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FACTORS DETERMINING COVID-19 SEVERITY IN MALAYSIA: FROM SOCIAL, ECONOMIC AND ENVIRONMENTAL PERSPECTIVES

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Abstract

This paper attempts to examine the factors affecting the COVID-19 pandemic situation in Malaysia. It investigates three major factors (social, economy and environment). Thirteen States and two Federal Territories of Malaysia were considered; and the data for the attributes of each major factor are derived from the official reports from the Department of Statistics Malaysia. Meanwhile, the infection rate and mortality rate of COVID-19 cases were obtained from the Ministry of Health, Malaysia. Using non-parametric statistical approach, the several interesting results are identified. Firstly, for the social factor, we found that the percentage of non-citizens has a positive relationship with both COVID-19 infection rate and mortality rate. Further, the number of students per teacher have a positive relationship with COVID-19 infection rate. Second, in terms of the economy factor, primary industry has a negative relationship with COVID-19 infection rate. Third, in the matter of social factor, it is found that population density and percentage of high-rise residential unit are positively related with COVID-19 infection rate. The result from this study can provides an insight for policymakers to understand factors contribute on the spread and severity of COVID-19 to informing better mitigation policy and control measures.

***Keywords**:* Malaysia; COVID-19; Social; Economy; Environment

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INTRODUCTION

Nearly two years, our world has been greatly affected by the implications of the COVID-19 pandemic. To date, approximately 250 million population have been infected globally (WHO, 2021a) and this number is expected to increase with the emergence of more aggressive variants (WHO, 2021b). In terms of economy, the global financial system is facing the worst recession since Second World War (World Bank, 2020). Like the global situation, Malaysia too, experiencing the unprecedented challenges that brought by COVID-19 that has threatened the lives and livelihoods of our community. As of September 2021, Malaysia recorded nearly two (2) million COVID-19 confirmed cases (from the 32 million national population) and 24 thousand deaths due to pandemic (Ministry of Health Malaysia, 2021). During the nationwide Movement Control Order (MCO) in 2020, the World Bank survey (with more than 100 thousand companies in Malaysia) reveals that a high percentage of businesses were closed (35%) or partially operate (49%) (Kuriakose and Tran, 2020).

For COVID-19 and built environment, urban and regional planning related professions in Malaysia have initiated various discussion concentrating on the theoretical debates over the future direction of urban development in the context of COVID-19 era concerning to spatial planning (Rameli 2021; Gunasilan, 2020), density (Lim et al., 2021) and urban design (Ujang, 2021; Soo, 2020). Further, there have been several attempts of empirical studies can be found Malaysia. At the fine geography scale, Aw et al (2021) examine the relationship of population density with the COVID-19 cumulative cases and mortality rate in Malaysia, using Pearson regression focusing on 143 districts in Malaysia from January 25, 2020 – December 31, 2020. Meanwhile, Ganasegeran et al (2021) conducted ecology study by applying hierarchical cluster analysis and region-wise correlation on the cities of five (5) different regions in Malaysia to determine the correlation between population density with COVID-19 cluster and incidence between January 22, 2020 and February 4, 2021. In terms of empirical clinical study, Sim et al (2020) analyse COVID-19 patient admission records from 18 designated hospitals in Malaysia between the period of February 1, 2020 and May 30, 2020, focusing on the sociodemographic, clinical histories and diseases staging factors through univariate and multivariate logistic regressions. These studies demonstrates that there are limited research efforts in Malaysia to explore the determinant factors from a more holistic dimension of social, economy and environment that contribute to the COVID-19 severity.

To address this gap, this study aims to examine the social, economy and environment factors affecting the COVID-19 infection and mortality rate in Malaysia at state level. This investigation supports the growing literature on determinant factors and COVID-19, also providing insights to assist government policymakers, epidemiologists, environmentalist and urban planners in

formulating mitigation policy and control measure for COVID-19 and potential future pandemic disease.

METHODOLOGY

Study Design and Data Source

The present study includes thirteen States and two Federal Territories in Malaysia comprising of Perlis, Kedah, Pulau Pinang, Perak, Selangor, Negeri Sembilan, Melaka, Johor, Pahang, Terengganu, Kelantan, Sarawak, Sabah, Federal Territory of Kuala Lumpur, and Federal Territory of Labuan. Due to the absence of data, Federal Territory of Putrajaya is not included in this study. Furthermore, the study focusses on the timeframe from January 25, 2020 to June 30, 2021, about one year and a half of the pandemic calendar in Malaysia. The COVID-19 cases and deaths data by state in Malaysia were extracted from the Ministry of Health Malaysia's (MOH) official website (http://covid-19.moh.gov.my, accessed on August 1, 2021).

The following attributes of the social, economy and environment determinant factors were examined in this study: social factor (percentage of non-citizen, average household income, percentage of low-income household, number of students per teacher); economy factor (percentage of primary industry, percentage of secondary industry, percentage of tertiary industry); and environment factor (population density, percentage of high-rise residential, hospital beds per inhabitants, number of inhabitants per medical doctor, percentage of broadband penetration rate). The data regarding to the attributes of the social, economy and environment determinant factors are derived from the up-to-date state-level statistic report (My Local Stats) published by the Department of Statistics Malaysia (DOSM). The attributes for the social, economic and environment factors as well as COVID-19 outcomes are defined as follow: percentage of non-citizen is the percentage of resident population that is non-Malaysian citizenship; average household income is the mean monthly household gross income (RM, Ringgit Malaysia); percentage of low-income household is percentage of household that is low-income (as of year 2016, bottom 40%, B40 earning less than RM 4,360 per month); number of students per teacher is the ratio of student-to-teacher; percentage of primary industry is the proportion of gross domestic product that belongs to the primary industry; percentage of secondary industry is the proportion of gross domestic product that belongs to the secondary industry; percentage of tertiary industry is the proportion of gross domestic product that belongs to the tertiary industry; population density measures the number of resident population per land area (in terms of people per square kilometre of land area; percentage of high-rise residential is the percentage of housing stock that is high-rise residential; hospital beds per inhabitants is the number of hospital beds per resident population; number of inhabitants per medical doctor is the ratio of resident population to medical doctor; broadband

penetration rate is the percentage of both fixed-broadband subscriptions and mobile-broadband subscriptions (with the speed equal to and greater than one megabyte per second) per 100 inhabitants; COVID-19 infection rate is the ratio of COVID-19 confirmed cases to population; COVID-19 mortality rate is the ratio of COVID-19 deaths to population.

The summary of statistics (mean, standard deviation, minimum and maximum) on the attributes from social, economic and environment factors by state in Malaysia are enlisted in Table 1.

Table 1: Descriptive statistics of the social, economic and environment attributes adopted in the model and aggregated by Malaysian States.

Factors	Attributes	Mean	Standard Deviation	Minimum	Maximum
Social	Percentage of Non-Citizen (2018)	7.916	6.449	2.55	28.81
	Average Household Income (2016)	6330.53	1793.544	4214	10692
	Percentage of Low-Income Household (2016)	6.667	4.115	0.2	12.5
	Number of Students per Teacher (2018)	10.67	1.718	8	15
Economy	Percentage of Primary Industry (2018)	14.93	12.931	0	45
	Percentage of Secondary Industry (2018)	27.27	13.188	7	46
	Percentage of Tertiary Industry (2018)	57.00	13.701	35	88
Environment	Population Density (2018)	855.87	1860.607	22	7366
	Percentage of High-Rise Residential (2018)	21.67	21.396	3	77
	Hospital Beds (per 1,000 Inhabitants) (2017)	1.546	0.483	0.86	2.83

	Number of Inhabitants ('000) per Medical Doctor (2017)	0.641	0.218	0.28	1.05
	Broadband Penetration Rate (per 100 Inhabitants) (2018)	116.707	40.995	72.0	240.8
COVID-19 Outcomes	Infection Rate (per 1,000 Inhabitants) (June 30, 2021)	24.290	20.108	2.30	82.52
	Mortality Rate (per 1,000 Inhabitants) (June 30, 2021)	0.215	0.298	0.03	1.23

Source: Author (2022)

Data Analysis

Using SPSS, the study performed descriptive and inferential analyses for the descriptions of data characteristics (i.e., mean, frequency and standard deviation) and hypothesis testing, respectively. Based on the normality test of cumulative cases and infection rates of COVID-19 (see Table 2), showing the significance values of Shapiro-Wilk of <0.05, the distributions of the two set of data are not normal. The study therefore adopted a non-parametric test. More precisely, in light of the small sample size (i.e., 14) and data types of the twelves social-environmental-economic predictors which are interval scaled, Kendall's Tau-b, instead of the Spearman Rank correlation, was used. Another advantage of adopting the former is that it has better statistical properties where it is more insensitive to errors (i.e., the coefficient values, although usually smaller than Spearman, are more accurate).

Table 2: Descriptive statistics of the social, economic and environment attributes adopted in the model and aggregated by Malaysian States.

	Shapiro-Wilk			**Skewness**		**Kurtosis**	
	Statistic	df	Sig.	Statistic	Std Error	Statistic	Std Error
Cumulative_cases	.668	15	.000	2.824	.580	9.304	1.121
Infection_rate	.808	15	.005	1.900	.580	4.396	1.121

Source: Author (2022)

RESULTS AND DISCUSSION

Table 3 shows the results of the analysis. The following attributes of social, economy and environment factors demonstrate statistically significant relationship to the COVID-19 infection rate: percentage of non-citizen (p-value < 0.05 and τb of 0.467), average household income (p-value < 0.05 and τb of 0.543), number of students per teacher (p-value < 0.05 and τb of 0.411), percentage of primary industry (p-value < 0.05 and τb of -0.425), population density (p-value < 0.05 and τb of 0.390) and percentage of high-rise residential (p-value < 0.05 and τb of 0.394). All these attributes show strong and positive correlation with the COVID-19 infection rate, in exception for the percentage of primary industry (from economic) exhibit strong negative correlation with the COVID-19 infection rate. However, there were no relationship between the percentage of low-income household, percentage of secondary industry, percentage of tertiary industry, hospital bed per 1,000 inhabitants, number of inhabitants ('000) per medical doctor and broadband penetration rate per 100 inhabitants to the COVID-19 infection rate.

Meanwhile, the percentage of non-citizen (p-value < 0.05 and τb of 0.510) and average household income (p-value < 0.05 and τb of 0.567) are statistically significant relationship to the COVID-19 mortality rate. No relationship is found between COVID-19 mortality rate with the following attributes of social, economy and environment factors: percentage of low-income household, number of students per teacher, percentage of primary industry, percentage of secondary industry, percentage of tertiary industry, population density, percentage of high-rise residential, hospital bed per 1,000 inhabitants, number of inhabitants ('000) per medical doctor and broadband penetration rate per 100 inhabitants.

In respect to social factor, the percentage of non-citizen (primarily migrant workers) has a strong positive association with the COVID-19 infection rate and mortality rate. These results reflect the frequent major MOH COVID-19 outbreak information reported that many COVID-19 hot spots are linked to the migrant workers dormitory often at the manufacturing and construction workplace. Some migrant workers lived in an overcrowded accommodations and unsanitary condition. Further, they had poor access to healthcare and little protection for their right. Nevertheless, we are surprised to learn that the average household income has a strong positive association with the COVID-19 infection rate and mortality rate. The result implies that an increase of average household income (also mean a higher income) would give arise to COVID-19 infection rate and mortality rate. Our average household income finding contradicts to the previous studies demonstrates that low-income individual (which also can be interpreted it to the low-income household) has lesser COVID-19 behaviour intention (Clemens et al., 2021) and tend to have higher risk of COVID-19 death (Drefahl et al, 2020). Perhaps, this might be explained by the large number of

COVID-19 workplace cluster that appear at the Malaysian states with higher average household income (e.g., Federal Territory of Kuala Lumpur, Federal Territory of Labuan, Selangor, Johor, Pulau Pinang and Negeri Sembilan). The number of students per teacher and COVID-19 infection rate has a positively strong correlation. This could be due to the larger class size with more students leads to close-contact setting and escalate the spread of COVID-19 in school. The finding supports Philips et al (2021) agent-based model of COVID-19 transmission in primary school setting demonstrating that larger class size (comparing 15:2 ratio to 7:3 ratio) intensify the outbreaks of COVID-19.

On the opposite end of the spectrum, the percentage of primary industry attribute (of the economy factor) has a strong negative effect on the COVID-19 infection rate. This suggests that higher percentage of primary industry reduce the COVID-19 infection rate. The finding is differing from the early studies where among majority of the COVID-19 positive case individual were observed to be agriculture workers (Shi et al, 2020; Wang, L et al., 2020; Wang, R. et al., 2020). A possible explanation is that the workplace for the primary industry activities such as agriculture, forestry, and fishing are relatively taking on a more spacious places (ample space, less confine) and tend to be in an outdoor backdrop (a better air ventilation). Furthermore, in our analysis for environment factor, we found that population density and percentage of high-rise residential correlated positively with COVID-19 infection rate. The result is conforming to our expectations that crowded living and housing condition are more likely to become COVID-19 hot spots. This is consistent with the recent evidence from Malaysia empirical research of Aw et al (2021) and Ganasegeran et al (2021) demonstrating the COVID-19 has an association with population density. Similarly, the population density finding is supportive to the study results from China (Han et al, 2021) and United States (Roy and Gosh 2020; Smith et al, 2021) identified COVID-19 case is highly influence by the population density. Regarding our finding on the percentage of high-rise residential, this is supportive to the study by Jonhson et at (2020) found that multi-unit dwelling contributes to the risk of COVID-19 infection.

Table 3: Results of the Kendall's Tau-b Correlation examining the association between state-level social, economic and environment attributes with the COVID-19 Infection Rate and Mortality Rate.

Factors	**Attributes**	**COVID-19 Infection Rate**		**COVID-19 Mortality Rate**	
		Correlation Coefficient	***P-value***	***Correlation Coefficient***	***P-value***
Social	Percentage of Non-Citizen (2018)	**0.467***	**0.015**	**0.510****	**0.009**

	Average Household Income (2016)	**0.543****	**0.005**	**0.567****	**0.003**
	Percentage of Low-Income Household (2016)	-0.143	0.458	-0.125	0.519
	Number of Students per Teacher (2018)	**0.411***	**0.042**	0.395	0.053
Economy	Percentage of Primary Industry (2018)	**-0.425***	**0.029**	-0.332	0.090
	Percentage of Secondary Industry (2018)	0.135	0.487	0.117	0.550
	Percentage of Tertiary Industry (2018)	0.000	1.000	-0.580	0.766
Environment	Population Density (2018)	**0.390***	**0.042**	0.240	0.215
	Percentage of High-Rise Residential (2018)	**0.394***	**0.042**	0.379	0.052
	Hospital Beds (per 1,000 Inhabitants) (2017)	-0.106	0.585	-0.290	0.881
	Number of Inhabitants (‘000) per Medical Doctor (2017)	-0.124	0.520	-0.010	0.960
	Broadband Penetration Rate (per 100 Inhabitants) (2018)	0.257	0.181	0.221	0.254

Source: Author (2022)

Note: Statistically significant results (*P<0.05 and **P<0.01) are displayed in bold.
*P<0.05 Correlation is significant at the 0.05 level (2-tailed)
**P<0.01 Correlation is significant at the 0.01 level (2-tailed)

CONCLUSION

At the state-level of Malaysia, several social, economy and environment factors were found statistically significant correlated with COVID-19 outcomes. For social factor, the percentage of non-citizen and average household income shows strong positive relationship with the COVID-19 infection rate and COVID-19 mortality rate. The percentage of primary industry (from economic factor) has a strong negative association to the COVID-19 infection rate. Meanwhile, concerning environment factor, both the population density and percentage of high-rise residential are contribute positively to the COVID-19 infection rate. These findings could provide an insight and helpful to assist government policymakers, epidemiologists, environmentalist, and urban planners for the purpose of formulating mitigation policy and control measure for COVID-19. This is particularly important for the present situation where most countries including Malaysia is prepared to live with COVID-19 for a long period of time. Further, this can be also supportive for the future pandemic disease.

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