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Geospatial analysis of type B and C hepatitis in South Sulawesi

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ABSTRACT

Introduction: *Hepatitis C and B are two infectious diseases that increase distribution and high mortality and morbidity. Conditions that exacerbate the economic burden of these two viral hepatitis infections are complications of cirrhosis and gastrointestinal bleeding. This study sought to assess the risk levels of hepatitis C and B across various districts and cities in South Sulawesi. It involved identifying spatial clusters of affected individuals through an analytical model, employing Generalized Poisson Regression to evaluate the potential impacts of these viral infections.* ***Methods:*** *The natural break method is a quantifiable technique for identifying value clusters indicative of data distribution and for detecting geographical illness clusters, using Global Moran's I statistics. This research utilizes data from health insurance members diagnosed with hepatitis C and B between January 2020 and December 2022, including 24 districts and cities in South Sulawesi Province.* ***Results:*** *According to the results of the Local Morans I analysis, there is no significant clustered hepatitis C and B in all districts and cities in South Sulawesi from 2020 until 2022.* ***Conclusions:*** *In South Sulawesi, the incidence of*

hepatitis C and B cases reported to National Social Health Insurance Administration Body (BPJS Kesehatan) appeared to manifest randomly or sporadically.

1. INTRODUCTION

Infectious diseases are still a problem in current health development because of a significant burden on the health financing budget for managing diseases and complications.[1] Hepatitis C and B are infectious diseases that increase distribution mortality and morbidity.[2–5] These viral hepatitis infections have more dangerous progression than other variants because most cases develop chronically and become hepatocellular carcinoma.[6–9] Hepatitis B occurs in 3.5-5.6% of people worldwide in different age groups.[10] Hepatitis C has happened in at least 1% of the world's population, around 71.1 million people, with an incidence reaching 23.7 people per 100,000 people.[11] Conditions that exacerbate the economic burden of these two viral hepatitis infections are complications of cirrhosis and gastrointestinal bleeding.[12]

Indonesia faces conditions of increasing non-communicable diseases, persistent infectious diseases, and new diseases.[13] The increase in cases of hepatitis C and B in Indonesia occurs due to movement through drug abuse, intercourse, and in a small population of health workers.[14,15] This increase in cases has increased the incidence of hepatocellular carcinoma and hepatic cirrhosis.[16,17] Control of hepatitis C and B needs to be improved by preventing the transmission of these diseases through vaccination and exceptional infection control in at-risk populations. Control through immunization of hepatitis B reduces the incidence of complications and mortality. Control of at-risk populations for hepatitis C and B requires assistance from relevant agencies, especially control of infection through transfusion or health workers.[18–21]

Spatial analysis of the conditions of hepatitis C and B in South Sulawesi needs to be carried out to prevent the development of widespread cases so that steps can be taken to reduce the spread and complications. This analysis allows for predictions and the knowledge of the spatial variations of an area in the occurrence of certain diseases. An analysis model and generalized Poisson regression were utilized in this study to determine the potential effects of hepatitis C and B. The study's objective was to ascertain the risk level of hepatitis C and B in each district or city within the province of South Sulawesi. This was accomplished by identifying spatial clusters on the number of people who suffer from the disease.

2. METHODS

Ethics approval

The Ethics Committee of Medical Research at the Faculty of Medicine Hasanuddin University has reviewed and approved this study (109/UN4.6.4.5.31/PP36/2024). The Helsinki Declaration carried out this study. The Ethics Committee of Medical Research at Hasanuddin University's Faculty of Medicine has waived the requirement for informed consent. The dataset utilized in this study was obtained from the National Social Health Insurance Administration Body (BPJS Kesehatan).

Study Area

South Sulawesi Province stands out as one of the Indonesian provinces characterized by a significant population density. In 2020, the population was approximately 9 million individuals, and the overall expanse encompassed approximately 46.717 km^2.

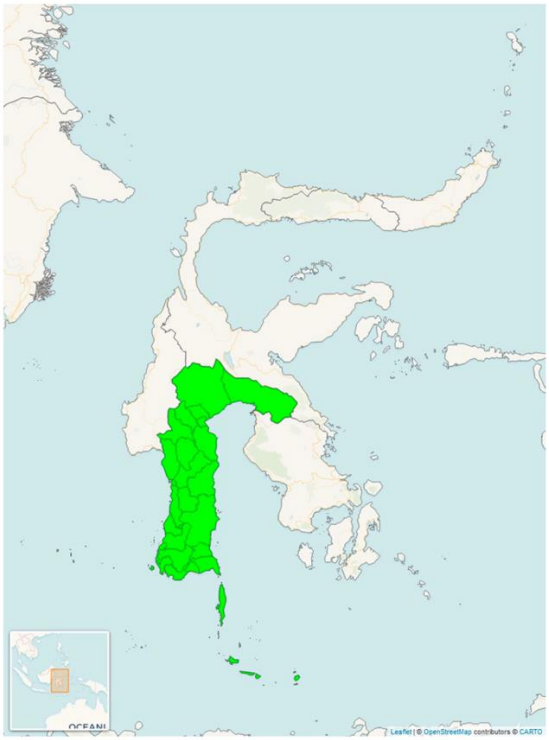

Figure 1. The map of research Area[47]

Data Utilized

This study used data from health insurance members diagnosed with hepatitis C and B between January 2020 and December 2022 across 24 districts and cities in South Sulawesi Province. This research used districts and cities as the geographical units of analysis. The data was sourced from the Social Health Insurance Administration Body, a government agency responsible for managing Indonesian health insurance initiatives. Population information were sourced from the Central Bureau of information of South Sulawesi Province, known locally as Badan Pusat Statistik (BPS), a non-departmental governmental entity responsible for conducting statistical surveys in Indonesia. A monthly aggregation of daily health insurance participant data was performed, and prevalence rates were computed for 100,000 individuals. The daily statistics for hepatitis C and B were analyzed according to the prevalence rates of these infections.

The yearly prevalence rate was calculated, with the average for 2020–2022 being the mean of the rates for each district or city in 2020, 2021, and 2022. Furthermore, we computed the prevalence rates' lowest, maximum, mean, and standard deviation for each disorder.

Natural break classification method

The natural break method is a statistical approach to classify data into distinct groups based on distribution patterns. This method applies an algorithm that aims to minimize differences within each group while enhancing differences between groups. The outcomes of this algorithm can be represented visually on a map using a color gradient to show the distribution of data.

Spatial cluster analysis

Global Moran's I statistic is commonly employed to detect spatial clusters of disease. This statistic measures spatial autocorrelation, assessing the correlation between a variable at one location and the same variable at nearby locations. If Global Moran's I indicated significant spatial correlation, we then applied Getis-Ord Gi and Local Moran's I statistics ([48,49]) to pinpoint areas identified as hotspots (high concentrations) and coldspots (low concentrations) for hepatitis C and B. This approach classifies spatial patterns into outliers and clusters, where outliers are spatial entities with attribute values that significantly differ from those of their neighboring locations, while clusters can be negative (coldspots) or positive (hotspots).

3. RESULTS

According to the natural breaks analysis results, there were fluctuating cases of acute and chronic hepatitis C and B in all districts and cities in South Sulawesi from 2020 until 2022. Makassar has always been the place with the highest distribution of hepatitis C and B cases from 2020 to 2022 (Figures 2 and 3).

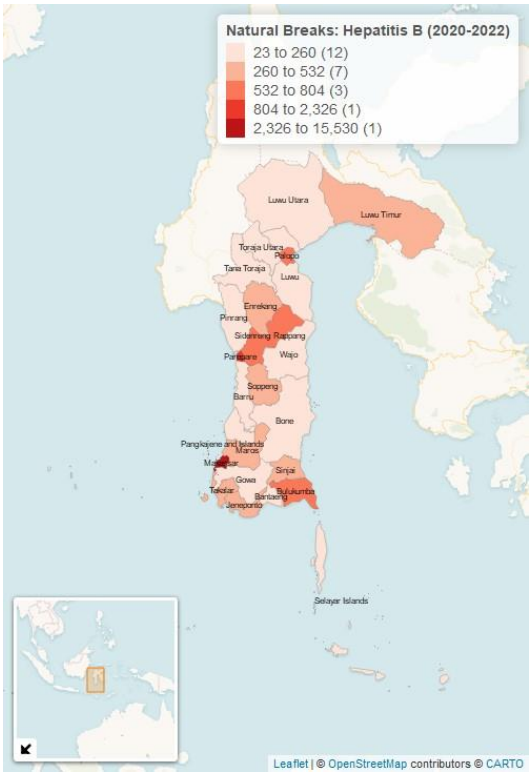

Figure 2. Natural breaks of hepatitis B.

Figure 3. Natural breaks of hepatitis C.

According to the results of the Local Morans I analysis, there was no significant clustering of hepatitis B (Figure 4 and Table 1) and C (Figure 5 and Table 1) in all districts and cities in South Sulawesi from 2020 until 2022.

Figure 4. Local Moran's Hepatitis B.

Figure 5. Local Moran's Hepatitis C.

Table 1. Local Moran's Hepatitis C and B

Variable	Global Moran's I	p-value	Conclusion
Hepatitis C	-0.039	0.451	Not significant
Hepatitis B	-0.061	0.693	Not significant

4. DISCUSSIONS

Hepatitis C and B are viral infections that can manifest acutely or chronically. Severe complications such as encephalopathy and gastrointestinal bleeding can occur, causing mortality.[22–25] The spread of hepatitis C and B through contact with body fluids is sometimes not detected because someone is in the asymptomatic period or accidentally, so the spread occurs in at-risk populations.[26,27] The development of hepatitis C and B in South Sulawesi 2020-2022 experienced fluctuations due to the COVID-19 outbreak.[28–31] Makassar is the area with the highest incidence as a referral center in South Sulawesi. This happens because diagnostic facilities are only available at advanced referral health facilities.

Hepatitis C and B also increased randomly, along with increases in oesophageal varices, hepatocellular carcinoma, and liver cirrhosis. This condition is by previous research, which shows that areas with a high prevalence of hepatitis C and B cause an increase in the incidence of oesophageal varices, liver cirrhosis, and hepatocellular carcinoma.[24,32,33] This occurs due to the unique mechanism of chronic viral hepatitis, which can become hepatocellular carcinoma without going through the cirrhosis phase. Although not absolute causes, hepatitis C and B significantly increase the incidence of complications of liver cirrhosis and hepatocellular carcinoma.[25,34–36] The mechanism underlying the complications of esophageal varices and hepatocellular carcinoma is hepatocyte death, which induces fibrosis and damage to cellular antiapoptotic factors, which triggers excessive proliferation of abnormal hepatocytes that develop into cancer.[37–40]

The spread of hepatitis C and B is sporadic because most cases are cases of transmission from blood and body fluids.[41–43] The Slower appearance of symptoms causes the detection of hepatitis C and B and its complications.[44–46] Case findings in the earlier period were discovered incidentally and not due to chief complaints. Distribution data from BPJS Kesehatan does not provide a complete picture of sufferers because findings in examination cases without indications are not recorded. Policies related to vaccination and screening programs and increasing the use of BPJS Kesehatan evenly in South Sulawesi and Indonesia increase data collection on hepatitis C and B description.

According to the mechanism of transmission, hepatitis is an infectious disease that can spread from person to person. The most common ways for it to spread are through sexual contact, which can spread the disease through vaginal secretions, blood, and semen secretions, as well as through infectious external sources like tattoos, dialysis machines, unsanitary needles and razors, and the transfusion of infected human blood. This transmission of contagion is referred to as horizontal transmission. It is also possible for the virus to be vertically transferred from mother to infant at the time of birth. Hepatitis C and B are primarily transmitted via the parenteral route. Individuals above the age of 35 were found as a major risk factor for HCV and HBV transmission in a study conducted by[52]. Research indicates that individuals with detectable anti-HBc, regardless of the presence of anti-HBs and negative for HBsAg, may have modest levels of viremia.[50-53]

There are several challenges in detecting hepatitis C and B viruses to eliminate hepatitis. One of these challenges is the need for diagnostic tests for viral infections, especially in low- and middle-income countries. This remains a barrier to the target of hepatitis elimination by 2030. Although conventional diagnostic tests are available, they are largely inaccessible in low- and middle-income countries due to lack of competent personnel or high costs. This can result in poor linkage to care and increased infections. A thorough approach to hepatitis C and B surveillance, screening, immunization, and treatment might be the main emphasis of the public health strategy for both diseases.[54,55]

5. CONCLUSION

This study conducted a geospatial analysis of patients with hepatitis C and B. In South Sulawesi, the cases of hepatitis C and B registered with BPJS Kesehatan appeared to be distributed randomly or sporadically, with no significant spatial clustering observed. This information can be valuable for policymakers in developing a comprehensive program aimed at reducing the prevalence of these diseases and mitigating the risks of complications such as esophageal varices bleeding and hepatocellular carcinoma.

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Conflict of Interest Statement:

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.