooking salt among this group overall was 6.1 g/d, and the median intake typically increased with age as children aged 6–8, 9–11, 12–14, and 15–17 years had intakes of 5.2, 6.2, 6.6, and 6.6 g/d, respectively. Overall, 67.8% of the children had an intake of cooking salt that exceeded recommended intake levels. These results suggested that the intake of cooking oil and salt in most children in China exceeded the recommended guidelines. Therefore, policymakers and associated stakeholders should continue to aim for reducing the intake of cooking oil and salt, strengthen education regarding related nutrition and health knowledge, and encourage reasonable food choices and improved dietary behavior.

In general, high intake levels of cooking oil and salt in children aged 6–17 years in China were an important issue to be addressed. The effects of government nutrition policies and nutrition education on improving dietary behavior and nutrition status had been recognized (*10*). Communities, schools, and families should work together to develop feasible and appropriate dietary environments for children.

This study was subject to at least two limitations. First, due to a limitation in the methodology, the intake of cooking oil and salt while eating out, i.e., not eating at home or at school, was not obtained. Second, the total consumption of cooking oil and salt was likely underestimated to a certain extent by using the weight records of the ingredients in the family kitchens or school canteens.

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**Conflicts of interest**: No conflicts of interest were reported.

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Preplanned Studies

# Trends of Adverse Pregnancy Outcomes in a High Prevalence Region of Birth Defects — Shanxi Province, China, 2007–2019

Shiqi Lin[1]; Yuan Zhang[1,2]; Jiajia Li[1]; Jilei Wu[1]; Lijun Pei[1,#]


## Summary

### What is already known about this topic?

Shanxi Province in northern China has been identified as a region with the highest prevalence of birth defects nationwide. With large amounts of financial support devoted for prevention and related interventions for birth defects, huge progress has been made as a 60% decrease in its prevalence was observed from 2009 to 2014.

### What is added by this report?

The study presented a recent trend of adverse pregnancy outcomes (APOs) in Shanxi Province, a region with high prevalence of birth defects in China from 2007–2019. The prevalence of serious APOs including birth defects, stillbirths, and neonatal deaths remained at a relatively low level, yet macrosomia, low birth weight (LBW), preterm births, and spontaneous abortion comprised a majority of all APOs, with macrosomia showing an obvious upward trend from 2007 to 2012.

### What are the implications for public health practice?

These findings provide new evidence for prevention and intervention strategies of APOs in northern China. Future research should focus on comprehensive interventions for multiple APOs, especially macrosomia, LBW, preterm births, and spontaneous abortion.


Adverse pregnancy outcomes (APOs) are important public health issues. Shanxi Province in northern China has been identified as a region with the highest prevalence of birth defects nationwide and also the highest prevalence of neural tube defects in the world (*1*). Since over 30 years ago, large amounts of financial support have been devoted for the prevention of birth defects and related intervention, and huge progress has been made as a 60% decrease in its prevalence was observed from 2009 to 2014 (*2*). With socioeconomic and nutritional improvements, the prevalence of other APOs might also have changed in recent years, yet indexes in that region were less reported. Our study aimed to investigate the trends of prevalence of APOs at birth and to provide evidence for new strategies for APO prevention and intervention in rural areas in northern China.

This study was a population-based descriptive study of APOs in Pingding and Xiyang County in Shanxi Province of China from 2007 to 2019. Data was derived from two birth surveillance systems: the Perinatal Health Care Surveillance System, which monitors the course and outcome of all births of resident women and their fetuses/infants from the onset of pregnancy to Day 42 after delivery, and the Birth Defects Surveillance System that specifically records live-born or stillborn infants with birth defects (*3*). To better understand the current situation of APOs, data was extracted from the National Free Pre-Pregnancy Checkups Project (NFPCP) in Pingding County that provided free physical examinations and counselling for local couples who planned to get pregnant and recorded the course and outcome of their pregnancies from 2017–2019 (*4*).

APOs were defined as neonatal deaths, stillbirths, birth defects, low birth weight, macrosomia, preterm births and spontaneous abortion. Livebirths or stillbirths were defined as birth defects if fulfilling the following conditions: 1) being of at least of 20 weeks' gestational age or having a birthweight of at least 500 g; 2) having an external structural birth defect that could be determined by physical examination at birth; and 3) having that birth defect diagnosed or its signs and symptoms recognized by 6 weeks of age. Stillbirths in the Perinatal Healthcare Surveillance System were defined as fetal losses in pregnancies beyond 20 weeks of gestation and defined in the NFPCP as fetal losses beyond 28 weeks of gestation. Neonatal deaths were the deaths of newborns between zero and seven days after birth. Preterm births were livebirths before 37 gestational weeks. Low birth weight (LBW) were livebirths ≥37 gestational weeks and weighing <2,500 g. Macrosomia was defined as livebirths of birth weight ≥4,000 g and ≥37 gestational weeks. The prevalence of APOs was calculated by using the total

number of APOs as the numerators and all births or pregnancies as the denominators and was described as the number of APOs per 1,000 births or per 1,000 pregnancies. The Cochran-Armitage trend test was adopted to examine the trends of incidence across years (denoted as $\chi^2_{trend}$) (5). R software 3.6.1 (R Development Core Team, Vienna, Austria) was used for the analysis.

From 2007 to 2012, there were 31,394 births in total, among whom were 4,858 cases of APOs. Table 1 showed that the total birth prevalence of APOs was 154.7 per 1,000 births. The birth prevalence of macrosomia, LBW, preterm births, stillbirths, birth defects, and neonatal deaths were 64.5 per 1,000 births, 40.5 per 1,000, 21.9 per 1,000, 12.3 per 1,000, 12.2 per 1,000, and 3.4 per 1,000, respectively.

Figure 1 showed that the birth prevalence of macrosomia increased significantly from 59.6 to 74.4 per 1,000 births from 2007–2012 ($\chi^2_{trend}$=20.314, $P$<0.001). Birth prevalence of LBW and preterm births declined significantly, from 43.8 per 1,000 births and 19.1 per 1,000 births in 2007 to 30.1 per 1,000 births and 11.8 per 1,000 births in 2012, respectively ($\chi^2_{trend}$=21.748, $P$<0.001; $\chi^2_{trend}$=14.342, $P$<0.001). The birth prevalence of neonatal deaths, stillbirths, and birth defects stayed at a relatively low level of 3.3 per 1,000 births, 12.1 per 1,000, and 12.2 per 1,000 ($P$>0.05), respectively.

Table 2 showed from 2017–2019 that the prevalence of LBW, preterm births, spontaneous abortion, birth defects, and stillbirths were 46.1 per 1,000 pregnancies, 36.2 per 1,000, 28.8 per 1,000, 6.6 per 1,000, and 2.7 per 1,000, respectively.

Figure 2 presented that the prevalence of LBW dropped from 49.5 to 41.5 per 1,000 pregnancies from 2017–2019, while preterm births rose from 31.8 per 1,000 to 40.3 per 1,000 pregnancies during the same time period. The prevalence of spontaneous abortion rose sharply from 14.1 per 1,000 in 2017 to 36.8 per 1,000 in 2018 and then dropped slightly to 36.5 per 1,000 pregnancies in 2019. Though with fluctuations, prevalence of stillbirths and birth defects both stayed at a relatively low level.

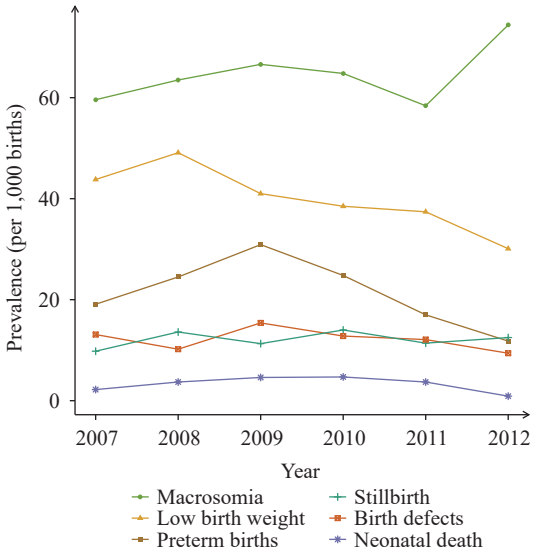


FIGURE 1. Prevalences of adverse pregnancy outcomes in Pingding County and Xiyang County from 2007–2012.

Figure 3 displayed that from 2007–2012, macrosomia, LBW, and preterm births were most severe in newborn babies, accounting for 91.4% of the 6 adverse birth outcomes (macrosomia, LBW, preterm births, birth defects, stillbirth, and neonatal death) with macrosomia comprising 41.7%.

## DISCUSSION

In this study, the prevalence of LBW (40.5 per 1,000 births) and macrosomia (64.5 per 1,000 births) from 2007–2012 were similar to those reported in

TABLE 1. Prevalence of adverse pregnancy outcomes in Pingding and Xiyang Counties from 2007–2012 (1/1,000 births).

| Year | Births | Macrosomia | | Low birth weight | | Preterm births | | Stillbirths | | Birth defects | | Neonatal deaths (≤7 d) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | n | Prevalence | n | Prevalence | n | Prevalence | n | Prevalence | n | Prevalence | n | Prevalence |
| 2007* | 4,497 | 268 | 59.6 | 197 | 43.8 | 86 | 19.1 | 44 | 9.8 | 59 | 13.1 | 10 | 2.2 |
| 2008 | 6,459 | 410 | 63.5 | 317 | 49.1 | 158 | 24.5 | 88 | 13.6 | 66 | 10.2 | 24 | 3.7 |
| 2009 | 5,658 | 377 | 66.6 | 232 | 41.0 | 175 | 30.9 | 64 | 11.3 | 87 | 15.4 | 26 | 4.6 |
| 2010 | 5,371 | 348 | 64.8 | 207 | 38.5 | 133 | 24.8 | 75 | 14.0 | 69 | 12.8 | 25 | 4.7 |
| 2011 | 4,895 | 286 | 58.4 | 183 | 37.4 | 83 | 17.0 | 56 | 11.4 | 59 | 12.1 | 18 | 3.7 |
| 2012† | 4,490 | 334 | 74.4 | 135 | 30.1 | 53 | 11.8 | 56 | 12.5 | 42 | 9.4 | 4 | 0.9 |
| Total | 31,394 | 2,024 | 64.5 | 1,272 | 40.5 | 688 | 21.9 | 385 | 12.3 | 382 | 12.2 | 107 | 3.4 |

* The 2007 data of Xiyang County were from October to December.
† The 2012 data of Xiyang County were from January to September.

TABLE 2. Prevalence of adverse pregnancy outcomes in Pingding County from 2017–2019 (1/1,000 pregnancies).

| Year | Pregnancies | Low birth weight | | Preterm births | | Spontaneous abortion | | Birth defects | | Stillbirths | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | n | Prevalence | n | Prevalence | n | Prevalence | n | Prevalence | n | Prevalence |
| 2017 | 849 | 42 | 49.5 | 27 | 31.8 | 12 | 14.1 | 6 | 7.1 | 4 | 4.7 |
| 2018 | 788 | 37 | 47 | 29 | 36.8 | 29 | 36.8 | 7 | 8.9 | 1 | 1.3 |
| 2019 | 795 | 33 | 41.5 | 32 | 40.3 | 29 | 36.5 | 3 | 3.8 | 1 | 1.3 |
| Total | 2,432 | 112 | 46.1 | 88 | 36.2 | 70 | 28.8 | 16 | 6.6 | 6 | 2.7 |

Note: The data came from the National Free Pre-Pregnancy Checkups Project and was a cluster sampling of Pingding County.

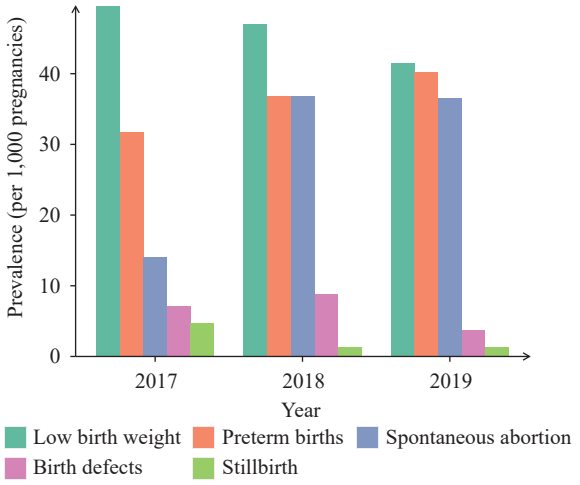


FIGURE 2. Prevalences of adverse pregnancy outcomes in Pingding County from 2017 to 2019.

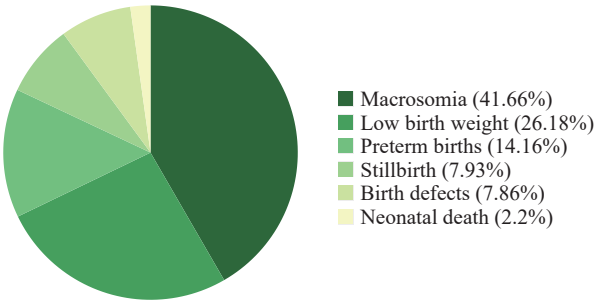


FIGURE 3. Proportions of 6 adverse pregnancy outcomes between 2007 and 2012 in Pingding County and Xiyang County.

Shanxi in 2010 (44 per 1,000 births for LBW and 63 per 1,000 births for macrosomia) (*6*). The prevalence of preterm births (21.9 per 1,000 births) from 2007–2012 was a much lower than that reported by a survey covering 132 cities in China from 2010–2013 [72 per 1,000 births (*7*)]. The prevalence of LBW (46.1 per 1,000 births) and preterm births (36.2 per 1,000 births) from 2017–2019 was higher than that from 2007–2012. Considering participants from 2017–2019 were couples who had plans for pregnancy and that planned pregnancies were normally observed to have lower risks of APOs (*8*), the prevalence of LBW and preterm births in general populations from 2017–2019 could have been even higher. This study called for attention on the rising prevalence of the three APOs, namely, macrosomia, preterm births and LBW.

It is worth noting that the total annual pregnancies from 2017–2019 were much lower compared to the total annual births from 2007–2012, mainly because the former only covered couples planning for pregnancy and participating in the NFPCP while the latter was based on population-based birth data. For a similar reason, the prevalence of stillbirths and birth defects from 2007–2012 was much higher compared to that from 2017–2019. In addition, stillbirth data from 2007–2012 covered fetal deaths at ≥20 weeks of gestation while data from 2017 to 2019 only included fetal deaths at ≥28 gestational weeks. A 2012–2014 national survey in 441 hospitals estimated the prevalence of stillbirths to be 8.8 per 1,000 births (*9*) and another more recent survey from 2015–2016 in 96 hospitals in 24 provinces estimated the prevalence of stillbirth to be 13.2 per 1,000 births (*10*).

This research found that the prevalence of macrosomia, LBW, preterm births, and spontaneous abortion was high among all APOs, with macrosomia increasing from 2007 to 2012 while prevalence of birth defects, neonatal deaths, and stillbirths staying at relatively low levels. China has been prioritizing the reduction of birth defects, stillbirths, and neonatal deaths; however, though infant mortality caused by these elements has declined, the prevalence of chronic diseases in children related to prematurity, LBW, and macrosomia have increased. Attention and investment in prevention and community coverage of preterm births, LBW, and macrosomia are still far from enough. Yet the short-term and long-term consequences, including neurodevelopmental impairments, cardiovascular diseases, and metabolic diseases, are significant and non-negligible (*11–12*). In addition, complications associated with preterm births are proven to be closely related to neonatal deaths, and

both fetal growth restriction and preterm births are strongly associated with placental dysfunction and subsequent poor fetal health, carrying increased risks of stillbirths (*9*,*12*). In other words, China cannot effectively reduce the infant mortality and incidence of chronic diseases without preventing preterm births, LBW, and macrosomia. Therefore, beyond infant mortality, these three APOs need to be addressed with adequate attention, proper investment, and strategic public health measures.

This study was subject to at least some limitations. As a local descriptive study covering only two counties, these results are likely not representative of the whole province or the country. In addition, because more detailed demographic data including socioeconomic factors and other exposure factors during pregnancy were not collected in the current study, the distribution of APOs was only described in terms of maternal age and offspring sex instead of exploring the risk factors for APOs. Due to data unavailability, continuous trends for all APOs from 2007–2019 could not be extracted using the same data source, creating difficulties in comparing results year by year and with results in other research. For the same reason, we could not report the prevalence of spontaneous abortion from 2007–2012 and macrosomia from 2017–2019. Furthermore, the APOs in the NFPCP were self-reported and thus the prevalence of APOs could be underestimated from 2017–2019. A major strength of this study was that the population-based surveillance system and its design ensured coverage of over 95% of the study population (*13*).

In conclusion, this population-based study described APO trends in a region with high prevalence of birth defects in China. The prevalence of serious APOs including birth defects, stillbirths, and neonatal deaths remained at a relatively low level, yet macrosomia, LBW, preterm births, and spontaneous abortion comprised a majority of all APOs, with macrosomia showing an obvious upward trend from 2007 to 2012. These findings provide new evidence that prevention and intervention strategies of APOs should be comprehensive with regard to multiple APOs, especially macrosomia, LBW, preterm births, and spontaneous abortion.

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Perspectives

# Achieving the Sustainable Development Goal of Eliminating Preventable Newborn Deaths — China in Action

Tao Xu[1,#]

## THE GLOBAL VISION OF ENDING PREVENTABLE NEWBORN DEATH

Although remarkable progress has been made in recent decades to reduce the number of child deaths worldwide, too many newborns continue to die each year despite the availability of feasible, evidence-based solutions. Globally, it is estimated that 5.2 million children under 5 years died in 2019. Of all reported child deaths, 2.3 million occurred in the first month of life (*1*). If current trends persist, more than 60 countries will fail to meet the global targets for reducing neonatal mortality and the 2030 Sustainable Development Goal (SDG) for eliminating preventable newborn deaths.

More than 80% of all newborn deaths result from three preventable and treatable conditions: complications due to prematurity, intrapartum-related deaths (including birth asphyxia), and neonatal infections (*2*). High coverage of interventions before conception, as well as during and after pregnancy could save nearly 3 million women, stillbirths, and newborns by 2025 in 75 high-burden countries at an additional cost of 1.15 USD per capita (*3*). In 2014, a comprehensive, multi-partner initiative called the Every Newborn Action Plan (ENAP) was launched by the World Health Organization (WHO), United Nations Children's Fund, and a group of partners; these organizations called on all stakeholders to take action to improve access to services and the quality of care for all pregnant women and newborns (*4*). ENAP sets out recommendations for countries on how to reduce mortality and morbidity as well as close gaps in equity. In adopting the ENAP at the World Health Assembly (WHA) as resolution WHA 67.10 in 2014, 194 countries committed themselves to move the recommendations into action, including China.

## CHINA'S EXPERIENCE IN IMPROVING NEWBORN SURVIVAL AND DEVELOPMENT

Newborn, infant, and under-five mortality rates in China have decreased steadily over the last two decades, dropping to 3.9 per 1,000, 6.1 per 1,000, and 8.4 per 1,000 in 2018, respectively (*5*). Despite the significant improvements, neonatal deaths still account for around 50% of all under-five deaths and the absolute number of annual neonatal deaths is larger than other countries. China remains one of the WHO's high-priority countries for advancement in neonatal health. Therefore, in conjunction with the key objectives of the SDGs, China has been taking actions to further reduce neonatal mortality in order to guarantee child survival and optimal physical and mental development.

### Policymaking and Legislation

Since the World Summit for Children in 1990, China has strengthened policy and legislation for improving the system for children's health. At the national level, the "Law on Maternal and Child Healthcare" and the "Measures for the Implementation of Law on Maternal and Child Healthcare" are used to provide general policy directions. Based on these two documents, the central government developed the "National Action Plan for the Development of Children (2011–2020)" to identify ten-year-objectives, main indicators, and the strategies for improving children's health, education, protection, and rights. In 2013, China collaborated with the Western Pacific Regional Office of the WHO to develop and adopt the Action Plan for Healthy Newborn Infants in the Western Pacific Region (2014–2020). This plan outlines an approach for implementing and scaling up a package of evidence-based Early Essential Newborn Care (EENC) interventions that have been

demonstrated to reduce newborn mortality from the three aforementioned most important conditions (*6*). In 2018, the National Health Commission (NHC) issued the "Maternal and Infancy Safety Action Plan (2018–2020)" and the "Healthy Child Action Plan (2018–2020)". More detailed and specific strategies and activities on improving newborn survival and development were reflected in these two documents. Guided by these action plans, health facilities at all levels should provide continuous and high-quality maternal and child health services, with a focus on their health needs.

## Establishing and Strengthening the Newborn Healthcare Service System

There are more than 25,000 health facilities providing childbirth services across the mainland of China, and the hospital delivery rate has reached over 99% (*5*). After birth, a child is placed on the Systematic Healthcare for Children (SHC) program. SHC is carried out by 3,080 maternal and child healthcare facilities at all levels, around 35,000 community healthcare centers, and 37,000 township hospitals (*7*). Every child below 7 years old is to be brought to community healthcare centers in urban areas and township hospitals in rural areas at specific intervals for physical check-ups, disease screening, and growth monitoring or high-risk case management. The basic newborn healthcare services in SHC include newborn home visits, neonatal disease screening, vaccination, etc., and are provided free of charge for the child. Children at high risks who need referrals or medical consultations will be transferred from grassroots health facilities to higher level facilities for further diagnosis and treatment. Starting from 2011, first dose hepatitis B vaccination rate among newborns in China has reached and maintained 99%. The newborn home visit rate has also reached and maintained over 90% since 2018 (*5*).

In 2017, the NHC issued the guideline on the "Construction of Critically Ill Newborn Treatment System," which planned to establish a regional referral and treatment system using critically-ill newborn treatment centers at all levels to reduce neonatal mortality and disability. By end of 2019, 3,070 neonatal treatment centers (based on neonatal intensive care units, NICUs) were set up across the mainland of China, establishing the three-tier (county-municipal-provincial) critically ill newborn referral and treatment system. Over 90% of counties had at least 1 functioning NICU. Evidence on the importance of breastfeeding as the cornerstone of neonatal survival, nutrition and development, and maternal health continues to increase. Starting from 1992, the Chinese government responded with the global Baby Friendly Hospital Initiative (BFHI) to promote breastfeeding within healthcare facilities (*8*). In 2014, the NHC announced the Revisited BFHI, broadening the scope of breastfeeding to newborns delivered by cesarean section and into all other obstetric and neonatal care measures. By the end of 2015, there were 7,036 baby-friendly hospitals in China, where 66% of all newborns were born (*5*).

## Implementing Evidence-based Newborn Health Interventions and Programs

Effective interventions for improving survival and health of newborns form one component of the integrated health services for reproductive, maternal, newborn, child and adolescent health in China. The care packages with the greatest impact on ending preventable neonatal deaths include: care during labor, around birth and the first week of life, and care for underweight and sick newborns (*9*). The Chinese government introduced and/or developed evidence-based technologies in these priority areas, making adaptions according to China's circumstances, conducting pilot programs to test the effectiveness and applicability, and developing guidelines for scaling up nationwide. These strategies cover newborn survival and development.

In order to reduce mortality and disability caused by neonatal asphyxia, the former Ministry of Health, now the NHC, launched a 15-year neonatal resuscitation program (NRP) in 2004 (*10*). The objective of the program was to ensure the presence of at least one trained and skilled attendant (midwife, obstetrician, pediatrician) for neonatal resuscitation for every delivery. The neonatal resuscitation training curriculum from the American Academy of Pediatrics was adapted and adopted into the Chinese NRP guidelines. The key component of the implementation of this plan was the training of trainers approach, with national and provincial instructors expanding training in a cascade. To promote the sustainability of the NRP in hospitals, the NHC issued a "red notice" in 2014 to regulate the newborn safety management in hospitals. The main regulation in this notice specified that at least 1 NRP-trained staff would be present at every delivery, medications and supplies would be readily

available, and the delivery room facilities would be well equipped to facilitate optimal neonatal resuscitation practice. This mandatory policy encourages every hospital to actively implement NRP (*11*). Since 2015, some other national training programs were implemented using a similar management model to China NRP, including pediatrician and obstetrician training programs in western provincial-level administrative divisions (PLADs), the breastfeeding consultation program, and the EENC piloting program. (*12*).

In order to prioritize newborn health and early development, the NHC also implemented several national programs, including neonatal disease screening, which is a special examination of congenital and genetic diseases that seriously endanger the health of newborns. Early diagnosis and treatment can minimize the impact of early diseases on children's long-term health. China's neonatal disease screening started from pilot studies in the early 1980s, and then continued to scale up nationwide by developing laws and regulations, strengthening the screening management system, and expanding screening to include more disease types (*7*). By the end of 2019, the screening rates of major neonatal genetic metabolic diseases [phenylketonuria (PKU) and congenital hypothyroidism (CH)] reached 97%, and newborn hearing screening rates reached 87%. Treatment rates of PKU and CH in children under one year old are now more than 90% (*5*).

The healthcare of premature babies is also a priority. In 2017, the NHC issued the Healthcare Regulation for Premature Infants to guide healthcare facilities at all levels to carry out standardized services for preterm babies. In 2019, two technical guidelines, the "Kangaroo Mother Care Guideline for Premature Babies" and the "Breastfeeding Guideline for Premature Babies," were developed and piloted in health facilities. These pilot programs have yielded significant increases in the breastfeeding rate and general health of preterm newborns.

## CHALLENGES AND PROSPECTS

After decades of efforts, China has established a relatively optimal maternal and child healthcare policy and management system. As a member state, China has committed to fulfill the 2030 Agenda for Sustainable Development and is actively innovating and investing in the field of neonatal health. However, there are still challenges that need to be solved. In many hospitals, there is still a shortage of midwives, obstetricians, and pediatricians. The amount of healthcare professionals is insufficient, especially at lower-level health facilities.

In addition, China has significant geographic diversity. There are large gaps among PLADs in terms of economic development. Some health facilities in rural areas of western PLADs still lack basic newborn healthcare equipment, medicine, and supplies (*13*). These are influencing factors that might hinder the equitable and universal coverage of high impact interventions. In order to address these challenges, the Chinese government is actively trying to increase policy and financial support for promoting newborn healthcare services. Due to trying to promote equitable distribution of resources, more newborn healthcare programs are intended for grassroots, rural, and western areas.

Ensuring quality maternal and child healthcare is one of the core objectives of China's National Plan on the Implementation of the 2030 Agenda to ensure the health of future generations. Moreover, as one of the leading economic entities in the world, China has embarked on its Belt-and-Road initiative to strengthen intercontinental collaboration in various areas, including health. The positive impact would be enormous if China could accelerate its national scale up of newborn healthcare programs and share these experiences to a global audience.

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Methods and Applications

# Statistical Analysis of Articles Published in *China CDC Weekly* — Worldwide, 2019–2020

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## ABSTRACT

**Introduction:** This study analyzed views and downloads of articles published in *China CDC Weekly* from 2019 to 2020 as part of an evaluation of the academic level and quality of the journal.

**Methods:** The study included articles published between November 29, 2019 and December 25, 2020 and evaluated views and downloads through February 9, 2021 using standard bibliometrics. We conducted network analysis with VOSviewer software.

**Results:** There were 283 articles from 101 institutions published in *China CDC Weekly* during the analysis period, among which 22 (21.8%) institutions were overseas institutions. There were 220 unique first authors, with 1.28 articles per first author. There were 2,404,882 views and 58,760 downloads in total. The article with the highest view and download counts had 1,244,826 views and 38,978 downloads. Article types with more than 4,500 views per article were Vital Surveillance, Notes from the Field, and Preplanned Studies. Subjects with more than 3,500 views per article were epidemiology of infectious diseases, epidemiology of non-infectious diseases, and maternal and child health. Articles with descriptive research and articles discussing public health monitoring received more attention, shown by larger average per article page views.

**Discussion:** Study results can help the editorial department improve the journal's international influence through targeted measures, such as adjusting article types according to view and download analyses and increasing the proportion of international manuscripts selected.


## INTRODUCTION

*China CDC Weekly* was established in November 2019. It is a weekly periodical focusing on all fields and topics related to public and global health and is managed by the National Health Commission of the People's Republic of China, prepared by China CDC, and published by the editorial department of *China CDC Weekly* that was established in and by China CDC. *China CDC Weekly* serves as a channel for China CDC to disseminate timely, reliable, authoritative, accurate, objective, and useful public health information, as well as recommendations for health professionals and the public. *China CDC Weekly* is the Voice of China CDC.

Since the journal was established, *China CDC Weekly* implemented firm guidelines and policies, with objectives that reflecting the aspirations of the editors, authors, and readers; it has played a vital role in communication, facilitation, and guidance of public health. By adhering to proper orientation and management and paying attention to a combination of theory and practice, *China CDC Weekly* is becoming increasingly influential and is making significant contributions to international research and cooperation in disease prevention and control. We conducted a systematic, quantitative analysis of articles published in *China CDC Weekly* from 2019 to 2020 to explore development of the journal and understand its academic contribution in the field of preventive medicine, as well as to look forward toward future developmental goals.

## METHODS

### Data Acquisition

The research obtained articles published on the official *China CDC Weekly* website between November 29, 2019, and December 25, 2020. The analytic domains were the following: 1) funding sources in five categories including national, provincial, municipal, institution/organization, and non-governmental; 2) study types (*1*): observational study and experimental study, including descriptive research, analytical research, experimental research, theoretical and methodological research, and also public health

monitoring, et al; 3) according to the branch of preventive medicine in the National Natural Science Foundation (*2*), type of subject in eight categories includes infectious disease epidemiology, non-infectious disease epidemiology, maternal and child health, environmental health, occupational health, health toxicology, human nutrition (including food hygiene), and other subjects; 4) first authors' institutions; and 5) number of views and downloads through February 9, 2021.

## Analytical Strategies

The study analyzed downloads and views using standard bibliometric methods with SPSS software (version 22.0, IBM, NYC, USA). Because downloads and views were not normally distributed, we represented central tendencies with medians and quartiles ($P_{25}$, $P_{75}$). We used VOSviewer 1.6.15 (Leiden university, Leiden, Netherlands)to illustrate author collaboration networks with network visualization maps composed of nodes and links based on the ris file type (file type (*3*–*4*). In the network visualization, authors were represented by a label and a circle. The sizes of the label and the circle were proportional to the number of author publications in *China CDC Weekly*. Clusters were grouped by label and circle color. The strength of links was in direct proportion to the degree of connection between authors. A key parameter of VOSviewer was the minimum number of documents by the author; we considered three articles as the minimum.

## RESULTS

*China CDC Weekly* published 283 articles in 2019 and 2020, representing 1,100 pages at 3.89 pages per article. This corpus of articles had 2,404,882 views and 58,760 downloads. The median ($P_{25}$, $P_{75}$) number of views and downloads for each article was 2,575 [interquartile range (IQR): 1,566, 3,770] and 23 (IQR: 11, 45). Overall, 96 articles (33.9%) were from funded projects.

### Highly Viewed and Downloaded Articles

The article with the most views and downloads had 1,244,826 views and 38,978 downloads. A total of 13 articles were browsed online more than 7,000 times; 11 of these articles were related to coronavirus disease 2019 (COVID-19); and 3 were viewed more than 50,000 times. There were 4 articles that had been downloaded more than 2,000 times; all were related to COVID-19.

### Views and Downloads by Paper Type

This research analyzed 18 types of articles: Announcements, Commentaries, Forewords, Health China, Insights, Key Statistics, Methods and Applications, Notes from the Fields, Notifiable Infectious Disease Reports, Outbreak Reports, Perspective, Policy Notes, Preplanned Studies, Profiles, Recollection, Recommendations, Reviews, and Vital Surveillance. The most common article type was Preplanned Studies (83 articles, 29.33%), followed by Perspectives and Notes from the Field. Article types with more than 4,500 views were those in Vital Surveillance, Notes from the Field, and Preplanned Studies (Table 1).

### Views and Downloads by Subject

Most articles (55.5%, 157 articles) were on infectious disease epidemiology; the next most common subject was "other" (21.9%, 62 articles). Epidemiology of infectious diseases, epidemiology of non-infectious diseases, and maternal and child health had over 3,500 additional page views more than the overall average number per article (Table 2).

### Views and Downloads by Study Type

More than half the articles were descriptive research (55.1%, 156 articles). The study types of descriptive research and public health monitoring each had more than 3,000 page views per article (Table 3).

### Institutional Source of Articles

The 284 published articles came from 101 institutions, 22 (21.8%) of which were overseas institutions. The top five institutions were China CDC, the National Center for Chronic and Non-Communicable Disease Control and Prevention, the National Institute of Parasitic Diseases, the National Institute of Environmental Health, and the National Institute of Occupational Health and Poison Control. Together, these 5 institutions produced 95 articles (33.5% of all articles).

### Authors

*China CDC Weekly* has attracted many authors who were experts and scholars of public health. There were 220 first authors, with 1.29 articles per first author; 20 (9.09%) authors published more than two papers.

The author collaboration network showed which teams had the most influence (Figure 1). The most influential authors and teams included the following: George F. Gao, Feng Tan, Zijian Feng, Xiaonong Zhou, and Peter Hao; a team from the Institute for Viral Disease Prevention and Control of Chinese Center for Disease Control and Prevention with Wenbo Xu and Guizhen Wu at its center; a team from the National Center for Chronic and Non-

TABLE 1. Comparison of views and downloads by article type in *China CDC Weekly* from 2019 to 2020.

| Type | Number of articles | Number of pages | Pages per article | Downloads | Downloads per article | Views | Views per article |
|---|---|---|---|---|---|---|---|
| Announcement | 22 | 28 | 1.27 | 293 | 13.32 | 53,603 | 2,436.50 |
| Commentary | 18 | 48 | 2.67 | 832 | 46.22 | 58,017 | 3,223.17 |
| Foreword | 10 | 16 | 1.60 | 265 | 26.50 | 19,395 | 1,939.50 |
| Healthy China | 7 | 28 | 4.00 | 250 | 35.71 | 16,792 | 2,398.86 |
| Insights | 1 | 3 | 3.00 | 17 | 17.00 | 2,453 | 24,53.00 |
| Key Statistics | 3 | 5 | 1.67 | 55 | 18.33 | 7,788 | 2,596.00 |
| Methods and Applications | 2 | 10 | 5.00 | 41 | 20.50 | 2,106 | 1,053.00 |
| Notes from the Field | 27 | 90 | 3.33 | 10,214 | 378.30 | 317,578 | 11,762.15 |
| Notifiable Infectious Diseases Reports | 12 | 20 | 1.67 | 295 | 24.58 | 30,443 | 2,536.92 |
| Outbreak Reports | 16 | 64 | 4.00 | 672 | 42.00 | 45,590 | 2,849.38 |
| Perspectives | 28 | 94 | 3.36 | 1,309 | 46.75 | 80,546 | 2,876.64 |
| Policy Notes | 4 | 15 | 3.75 | 152 | 38.00 | 8,254 | 2,063.50 |
| Preplanned Studies | 83 | 450 | 5.42 | 3,826 | 46.10 | 390,015 | 4,698.98 |
| Profiles | 14 | 28 | 2.00 | 145 | 10.36 | 20,335 | 1,452.50 |
| Recollection | 13 | 63 | 4.85 | 376 | 28.92 | 37,025 | 2,848.08 |
| Recommendations | 1 | 2 | 2.00 | 200 | 200.00 | 10,926 | 10,926.00 |
| Review | 1 | 4 | 4.00 | 104 | 104.00 | 3,974 | 3,974.00 |
| Vital Surveillance | 21 | 132 | 6.29 | 39,714 | 1,891.14 | 1,300,042 | 61,906.76 |
| Total | 283 | 1,100 | 3.89 | 58,760 | 207.63 | 2,404,882 | 8,497.82 |

TABLE 2. Comparison of views and downloads by subject in *China CDC Weekly* from 2019 to 2020.

| Subjects | Number of articles | Number of pages | Pages per article | Downloads | Downloads per article | Views | Views per article |
|---|---|---|---|---|---|---|---|
| Epidemiology of infectious diseases | 157 | 621 | 3.96 | 55,138 | 351.20 | 2,001,997 | 12,751.57 |
| Epidemiology of non-communicable diseases | 19 | 90 | 4.74 | 575 | 30.26 | 67,233 | 3,538.58 |
| Maternal and child health | 15 | 83 | 5.53 | 423 | 28.20 | 79,483 | 5,298.87 |
| Environmental health | 9 | 46 | 5.11 | 250 | 27.78 | 21,354 | 2,372.67 |
| Other subjects | 62 | 162 | 2.61 | 1,734 | 27.97 | 168,371 | 2,715.66 |
| Human nutrition (including food hygiene) | 7 | 30 | 4.29 | 189 | 27.00 | 19,262 | 2,751.71 |
| Health toxicology | 3 | 16 | 5.33 | 168 | 56.00 | 10,226 | 34,08.67 |
| Occupational health | 11 | 52 | 4.73 | 283 | 25.73 | 36,956 | 3,359.64 |
| Total | 283 | 1,100 | 3.89 | 58,760 | 207.63 | 2,404,882 | 8,497.82 |

TABLE 3. Comparison of views and downloads by study type in *China CDC Weekly* from 2019 to 2020.

| Study Type | Number of articles | Number of pages | Pages per article | Downloads | Downloads per article | Views | Views per article |
|---|---|---|---|---|---|---|---|
| Analytical research | 4 | 24 | 6.00 | 149 | 37.25 | 9,411 | 2,352.75 |
| Public health monitoring | 14 | 73 | 5.21 | 908 | 64.86 | 50,742 | 3,624.43 |
| Research on theory and methodology | 6 | 22 | 3.67 | 103 | 17.17 | 7,295 | 1,215.83 |
| Descriptive research | 156 | 731 | 4.69 | 54,500 | 349.36 | 2,076,637 | 13,311.78 |
| Others (including no research methods) | 102 | 245 | 2.40 | 3,087 | 30.26 | 258,849 | 2,537.74 |
| Experimental research | 1 | 5 | 5.00 | 13 | 13.00 | 1,948 | 1,948.00 |
| Total | 283 | 1,100 | 3.89 | 58,760 | 207.63 | 2,404,882 | 8,497.82 |

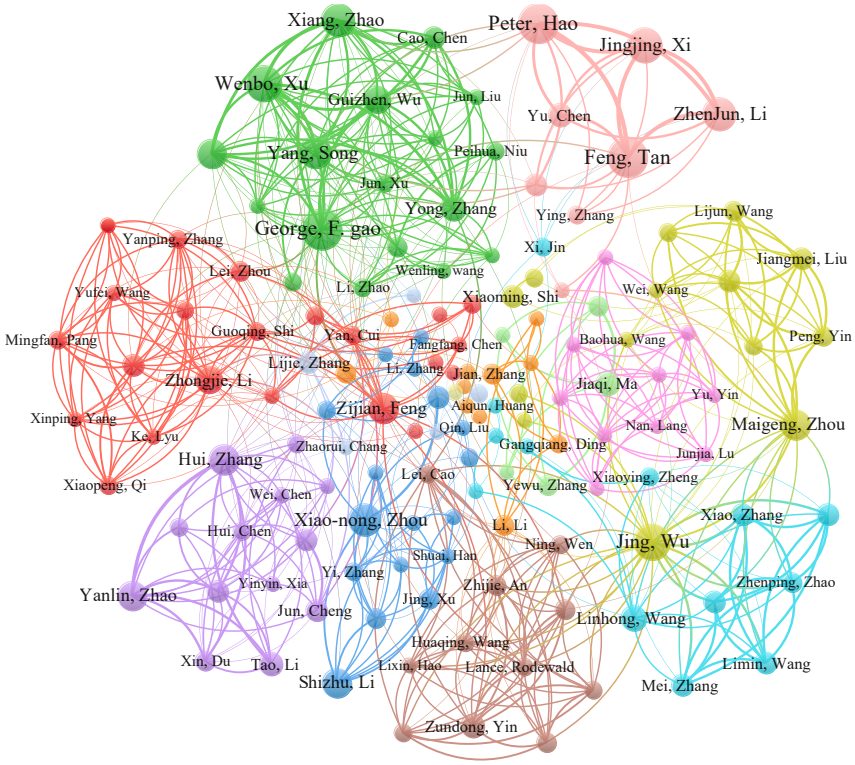


FIGURE 1. *China CDC Weekly* author collaboration network, 2019 to 2020.

Communicable Disease Control and Prevention with Jing Wu and Maigeng Zhou at its center; and a team from National Center for Tuberculosis Control and Prevention with Hui Zhang and Yanlin Zhao at its center.

## DISCUSSION

Citation frequency is an important indicator of the quality and influence of academic journals (*5*–*6*). However, long publication cycles may make it difficult for articles to be cited in a timely manner, which lags behind the possibilities brought forth by our current digital environment (*7*). Given the widespread use of electronic resources and literature databases, the views or downloads per article reflects the usefulness of the article, and to some extent has become a common index for evaluating the communication power and influence of articles (*8*). Therefore, we used downloads and views to evaluate the influence of *China CDC Weekly*.

According to our download and view analyses, Vital Surveillance, Notes from the Field, and Preplanned Studies have the highest viewing frequency, while Profiles and Methods and Applications have comparatively low viewing frequency — a finding that differs from a previous study (*9*). Vital Surveillance articles are based on monitoring data from the national-level CDC, so that a standard of data quality is ensured. We suggest that manuscripts should be optimally organized to improve the influence of the journal. "Methods and Applications" is an article type that was established after the others had been established; perhaps leading to its lower viewing frequency. Further analysis is warranted.

The influence of articles from different disciplines and research types varied greatly. Epidemiology of infectious and non-infectious diseases, which are the main components of traditional public health disciplines, had a higher average viewing frequency, consistent with a previous study (*9*). Among research types, descriptive research and public health monitoring had relatively higher levels of downloads and views, while theoretical and methodological research received less attention. A large proportion of articles related to COVID-19 were viewed more than 7,000 times, indicating that *China CDC Weekly* has played an important role in the academic exchange concerning COVID-19 and has provided strong scientific and technological support for epidemic prevention and control.

In conclusion, since its inception, *China CDC Weekly* has played a clear role in the field of public health in China. *China CDC Weekly* came into

existence before COVID-19, and therefore has been able to play a highly active role in the global fight against the pandemic. Based on our analyses, we have some recommendations to improve the journal's quality and communication ability. First, according to view and download analyses, adjusting article types at the right time is essential. For instance, the number of times Vital Surveillance and Preplanned Studies articles were viewed was highest, so soliciting these articles should be prioritized. Second, special issues should be organized to publish collections of timely articles on specific and important topics. Third, as *China CDC Weekly* enters the Web of Science database, the editorial department can use citation frequency, page views, and downloads to analyze the influence of the journal and help solicit the highest-quality manuscripts for publication. Fourth, the journal should continue to adhere to international norms and standards of publication and further increase the proportion of internationally-sourced articles, currently 21.8% of articles. The number of international editorial board members and international peer reviewers should be increased to improve the international influence of the journal (*10*). Finally, mature digital publishing technologies should be applied to provide high-quality services for authors and readers from multiple perspectives and levels to open a rapid publication channel for excellent papers as is being done with pre-prints (*11*).

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