

Trend and Distribution COVID in Semarang City, Central Java Province, Indonesia

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Abstract: -

Background: In Indonesia, the first case of covid-19 occurred on March 2, 2020. Since then, cases have continued to increase and have spread to 34 provinces in Indonesia. Semarang City is one of the cities in Central Java Province with the highest positive number and covid-19 death rate.

Objectives: This study was conducted to find out the description of the distribution of covid-19 cases and to assess the effectiveness of the restrictions on community activities (PKM) implemented in the Semarang City.

Methodology: The data used in this study were obtained from the Semarang City Health Office. While the spatial data was obtained through OpenStreetMap. Data analysis was used to describe the distribution of confirmed Covid-19 cases based on the age and sex characteristics of the respondents, to see the trend of increasing and spreading of Covid-19 cases in Semarang City, and to see the effectiveness of the implementation of PKM.

Results: The results showed that the highest percentage of people infected with Covid-19 is in the age group 31-45 years (28.7%), male (50.2%), and the level of population density is not related to the distribution of new Covid-19 cases. Meanwhile, the effectiveness of PKM only occurred for the first time as evidenced by a decrease in new cases of 75.9%.

Conclusion: The distribution of Covid-19 cases in Semarang occurred randomly and was not related to the level of population density. Meanwhile, the effectiveness of reducing new cases has only occurred in the first PKM implementation.

Keywords: Covid-19, The Spread of Covid-19, Community Activity Restriction.

I. INTRODUCTION

At the end of 2019, precisely in December, the first case of pneumonia was reported in Wuhan City, Hubei Province [1] This disease was caused by a virus from the Coronavirus family and is a new type of virus that has never been previously identified in humans. Coronavirus Disease 2019 (Covid-19) was caused by the Severe Acute Respiratory Syndrome Coronavirus (SARS-Cov 2). This disease was referred to as a dangerous infectious disease and was named 2019 Novel Coronavirus (2019 n-Cov) which was later designated by WHO on March 11, 2020, as a global pandemic.[2,3] The increase in the number of Covid-19 cases is happening quite quickly and has spread between

countries.[4] Starting from the first case in Wuhan, the transmission of the virus continued to increase to various countries such as Europe, Asia, and America. Europe and North America are the countries with the highest case rates in the world with the number of cases as of March 2020 in America as many as 19.332 and followed by Spain with 6.549 cases.[5]

In Indonesia the first case of Covid-19 occurred on March 2, 2020 and infected 2 people.⁵ However, since then cases have continued to increase and spread to 34 provinces. Even from the end of 2020 until the beginning of 2021 there was a significant increase in cases. Currently, as of July 2, 2021, there are 2.228.938 million confirmed cases. Indonesia has the highest mortality rate in Southeast Asia with a percentage of 8.9%.[6] The increase in cases in Indonesia is dominated by three provinces on the island of Java. One of them is Central Java (232.839) which is the province that occupies the top three levels with positive numbers and the highest number of deaths in Indonesia after DKI Jakarta (482.264) and West Java (350.719). Central Java Province has 29 regencies and 6 cities with different cases of Covid-19 distribution. Semarang City is one of the cities in Central Java with the highest positive number and Covid-19 death rate. So that the City of Semarang becomes the largest contributor to daily cases in Central Java. The case fatality rate (CFR) of Semarang City is 5.3% greater than the national CFR.[7]

Efforts were made to reduce the spread of cases in stages, starting with the President's directives to carry out social distancing where one of the directions was to study and work at home, then changing the term from social distancing to physical distancing according to the direction of the WHO, the establishment of Presidential Regulation No. 2020 concerning Large-Scale Social Restrictions (*Pembatasan Sosial Berskala Besar* also known as *PSBB*) in the Context of Accelerating the Handling of Covid-19 and Presidential Decree No. 11 of 2020 concerning the Establishment of a Coronavirus Disease Public Health Emergency and the latest Presidential Decree No. 12 of 2020 concerning Determination of Non-Natural Disasters for the Spread of Covid-19 as a national disaster.

The spread of Covid-19 in various provinces in Indonesia varies in speed and extent of its spread. One of the factors causing the spread of Covid-19 deaths was identified at least by the underlying comorbidities in the patient, such as hypertension, diabetes mellitus, respiratory diseases such as asthma, and chronic obstructive pulmonary disease. For this reason, it is necessary to conduct a careful analysis of the

distribution of Covid-19 cases in service areas with the assumption of a certain distance and travel time, each type of analysis can be carried out using a geospatial approach, in particular using a Geographic Information System (GIS) network analysis and modeling.[8]

Therefore, this study will analyze the characteristics of the distribution of confirmed Covid-19 in the Semarang City. This study aims to describe the distribution of Covid-19 cases in Semarang City based on population density, as well as to assess the effectiveness of community activity restriction (*Pembatasan Kegiatan Masyarakat* also known as *PKM*) implemented in Semarang City. This study is expected to help make the right decisions in reducing the spread of Covid-19, minimize the number of positive Covid-19 patients and find out how the distribution of Covid-19 in Semarang City.

II. RESEARCH METHODS

This study is a descriptive study using a cross-sectional design. This research was conducted in the City of Semarang with a duration of observation from March 2020 to March 2021. This research has been approved by the health research ethics commission-Faculty of Public Health, Diponegoro University.

A. Research Population and Sample

The samples used in this study were all people who were positively infected with the Covid-19 virus in Semarang City. The sample of this research is the research population that meets the inclusion and exclusion criteria. The inclusion criteria in this study were all residents of Semarang City who were positively infected with the COVID-19 virus and the exclusion criteria for samples who declared cured and died during the observation process.

B. Data collection & Data processing

This data was obtained from the Semarang City Health Office. Spatial data in the form of vector maps of Semarang City with sub-district administrative area divisions were obtained through OpenStreetMap (OpenStreetMap.id) which is a web-based project to develop free and open-world maps. The variables in this study consisted of age, gender, time of being confirmed positive for Covid-19, and location of residence. Variable time confirmed for Covid-19 and special residence location for spatial evaluation of cases.

Patient data confirmed for Covid-19 are grouped based on the criteria set on the confirmed time variable for Covid-19 according to the needs of spatial analysis. Phase 1 grouping was carried out based on the criteria for a confirmed time of Covid-19 in March, June, September, December 2020, and January 2021. Stage 2 grouping was carried out based on the criteria for confirmed Covid-19 time 14 days before and after the implementation of the 1st (27 April 2020), 3rd (8 June 2020), and 7th (January 11, 2021) in Semarang City. Data collection on the implementation of the 1st *PKM* was carried out to assess the effectiveness of the *PKM* which was first implemented, while data collection on the implementation of the 3rd and 7th *PKM* was carried out to assess the effectiveness of the *PKM* during the highest spike in Covid-19 cases.

C. Data Analysis

Data analysis in this study was carried out descriptively. This analysis was conducted to describe the distribution of Covid-19 confirmations based on the age and gender characteristics of the respondents. The variable location of residence which contains coordinate data in the form of longitude and latitude is described spatially to produce distribution points for confirmed cases of Covid-19. The spatial distribution analysis carried out on the data from the grouping of phase 1 aims to see the trend of increasing and spreading of Covid-19 cases in Semarang City. While the analysis carried out on the data from the grouping of stage 2 aims to see the effectiveness of the implementation of *PKM*.

III. RESULTS

The distribution of positive cases in Semarang City by age group was mostly found in the 31-45 years age group, and the shrink percentage in the 0-5 years age group (Table 1). Meanwhile, the distribution of positive cases of Covid-19 shows that men tend to have a larger proportion than women (50.2%).

Table 1. Distribution of Positive Cases based on Demographic Characteristics

Variable	Frequencies	(%)
Demographic Factors		
Age		
0-5	555	1.7
6-18	1662	5.1
19-30	6781	20.8
31-45	9344	28.7
46-59	9031	27.7
≥60	5182	15.9
Total	32555	100.0
Sex		
Male	16334	50.2
Female	16221	49.8
Total	32555	100.0

The development of Covid-19 cases in Semarang City from April 2020 - to March 2021 (Figure 1) was observed to tend to be rapid, while the severity of cases tended to change. The severity of the Covid-19 cases or CFR in Semarang City from April 2020 to March 2021 has always been below 2%. The lowest CFR was observed in May 2020 (0.43%) and the highest in December 2020 (1.84%). The highest jump in CFR occurred in June 2020 or up 0.78% from the previous month.

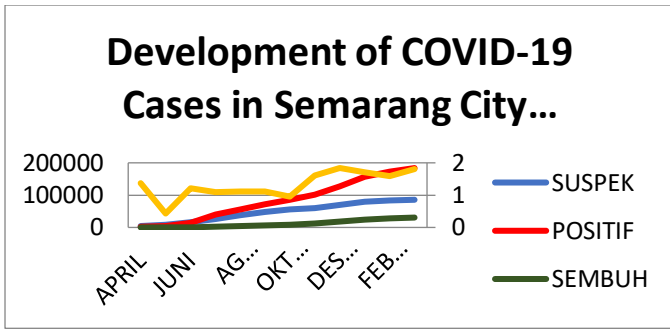


Fig 1. Line Chart of Semarang City Covid-19 Cases April 2020 – March 2021

From 16 sub-districts and 117 urban villages in Semarang City, the total positive confirmation based on reverse transcription-polymerase chain reaction (RT-PCR) was recorded as 34,276 cases as of March 2021 with different distributions in each region. The mapping carried out on the distribution of the findings of positive Covid-19 cases in the City of Semarang is shown in Figures 2-6, shows that the Covid-19 cases in Semarang City spread throughout all sub-districts, except in March 2020.

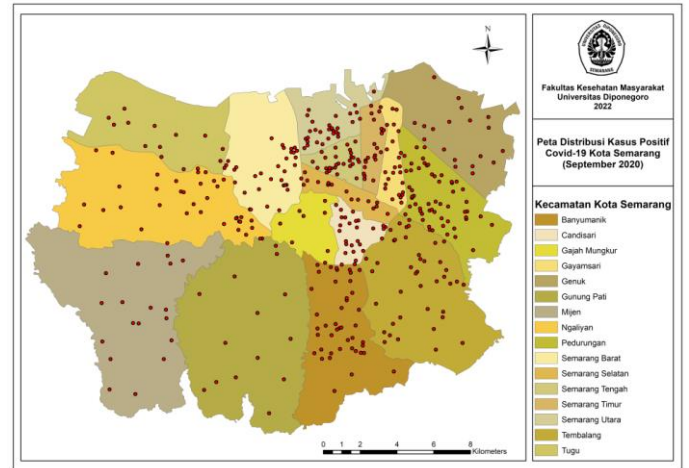


Fig 4. Distribution of Semarang City Covid-19 Cases September 2020

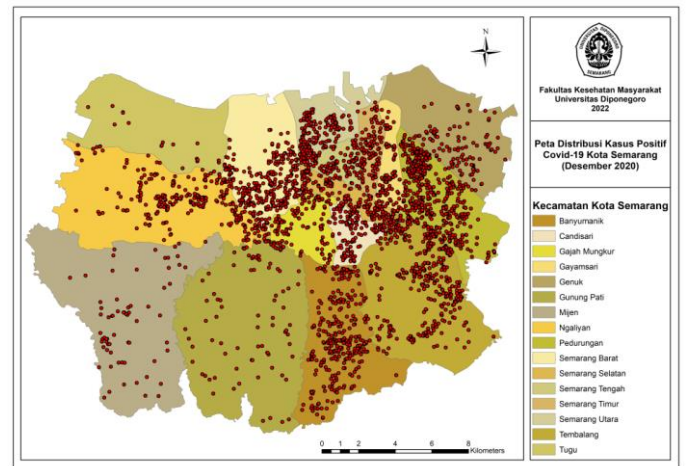


Fig 5. Distribution of Semarang City Covid-19 Cases December 2020

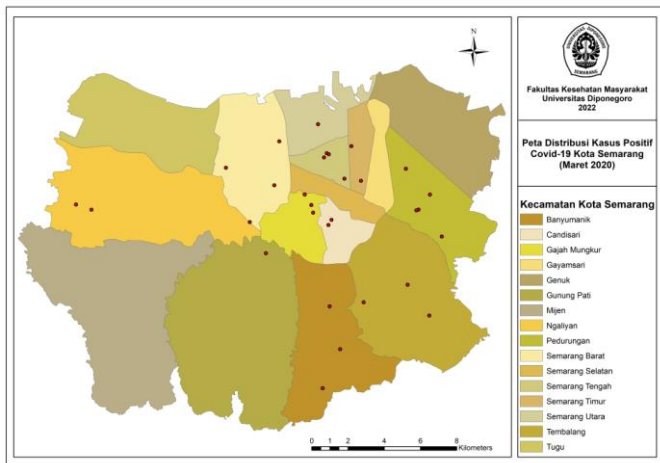


Fig 2. Distribution of Semarang City Covid-19 Cases March 2020

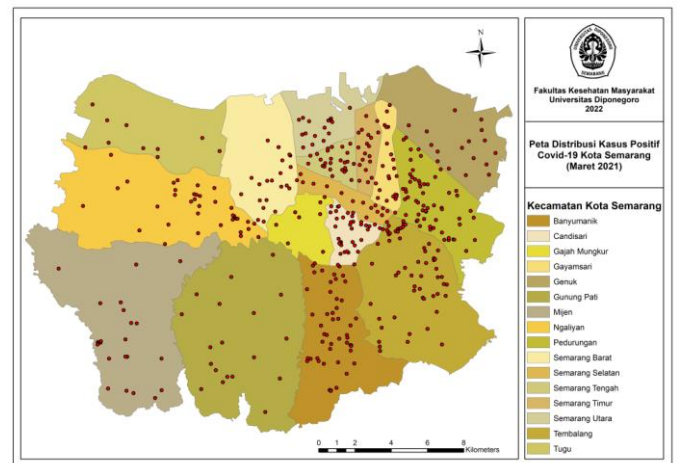


Fig 6. Distribution of Semarang City Covid-19 Cases March 2021

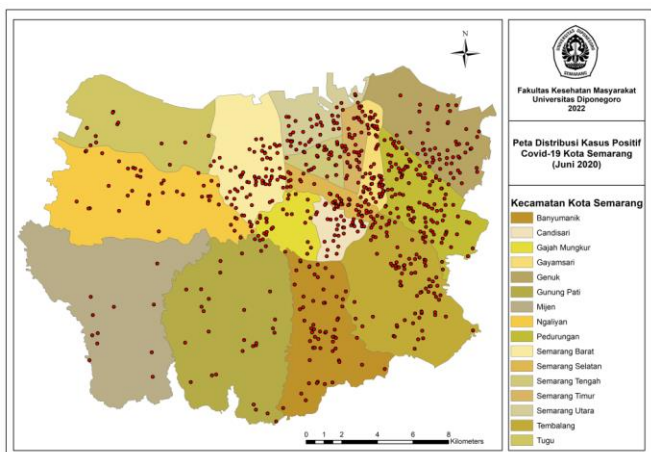


Fig 3. Distribution of Covid-19 Cases in Semarang City June 2020

The Semarang City Government has established a *PKM* policy to break the chain of the spread of Covid-19 in Semarang City. From March 2020 to March 2021, 9 times the *PKM* has been implemented (Figure 7-12). The 1st *PKM* takes effect from 27 April 2020-24 May 2020 (4 weeks), and

continued with PKM during 2 weeks of 2nd PKM (25 May-7 June 2020), 3rd PKM (8-21 June 2020), 4th PKM (22 June-5 July 2020), and 5th PKM since 6 July until the deadline is not yet known. Along with its development, PKM was tightened and entered the 6th PKM on August 13, 2020. PKM is again in effect for 2 weeks from 11-25 January, 2021 (7th PKM), followed by the 8th PKM (26 January-8 February, 2021), and after that the 9th PKM. We can observe the effectiveness of the PKM implemented by the City of Semarang by mapping the distribution of cases before and after the implementation of the 1st, 3rd, and 7th PKM.

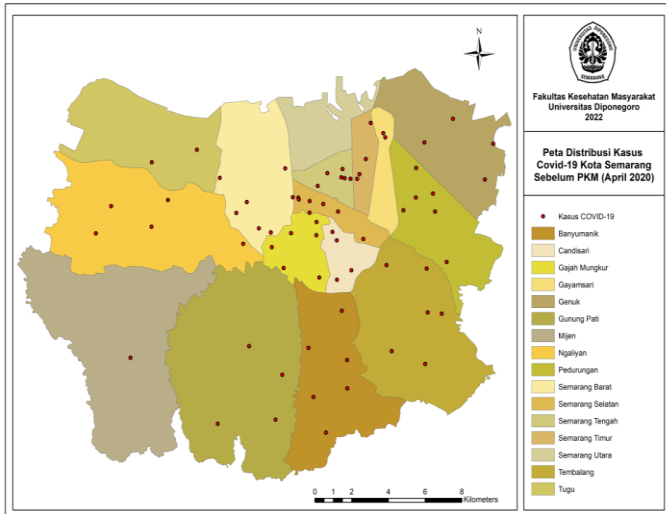


Fig 7. Distribution of Covid-19 Cases in Semarang City H+14 PKM-1st

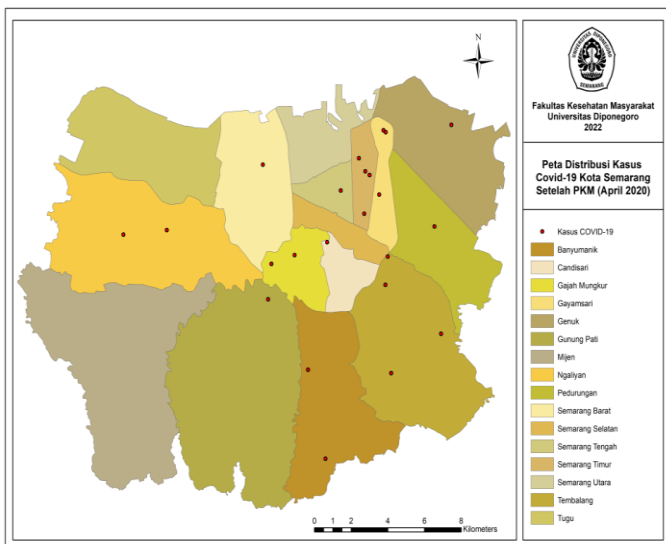


Fig 8. Distribution of Covid-19 Cases in Semarang City H+14 PKM-1st

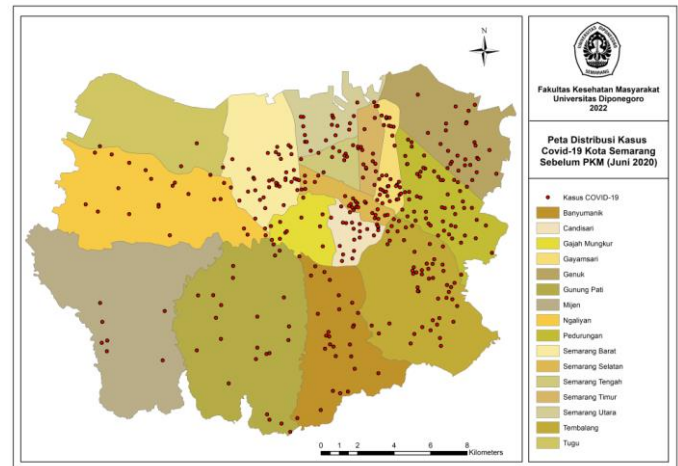


Fig 9. Distribution of Covid-19 Cases in Semarang City H-14 PKM-3rd

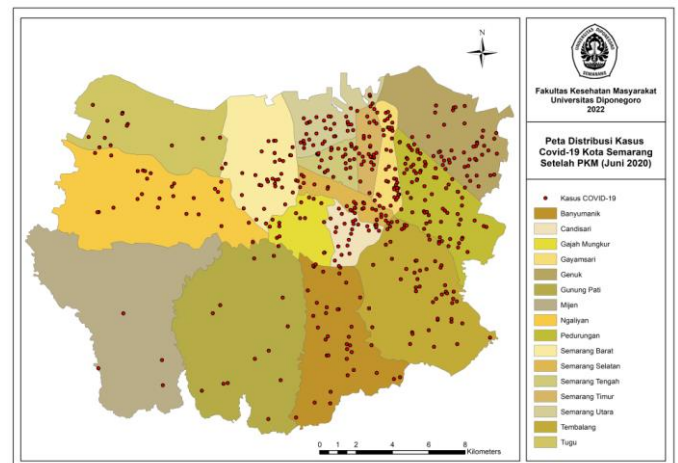


Fig 10. Distribution of Covid-19 Cases in Semarang City H+14 PKM-3rd

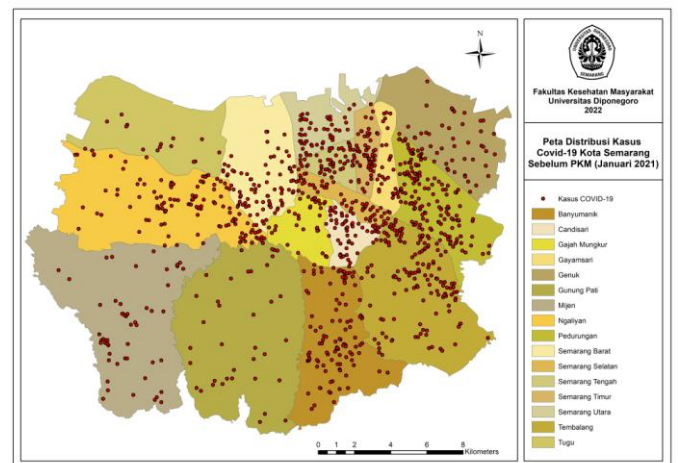


Fig 11. Distribution of Covid-19 Cases in Semarang City H-14 PKM-7th

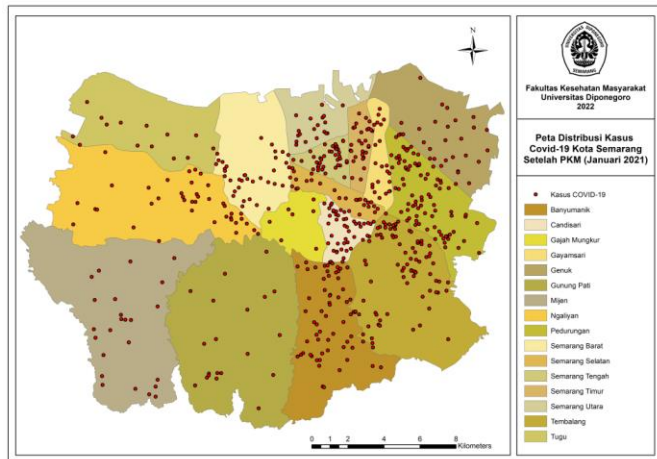


Fig 12. Distribution of Covid-19 Cases in Semarang City H+14 PKM-7th

IV. DISCUSSION

As a characteristic of Covid-19 patients hospitalized in Wuhan, China, it was found that of the 138 patients hospitalized with novel coronavirus-infected pneumonia (NCIP), the mean age was 56 years (interquartile range, 42-68; 22-92 years) and 54.3% were male.[9] Likewise, the report submitted by the center for disease control (CDC) in the morbidity and mortality weekly report said that among 508 (12%) patients known to have been hospitalized, 9% were aged 85 years, 36% were 65-84 years, 17% 55-64 years, 18% are 45-54 years, and 20% are 20-44 years. Less than 1% of hospitalizations were among persons 19 years of age. The percentage of people hospitalized increases with age, from 2%-3% among people aged 19 years, to 31% among adults aged ≥ 85 years.[10]

A study shows that there are many differences between men and women in the immune response to Covid-19 infection and inflammatory diseases. Males are more susceptible to viral infections based on different innate immunity, steroid hormones, and factors associated with sex chromosomes. The presence of two X chromosomes in females stresses the immune system even if one is inactive. The immune regulatory gene encoded by the X chromosome in females causes lower viral load levels, and less inflammation than in males, while higher CD4⁺ T cells with better immune responses. In addition, women generally produce higher levels of antibodies that stay in circulation longer. The level of activation of immune cells is higher in women than in men.[11] In addition to differences in genetic factors between men and women, a survey conducted nationally in France proved that age and gender are related to efforts to prevent the spread of Covid-19. Women tend to be more attentive in preventing transmission[12] this is one of the causes that Covid-19 is more common in men.

Semarang is one of the cities with the highest Covid-19 cases in Central Java Province. The peak of the highest cases occurred in December 2020 with a total of 5142 positive case findings spread across 16 sub-districts. Every month, Covid-19 cases have always increased, since March 2020 with 35

confirmed positive cases, spread across 11 sub-districts. During the 5 months of observation, Pedurungan and Tembalang sub-districts consistently became sub-districts with high positive case findings, ranging from 10%-15% of the total positive case findings in Semarang City every month.

Based on data from the Central Statistics Agency (*Badan Pusat Statistik* also known as *BPS*) of Semarang City, the Pedurungan sub-district occupies the top 5 sub-districts with the highest population density in Semarang City with a value of 9.322 inhabitants/km². On the other hand, the Tembalang sub-district has a low population density of 4.291 people/km², slightly below the City of Semarang (4.425 inhabitants/km²). Based on the results of the 2020 population census, the population of Semarang City is recorded at approximately 1.6 million people. However, the distribution of the population in Semarang City is not evenly distributed, it is noted that the Candisari sub-district is the most densely populated area (11.538 people/km²) while the Tugu sub-district is the area with the lowest density (1.033 people/km²).[13,14] The City of Semarang with a high average population density (4.425 people/km²) makes the potential for the spread of Covid-19 cases to be faster within the scope of local transmission.

Tugu Sub-district, which is the sub-district with the lowest population density in Semarang City, in 5 months of observation showed lower positive cases of Covid-19 compared to other sub-districts. Every month, the Tugu sub-district only contributes 0%-2.1% of new case findings in Semarang City. Another sub-district with a low population density, namely Mijen District (1.406 people/km²) was also observed to have relatively low new case findings compared to other sub-districts. Findings of new cases in Mijen District in 5 months of observation ranged from 0%-4.3% of the total new case findings in Semarang City. Slightly different, the Gunungpati sub-district which has a population density of 1.812 people/km² has a higher case finding rate, which is around 3.3%-6.8% of the total new case findings in Semarang City.

The number and density of the population are one of the factors that can affect the incidence of disease in a particular area, especially infectious diseases.[15] Population density can cause various negative impacts such as the dense population in an area also indicates high close contact, so that high close contact between residents can increase the risk of spreading the Covid-19 virus.[16] Research conducted by Nelwan, (2020) states that areas with high population density tend to have high cases of Covid-19 spread.¹⁵ This statement is supported by Alam (2021), that population density is one of the risk factors for the high rate of transmission of Covid-19.[17] However, population density is not always the main factor in the spread of Covid-19 cases, for example in the Candisari sub-district which is the most populous sub-district in Semarang City, the distribution of cases is not too significant.

During the 5 months of observation, each month the findings of new cases in Candisari District only ranged from 4%-5.7% of the total findings of new cases in Semarang City. The same thing was also observed in the Gayamsari sub-

district which is the second most populous sub-district in Semarang City. Where has a relatively lower case finding compared to other sub-districts (0-3.1%), except in June (8.3%). This happened because of several other factors that influenced the spread of Covid-19 such as population mobility, close contact between communities, and compliance with the application of health protocols. Location factors and interactions between regions are important factors in the spread of Covid-19, local or international trade and travel have the potential for the spread of cases.[18,19]

One of the Indonesian government's strategies to reduce the rate of transmission of Covid-19 is through *PSBB*, *PSBB* that is strictly implemented can restrain the public from traveling out and gathering in public places to reduce the risk of transmission of Covid-19.[20,21] The imposition of curfews, the closure of public facilities such as shops, restaurants, offices, educational institutions, and the cancellation of meeting activities have proven to be effective interventions.[22] In contrast to the City of Semarang, since April 25, the Mayor issued a Mayor's Regulation on *PKM* as a middle way to suppress the spread of Covid-19 cases which still provides space for activities for the community but with fairly tight control by involving parties such as neighborhood and citizens association (*Rukun Tetangga/Rukun Warga* also known as *RT/RW*), village community empowerment institution (*Lembaga Pemberdayaan Masyarakat Kelurahan* also known as *LPMK*), and the Civil Service Police Unit.[23]

PKM activities in Semarang City have been taking place since April 27, 2020, with the implementation of the 1st *PKM* which ends on May 24, 2020. *PKM* is enforced for at least 14 days, referring to the Covid-19 incubation period, which is 5-6 days and the longest is 14 days.[24] *PKM* is expected to reduce the transmission of Covid-19 from patients who have not yet experienced symptoms or are still in the incubation period. Assuming the average incubation period for Covid-19 is 5.2 days, the peak infectious period is 2 days before symptoms appear until 1 day after symptoms appear and then decreases dramatically within 7 days.[25] Research also shows that 37% - 48% of Covid-19 transmissions occur before symptoms appear,²⁵ So *PKM* has an important role.

The *PKM* that was implemented for the first time succeeded in reducing the findings of new cases by 75.9%, from 112 new cases in the 14 days before the *PKM* to 27 new cases within 14 days after the *PKM*. The implementation of *PKM* continues to be extended to the 2nd *PKM* and so on. This is because the number of Covid-19 cases has not decreased even though sometimes cases have decreased but after that, the cases rose again. In the 3rd *PKM*, the findings of new cases after the implementation of the *PKM* did not decrease, from 549 new cases in the 14 days before the implementation of the *PKM* to 825 new cases 14 days after the *PKM*, or an increase of 50.3%. Meanwhile, the implementation of the 7th *PKM* succeeded in reducing the findings of new cases by 9.1%, from 2.779 new cases in the 14 days before the *PKM* to 2.527 new cases in the 14 days after the *PKM*. The implementation of *PKM* will be effective if it is accompanied by an increase in epidemiological surveillance,[26] as well as the

implementation of the health protocol by the community properly and regularly.[23]

V. CONCLUSION

The distribution of Covid-19 cases in Semarang City over 5 observation periods was observed to spread randomly and was not related to the level of population density in 17 sub-districts. The *PKM* policy implemented by the Semarang City government to reduce the findings of new cases is effective only at the first implementation of *PKM*.

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REFERENCES

- [1]. Abdelhafiz AS, Mohammed Z, Ibrahim ME, et al. Knowledge, Perceptions, and Attitude of Egyptians Towards the Novel Coronavirus Disease (COVID-19). *J Community Health*. 2020;45(5):881-890. doi:10.1007/s10900-020-00827-7
- [2]. Mansuri FMA, Zalat MM, Khan AA, Alsaedi EQ, Ibrahim HM. Estimating the public response to mitigation measures and self-perceived behaviours towards the COVID-19 pandemic. *J Taibah Univ Med Sci*. 2020;15(4):278-283. doi:10.1016/j.jtumed.2020.06.003
- [3]. Shi Y, Wang J, Yang Y, et al. Knowledge and attitudes of medical staff in Chinese psychiatric hospitals regarding COVID-19. *Brain, Behav Immun - Heal*. 2020;4(March):100064. doi:10.1016/j.bbih.2020.100064
- [4]. Masriadi. Epidemiology of Infectious Disease (Epidemiologi Penyakit Menular). *Rajawali Pers*. PT. Raja Grafindo Persada
- [5]. World Health Organization. Coronavirus Disease (COVID-2019) Situation Reports. www.who.int.
- [6]. Kementerian Kesehatan Republik Indonesia. Emerging Infections: Latest Official Information Media of Emerging Infectious Diseases Covid-19 (*Infeksi Emerging: Media Informasi Resmi Terkini Penyakit Infeksi Emerging Covid-19*). 2021. Available: <https://infeksiemerging.kemkes.go.id/dashboard/covid-19>.
- [7]. Dinas Kesehatan Kota Semarang. Distribution Data of Covid-19 (*Data Sebaran COVID-19*). 2021.
- [8]. Silalahi FES, Hidayat F, Dewi RS, Purwono N, Oktaviani N. GIS-based approaches on the accessibility of referral hospital using network analysis and the spatial distribution model of the spreading case of COVID-19 in Jakarta, Indonesia. *BMC Health Serv Res*. 2020;20(1):1-20. doi:10.1186/s12913-020-05896-x
- [9]. Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *JAMA*. 2020;323(11):1061-1069. doi:10.1001/jama.2020.1585

- [10]. CDC. *Severe Outcomes Among Patients with Coronavirus Disease 2019 (COVID-19) — United States, February 12–March 16*. Vol 69.; 2020. doi:<http://dx.doi.org/10.15585/mmwr.mm6912e2>
- [11]. Conti P, A. Younes. Coronavirus COV-19/SARS-CoV-2 affects women less than men: clinical response to viral infection. *J Biol Regul Homeost Agents*. 2020;34(2). doi:10.23812/Editorial-Conti-3.
- [12]. Brouard S, Vasilopoulos P, becher michael. *Sociodemographic and Psychological Correlates of Compliance with the Covid-19 Public Health Measures in France.*; 2020.
- [13]. Badan Pusat Statistik Kota Semarang. Population Density (people/km²) 2019-2021 (Kepadatan Penduduk (jiwa/km²) 2019-2021). Available: <https://semarangkota.bps.go.id/indicator/12/48/1/kepadatan-penduduk.html>.
- [14]. Badan Pusat Statistik Kota Semarang. Semarang ity in Figures 2021 (Kota Semarang Dalam Angka 2021). Published online 2021.
- [15]. Nelwan JE. Corona Virus Disease 2019 Incidence Based on Population Density and Altitude of Place per District Area (Kejadian Corona Virus Disease 2019 berdasarkan Kepadatan Penduduk dan Ketinggian Tempat per Wilayah Kecamatan). *J Public Heal Community Med*. 2020;1(2):32-45.
- [16]. Daud MM, Arum S. Risk Analysis of Covid-19 Transmission Based on Demographic and Geographic Aspects in Semarang City in 2020 (Analisis Risiko Penularan Covid-19 Berdasarkan Aspek Demografis dan Geografis Di Kota Semarang Tahun 2020). *Ahmr Metastasis Health Journal*. 2021;1(2):49-58.
- [17]. Alam MZ. Is Population Density a Risk Factor for Communicable Diseases Like COVID-19? A Case of Bangladesh. *Asia-Pacific J Public Heal*. 2021;33(8):949-950. doi:10.1177/1010539521998858
- [18]. Edriani TS, Rahmadani A, Noor DMM. Analysis of the Relationship between Population Density and the Pattern of Spread of COVID-19 in DKI Jakarta Province using Robust Regression (Analisis Hubungan Kepadatan Penduduk dengan Pola Penyebaran COVID-19 Provinsi DKI Jakarta menggunakan Regresi Robust). *Indones J Appl Math*. 2021;1(2):51. doi:10.35472/indojam.v1i2.353
- [19]. Ulva F, Yuliza WT. The Relationship between Population Density and the Distribution of Covid-19 Cases in West Sumatra (Hubungan Kepadatan Penduduk dengan Sebaran Kasus Covid-19 di Sumatera Barat). *J Ilmu Kesehatan*. 2021;5(2):263-267.
- [20]. Presiden Republik Indonesia. Government Regulation of the Republic of Indonesia Number 21 of 2020 concerning Large-Scale Social Restrictions in the Context of Accelerating Handling of Corona Virus Disease 2019 (Peraturan Pemerintah Republik Indonesia Nomor 21 Tahun 2020 Tentang Pembatasan Sosial Berskala Besar Dalam Rangka Percepatan Penanganan Corona Virus Disease 2019). Available: <https://peraturan.bpk.go.id/Home/Details/135059/pp-no-21-tahun-2020>.
- [21]. Andriani H. Effectiveness of Large-Scale Social Restrictions (PSBB) toward the New Normal Era during COVID-19 Outbreak: a Mini Policy Review. *J Indones Heal Policy Adm*. 2020;5(2):61-65. doi:10.7454/ihpa.v5i2.4001
- [22]. Haug N, Geyrhofer L, Londei A, et al. Ranking the effectiveness of worldwide COVID-19 government interventions. *Nat Hum Behav*. 2020;4(12):1303-1312. doi:10.1038/s41562-020-01009-0
- [23]. Putra DT, Nuh DM. A Study on the Implementation of Community Activity Restrictions (PKM) Policies in Handling the Covid-19 Pandemic in Semarang City in 2020 (Kajian Implementasi Kebijakan Pembatasan Kegiatan Masyarakat (PKM) Dalam Penanganan Pandemi Covid-19 di Kota Semarang Tahun 2020). *Spektrum*. 2021;18(2):32-49.
- [24]. WHO. Coronavirus disease 2019 (COVID-19) Situation Report-73. *World Heal Organ*. 2020;2019(March):2633. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>
- [25]. He X, Lau EHY, Wu P, et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. *Nat Med*. 2020;26(5):672-675. doi:10.1038/s41591-020-0869-5
- [26]. Das RK, Sudaryo MK. Epidemiological patterns and spatial distribution of covid-19 cases in DKI Jakarta (March-December 2020). *Kesmas*. 2021;16(1):17-22.