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Analysis of the Incidence of Hepatitis B and Hepatitis C and Association with Socio-Economic Factors in Various Regions in China

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Abstract

The incidence of liver cancer in China accounts for more than half of the world, and the majority of them is caused by hepatitis B and hepatitis C. China is known as a great contributor to hepatitis. The Chinese government has implemented a series of preventive measures to solve this problem, especially the policy of free hepatitis B vaccination for newborn babies and effectively reduced the incidence of hepatitis. The incidence of infectious diseases is often related to socio-economic factors. Therefore, we used data on the incidence of hepatitis B and C and socioeconomic factors to analyze and find out the relationship among them in various regions. There were high incidence areas and low incidence areas in China, and the high incidence area of hepatitis B was also the high incidence area of hepatitis C. Especially in Xinjiang, the highest incidence of hepatitis B and hepatitis C was observed at the same time. The incidence of hepatitis B and hepatitis C was more affected by regional economic factors. The economic factors in low incidence areas of hepatitis were better than those in high incidence areas. There was a negative correlation between economic factors and the incidence of hepatitis. In conclusion, in economically developed areas, the government has invested more money and resources in public health and people's health awareness in comparison to underdeveloped areas. In the future, various preventive strategies should be carried out according to the background of different regions.

Keywords

Hepatitis, Socioeconomic Factors, Incidence, Prevention, China

1. Introduction

Hepatitis B and C are the liver disease caused by the hepatitis B virus (HBV) and hepatitis C virus (HCV), respectively. The virus can cause both acute and chronic hepatitis, ranging in severity from a mild sickness lasting a short period to a serious lifelong illness. The World Health Organization (WHO) estimated that globally 257 million and 71 million people are living with HBV and HCV infection and accounted for 887,000 deaths in 2015 and 399,000 deaths every year, respectively [1]. The death is mostly due to complications as cirrhosis and hepatocellular carcinoma (HCC) [2]. Hepatitis B and hepatitis C are responsible for 96% of all hepatitis-related mortality to the HCC-related virus; HBV is accountable for 70% - 80%, while HCV is for 10% - 20% of virus-associated HCC [3]. HBV & HCV coinfection with other blood-borne viruses is also associated with a higher likelihood of progressions to cirrhosis, HCC and related mortality [4].

There is a geographical association among HBV and HCV prevalence and the burden of HCC, and the proportion is attributable to hepatitis considerably according to the region. In some regions, high incidence of HCC is also influenced by some other factors such as aflatoxin B1 contamination and HBV genotypes [4]. There is a disproportionate burden of liver cancer geographically impacting by high incidence in China, contributing half of global liver cancer cases [5].

The mean reported incidence of hepatitis B was 73.28 per 100,000 and hepatitis C was 14.70 per 100,000 in China during 2011-2016 [6]-[11]. In 31 provinces in China, the incidences of HBV and HCV are varied enormously based on time and regional distribution, population distribution, route of transmission of the disease, the economic situation of the area, and regional preventive measures. There is an evidence of the relationship between socioeconomic factors and infectious diseases in China. For an example, the incidences of infectious diseases have a positive correlation with the population of each region, and there was a negative correlation with the gross domestic product (GDP) because the government with better economic development can pay more attention to public health [12].

To control AIDS, HIV, tuberculosis and other communicable diseases accessible programs are in operation such as health education, screening, diagnosis, treatment, and financial reimbursement plans are active in China. However, these services are very limited for HBV and HCV. In addition, based on the incidence rate of the region, there is a lack of information regarding the relationship between hepatitis (B and C) and socio-economic factors. By finding this gap, we can recommend region-wise preventive measures based on the actual situation. Therefore, we aim to identify the association between the incidence of hepatitis B and hepatitis C and socioeconomic factors based on publicly available data and specify the reasons for the regional differences in hepatitis B and hepatitis C.

2. Method

2.1. Data Source and Items

All the data were acquired from the "China Sanitation Statistics Yearbook"

which was published in 2016 [10]. In this study, we used the data of the incidence rate of hepatitis B and C, the outpatient and admission expenditure data per person, region GDP, urban and rural population, per capita expenditure in rural and urban areas, per capita income in rural and urban areas, rate of hospital delivery in urban and rural area, prenatal examination rate, the number of staff of disease management center and health workers nationwide, the frequency of counseling and group education by government every year in each region in China.

2.2. Data Analysis

In the beginning, we divided 31 provinces into two regions according to the median incidence rate of hepatitis B and C of the provinces since normalcy was confirmed. The areas which incidence higher than median incidence were set as high incidence area (high area), and the area's incidence lower than the median incidence rate were set as low incidence area (low area). The median of hepatitis B is Shanxi, and the median of hepatitis C is Guizhou, and they were categorized as high incidence area. For comparing the differences in the incidence rate of hepatitis B and C, the socio-economic factors between the high incidence areas and low incidence areas the t-test analysis was conducted. To detect the correlation between hepatitis B/C and socioeconomic factors, Pearson correlation analysis was performed. Data were analyzed using SPSS ver. 20.0, and the significance level was set at the level of $p < 5\%$. This study was conducted between April and July 2018.

2.3. Ethics Statement

The data we used in this study were taken from the "China Statistical Yearbook", which was published in 2016. The "China Statistical Yearbook" was publicly available at the Chinese government website; therefore, there was no special ethical committee of the institutional approval required.

3. Results

3.1. The Incidence of Hepatitis B and C Situation in 31 Provinces of China in 2015

The highest incidence rate of hepatitis B was Xinjiang (164.31 per thousand people), and the lowest was Beijing (7.82 per thousand people). The highest incidence rate of hepatitis C was also Xinjiang (47.66 per thousand people), and the lowest was Xizang (0.98 per thousand people).

The mean incidence rates of hepatitis B and hepatitis C in 31 provinces of China in 2015 were 70.03 and 16.51 per 100 thousand people, respectively. The mean incidence rates of hepatitis B in high and low incidence areas were 101.12 and 36.88 per 100 thousand people, respectively. The incidence rates of hepatitis C in high and low incidence areas were 24.57 and 7.91 per 100 thousand people, respectively. Among them, both hepatitis B and hepatitis C, there were 16 (51.6%)

areas in the high incidence area (high area), 15 (48.4%) areas were in the low incidence area (low area). According to the results, the high incidence area of hepatitis B was also a high incidence area of hepatitis C, except the region of Xizang. Xizang was in a high incidence area of hepatitis B, but it was a low incidence area of hepatitis C (Table 1).

3.2. The Differences of Incidence Rate of Hepatitis B and C, Socio-Economic Factors between High and Low Incidence Area of Hepatitis B and C

The differences of socioeconomic factors between high incidence and low incidence area of hepatitis B, the statistically significant difference of the incidence of hepatitis B ($p < 0.01$) and hepatitis C ($p = 0.02$), outpatient expenditure per capita ($p = 0.03$) were found between the two groups. There was no significant difference in other items (Table 2).

Results of comparison with high incidence area and low incidence area according to the median incidence rate of hepatitis C, there were significant differences on the incidence rate of hepatitis B ($p = 0.01$), the incidence rate of hepatitis C ($p < 0.01$), urban income ($p = 0.04$), rural income ($p = 0.01$), rural spending ($p = 0.02$) between two areas (Table 3).

3.3. The Relationship between Hepatitis B and C and Each Socio-Economic Factor

The incidence of hepatitis B was positively correlated with the incidence of hepatitis C ($r = 0.526$, $p < 0.01$), had negative correlation with the outpatient expenses ($r = -0.46$, $p < 0.01$), prenatal examination rate ($r = -0.547$, $p < 0.01$) and the rate of hospital delivery in rural area ($r = -0.422$, $p < 0.01$). The incidence rate of hepatitis C had negative correlation with the urban income ($r = -0.450$, $p < 0.05$), rural income ($r = -0.499$, $p < 0.05$), rural spending ($r = -0.443$, $p < 0.05$), and rate of hospital delivery in rural area ($r = -0.379$, $p < 0.05$) (Table 4).

Table 1. The high and low incidences areas of hepatitis B and C.

Type of hepatitis	Group (n)	Region			
HBV	High area 16	Hainan	Qinghai	Xinjiang	Shanxi▲
		Fujian	Guangdong	Hebei	Neimenggu
		Jiangxi	Hubei	Hunan	Guangxi
		Xizang	Henan	Chongqing	Shanxi▲▲
	Low area 15	Beijing	Tianjin	Liaoning	Jilin
		Heilongjiang	Shanghai	Jiangsu	Anhui
		Shandong	Sichuan	Ningxia	Yunnan
		Zhejiang	Gansu	Guizhou	Gansu
HCV	High area 16	Hainan	Qinghai	Xinjiang	Shanxi▲
		Guangdong	Neimenggu	Liaoning	Jilin

Continued

Low area 15	Henan	Hunan	Guangxi	Yunnan
	Shanxi▲▲	Gansu	Guizhou	Hubei
	Fujian	Beijing	Tianjin	Hebei
	Heilongjiang	Shanghai	Jiangsu	Zhejiang
	Anhui	Jiangxi	Shandong	Xizang
	Chongqing	Ningxia	Sichuan	

NOTE. ▲Shanxi = 山西, ▲▲Shanxi = 陕西.

Table 2. Comparison between 2 groups according to the median of HBV incidence rate.

Variable	High area (N = 16)	Low area (N = 15)	p-value
	Mean ± SD	Mean ± SD	
Hepatitis B	101.12 ± 32.38	36.88 ± 16.06	<0.001
Hepatitis C	20.68 ± 11.94	12.06 ± 7.66	0.02
Outpatient expenses per capita (CNY)	209.10 ± 32.09	248.88 ± 62.79	0.03
Expenses of hospital admission per capita (CNY)	8000.23 ± 1078.10	10161.77 ± 4222.50	0.06
Regional GDP per capita	21,183.20 ± 17,336.09	25,640.63 ± 19435.80	0.51
Urban population	20,164,200.88 ± 16,364,435.42	22,832,692.73 ± 15,840,213.48	0.65
Rural population	25,358,662.94 ± 18,737,236.33	20,720,380.67 ± 17,798,274.73	0.49
Urban income (CNY)	27,568.54 ± 2891.26	32,375.49 ± 10,046.78	0.09
Urban spending (CNY)	19,041.74 ± 2673.65	22,500.96 ± 6835.26	0.08
Rural income (CNY)	10,523.86 ± 1640.72	13,326.53 ± 1369.33	0.07
Rural spending (CNY)	8780.42 ± 1584.18	10,495.59 ± 921.69	0.10
Rate of hospital delivery in Urban area	99.83 ± 0.46	99.89 ± 0.22	0.63
Rate of hospital delivery in Rural area	98.89 ± 2.71	99.59 ± 0.81	0.34
Number of health officer in each region	251,412.06 ± 167,123.35	264,996.27 ± 161,986.74	0.82
Frequency of consultation	324.81 ± 282.65	373.80 ± 387.62	0.69
Frequency of group education	2725.94 ± 1975.38	2402.87 ± 1975.38	0.69
Number of staffs in CDC	6378.00 ± 4132.12	5925.47 ± 3139.32	0.73
Prenatal examination rate	95.86 ± 2.61	97.39 ± 1.89	0.07

Note. CDC = Center for Disease Control and Prevention. CNY = China Yuan. Group education = Public health education activities.

Table 3. Comparison between 2 groups according to the median of HCV incidence rate.

Variable	High area (N = 16)	Low area (N = 15)	p-value
	Mean ± SD	Mean ± SD	
Hepatitis B	88.31 ± 40.97	50.54 ± 32.79	0.01
Hepatitis C	24.57 ± 8.76	7.91 ± 4.09	<0.001
Outpatient expenses per capita (CNY)	213.41 ± 31.35	244.29 ± 65.88	0.12
Expense of hospital admission per capita (CNY)	7899.94 ± 1273.95	10,268.75 ± 4100.81	0.05
Regional GDP per capita (CNY)	20,231.48 ± 17,169.87	26,655.80 ± 19,288.85	0.33
Urban population	20,024,722.31 ± 16,074,470.63	22,981,469.87 ± 16,127,420.29	0.61
Rural population	24,635,187.00 ± 17,827,317.13	21,492,088.33 ± 18,943,593.48	0.64
Urban income (CNY)	27,076.26 ± 2896.12	32,900.59 ± 9743.02	0.04
Urban spending (CNY)	18,852.15 ± 2462.58	22,703.19 ± 6804.29	0.05
Rural income (CNY)	9974.96 ± 1824.47	13,912.02 ± 4818.30	0.01
Rural spending (CNY)	8403.81 ± 1342.21	10,897.30 ± 3419.05	0.02
Rate of hospital delivery in Urban area	99.86 ± 0.24	99.85 ± 0.46	0.98
Rate of hospital delivery in Rural area	99.44 ± 0.90	99.01 ± 2.79	0.58
Number of health officer in each region	250,815.94 ± 156,200.45	265,632.13 ± 173,217.34	0.80
Frequency of consultation	309.56 ± 270.77	390.07 ± 393.75	0.51
Frequency of group education	3105.38 ± 2357.16	1998.13 ± 1908.56	0.16
Number of staffs in CDC	6914.31 ± 3766.32	5353.40 ± 3422.98	0.24
Prenatal examination rate	96.61 ± 1.42	96.59 ± 3.16	0.99

Note. CDC = Center for Disease Control and Prevention. CNY = China Yuan. Group education = Public health education activities.

Table 4. Correlation analysis of hepatitis B and hepatitis C and socioeconomic factors.

Variable	HBV	HCV
Hepatitis B	1	
Hepatitis C	0.526**	1
Outpatient expenses	−0.460**	−0.297
Urban income	−0.161	−0.450*
Rural income	−0.331	−0.499**
Rural spending	−0.261	−0.443*
Prenatal examination	−0.547**	−0.266
Rate of hospital delivery in rural area	−0.422*	−0.379*

* $p < 0.05$; **$p < 0.01$.

4. Discussion

4.1. Regional Distribution of Incidence of Hepatitis B and C

This study showed a positive correlation between the high incidence rate of hepatitis B and C. As previously reported [13] [14], this statistic showed wide differences of incidence of hepatitis B and C. Hepatitis B and C have a similar pathogenesis and route of infection; therefore, we need to pay attention similarly on preventive measures of both at the same time with high incidence areas in the future.

Beijing is the capital of China and the most developed region in policies and economy, bringing young generations towards the city, which is the lowest incidence area of hepatitis. Young people are much sensitized and received the hepatitis B vaccine in comparison to other areas. They have the higher awareness of their own health, the intention to accept disease-related knowledge than other areas because of relatively higher income and knowledge. However, the incidence of hepatitis B occurs mostly among young people from 15 to 30 years [15] [16], and sexually transmitted infection is one of the main routes of hepatitis B circulation [17]. On the other side, Beijing also has a large number of floating populations, which is a high-risk group of hepatitis [18] [19] [20]. The high HBsAg (Hepatitis B surface antigen) prevalence among floating population is attributed to poor understanding of HBV vaccination, low awareness of HBV infection control and prevention measures, and low educational levels [21]. Therefore, special strategies need to focus more on the prevention and control of sexually transmitted hepatitis for younger gathering areas. For the floating population, we need to focus on improving their knowledge of hepatitis and health awareness according to their education level.

Xinjiang is the western part of China where ethnic minorities migrate and economically developed areas, which is the highest incidence areas for both hepatitis B and C. Economic retardation, inconvenient transportation, and language disunity are the main causes of high incidence of hepatitis, high rate of home delivery, and low hepatitis screening [22] [23]. There are still a large number of ethnic minority areas in China and use various languages. The disunity of language is a barrier to medical treatment, poor acceptance of disease-related knowledge and information among local residents [24]. To reduce these obstacles of the languages, it is required to set up the health personnel who are familiar with local languages and customs to communicate properly and write a handbook of disease knowledge. Strong motivation and promotion to access to the screening of adult people, community education, and primary to tertiary prevention are needed to work together. With the existing government programs, community education and school health programs are also the key measures to improve the awareness and sensitize the people to ensure hepatitis screening and early treatment.

4.2. The Socio-Economic Factors and the Incidence of Hepatitis B and C

In this study, there is no statistical difference between the two groups on per capita GDP; however, still it is observed that per capita GDP in low-incidence areas is higher than that in high-incidence areas. The same economic disparity is also observed in the cost of health care and the daily cost of living in rural and urban areas. The economies have a potential impact on the incidence of hepatitis B and C. For example, people in economically developed areas have a relatively high level of health literacy, more responsive to regular physical examination and the compliance rates are as well higher than economically underdeveloped areas [14]. As a result, the people in higher regional GDP per capita have more opportunities for early diagnosis and treatment to prevent disease-related complications.

Population density determines the rate of transmission of infectious diseases [25]. For example, the higher the population density, the faster the disease spreads. However, our study observed that the incidence of hepatitis is not related to the density of the population. This might be due to their routes of transmission perceiving that hepatitis B and C are mainly transmitted through blood and body fluids.

The government's participation in public facilities can reflect the importance of public health. The more investment in public facilities can ensure the better capacity to prevent and control diseases. If there are a large number of health officers and staffs in the center for disease control and prevention, more frequencies of public health education activities and consultations will be organized; the infectious disease prevention and management will also be better. However, our comparison showed that there was no significant difference between the two groups. Even for high incidence areas, the government's emphasis on disease prevention is higher than that of low incidence areas. It shows that the government also attaches great importance to diseases in high incidence areas and expects to raise awareness of disease prevention through increased staffing and public health education activities.

The prenatal examination can detect the liver function of the mother, whether it is normal or infected with viral hepatitis [26]. The choice of delivery at hospitals ensures that newborns can be injected with hepatitis B vaccine and prevent the transmission of hepatitis from mother to infants. In our analysis, there was a negative correlation between the rate of hospital delivery in the rural area with hepatitis B and hepatitis C, and between prenatal examination rate and hepatitis B. The higher prenatal screening rate is related to the family's emphasis on mothers and infants. Therefore, it is a good way to avoid mother-to-child transmission for mothers who choose to delivery in hospitals and receive the prenatal examination. Moreover, we need special attention to reduce the risk of transmission from mother to child for women in economically and communicatively developed areas who are unable to receive adequate prenatal care and choose in-

stitutional delivery.

4.3. Study Limitation

In this study, we used publicly available data, and we were able to conduct the limited analysis. Therefore, we could not conduct an analysis of the causal relationship about the regional socio-economic factors, which could relate to the incidence rates of hepatitis B and C.

5. Conclusion

In this study, we found that the high incidence area of hepatitis B is also the high incidence area of hepatitis C, and the incidence of a disease is closely related to the local economic development. The better economy reflects the lower likelihood of the incidence of hepatitis. For areas with a high incidence of hepatitis B and C, the residents' health awareness level and the ability of disease managers are limited, which affects the prediction and control ability of infectious diseases. We need to formulate preventive strategies for hepatitis according to local conditions.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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