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Special Issue: *Evaluating of the COVID-19 Pandemic Responses*

Handling by: Dewi Susanna, MS., Zarfiel Tafal, MPH., Dumilah Ayuningtyas, MARS.

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Dear Editorial Team, Authors, Viewers, Subscribers, and Readers

The Special Issue of **Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)** is a great breakthrough in this COVID-19 Pandemic. Many people, moreover in Indonesia, still not believing that this virus is real. The people are still busy debating whether the COVID-19 is real or just a conspiracy, when there are millions of deaths in this country. That's why the Special Issue (last year and this year) will be so impactful to society. So many information about COVID-19, which the government does not disclose, can be accessed here. Not only can be a new knowledge for myself, but also can be a weapon to shut the ones who are still not believing that this virus is real. I hope we can get through this together. **(Jennie, Jakarta)**

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Evaluating the COVID-19 Pandemic Responses

Dear respected colleagues,

The coronavirus disease 2019 (COVID-19) pandemic has been ongoing for almost two years worldwide, leaving a considerably broad impact on the economic, educational, health, social, and psychological fields. Joint efforts have been made at the international, national, regional, and local levels to limit the spread of COVID-19. These have included public health campaigns, international travel restrictions, and mass screening, all of which have proven effective in reducing the number of active cases. Southeast Asian countries have different strategies for controlling the pandemic by managing trade-offs between the economy and public health. At the start of the pandemic, Malaysia and Thailand implemented strict national lockdowns. Indonesia implemented health protocols[1]; wearing masks, maintaining distance, and washing hands.[2] Nevertheless, Indonesia has now added avoiding crowds and reducing mobility to these precautions.

The policies are always dynamic, from wearing masks, maintaining distance, washing hands, avoiding crowds, and avoiding mobility. The enforcement level of regional restrictions has changed from "*Pembatasan Sosial Berskala Besar (PSBB)*" or Large-Scale Social Restrictions (LSSR)[3] to the enforcement of community activity restrictions "*Pemberlakuan Pembatasan Kegiatan Masyarakat (PPKM)*."[4] Both *PSBB* and *PPKM* are enforced in certain areas and at certain times, and not all areas are subject to the same policy. Even at the provincial level, governors issue particular policies for their regions, including DKI Jakarta, East Java, Bali, and any provinces or subdistricts. Policies have been made, disseminated, and socialized, but people are still not disciplined in implementing them. In some public places, such as traditional markets, the requirement for masks is still not wholly obeyed.

The clinical characteristics of mild and asymptomatic cases were similar, but moderate cases with symptoms of pneumonia were common in this study. Most confirmed asymptomatic, mild, and moderate cases of COVID-19 have recovered. Only a tiny proportion of COVID-19 patients develop severe and progressive disease requiring further hospitalization. However, COVID-19 emergency care for mild/asymptomatic/moderate cases is still necessary to monitor patients for progressive disease and stop community transmission in resource-limited settings.

The characteristics of hospitalized patients have been studied, including clinical symptoms, laboratory test results, chest X-Rays, SARS-CoV-2 immunoserology, and RT-PCR results from nasopharyngeal/oropharyngeal preparations. Some of the deaths from the virus were accompanied by comorbidities, such as diabetes, heart disease, malignant uterine tumor, cancer, asthma, pulmonary TB, cardiomegaly, hypertension, chronic obstructive pulmonary disease (COPD), and renal failure. It is hoped that people, especially those with comorbid conditions, are more alert and careful and remain disciplined in implementing health protocols.

In addition to COVID-19's threat to health, impacts of the pandemic are seen on mental health and sleep quality. The impacts include anxiety, depression, stress, post-traumatic stress disorder, psychological distress, somatization symptoms, suicidal ideation, high risk of severe mental illness, anxiety, and insomnia. A high prevalence of various psychological problems and sleep disorders was reported in most studies, both for medical workers, non-medical workers, and the public. These psychological problems have not been thought about much because the general focus has been on health and the economy, even though these problems are all related to the economy and public health.

The COVID-19 is generally transmitted through droplets and contaminated surfaces and can also be transmitted through aerosols. While the level of transmission through aerosols is still in debate, COVID-19's ability to survive and be transmitted in indoor air must be considered. Thus, administrative controls related to indoor activities are needed during the COVID-19 pandemic.

Climate plays a role in the spread of COVID-19 in Asia. A review found a positive relationship between COVID-19 cases and a region's temperature (mean, minimum, maximum, and ambient), humidity, wind speed, average rainfall, and the number of sunny days. Indoor air must also receive attention, considering that the virus can be present in aerosols and droplets within a room, especially a closed one. Therefore, it is necessary to study how to manage indoor air quality, especially in rooms with air-conditioning, to avoid risk factors leading to COVID-19 transmission.

There is a healthy city concept where exercise is essential, especially outdoor sports. This new urban model encourages increased cycling, running, and walking to reduce pollution and improve physical, psychological, and social fitness. Running has become one of the most popular recreational sports worldwide and is still frequently practiced during this COVID-19 pandemic. Of course, the use of masks is still mandatory. Outdoor physical activity positively affects the parame-

ters of psychological, physiological, biochemical, and social health. However, this activity requires clear rules so that the benefits obtained can be significant while minimizing the risk of transmission of COVID-19 infection. "How physical activity becomes a protective measure or an open window for upper respiratory tract infection (ARI)/COVID-19". A healthy city strategy to manage the COVID-19 pandemic is a challenge and may include planning and action.

Indonesia's current strategic response has not reduced the transmission of COVID-19. The leading causes of this failure include the limited response to case management, LSSR, and the slow development of drugs and vaccines. Case management faces incurable challenges to date, namely inaccurate datasets, a low number of tests, limited contact tracing, high positivity rates, and a high case fatality rate (CFR).

Various government policies made during the COVID-19 pandemic must be analyzed. Also, local governments are responsible for empowering the people who are most at risk of developing COVID-19, including people with disabilities. Implementing COVID-19 prevention policies in social institutions is not easy enough. Some studies recommend a combination of reasonable control with solid law enforcement and the provision of cash transfers and other social assistance programs as a strategy to save lives and livelihoods. These recommendations are considerate of people with disabilities, who so far have received little attention.

Good communication is an important aspect that can reduce the level of panic and infection rates significantly in many developing countries. COVID-19 knowledge, attitudes, and practices were found to vary based on sociodemographic factors. Literacy is also crucial in particular environments, such as workplaces, offshore workplaces, schools, Islamic boarding schools, shopping centers, and public places. Studies show that controlling COVID-19 in Islamic boarding schools requires a leadership commitment to form an internal COVID-19 task force.

Scientists, health professionals, religious leaders, and recovered patients and their families have a role to play in the fight against disinformation; therefore, they must actively address this issue. The literacy provided is about maintaining distance, washing hands, using masks, and other applicable policies and essential information related to COVID-19, such as vaccines, vaccinations, isolation, quarantine, comorbidities, and more. Also, monitoring the vaccination program, including vaccine availability, distribution, local development, and side effects, is necessary to achieve herd immunity.

Strategies to evaluate policies or programs have been implemented, including the creation of Strategic and Operational Responses for Reducing COVID-19 Transmission, which pays attention to outputs, outcomes, and implications. A strengthening strategy aims to evaluate the strategic response for reducing transmission of COVID-19. These responses mainly consist of case management, large-scale social restrictions/*Pembatasan Sosial Berskala Besar* (*PSBB*), micro-scale social restrictions/*Pemberlakuan Pembatasan Kegiatan Masyarakat* (*PPKM*), and drug and vaccine development. The strategic evaluation also needs to address the impact of COVID-19 pancemic on any related diseases such as dengue hemorrhagic fever (DHF).

With the publication of this special edition, we have all contributed to our capacity to respond and fight the COVID-19 pandemic, especially in Indonesia.

Thank you. I hope this special edition can be beneficial for all.

On behalf of the Editors,

Dewi Susanna
Editor in Chief

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Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)

Strengthening the Strategic and Operational Response for Reducing COVID-19 Transmission in Indonesia

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Abstract

Indonesia reported the first two cases of COVID-19 from Depok City, West Java, on March 2, 2020. This study aimed to evaluate the strategic response for reducing the COVID-19 transmission which mainly comprised case management, large-scale social restrictions, including micro-scale social restrictions, and the development of drugs and vaccines. The data were collected from the Indonesian Government's official websites and the latest information from March 2020 to May 2021. A logical framework approach and a theory of change were used to describe, evaluate, and strengthen the strategic response. The current strategic response has not reduce the COVID-19 transmission. As of May 30, 2021, 1,879,730 confirmed cases with 101,639 active cases, 1,663,998 recovered, and 50,404 deaths have been reported from 34 provinces. The case management faced a high positive rate and case fatality. The large-scale social restrictions have not increased public awareness and behavior practice on the prevention and control. Currently, there is no cure, and the vaccination needs more time to complete. Strengthening the current strategic response needs more testing, contact tracing, better quality treatment, community education for behavior change, and effective vaccination.

Keywords: community education for behavior change, COVID-19, strategic response, vaccination

Introduction

Indonesia reported the first two cases of COVID-19 in Depok city, West Java on March 2, 2020.[1] The number of cases has continuously increased, causing high morbidity and mortality from cities and districts. The Government formed Task Forces for COVID-19 Mitigation (Task Force) to support high-level coordination of the national response for the pandemic on March 3, 2020.[2] This Force implemented a primary strategic response for physical distancing through mask-wearing at public places, contact tracing, rapid diagnostic test (RDT) or real-time polymerase chain reaction (PCR). They implemented screening and education for self-isolation with medical care at the general, referral, or emergency hospitals. The Ministry of Health (MoH) provided leadership for health system response and adopted its influenza pandemic contingency plan for the COVID-19 response.[3] The government also declared a regulation on large-scale social restrictions (LSSR)/*Pembatasan Sosial Berskala Besar* (*PSBB*) in response to the pandemic on March 31 which aimed to prevent the spread of the virus. Local governments were allowed to confine the movement of people or goods in and out of their respective localities, closing public places, schools, restricting public transport, and limiting travel to and from the provinces or regions with the approval of the MoH.[4]

The President of Indonesia, Joko Widodo declared the pandemic as a National disaster and adopted LSSR based on the Health Quarantines Law 2018.[5] It was also included as a non-natural disaster by National Disaster Management Office on April 3.[6] In line with the 2020 World Health Organization (WHO) strategic preparation and response plan, Indonesian Government, through the MoH and the National Disaster Management Agency/ *Badan Nasional Penanggulangan Bencana* (BNPB) responded to the fight against COVID-19 pandemic on April 4.[7] The outbreak was categorized as a National non-natural disaster due to its various impacts on humanitarian, public health, education, social, cultural, and economy. A road map with the protocol was issued by the Task Force for accelerating the handling of COVID-19 and the fight against the virus.

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The protocol's goal included saving the lives of the population, provision of basic human needs, reducing the impact on socio-economic, and preventing the spread of the virus. It also provided guides on the role and responsibility of the subnational and local leaders, such as data collection, analysis, information management, coordination with stakeholders, public communication, safety or security, LSSR, and stakeholder participation. The strategic response plan of health operation, education, economy, distribution logistic, monitoring, evaluation, and early diagnostic mechanisms were also included in the protocol.[8]

From August 11 to 14, 2020, the World Health Organization Intra-Action Review of Indonesia's Response to COVID-19 conducted a national review of the strategic and operational response. This was assessed based on the nine pillars of the strategic preparedness and plan to identify areas within the public health response that require remediation and improvement. The participants included various representatives units within the Republic of Indonesia MoH, other Government Departments, WHO, and the United Nations agencies who met virtually to review the progress. The results showed the current strategic response was limited coordination and communication between sectors at the national and subnational. It also had limited monitoring indicators, data, and information management, such as delayed reporting or mismatched data and limited utilization of health facilities.[9] The government, through the Ministry of Internal Affairs, modified the LSRR into micro-scale activities restriction/ *Pemberlakuan Pembatasan Kegiatan Masyarakat* (PPKM) on January 7, 2021, and enforced on January 11, 2021. The measures, which were implemented in 10 provinces of Java and Bali included limiting activities at workplaces, restaurants, or shopping centers, and fully approving essential sectors activities. On March 23, 2021 PPKM was extended to most Indonesia's provinces.[10]

Over the past 14 months, the implementation of the strategic response has not reduced the pandemic transmission. On May 30, 2021, the number of cases increased to 1,879,730 confirmed, 101,639 active, 1,663,998 recovered, and 50,404 deaths.[11] Several studies were reported on the strategic and operational responsibility of reducing the COVID-19 transmission, which includes reviews on community perception, knowledge, awareness, and behavior practice on its prevention and control. Most of these studies showed the response affected public understanding but limited behavior practice on the prevention and control. Most people ignored mask-wearing in public, maintaining social distance in crowded areas, and avoiding overcrowded public places. Moreover, there are few studies based on impact evaluation of the strategic response. Why has the COVID-19 transmission not reduced? What are the causes? How can the current strategic response be strengthened? This study aims to understand the problem, challenges, proposed solutions, and strengthening the current strategic response for reducing virus transmission. However, the usual implementation of this response has not reduced the transmission but worsen it. Strengthening the current strategic response is required to aid in reducing the disease transmission curve and save more lives.

Method

A logical framework approach (LFA) was used to describe the current strategic response, while the theory of change (ToC) evaluate the impact, outcome, and outputs for the basis of its strengthening. Data were obtained from the official websites of Indonesian Governments and the latest information from March 2020 to May 2021. The LFA is an analytical or management tool utilized by most multilateral and bilateral aid agencies, international non-governmental organizations, as well as several partner governments for the development program or projects. It is an effective tool when understood and intelligently applied. It also described the current strategic response, including the goal, objective, outputs, indicators, strategy, activities, and risk of achieving the objectives according to the vertical or horizontal logic.[12] The results provided a basis for the response evaluation.

The ToC is a planning method that works backward through a logic model from a statement of the desired impact that the organization plans to achieve through one or more desired outcomes that need to be achieved before the impact can happen to the outputs that should be planned to reach the desired results. The evaluation objective was to identify the problem, causes, effect, and key success factors for strengthening the response. It is a comparison of the actual results with the desired ones, including the impact, outcome, and output before its implementation.[13] Also, the evaluation results provided the government and its stakeholders, including the community, to continue the fight against COVID-19 and strengthening the current strategic response (Figure 1).

Results

Strategic Response

The overall strategic response was to reduce the pandemic transmission with a target of a reproductive number less than one (RO <1.0) through case management, LSSR, as well as drugs and vaccines development. Case management, which is a medical care approach, helped to reduce morbidity and mortality by reducing positivity and case fatality rate (CFR) with <5% and <3% targets respectively. The main activities included testing, contact

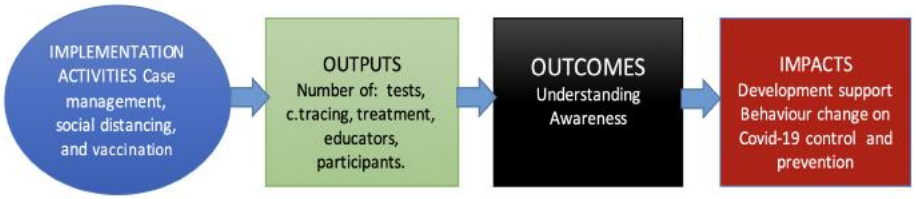

Figure 1. The Logic Model (Source: The North Atlantic Treaty Organization (NATO, 2013)[13]

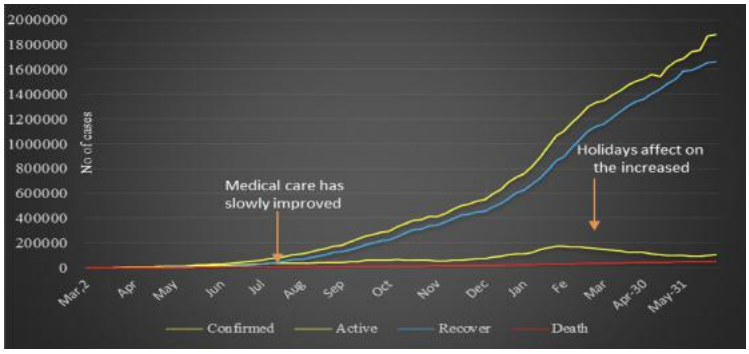

Figure 2. Cases: Confirmed, Active, Recovered, and Deaths March 2, 2020 – May 31, 2021.[11]

tracing, isolation, and treatment. A rapid test (RT) for antibody, and antigen, as well as real-time polymerase chain reaction (RT-PCR) provided epidemiological data. The RT antibody was carried out for contact cases of positive patients and those under supervision in areas with no RT-PCR test. In addition, the results were confirmed by RT-PCR.[14,15]

The LSSR was a prevention approach to reduce the COVID-19 transmission through community mobilization and participation. It was also an estimated target to increase public (>80%) knowledge, attitude, and behavior practice on prevention and control. The MoH guided LSSR by suspending activities at schools, workplaces, religious worship, public facilities, social-cultural, and transportation. The population was encouraged to implement mask-wearing, maintaining a minimum 1-1.5 meters distance from others, and regular hand-washing with soap in running water for 20 seconds, which was applied in all provinces, cities, and districts. The government through the Ministry of Internal Affair, modified LSSR to micro-scale activity restrictions as implemented by Java and Bali provinces on January 11, 2021, and subsequently to others regions.[16]

The development of drugs and vaccines was to strengthen both strategies in reducing COVID-19 transmission. This aims to ensure the utilization of medications for treatment and vaccines in public immunity, targeting their availability for prevention. The government through the MoH and Task Force, partnered with research institutes, private sector, local pharmaceutical companies, and foreign countries developing drugs and vaccines. These include the National Institute of Science, Eijkman Institute for Molecular Biology, PT Bio Farma, National Institute of Health Research and Development, Research Institute of the Universitas Indonesia, Gadjah Mada University, as well as Airlangga University.

Evaluation Strategic Response

Over the past 14 months, the current strategic response had not reduced the transmission. As of May 31, 2021, the number of cases had increased to 1,927,027 confirmed, 102,006 active, 1,669,119 recovered, and 50,578 deaths from 34 provinces. The RO was estimated as >1.0.17 (Figure 2). Assessment of case management, LSSR, drugs, and vaccine development explained several causes of the problem.

The case management aid in the reduction of morbidity and mortality by reducing positivity rates and CFR. Based on the strategic response implementation, a weekly average positivity rate was 18.4%, and range of 12.0-35.5%. A weekly average of CFR was 5%, and a range of 3.1-9.5%. The total active and recovered cases were 7.3%, and 91% respectively in the last week of May 2021. The case management slowly improved in July 2020 but remained a burden on health services at the central and local levels depending on the transmission status. Several government hospitals, such as in Jakarta, West Java, and Central Java Provinces, reported a bed occupancy ratio (BOR) more than 50% in the last week of May 2021. The BOR in COVID-19 referral hospitals was over 50% in the province of North Sumatra, Riau Islands, Riau, South Sumatra, Jambi, and Lampung Provinces. After holidays, including New Year and Eid holidays, most hospital

beds, intensive care unit (ICU) rooms, stock of medicines, and oxygen supplies were needed more for COVID-19 patients.[17,18] The Amnesty International Indonesia reported that Indonesia is among the countries with the highest number of health workers who have lost their lives to COVID-19, with 188 deaths recorded as of September 2020.[19]

The LSSR involved the central and local governments, related stakeholders, as well as social media in community mobilization or participation for reducing the virus transmission. The Task Force reported 24% (range of 15-37%) of public perception on LSSR as the prohibition of exit/entry into the area for a certain period. There was closure of airport and seaports, terminals, train stations, and marketplace. The Median-NGO reported 55% (range 52-60%) in the public discipline, compliance to transportation rules, and temporarily worshiping from home. The Task Force, Central Agency for Statistics, and the Median-NGO also reported that public mask-wearing was 60% when people leave home, 38% had symptoms, and 42% were interested in buying. According to UNICEF, the most preventive behavior was the use of masks (50%) and hand washing (34%). Indonesian Red Cross reported that 48.5% Indonesian thought the COVID-19 was not threatening, and 51.5% thought it was a threat.[20,21] A community survey on knowledge, attitude, and practice (KAP) of the adult population was reported by several research teams. Out of the total 640 samples in Yogyakarta (April 2020), 57.1% had a general knowledge of COVID-19, 44.9% attitude, and 43.2%practiced hand-washing, mask-wearing, social distancing, coughing etiquette, and nose touching.[22] Furthermore, among the 6,249 undergraduate respondents in April-May 2020, 75% have appropriate knowledge of the virus, 80.4% have a positive attitude, and 69.9% practiced health protocol. There was also a significant correlation among knowledge, attitude, and practice on health protocol ($p < 0.000$), with an R-square of 0.04-0.18.[23] A national online survey (August 2020) reported that out of the total 816 sample residents over 18 years, 70% had appropriate knowledge of the disease, 51.3% focused on the symptoms, transmission, and prevention, while 40%had a limitation on the spread.[24] Micro-scale social restriction was extended and implemented in most provinces, covering more than 14,000 COVID-19 posts in 323 districts of 25 provinces.[25]

The development of drugs and vaccines aims to produce medicines for patient treatment. The MoH identified a substantial amount of therapeutics that could hinder the disease, such as remdesivir, favipiravir, oseltamivir, and lopinavir-ritonavir, which were distributed directly to hospitals as an antiviral agent for quick recovery in moderately ill patients with pneumonia.[26] The vaccination program proceeded after the Food and Drug Administration granted emergency authorization to Sinovac and AstraZeneca as well as the Indonesian Islamic Clerical Council approval on January 8, 2021.[27,28] This program targeted a total of 181.5 million people for 15 months. On May 3, 20,422,518 people had received first and second-dose vaccination where 92.3%, 77.6%, and 18.1% of the total health workers, public services, and older people were included respectively.[29] Development of local vaccines *Nusantara, Merah Putih* with testing tool GeNose C-19 are still in the development process (Table 1).

Discussion

Strategic Response

The current strategic response had not reduced the COVID-19 transmission. In May 2021, the average weekly number of the case was 1,786,487 confirmed, 96,399 active, 1,625,201 recovered, with 48,813 deaths. The estimation showed that RO > 1, but there was insufficient data to calculate Rt.[30] Over the past months, the incidence rate varied according to the provinces. However, nationally it has never been below zero. The COVID-19 transmission had not been controlled for several reasons such as case management, LSSR, and the development of drugs or vaccines. Meanwhile, the Oxford COVID-19 Government Response Tracker (OxCGRT), using nine indicators including school or workplace closures, as well as travel bans was scored at the Stringency Policy Index (SPI) scale of 60.2 (range 13.9-72.7), and 68.9 (100, strictest) on May 13, 2021.[31] Strengthening the current strategic response is required.

Evaluation of Strategic Response

Case Management

Testing, which is updated twice a week, is important for the understanding of the virus spread and the appropriate response. On October 7, 2020, the number of people tested daily was 32,167, while the suspected cases were 142,213, with a wide gap between both. Over the past 14 months, the average weekly proportion tests of 0.09 per 100,000 population ranged from 0.01 to 0.16. This gap had continuously existed due to the limited capability of laboratories, personnel, reagents, and cost. The daily average of the test was 100 persons per case, which is less than 1000 recommended by WHO. More testing is required to describe the disease epidemiology. It is also crucial to increase laboratory capacity to ensure the testing of all suspected cases, while the RT antigen could be used to scale up the testing capacity for COVID-19.

The accurate number of tests or contact tracing provided a better quality of epidemiology data and strategic response for reducing the spread. In August 2020, an average number of contact tracing was one suspected case

Table 1. Summary Evaluation of the Strategic Response

Strategy	Goal	Objective	Target	Achieved	Finding and recommendation
Overall strategy	Stop transmission	Reduced morbidity Reduced mortality	RO<1	RO>1	Transmission had not reduced Strengthen the strategic response
Case management Testing, tracing, isolation, treatment	Contributed reduced morbidity, mortality	Reduced positivity rate, Reduced CFR	<5% <3%	36.1% Feb 2021 25.3% Feb 2021	Limited testing, tracing, surveillance self-isolation, and treatment, strengthen the case management
LSSR/PSBB SSSR/PPKM	Behavior change	Public awareness and behavior practice	Most public	Low KAP: K59%, A67.9%, P64.2%	Massive information, lack of education Conduct health education campaign
Develop drugs and vaccine, Local vaccine	Reduced mortality Public immunity	Drugs available Most vaccinated Increase coverage	Use 181,5 M/15mo More coverage	No medicines for the cure, Low coverage Incomplete research	Limited treatment, Low coverage vaccination, Need BPOM Emergency Use Authorization

traced by three persons, which was less than the 10-30 recommended by WHO.[32] With one of the reasons being the limited number of trained frontline health workers from the community health or sub-health centers, village cadres, and volunteers. Also, the low number of testing and limited contact tracing indicated insufficient information on the epidemiological status of COVID-19 as well as the difficulty to decide on the control and prevention of the transmission. More testing and contact tracing should be resolved to provide a better strategic decision for reducing the transmission.

Positivity rate and CFR indicated the transmission status. According to the reported cases from the first week of 2020 to the third week of May 2021, a weekly average positivity rate was 15.0% (range 9.0 – 28.8%), with a high rate reported in Java-Bali, including DKI Jakarta, Central, and East Java, as well as outside the region such as North Sumatra, East Kalimantan, and Riau. The positivity rate increased during the holiday seasons of Ramadan, Muslims Eid, and New Year. On May 15, it was 13.3% higher than the WHO recommended < 5%. The case management was yet to control the pandemic spread. In fact, over the past 14 months, the weekly average of CFR was 4.2%, with a range of 2.7-8.2%, compared to the WHO of <3% for three weeks which indicated that the COVID-19 was under control.[33] It also declined from 2.98% (last week of December 2020) to 2.7% (last week of March 2021) and increased to 2.76% in the second week of May 2021. The CFR was higher compared to the global value of 2.3%. Although there was an increase in the recovered cases, COVID-19 remained a burden of the government resources. Most of the reported confirmed cases and deaths based on antigen RT and PCR were included in the test. It was difficult to meet the 90% surveillance criteria of suspected cases that were isolated and confirmed within 48 hours of symptom onset. At least 80% of new confirmed cases had their close contacts traced and quarantined within 72 hours of confirmation. There was no benchmark for the number of close contacts that needed to be traced per confirmed case as it depends on how quickly they were isolated to minimize contact with others.

Over the past year, there had been limited health care supplies at the national, province, cities, and district levels, with shortages in laboratory reagents or supplies, personal protective equipment (PPE), as well as critical medications for treatment. Consequently, more frontline health workers were at infection risk due to a lack of protection, which is a significant burden of health services facilities. Since the beginning of the reported cases on March 2, 2020, the Indonesian Medical Association had reported that at least 647 health workers died due to the virus, including 289 doctors, 221 nurses, 84 midwives, 27 dentists, 15 medical laboratory personnel, and 11 pharmacists. It was also estimated that 92 of the workers died per 100,000 cases, the highest in Asia and the fourth-highest fatality rate for health practitioners after Mexico, Egypt, and UK.[34] Medical care services for non-communicable diseases such as cancer, diabetes, and children immunization were disrupted due to COVID-19 priority. Hence, protecting all frontline health workers is required to avoid more deaths.

The Large-Scale Social Restriction

Implementation of LSSR has successfully mobilized media, with various general information being provided daily on the virus, testing, tracing, transmission, prevention, and vaccination. Several acronyms had been introduced, such as 3M, 5M, 3T, PHBS, Food, and Nutrition. The media also provided information integrated into various purposes of communication, education, and advertisement. The news may be dominated by inaccurate information or advertisement, therefore, resulting in confusion and panic.

Disinformation and ignoring scientific beliefs have circulated the public and affected the government's ability to address the pandemic. During the COVID-19 period, the public needed access to information and recommendations from trusted sources like health professionals, scientific experts, experienced patient, and their fam-

ilies. Conversely, they did not receive what they wanted. Besides the information on mask-wearing, hand-washing, or social distancing, they also needed a correct and accurate explanation of the what, why, and how the virus is transmitted. The public has a different level of education, social status, risks, or vulnerability and also need different messages, communication channel, specific information, as well as education on the primary context of the pandemic causes, treatment, and prevention. It is therefore pertinent that information only is not enough to change behavior practice, but also education, value, attitude, and motivation.

The National Family Planning Board partnered with Population Communication Services (PCS). John Hopkins School of Public Health had successfully increased awareness, attitude, and behavior practice on declining population fertility from TFR 5.6 to 2.6 children per woman (1970-1995).[35,36] Learning from their lessons is required. Based on the introduction of the various acronym, the MoH, through the Directorate General for Communicable Disease Control and Environmental Health with the public have used more than 50 years for the abbreviation of cleaning, covering, and burying *(menguras, menutup, dan mengubur, (3M)* as an integrated tool of source reduction for dengue fever/dengue hemorrhagic fever (DF/DHF).[37] Introducing 3M for COVID-19 prevention and control tool, particularly for those living in an endemic DF/DHF, confused the public. Moreover, the additional acronym of 5M may affect more difficult-to-understand limited reading literacy. Although, there was no logical explanation for this except information. Therefore, the introduction of an acronym related to prevention and control should be carefully discussed with the MoH.

Providing only general information is not enough to increase public awareness or behavior practice on COVID-19 prevention and control. The public needs to involve education, attitude change, and motivation. This education includes providing tangible information, personalized messages (unique message for each audience), and interaction with the audience. The information should also be communicated with a great cause, target a specific audience, and interact. Meanwhile, the attitude should be changed through personal value, whether it provides physical, mental, or financial benefits. Furthermore, changing behavior should set expectations and values in learning, sources, and cost. The motivation is a social norm where the audience increases community awareness and behavior practice on health protocols to reduce the number of cases and deaths. Finally, the behavior practice should be based on the usual community norms of the people.[38] The government and their stakeholders, therefore, need to provide information and include behavior change through public education, value, and attitudes to reduce the COVID-19 transmission.

The Development of Drugs and Vaccines

To date, there has been no cure for COVID-19. The Food and Drug Administration (FDA US) had granted emergency with authorization to some treatments, including remdesivir, but may provide a modest benefit to patients. Their effectiveness against the virus has not been demonstrated on large-scale, and randomized clinical trials. Also, scientists are currently studying a wide range of other potential treatments, but most are still in the early stages of research. Remdesivir is used in critically ill patients who need oxygen supplementation. It blocks the virus's ability to replicate its genetic material. Meanwhile, Oseltamivir is an antiviral neuraminidase inhibitor used for the treatment and prophylaxis of influenza viruses infection. Recently, Lopinavir and ritonavir are combined to treat HIV, and some studies have tried to stop coronavirus from replicating new cells using Hydroxychloroquine and chloroquine. Convalescent plasma from the blood of recovered flu patients and rich in antibodies, helped the patients fight their illness.[39]

As the Food and Drug Administration *(Badan Pengawas Obat dan Makanan*/BPOM) granted the emergency authorization to use Sinovac, Sinopharm, and AstraZeneca vaccines with approval from the Indonesian Islamic Clerical Council (*Majelis Ulama Indonesia*/MUI), sub-sequently, the MoH began mass vaccination targeting a total of 181.5 million people (65.7%) in 34 provinces for 15 months. The first vaccination included 1.3 million health workers and 17.4 million public officials from January-April 2021. The remaining was scheduled for 11 months, from April to March 2022. At the end of April 2021, a total of 12.5 million people had completed Sinovac and AstraZeneca vaccination. On April 30, it was reported that 13 million people had been vaccinated in the provinces. Although there were no significant reported side effects, monitoring of vaccine distribution and side effects should be conducted to guarantee the safe completion of the vaccination program. Development of local drugs in treatment, GeNose C19 for testing, *Nusantara and Merah Putih* vaccines should subsequently meet the general scientific principle with the outcome receiving the BPOM emergency use authorization.[40] In addition, approval for the use should be obtained from the MUI.

Conclusion

The current strategic response for COVID-19 in Indonesia has not reduced its transmission. The main causes include limited response for case management, LSSR, with the development of drugs and vaccines, strengthening is required. The case manage-ment faced challenges of incurability to date, inaccuracy data set, low testing number, limited contact tracing, high

positivity rate, and CFR. Resolving the critical supply and drug shortages for cases treatment increased the availability and accessibility of RDT or PCR testing, contact tracing, and health services accessibility, quality, or inequality to reduce positivity rate and CFR. The large-scale social restriction, including the micro-scale social restriction has been implemented by most provinces, cities, and districts partnered with various media. However, most people have not changed their behavior practices on the COVID-19 control and prevention. Providing only general information is not enough for behavior change but community education is also required to give tangible, specific, or unique information for benefit value.

Scientists, health professionals, religious leaders, recovered patients, and their families have a role in combating disinformation, hence, they should actively address the issues. Also, monitoring vaccination programs, including the availability of vaccines, distribution, development of local ones, and the side effect, is required to achieve herd immunity. With the completion of the vaccination program, people are still required to wear masks and maintain social distance. The current national standards based on scientific knowledge of the virus, its spread, possible mutations, treatment, and prevention, research, and development, should be implemented to guide strategic and operational decisions.

Abbreviations

BNPB: Badan Nasional Penanganan Bencana/National Disaster Management Office; BOR: Bed Occupancy Ratio; BPOM: Badan Pengawas Obat dan Makanan/Food and Drug Administration; CFR: Case Fatality Rate; COVID-19: coronavirus disease 2019; HIV: Human Immunodeficiency Virus; ICU: Intensive Care Unit; KAP: knowledge, attitude, practice; LFA: logical framework approach; LSSR/PSBB: large-scale social restrictions; 3M: mask-wearing, hand washing, maintaining social distance; 5M: 3M+avoid overcrowd, and reduce mobility; MoH: Ministry of Health; MUI: Majelis Ulama Indonesia/Indonesian Islamic Clerical Council; NGO: Non-governmental organization; OxCGRT: Oxford COVID-19 Government Response Tracker; PCR: Polymerase chain reaction; PHBS: Perilaku Hidup Bersih dan Sehat/Clean and healthy living behavior; MSSR/PPKM: Micro-scale social restrictions; R&D: Research and Development; RDT: Rapid diagnostic test; RO: Reproductive number; Rt: Effective RO; 3T: Testing, Contact Tracing, Treatment; Task Force: Task Force for COVID-19 Mitigation; TFR: Total fertility rate; ToC: Theory of change; WHO: World Health Organization.

Ethics Approval and Consent to Participate

Not applicable.

Competing Interest

The authors have no conflict of interest.

Availability of Data and Materials

The datasets used and analyzed during the current study are available from the official government document and the internet.

Authors' Contribution

SS contributed to the designing, conducting, as well as the writing of the article and also assisted with the data collection, review, and described the strategic response. BS contributed to analysis data interpretation. WL contributed to the designing and oversight of the report, while HH assisted with the overall review of the data.

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Epidemiological and Clinical Features of COVID-19 Patients at National Emergency Hospital Wisma Atlet Kemayoran, Jakarta, Indonesia

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Abstract

The emergency hospital is intended to prevent transmission of COVID-19 in the community by isolating patients without symptoms, with mild or moderate symptoms. This study evaluated the clinical characteristics and outcomes of COVID-19 patients who were admitted to this facility. This retrospective study reviewed data of patients treated at the National Emergency Hospital Wisma Atlet Kemayoran in Jakarta, Indonesia, from March 23 to April 30, 2020. Patient characteristics (clinical symptoms, laboratory test results, Chest X-Ray, SARS-CoV-2 immunoserology, and RT-PCR results from nasopharyngeal/oropharyngeal preparations) were compared between severity groups. There were 413 COVID-19 cases analyzed, of which 190 (46%) were asymptomatic, 93 (22.5%) were mild, and 130 (31.5%) were moderate cases. Most asymptomatic cases were male, with young age, and without comorbidity. Mild cases were dominated by female and young patients, while most moderate cases were male and older patients. The number of patients with comorbidities was higher in mild and mod-erate cases. The patient's overall outcome was good and did not differ based on the severity of symptoms. Despite the many challenges, patients with moderate symptoms can be safely treated in the emergency hospital.

Keywords: asymptomatic, COVID-19, emergency hospital

Introduction

By the time the World Health Organization (WHO) declared a pandemic of COVID-19 in early March 2020, the disease had already reached many countries worldwide, including Indonesia. Indonesia is a middle-income country with per capita health expenditure among the lowest in the category.[1] The COVID-19 pandemic has been expected to hit low- and middle-income countries (LMICs) the hardest. The low socioeconomic status of the population, as characterized by overcrowded living conditions, limited access to daily basic needs (e.g., food, clean water), and reliance on daily earnings, makes physical distancing and lockdown almost impossible. Furthermore, the care of COVID-19 patients is challenging as the already limited health care capacities become quickly overwhelmed.

Confirmed COVID-19 was first reported in Indonesia on March 2, 2020;[2] since then, Jakarta became the first and ongoing epicenter. The number of positive cases had risen dramatically to more than 250,000 by the time this manuscript was prepared, and 9,800 deaths were recorded, the highest in Southeast Asia.[3] During the early phase of the pandemic, Indonesia faced a challenging situation, including lack of personal protective equipment (PPE), medical supplies and diagnostic tools, unequal medical services distribution, and no standardized national guidelines.[4,5] This situation was complicated by inadequate/inconsistent public information from the government. One of the recommendations for handling the COVID-19 pandemic in a resource-limited setting is shifting public facilities into emergency hospitals. The Indonesian Government adopted this strategy by converting four apartment towers of Wisma Atlet Kemayoran in Jakarta into an emergency hospital to anticipate the surge of new cases in Jakarta. Wisma Atlet Kemayoran has a total of 24,000 beds at maximum capacity.[6] These facilities were intended to isolate asymptomatic, mild, and moderate cases to stop community transmission. Routine monitoring was undertaken on each case, with those identified with worsening conditions to be transferred to referral hospitals.[7] The emergency hospitals in Wuhan, China (such as Huoshenshan Hospital and Leishenshan Hospital) proved to approach disease containment successfully.[8] The characteristics of patients in this kind of emergency hospital in LMICs settings are still largely unknown, especially during the early phase of the pandemic.

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In this study, the clinical characteristics, therapies, and outcomes of COVID-19 patients treated in the emergency hospital were evaluated.

Method

Study Design and Population

This retrospective study used data from all confirmed COVID-19 patients admitted to the National Emergency Hospital Wisma Atlet Kemayoran, Jakarta, from March 23 to April 30, 2020. Patients were diagnosed according to the criteria of World Health Organization (WHO) interim guidance. Patients with complete data of clinical, radiological, basic laboratory results were included in the analysis. The laboratory-confirmed case was defined as a case with a positive result on real-time reverse transcription polymerase chain reaction (RT-PCR) for SARS-CoV-2 in either the nasal or pharyngeal swab specimens irrespective of the clinical signs and symptoms.

Data Collection

Data of all patients during the study period were extracted from the paper-based medical records into an electronic database. Age was recorded as continuous data but classified into three groups; 0-19 years, 20-49 years, and older than 50 years. Data related to signs and symptoms and the presence of comorbidity were recorded at admissions. The recorded symptoms were cough, sputum production, fever, dyspnea, sore throat, cold/runny nose, and anosmia. Comorbidities such as hypertension, diabetes, heart disease, asthma, and arthritis were recorded based on anamnesis. The peripheral blood test was taken at admission and measured hemoglobin, lymphocyte, white blood cell differential count, and platelets. Serological tests for detecting IgG and IgM antibodies against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) were performed using commercially available immunochromatographic test (ICT) method with reactivity reported as IgG, IgM, or both. Chest X-Ray (CXR) was used as a simple imaging study for all new cases during admission in this facility and reported as normal, increased broncho vascular markings, and consistent pneumonia. Real-time reverse transcription polymerase chain reaction (RT-PCR) for SARS-CoV-2 detection conducted from nasal or pharyngeal swab specimens in the central laboratory based on standard WHO protocol. The RT-PCR tests were measured on day one or day two, day 14, and day 15 as the end date of the isolation period.

Cases were classified into three different clinical classifications, i.e., asymptomatic, mild, and moderate, based on symptoms, laboratory, and radiological findings. An asymptomatic case is defined as no symptoms with normal laboratory and CXR findings despite a positive SARS-CoV-2 RT-PCR test. A mild case is a positive SARS-CoV-2 RT-PCR with acute non-specific upper respiratory tract symptoms but no sign of pneumonia. A moderate case is defined as positive SARS-CoV-2 RT-PCR with clinical findings consistent with mild pneumonia but where the patient does not require hospitalization/is still able to perform daily activities. This clinical COVID-19 classification was under the direction of the Ministry of Health of the Republic of Indonesia COVID-19 guidelines in March 2020.[9] Since the nationally endorsed guidelines were not established at that time, clinical management of COVID-19 during the early phase of the pandemic in Indonesia was based on the consensus of five local professional organizations (5-OP/*5 Organisasi Profesi*), i.e., Indonesian Society of Respirology, Indonesian Society of Internal Medicine, Indonesian Heart Association, Indonesian Society of Anesthesiologists and Intensive Therapy, and Indonesian Pediatric Society.[10] Data regarding medication and clinical outcomes during hospitalization were recorded.

Outcome Measures

The first day of admission was recorded as the start of hospitalization, while discharge from the hospital was recorded as the end of hospitalization. Clinical outcomes were classified into whether recovery was reached or not. Recovered cases were defined as two consecutive negative SARS-CoV-2 RT-PCR results based on WHO guidelines. Furthermore, the conversion time–duration in days until RT-PCR result turned negative–and length of stay–duration of hospitalization in days–were also evaluated. The cases were followed up until April 30, 2020.

Data Analysis

Patients' demographic information and clinical characteristics were tabulated based on clinical classification of the disease for descriptive purposes. Differences between asymptomatic, mild, and moderate cases of COVID-19 were evaluated and tested either using one-way ANOVA or Kruskal-Wallis for continuous variables and either using Pearson's Chi-square or Fisher's exact test for categorical variables, where appropriate. Statistical significance was considered to be a two-sided p-value <0.05. All analyses were performed using SPSS Version 25.0 for Mac (SPSS Inc., Chicago, IL, USA).

Result

Presenting Characteristics

There were 1,070 cases admitted early in the pandemic, with 828 cases classified as COVID-19 confirmed cases and 415 discarded COVID-19 based on WHO case definition. Of the total confirmed cases, 382 cases had no CXR, 17 cases with no lab test, and 16 cases had no clinical baseline data. Four hundred thirteen cases were included in the analysis with a complete data set, with 55.4% (229) male and 44.6% (184) female. The mean age was 39.9 years old, with the majority belonging to the productive-age group (20-49 age range). Older cases

(>50 years) were more likely to be classified as moderate cases as compared to the younger groups. In general, the most common symptoms reported at onset were cough, followed by fever, dyspnea, sore throat, runny nose, and anosmia. Both in mild and moderate cases, the most common symptoms found were cough, fever, and dyspnea. The 10% of cases had pre-existing comorbidities, of which hypertension and diabetes were the commonest. Those without comorbidity were more likely to be in the asymptomatic group, as seen in Table 1.

Laboratory and Radiologic Findings

Abnormal laboratory findings such as reactive rapid serology test increased NLR, and lymphopenia was commonly reported. Other notable laboratory findings were thrombocytopenia and leucopenia. However, these laboratory findings did not differ based on clinical classification, as seen in Table 2. The normal radiologic finding was found in nearly half of all initial Chest X-Ray examinations, and all moderate cases had CXR consistent with pneumonia. Increased broncho vascular markings were found more frequently in mild cases than asymptomatic cases.

Table 1. Clinical Characteristics of COVID-19 Patients Admitted to National Emergency Hospital Wisma Atlet Kemayoran

Characteristics	Total (n=413)	Clinical degree			p-value
		Asymptomatic (n=190)	Mild (n=93)	Moderate (n=130)	
Sex					0.03[1]
Male	229 (55.4)	103 (54.2)	43 (46.2)	83 (63.8)	
Female	184 (44.6)	87 (45.8)	50 (53.8)	47 (36.2)	
Age (in years)	39.9 (14.2)[2]	38.3 (14.7)	37.1 (11.5)	44.3 (14.1)	<0.001[3]
Age					<0.001[1]
0-19 years	30 (7.3)	20 (10.5)	4 (4.3)	6 (4.6)	
20-49 years	267 (64.6)	122 (64.2)	75 (80.6)	70 (53.8)	
>50 years	116 (28.1)	48 (25.3)	14 (15.1)	54 (41.5)	
Symptoms					
Cough	93 (22.5)	0 (0.0)	61 (65.6)	32 (24.6)	<0.001[4]
Sputum production	15 (3.6)	0 (0.0)	13 (14.0)	2 (1.5)	<0.001[4]
Fever	59 (14.3)	0 (0.0)	39 (41.9)	20 (15.4)	<0.001[4]
Dyspnea	27 (6.5)	0 (0.0)	14 (15.1)	13 (10.0)	<0.001[4]
Sore throat	22 (5.3)	0 (0.0)	15 (16.1)	7 (5.4)	<0.001[4]
Cold/runny nose	20 (4.8)	0 (0.0)	10 (10.8)	10 (7.7)	<0.001[4]
Anosmia	6 (1.5)	0 (0.0)	5 (5.4)	1 (0.8)	0.002[4]
Pre-existing comorbidity					<0.001[1]
Yes	43 (10.4)	7 (3.7)	18 (19.4)	18 (13.8)	
No	370 (89.6)	183 (96.3)	75 (80.6)	112 (86.2)	
Comorbidities					<0.001[1]
None	370 (89.6)	183 (96.3)	75 (80.6)	112 (86.2)	
Hypertension	17 (4.1)	1 (0.5)	7 (7.5)	9 (6.9)	
Diabetes and Hypertension	4 (1.0)	2 (1.1)	0 (0.0)	2 (1.5)	
Diabetes	8 (1.9)	3 (1.6)	1 (1.1)	4 (3.1)	
Heart disease	3 (0.7)	0 (0.0)	2 (2.2)	1 (0.8)	
Asthma	2 (0.5)	0 (0.0)	2 (2.2)	0 (0.0)	
Arthritis	1 (0.2)	0 (0.0)	1 (1.1)	0 (0.0)	

Notes: Values are means with standard deviations for continuous variables and n (%) for frequencies. [1]Pearson Chi-square, [2]The median with the interquartile range is presented, [3]ANOVA, [4]Fisher's Exact Test

Intervention and Outcome

Among 413 cases, data related to therapy were available in only 108 cases. All cases received vitamin C, 5.6% of them also received Azithromycin, 10.2 % Oseltamivir and Azithromycin, 4.6% Oseltamivir and Hydrochloroquine, 7.4% Oseltamivir and Chloroquine, 28.7% Oseltamivir with Hydrochloroquine and Azithromycin, 10.2% Oseltamivir with Chloroquine and Azithromycin, and 3.7% a combination of Chloroquine with Azithromycin and Levofloxacin. No adverse effects were reported in the majority of the cases (83.1%). Almost all patients recovered, and the median length of stay at the facility was 24 days. Conversion time varied between patients, with around half of them converted in less than 14 days and the other half in more than 14 days. Clinical classification did not seem to correlate with conversion time and length of stay (Table 3).

Table 2. Laboratory and Radiologic Findings of COVID-19 Patients Admitted to National Emergency Hospital Wisma Atlet Kemayoran

Characteristics	Total (n=413)	Clinical degree			p-value
		Asymptomatic (n=190)	Mild (n=93)	Moderate (n=130)	
Thrombocytopenia (<150000/uL)	7 (1.7)	2 (1.1)	1 (1.1)	4 (3.1)	0.39[1]
Leucopenia (<4000/uL)	2 (0.5)	1 (0.5)	0 (0.0)	1 (1.1)	0.50[1]
Lymphopenia (<20%)	45 (10.9)	17 (8.9)	9 (9.70	19 (14.6)	0.25[2]
Increased NLR (>3.13)	76 (18.4)	31 (16.3)	15 (16.1)	30 (23.1)	0.25[2]
Reactive rapid serology test	202 (48.9)	89 (46.8)	44 (47.3)	69 (53.1)	0.78[2]
Chest X-ray					<0.001[1]
Consistent with Pneumonia	130 (31.5)	0 (0.0)	0 (0.0)	130 (100)	
Increased *broncho vascular* markings	110 (26.6)	71 (37.4)	39 (41.9)	0	
Normal	173 (41.9)	119 (62.6)	54 (58.1)	0	

Notes: Values are n (%) for frequencies, [1]Fisher's Exact Test, [2]Pearson Chi-square

Table 3. Clinical Outcomes of COVID-19 Patients Admitted to National Emergency Hospital Wisma Atlet Kemayoran

Characteristics	Total (n=413)	Clinical degree			p-value
		Asymptomatic (n=190)	Mild (n=93)	Moderate (n=130)	
Outcome					0.14[1]
Recovered	410 (99.3)	190 (100)	91 (97.8)	129 (99.2)	
Referred	1 (0.2)	0 (0.0)	1 (1.1)	0 (0.0)	
Discharged by patient's request	2 (0.5)	0 (0.0)	1 (1.1)	1 (0.8)	
Conversion Time					
Less than 14 days	196 (47.5)	80 (42.1)	48 (51.6)	68 (52.3)	0.13[2]
14 days or more	217 (52.5)	110 (57.9)	45 (48.4)	62 (47.7)	
Length of stay (in days)	24 (15)4	25 (16)	22 (16)	24 (11)	0.20[3]

Notes: Values are n (%) for frequencies, [1]Fisher's Exact Test, [2]Pearson Chi-Square, [3]Kruskal Wallis Test, [4]The median with the interquartile range is presented.

Discussion

Confirmed COVID-19 Case Proportion

There were 828 confirmed cases of COVID-19 from a total of 1070 suspected cases admitted to the national emergency hospital during the early phase of the pandemic. A confirmed case is based on the WHO COVID case definition, of which positive SARS-CoV-2 RT-PCR must be detected from nasopharyngeal/oropharyngeal swab.[11] The number of cases not included in the analysis was 415 cases due to incomplete data collection. During the early phase of the pandemic in this emergency hospital, the data management of all patients was based mainly on manual/paper-based records since the paperless system was still in preparation and most health care providers were volunteers.

Additionally, 413 with a complete data set were analyzed. Clinical classification presenting in this study mainly was asymptomatic cases (46%), followed by moderate and mild cases, respectively. The high proportion of asymptomatic COVID-19 confirmed cases might be due to the nature of this national facility that intended to take care of asymptomatic, mild, and moderate cases. A study by Young *et al.*, Michelen *et al.*, Zhao *et al.* conducted in general hospitals in each country showed about 60-80% of cases reported asymptomatic to the mild clinical condition.[11–13] Another study in an emergency hospital setting showed a different clinical condition proportion in which asymptomatic cases were less than 10%.[11,13]

General Characteristic of the Confirmed Case

Confirmed case prevalence in males was about 1.24 times higher than in females in this study. This result was consistent with two other previous studies that showed higher prevalence in the male population.[12,14] Almost 92% of the cases were younger than 60 years old with a mean age of 39,94±14,17 years old. This characteristic was slightly different from what Ma *et al.* reported in their studies where the median age of 49.8 years old.[14] In that study, severe cases were also included. Age as a predicting factor of COVID-19 severity was also reported (≥ 50 years old).[14] This was consistent with the fact that younger people have more robust immune responses and tend to have a milder infection compared to their elder counterparts.[15] Therefore, is it likely that most asymptomatic covid confirmed cases were relatively younger.[12,14,16] This study presented that almost 90%of the cases had no known comorbidity. Of those with comorbidities, hypertension and diabetes mellitus were the commonest. This characteristic is in line with a sys-tematic review by Ma *et al.* that showed cerebrovascular disease, hypertension, and diabetes mellitus were the most prevalent comorbidities in COVID-19 with proportions of 6.75%, 4.48%, 4.43% consecutively.[14]

Clinical, Imaging, and Laboratory Characteristics of Confirmed Cases

In this study, the most common symptoms were cough and fever in almost 22.5% and 14.3% of cases, respectively, followed by dyspnea, sore throat, and cold, in order. Noor *et al.* reported that nearly 80% of the cases showed respiratory symptoms, with the most prevalent cough and fever symptoms.[17] Another systematic review reported gastrointestinal and neurologic symptoms following respiratory symptoms.[14] The differences between studies might be affected by country demography, population subjectivity, and subject honesty in each study setting. This study did not record other gastrointestinal and neurological symptoms because it was based on early manual medical records limited to basic main symptoms.

Chest X-Ray findings showed that about 40% of cases had a normal description, and 30% were consistent with pneumonia in all moderate cases. A study by Ma *et al.* reported 33% of abnormal imaging findings in infiltrate and crepitation based on CT scan.[14] High-resolution CT scan of the chest was not possible in these facilities. Therefore CXR was conducted as a simple and affordable imaging modality. This study showed that CXR could be used as a baseline imaging in resource-limited settings. It was found that the reactive result of rapid serology test only in 50% of confirmed cases. This finding then led to differences in previous studies results reporting rapid serology test sensitivity, about 62.2%-83.8% for asymptomatic and symptomatic cases.[18,19] Differences between results might be affected by the examination method as well as the sensitivity and specificity of the examination tools in each study.

Routine laboratory tests in this study were mainly within normal limits. About 20% of cases with abnormal findings included lymphopenia, leucopenia, and thrombocytopenia. This finding was in line with other studies.[11,12,14,20] Interestingly, an NLR value of more than 3.13 was also found in asymptomatic and mild clinical degree cases. Contrary to recent study findings, which reported that NLR value >3.13 could be used as a reliable indicator of severe COVID-19.[21] The different results found might be related to the variability of country demography, clinical degree, and/or individual systemic immune response used in each study.

This study found no significant relationship between clinical condition and laboratory findings mentioned previously. A previous systematic review reported thrombocytopenia, lymphopenia, and elevated d-dimer as negative prognostic factors.[13] However, this study could not conclude since most cases were asymptomatic and mild. Lymphopenia and increased NLR appeared higher in the moderate cases than the asymptomatic and mild cases, although not statistically significant. Another study also reported lymphopenia (8.1%) and thrombocytopenia (2.7%) in asymptomatic cases.[18] What might be inter-

esting is that the proportion of lymphopenia and thrombocytopenia in asymptomatic case reporting was 37.8% and 28.6%, respectively, higher than previously reported. Innate and adaptive immunity in this study population might differ in response to SARS-CoV-2, especially in asymptomatic and mild cases. Further study is needed to delineate this assumption.

Outcomes

Ninety-nine percent of cases in this study were recovered based on negative SARS-CoV-2 RT-PCR testing. Of note, 100% of asymptomatic cases recovered, only 1.1% (1) mild case was referred to the referral hospital due to worsening condition, and 0.5% (2 patients) were discharged by request. None of the moderate cases became progressed even though they had evidence of pneumonia based on CXR and were given standard therapy. Since there is no solid evidence for COVID definitive treatment, standard therapy might be still be needed and might play a role in COVID-19 recovery, especially in asymptomatic, mild, and moderate cases.

This is different from the results of the study by Tian *et al.*, where 45 (17.2%) patients were discharged or recovered, 214 (81.7%) stayed in the hospital, and three patients died.[16] Zhao *et al.* stated that out of 77 patients, 64 patients were discharged, recovered, eight remained in treatment, and five died. Five patients died, and three of them were confirmed positive to COVID-19.[11] The difference in the outcome of treatment in this study compared to other studies might be due to the emergency hospital function of treating asymptomatic, mild, and moderate patients.

The mean length of stay in this study was 24 days and was similar across asymptomatic, mild, or moderate cases. Conversion time among groups was also similar, with 52.3% cases virologically converted after 14 days. It was because, during the early phase of the pandemic, only one central laboratory was able to run SARS-CoV-2 RT-PCR tests and needed 5-7 working days to acquire the results. Young *et al.* found that from 18 subjects with confirmed COVID-19 in Singapore, there was a prolonged duration of conversion to 24 days after symptoms onset.[12] Zhou *et al.* obtained a median duration of viral retention of 20 (17-24) days from the onset in surviving patients and a maximum of 37 days.[21]

This study is among the first to have reported patients' clinical characteristics and outcomes with COVID-19 treated at the emergency hospital in Indonesia. However, this study's limitations were that patients with incomplete data could not be included in the analysis. CXR data was missing in more than 40% of all COVID-19 patients in our hospital during the study period. This may cause the selection of study subjects, although we believe that this missingness was random and did not influence the validity of our findings.

Conclusion

Clinical characteristics of mild and asymptomatic cases were similar, but moderate cases with signs of pneumonia are commonly found in this study. Asymptomatic, mild, and moderate COVID-19 confirmed cases mainly were recovered. Only a small proportion developed a severe and progressive disease that needs further hospitalization. In emergency COVID care for mild/asymptomatic/moderate cases, it was still necessary to monitor the patients for progressive disease and stop community transmission in resource-limited settings. Even a moderate clinical condition with signs of pneumonia could be treated/monitored safely in an emergency hospital despite many challenges. Further studies should be directed towards improving the quality of care and optimizing the role of the emergency hospital during the pandemic.

Abbreviations

WHO: World Health Organization; LMICs: low- and middle-income countries; 5-OP: 5 organisasi profesi; ANOVA: analysis of variance; COVID-19: coronavirus disease 2019; CT: computed tomography; CXR: Chest X-Rays; NLR: neutrophil to lymphocyte ratio; ICT: immunochromatographic test; LMIC: low- and middle-income countries; PPE: personal protective equipment; RT-PCR: reverse transcription polymerase chain reaction; SARS-CoV-2: severe acute respiratory syndrome coronavirus 2.

Ethics Approval and Consent to Participate

This study was approved by The Ethics Committee of the Faculty of Medicine Universitas Indonesia (No. KET-636/UN2.F1/ETIK/PPM.00.02/2020).

Competing Interest

The authors reported no potential competing interests.

Availability of Data and Materials

The datasets generated and analyzed during the current study may be available from the corresponding author on reasonable request.

Authors' Contribution

ADS, AR, and BP, were responsible for the study concept and design. ARA, SP, BDH, and TR contributed to data collection. AIS, ES, and HA performed data analysis and interpretation. JZ and HB prepared the first draft of the manuscript. BH, AN, and EB provided scientific input and revision of the manuscript. All authors critically reviewed and approved the final version of the manuscript.

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Epidemiological Patterns and Spatial Distribution of COVID-19 Cases in DKI Jakarta (March–December 2020)

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Abstract

Severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2) is the causative agent of COVID-19 that began in Wuhan, Hubei Province, China. In Indonesia, the first two cases were reported on March 2, 2020; the first major response to block transmission of the virus was the declaration of large-scale social restrictions (LSSR) or *Pembatasan Sosial Berskala Besar* (*PSBB)*. This study aimed to identify the epidemiology patterns and spatial distribution of the COVID-19 pandemic in five municipalities of DKI Jakarta. The research design comprised an ecological and case-series study uncovering the epidemiological trends and distribution of COVID-19 in DKI Jakarta based on secondary surveillance data. The results from the data analyzed between March-December 2020 showed an increasing epidemiological trend due to COVID-19, and Central Jakarta was the municipality most affected due to pandemic during this period. The implementation of the first *PSBB* in DKI Jakarta reduced the average number of daily cases during the first month, although the decrease was not statistically significant. There was a spatial autocorrelation of COVID-19 with the neighboring urban villages. There were fifteen COVID-19 hotspots all over DKI Jakarta based on the data analyzed in December 2020.

Keywords: COVID-19, DKI Jakarta, epidemiological surveillance, *pembatasan sosial berskala besar,* spatial analysis

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the causative agent of the recent COVID-19. In late December 2019, the first infection of SARS-CoV-2 was identified in Wuhan, Hubei Province, China, after the Wuhan Municipal Health Commission reported a cluster of pneumonia-like symptoms cases.[1] On January 30, 2020, after an upsurge of COVID-19 cases in countries outside China, the World Health Organization (WHO) declared the SARS-COV-2 outbreak a Public Health Emergency of International Concern (PHEIC). On March 11, 2020, WHO characterized COVID-19 as a global pandemic, opening the gate to the worldwide community and governments working together to fight the disease.[2]

Southeast Asian countries, namely Thailand, the Philippines, Singapore, Cambodia, Vietnam, and Malaysia, reported index cases in January 2020 and were classified as the first region to be affected by the pandemic.[3] Indonesia, as the most populous country in the region, reported its first two cases on March 2, 2020 much later than its neighboring countries. Delayed response and poor contact tracing were cited as reasons for the late reporting of cases.[4] As of December 2020, the government had declared 664,930 confirmed cases in all 34 provinces across Indonesia, with 19,880 deaths.[5]

On April 10, 2020, the provincial government applied large-scale social restrictions (*Pembatasan Sosial Berskala Besar* or *PSBB*) in DKI Jakarta, around one month after the first case of COVID-19 was reported in Jakarta. Social distancing, as the first response taken by the government, was the action most preferred by the local government to reduce the spread of COVID-19. The regulation entailed the mandatory closure of schools and public facilities such as malls, reduced capacity at restaurants, a ban on international flights, and restrictions on many other locations where people may congregate.[6]

The COVID-19 pandemic severely affected the health system in DKI Jakarta,[7], as the Provincial Health Authorities fought hard to deal with the growing number

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of cases. Meanwhile, the limited number of doctors and beds led to public anxiety. The objective of this study was to identify the epidemiological trends and spatial distribution of the COVID-19 pandemic in five municipalities of DKI Jakarta. It was also designed to yield important insights for prevention as well as control programs from the community up to the local government level.

Method

Research Design

This was an ecological and case-series study using surveillance data of confirmed COVID-19 cases in the Special Capital Region of Jakarta (DKI Jakarta).

Research Location and Time

The research data covered five administrative regions (municipalities) and 261 urban villages/*kelurahan* in DKI Jakarta: Central Jakarta (44 urban villages), East Jakarta (65 urban villages), South Jakarta (65 urban villages), West Jakarta (56 urban villages) and North Jakarta (31 urban villages). The COVID-19 surveillance data covered the period March 2-December 20, 2020.

Collection of Surveillance Data

The study employed secondary data of confirmed positive COVID-19 patients registered by the DKI Jakarta Health Office. The provincial health office of DKI Jakarta collected COVID-19 data using Epidemiological Surveillance Forms (ESF) distributed to all healthcare facilities in the province, including all public primary care centers and public and private hospitals. Health workers providing care to COVID-19 patients completed ESF, and these were submitted to the provincial health office of DKI Jakarta. The demographic data of the population across the urban village in DKI Jakarta was obtained from Jakarta Open Data.[8]

Inclusion and Exclusion Criteria

Cases with an address in one of the five municipalities of DKI Jakarta were included. Cases from the Thousand Islands were excluded because they were not connected to the main island. Besides, this area has very different population dynamics.

Data Analysis

The data were analyzed in Excel version 2013, SPSS version 22, and GeoDa version 1.17. The hypotheses were tested in SPSS at a 95% confidence interval, and the association was significant at p-value<0.05. Spatial analysis was conducted using GeoDa, and Moran's Index (I) was used to determine the existence of spatial autocorrelation of COVID-19 cases in DKI Jakarta. The indices were evaluated by simulation (99 permutation tests). Then, LISA Cluster Map analysis was used to identify the spatial patterns and hotspots of COVID-19 in Jakarta. The authors used the Microsoft Excel spreadsheet reproduced below to measure the reproduction number, which provided the implementation method (http://tools.epidemiology.net/EpiEstim.xls).

Results

There is an upward trend of COVID-19 in DKI Jakarta. The minimum age of the patient was below one year, and the maximum age was as much as 102 years. The mean age of the infected cases was 37.7 years. The variation of data with gender, age, and status of the patient has been illustrated below.

Table 1 shows the distribution of the total confirmed cases by December 20, 2020; female cases (50.94%) slightly exceeded male cases (49.06%). In the age category, the number of confirmed COVID-19 cases was highest among those aged 30–39 years (22.3%), followed by 20–29 years (21.4%) and 40–49 years (17.4%). The overall number of deaths was 2,440 (1.97%) from a total of 123,546 confirmed cases.

Based on the date of reporting of cases, the graph of daily cases, cumulative deaths, and cumulative cases showed an increasing trend. The curves displayed an upward trend from August 2020 onwards. By the last date of this study, the number of confirmed cumulative

Table 1. Distribution of Cases by Gender, Age Category, and Status of the Patient

Variables	Categories	Number (%)
Gender	Male	60,610 (49.06)
	Female	62,936 (50.94)
	Grand Total	123,546 (100)
Age category	<=5	3,919 (3.17)
	6–19	12,084 (9.8)
	20–29	25,995 (21.04)
	30–39	27,557 (22.30)
	40–49	21,493 (17.4)
	50–59	18,840 (15.25)
	>=60	13,658 (11.05)
Status/clinical outcomes of patient	Deaths	2,440 (1.97)
	Hospitalized	3,886 (3.15)
	Completion of monitoring	74,327 (60.16)
	Self-isolation	7,010 (5.67)
	Cured cases	35,883 (29.04)
	Grand Total	123,546 (100)

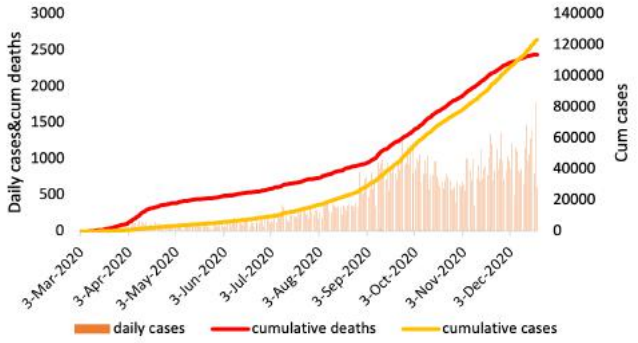

Figure 1. Trends of Daily Cases, Cumulative Deaths, and Cumulative Cases

Table 2. Mean Mortality Rate, Incidence Rate, and Case Fatality Rate

Municipalities	Population	Incidence cases	Deaths	Cum. Incidence per 1000	Mean Mortality rate per 1000	CFR per 1000
West Jakarta	2,505,315	25,202	537	10.99	0.23	21.31
SD				3.87	0.12	9.02
Central Jakarta	1,127,593	17,174	386	17.66	0.38	23.30
SD				13.25	0.16	7.43
South Jakarta	2,309,643	26,772	480	14.34	0.23	17.80
SD				9.81	0.14	8.95
East Jakarta	3,146,725	33,514	647	11.14	0.21	19.06
SD				2.64	0.09	7.40
North Jakarta	1,797,871	18,492	354	10.52	0.20	18.65
SD				2.72	0.09	6.34
Total	10,887,147	121,154	2,404	12.94	0.25	19.95
SD				8.07	0.14	8.26
Missing Information	-	*2,392	*463	-	-	-

Notes: SD = Standard Deviation, Missing information rate = 10.16%

Table 3. Differences in Daily Cases Before and After *PSBB*

PSBB	Mean	SD	Standard Error Mean	Independent t-test for Equality of Means				
				Mean Difference	Std. Error Difference	95% CI		p-value
						Lower	Upper	
Difference in daily cases before PSBB	4.29	24.46	4.2	4.91	8.11	-11.35	21.17	0.55
Difference in daily cases after PSBB	-0.62	40.48	6.9					

Notes: SD = Standard Deviation

cases in the five municipalities of DKI Jakarta stood at more than 120,000.

The curve for the daily reproduction number or R (given in supplementary Figure 1) displayed a highly fluctuating trend over the study period. During the first ten days, the epidemic curve was characterized by high incidence. Then, R decreased, from an initial median value of 2.2 in the first week to 1.0 in the third week, before fluctuating continuously around 0.8 and 1.2 until the final day. The curve then resumed an upward trend over the closing seven days.

Table 2 shows that Central Jakarta had the highest mean incidence rate (17.66/1000), mean mortality rate, 0.38/1000 (0.038%), and case fatality rate, 23.30/1000 (2.33%). North Jakarta recorded the lowest rates for all indicators and seemed to be relatively less affected by the pandemic. In the normality test, the distribution of the mortality rate, incidence rate, and the case fatality rate was not normal. A nonparametric test using the Mann-Whitney U test was conducted to discern the association between the municipalities regarding their mortality rate, incidence rate, and case fatality rate. Central Jakarta and South Jakarta significantly associated with other municipalities in terms of incidence rate, mortality rate, and case fatality rate (p-value<0.05).

In Jakarta, *PSBB* was declared on April 10, 2020, resulting in the daily increase in COVID-19 cases pre-

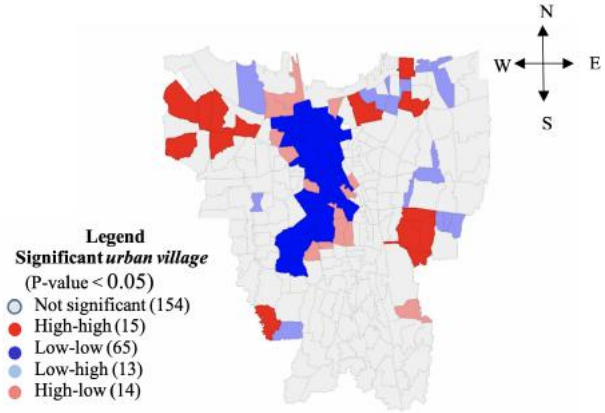

Figure 2. LISA Cluster Map of DKI Jakarta

PSBB was assessed from March 2 to April 9, 2020. While the post-*PSBB* assessment took place from April 10 to May 13, 2020, with an equal duration of 34 days. In the normality test, the distribution of cases before and after *PSBB* was normal. Therefore, the association was analyzed using an independent samples t-test at a 95% confidence interval.

The average differences in daily cases before and after *PSBB* were 4.29 and -0.62, respectively. While the negative average value of the difference in daily cases post-*PSBB* showed a slightly decreasing trend, the statistical test showed no significant association between the difference in daily confirmed COVID-19 cases before

and after *PSBB* (P-value, 0.55>0.05).

The Global Moran's Index obtained for the period between March 2020 and December 2020 (I=0.0268 and pseudo p-value=0.01) displayed a positive spatial association. In the Moran scatter plot, scattering was observed in quadrant Q1, indicating the presence of a positive spatial correlation. The local Moran's I index showed the cluster feature analysis as shown in Figure 2 above.

Altogether, 107 urban villages were significant (p-value<0.05) in the spatial analysis and showed differences in COVID-19 cases with the neighboring urban village, as shown on the LISA Cluster Map (Figure 2). The division of urban villages into quadrants, namely high-high, low-low, low-high, and high-low, can be seen above. The local statistics for each observation indicate how the spatial clustering of the same values was significant around the observations and was proportional to global statistics. The clusters were non-randomly distributed across Jakarta city, and the hotspots demonstrated as high-high regions and marked by red color were located mainly in the city's peripheral areas.

Discussion

The epidemiological indicators for COVID-19 show that the city inhabitants should continue to follow the health protocols and avoid normal social activities in the subsequent months of the pandemic. COVID-19 cases were slightly more significant in females (51%>49%), while 20–60 years accounted for 76% of cases. This is because the age group of 20–60 years old comprises the active or working population at increased risk of coronavirus exposure. The study by Tian *et al.* (2020) in Beijing, China, is comparable to this finding.[9]

From November 22, 2020 casualties were reported at an alarming level that precipitated the start of a lengthy wave in Indonesia. The daily death toll rose to three digits, lasting up to the final day of this study. The worst aspect was that most of the casualties were reported in the capital city, with the majority being elderly patients and those with pre-existing co-morbidities.[10] Entering the sixth month of the outbreak, the situation in Jakarta has spiraled at an alarming rate, as indicated by a sudden rise in confirmed cases of COVID-19.[11]

The quantification of transmissibility during the coronavirus epidemic helped assess public health responses. The declaration of COVID-19 as a national health emergency and the enforcement of health protocols such as the use of masks, physical distancing, and restrictions on mass gatherings, along with online schooling and a work from home strategy, seems to have played a positive role in preventing an unprecedented number of cases in Jakarta.[12] Prolonged social distancing was a vital step in blocking the chain of virus transmission, as a result of which the reproduction number showed a decreasing trend.

International mass media and foreign bodies outside Indonesia raised concern over data transparency during the early response. The study by Djalante *et al.* (2020) estimated that underreporting of the actual number of cases during this early response may have been due to a lack of proper diagnoses.[4] The continuation of everyday activities such as schooling, the operation of mass transportation, office working, and religious activities might have resulted in these activities acting as "super-spreaders" and potentially leading to higher transmissibility in the early days. The higher value shows this for R during the early spread of COVID-19 in Jakarta. However, R remains above 1, indicating that the epidemic is not yet over; indeed, efforts are still needed to control the transmission rate.[13]

Based on the data, Central Jakarta seemed to be the most affected municipality in Jakarta. Both the incidence and mortality rates were relatively higher than the average for the whole of Jakarta. The COVID-19 task force created on March 13, 2020, has been unable to effectively mobilize resources to slow the spread of COVID-19 in the months since its formation. Due to the inadequate early detection of cases through testing, the implementation of a contact-tracking system and the extension of *PSBB* failed to have a significant impact in Jakarta.[14] Central Jakarta is the most vibrant municipality of Jakarta and has the highest population density and transportation movement in addition to being a hub of government administrative offices.[15] The report by the Jakarta City Administration in September 2020 stated that thirteen government offices and institutions were among the top 20 office clusters with the highest number of COVID-19 cases.

The application of *PSBB* in the national capital seemed to positively reduce the average number of daily cases during the first month. Although the first month of PSBB did not show a significant association (p-value>0.05), during the subsequent months (not analyzed in this study), PSBB may have delayed spikes in cases.[11] Large-scale social distancing, particularly online schooling and working from home, reduced person-to-person contact and thus helped break the chain of transmission. This finding was comparable to the research by Rozaliyani *et al.*, in which a similar trend was found for the weekly trends of COVID-19 cases analyzed.[10] The PSBB result could have been affected by the study's relatively large number of observations and the lack of extensive PCR testing at the beginning.

A similar study by Medeiros de Figueiredo *et al.* reported the impact of the social distancing measures applied in two provinces of China (Hubei and Guangdong) that effectively reduced the incidence of cases.[16] However, this was achieved due to improved epidemio-

logical surveillance and effective social isolation strategies, which was contrary to the situation in DKI Jakarta Province. Another study by Oraby *et al.* revealed that correctly timing lockdowns could help avoid a peak and prevent hospital capacity from being exceeded by the pandemic caseload.[17]

In June 2020, Indonesia entered a "new normal" period when certain restrictions were lifted. During this time, the COVID-19 burden increased across Indonesia, and community transmission was evident across the six provinces of Java. *PSBB* was subsequently re-imposed in Jakarta in mid-September for four weeks in response to pressures on healthcare facilities across the city.[11] Unfortunately, cases and deaths due to coronavirus-2 continued to rise, and vaccination was considered the long-term solution for fighting the virus. However, uncertainty and limitations arose regarding the efficacy of the vaccine, the length of immunity provided, availability, coverage, vaccine vitality, the cold chain, and coverage at the full dose needed to reach immunity.[18] Thus, health protocols, combined with effective quarantine and isolation, were the principal and most effective interventions that were followed strictly and continuously in an effort to combat the virus, along with vaccination.

The distribution of COVID-19 cases did not occur randomly but was instead determined by the connected neighboring urban villages. A total of 15 hotspots were identified in Jakarta during the study period of the epidemic. Interestingly, the five municipalities of DKI Jakarta are densely populated and relatively well connected. Furthermore, several regions of Jakarta are connected to neighboring satellite cities such as Bogor, Depok, Tangerang, and Bekasi. Many of the people who live in these satellite cities work in Jakarta. The big manufacturing companies and factories are mostly located in Bekasi and Tangerang, meaning people frequently travel to and from these cities to Jakarta. Eventually, there would be more person-to-person contact, leading to human-to-human transmission.[19] Several studies have suggested the common role of family clusters in developing the ongoing epidemic. A recent study in the UK estimated that contact within households was responsible for roughly 70% of SARS-CoV-2 transmission when widespread community control measures were in place.[20,21]

This study has several limitations. The very high volume of missing data could have led to potential bias. There was a delay in the reporting of data; for example, data were not reported promptly after symptom onset, resulting in inconsistency and unnatural fluctuation of the curve. In terms of evaluating the effectiveness of PSBB, an assessment of other indicators such as people's mobility, social activities, the use of face masks, hand washing, and so forth may provide better results. However, data for these indicators were not available.

Conclusion

From March to December 2020, the incidence, mortality, and case-fatality rates in DKI Jakarta all showed an increasing trend. Central Jakarta seems to have been more severely affected by COVID-19 compared to other municipalities. The implementation of first PSBB in DKI Jakarta reduced the average number of daily cases during the first month, although the decrease was not statistically significant. Spatial analysis (LISA) revealed that cases did not occur randomly but were rather determined by neighboring urban villages connected, and altogether 15 COVID-19 hotspots were identified in DKI Jakarta.

Implications of the Study

This research recommends a review of the *PSBB* model by the health authority and local government with the aim of making it more effective. The provincial government can apply specific preventative measures in high-risk zones, including stricter implementation of physical distancing and an extension of online schooling. This study may be helpful to the scientific community in further research that employs a better study design. This may include cohort studies to view changes in the epidemiological trend of the disease over time.

Recommendation

The use of complete data or data with less missing information would produce better results. A consideration of socio-economic factors at the time of the pandemic would further demonstrate the health impacts on the population.

Abbreviations

DKI Jakarta: Daerah Khusus Ibukota Jakarta or Special Capital Region of Jakarta; PCR: Polymerase Chain Reaction; PSBB: Pembatasan Sosial Berskala Besar or large-scale social restrictions; ESF: Epidemiological Surveillance Forms; LISA: Local Indicator Spatial Analysis.

Ethics Approval and Consent to Participate

The ethical committee approved the Faculty of Public Health, the Universitas Indonesia, with the number Ket-50/UN2.F10.D11/PPM.00.02/2021. The study used secondary data, so no consent was given required from the participant.

Competing Interest

The authors declare no conflict of interest.

Availability of Data and Materials

The data was provided by Provincial Health Office, DKI Jakarta after submitting an official letter for research obtained from the Department of Epidemiology, University of Indonesia.

Authors' Contribution

RKD and MKS contributed to designing the study and analysis of the data. RK drafted the final manuscript, and MK read and approved it.

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Epidemiological Pattern of COVID-19 Infection from March to November 2020 in Situbondo District, East Java, Indonesia

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Abstract

The COVID-19 pandemic continues to pose a global threat. As of March 31, 2020, there were 1,528 confirmed COVID-19 cases with 136 deaths in Indonesia. This study aimed to describe the epidemiological features and clinical course of COVID-19 in Situbondo District, East Java Province, Indonesia, to facilitate understanding of the epidemiological situation and the spread of infection in the community to improve the control and prevention measures. This study examined the epidemiological features of COVID-19 cases in Situbondo using descriptive analysis. The results revealed that from March to November 2020, there were 1,622 suspected cases and 816 confirmed cases. Moreover, females (total case 470%) were more likely to be infected than males (total case 346%). Mainly, the cases of COVID-19 infection were in the age group of 19-37 years old (36.8%), and almost half of the confirmed cases (41 cases) were caused by the infection from close contact to confirmed cases, based on the epidemiological investigation report. People with comorbidities were more susceptible to being infected. Hypertension (8.7%), diabetes (8.6%), heart disease (3.7%), kidney failure, and COPD, each by (1%) were the highest reported comorbidities in COVID-19 patients. There was another disease with a low percentage like asthma, pulmonary TB, and cancer.
This study opens the gate to further studies, which are needed to understand more about the epidemiological COVID-19 situation in the community.

Keywords: COVID-19, epidemiological pattern, infection, Situbondo

Introduction

The novel coronavirus disease is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The COVID-19 pandemic continues to pose a global threat. Despite extensive research efforts worldwide, scientists have yet to develop either an effective vaccine or viable treatment options.[1] As of March 31, 2020, there were 1,528 confirmed COVID-19 cases with 136 deaths in Indonesia.[2]

After the emergence of many cases of respiratory infection in Wuhan, Hubei Province, China, in December 2019, coronavirus was identified as the primary cause behind the disease and death cases; as of January 31, 2020, this pandemic has spread to 19 countries, where the number of confirmed cases was about 11,791 including 213 deaths. The World Health Organization (WHO) declared this pandemic a Public Health Emergency of International Concern (PHEIC).[3]

Coronaviruses are members of the Coronaviridae (Coronavirinae) virus family, infecting a wide range of hosts and can spread through direct or intermediate hosts, including avians and bats bovines, camels, canines, civets, felines, murines, and porcine. Bats have been proposed as natural reservoirs for SARS-CoV and most coronaviruses.[4] The symptoms of infection also ranging from the common cold to severe and ultimately fatal infections such as SARS, MERS, and, most recently, COVID-19. SARS-CoV-2 is one of seven human-infecting members of the Coronavirus family; the International Committee on Virus Taxonomy (ICTV) has named this virus as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[5] The transmission of COVID-19 from one person to another can be where aerosols can penetrate the human body, for instance, through the lungs by inhalation through the nose or mouth, which occurs due to close contact with an infected person or exposure to coughing, sneezing respiratory droplets, or aerosols.[6] Moreover, the transmission of droplets (a diameter of > 5-10 μm) may also occur through evaporation in the natural environment, where the indirect transmission can

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occur through surfaces in the immediate environment or other items used by an infected person.[7]

COVID-19 infection symptoms usually occur after a period of around 5.2 days of incubation.[8] The average number of days from infection to symptom onset is approximately 14 days. In addition, the time between the beginning of COVID-19 symptoms and death varies between 6 and 41 days. The efficacy of the human body's immune system and age dictate this interval; it is shorter in older age groups (70 years old).[9] The most common symptoms of COVID-19 infection are fever, cough, and tiredness, while other signs and symptoms include sputum production, nausea, and vomiting. Symptoms of lymphopenia include headache, hemoptysis, diarrhea, dyspnea, and lymphopenia.[10,11] In addition, according to the findings of another study, fever and cough were the most common COVID-19 symptoms, and they were accompanied by myalgia, tiredness, dyspnea, and anorexia.[12]

Individuals infected with COVID-19 rarely had intestinal signs and symptoms (e.g., diarrhea); around 20% to 25% of patients infected with SARS−CoV and MERS-SARS suffered from diarrhea.[12] According to the findings of research conducted in Mainland China, hypertension and diabetes were the most-often reported comorbidities in patients with COVID-19 infection, along with COPD and malignancies.[13] Other studies reveal that obesity also is one of the common comorbidity in COVID-19 patients.[14] The goal of this study was to characterize the epidemiological characteristics and clinical course of COVID-19 in Situbondo District to better understand the epidemiological situation and the transmission of infection in the community and improve control and preventative efforts.

During epidemic week 47, November 2020, there had been an increase in the confirmed cases of COVID-19 in Indonesia. Also, there was an increase of confirmed cases (29,419) which were higher (17.8%) compared to the rise in cases epidemic week 46 (24,995). Twenty-two provinces experienced an increase in confirmed cases, while only 12 provinces experienced a decrease in cases. East Java is still in the second position with the highest number of positive confirmed cases in Indonesia (November 2020). It has a total of 55,286 cases and is still in the first position concerning the highest number of cumulative deaths with a CFR of 7.15%.[16]

Situbondo District is one of the regions in East Java Province. This area is located in the northern part of East Java, with a total population of about 685,776. The region is significant in terms of intense economical activity and geographical location, as it is located on the Java-Bali road route, leading to the island of Bali, and has faced an unrelenting rise in the incidence of COVID-19 infection and death. These factors made it critical for the authors to conduct this study in this district. The total of suspected cases was 1,622 (from March-November 2020).The confirmed cases were 816 via the laboratory confirmation testing using the rapid test and SWAB analysis for all the confirmed cases. In addition, the growing of confirmed positive cases suggested that the epidemic has continued to spread in the community, which culminates in a more significant burden on the health system to deal with the epidemic.

Method

A descriptive Epidemiology study was utilized, and the study results were interpreted using percentages, numbers, and graphs. The data of COVID-19 were collected from The Epidemiological Surveillance system in the Situbondo District. Data from March 28 to November 16, 2020, were extracted in this study. The positive cases of COVID-19 were confirmed according to the results of a quantitative Reverse Transcription-Polymerase Chain Reaction (qRT-PCR) assay of throat or inside the nose swab specimens of those identified as confirmed cases of COVID-19. All the cases with incomplete information were excluded. Data were analyzed using (SPSS) Statistics (25.0) Excel program and presented using tables, graphs, and charts for analysis, display, and interpretation.

Results

From March to November 2020, the number of suspected cases was 1,622, and confirmed cases were 816. Females were more likely to be infected with COVID-19 than males, with a total confirmed case of females was 470 (58 %), and the male was 346 (43%) (Table 1). The most significant number of positive confirmed cases, with 36.8%, were in the age range of 19-37 years old. The second-largest percentage was from the age group of 38-56 years old (32.5%). It was followed by the age group of 57-75 years old (18.9%), 0-18 years old (9.4%), and 76-94 years old (1.6%). Some exposure criteria were identified and presented in Table 1 of the confirmed positive cases.

There is still debate about whether gender is a predisposing factor for COVID-19. Many reports conducted in China and other countries stated that the male gender

Table 1. The Sex Ratio and Age Groups for a Confirmed Case of COVID-19 in Situbondo District on March to November 2020

Variable	Category	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Gender	Male	346	42.4	42.4	42.4
	Female	470	57.6	57.6	57.6
	Total	816	100.0	100.0	
Age Group	0-18	84	10.3	10.3	10.3
	19-37	300	36.8	36.8	47.1
	38-56	265	32.5	32.5	79.5
	57-75	154	18.9	18.9	98.4
	76-94	13	1.6	1.6	100.0
	Total	816	100.0	100.0	

has more severity and high mortality.[16,17] Men's cases tended to be more severe than women's (p = 0.035), according to research by Jin *et al.* [19] Based on statistics in Situbondo, the number of males who died from COVID-19 is 2.4 or twice the number of women. The SARS-CoV-2 virus targets the cells via an angiotensin-converting enzyme (ACE2) receptor, where had previously been reported that increased ACE2 receptor protein expression in distinct organs was associated with specific organ failures as evidenced by clinical data in SARS patients.[18] It has been shown that circulating ACE2 levels are higher in men than in women and patients with diabetes or cardiovascular diseases.[19] There is still no universal surveillance description for recovery in COVID-19 patients; even though they were not hospitalized for SARS-CoV-2 infection, many people experience long-term symptoms, ill health, and diminished functioning.[20] Long-haul COVID must be transformed from an anecdote into something that is regularly quantified and tracked, just as deaths and positive tests are now.[21]

The COVID-19 cases must be counted in addition to positive test statistics to make this pass. Healing should be described in terms of symptom length, fluctuations, severity, quality of life, and functions, rather than relying solely on no active SARS-CoV-2 infection or hospital discharge. Thus, the number of people who have been sick for a long time must be monitored, not just to provide treatment and care but also to redefine the true impact of the epidemic and report the appropriate response. This is obtained information by knowing the actual number of recovered cases from infection SARS-CoV-2. It is critical to improving reporting of clinical cases without laboratory confirmation by defining how current programs should perform. To assess the actual risk of disease associated with SARS-CoV-2 infection, public health agencies must also agree on definitions of what constitutes recovery.[22] The findings of the study also indicated that, in Situbondo (Figure 1), at least 681 persons recovered from all instances of coronavirus infection (84 %), while the number of fatalities was 72 (9%).

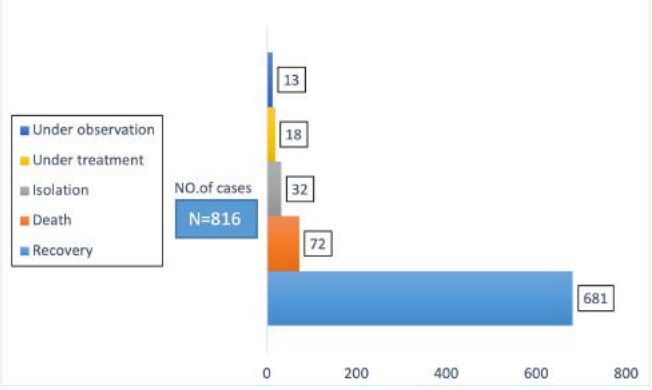

Figure 1. The COVID-19 Case in the Situbondo Area from March to November 2020

Transmission of coronavirus infection from asymptomatic persons is a severe issue in the COVID-19 pandemic. This was because individuals with no or mild symptoms might be unrecognized and would be a source of infection among the community, especially when health services are weak or non-existent in some places.[23] Also, the level of health awareness and the economic influence transmission of the virus in the community. Some test results may not identify the person who carries the virus. Yet, Serologic testing for SARS-CoV showed a positive rate of 13% in asymptomatic individuals compared to 82% in severe disease and 4% with mild symptoms.[24] The result obtained in Figure 2 showed that the number of 41% cases was in close contact with confirmed cases. Also, the most significant percentage of disease transmission was among those exposed while going to their workplaces or by people who interacted with them daily, either in the work environment or elsewhere. One of the reasons behind a high infection rate in society was the failure to follow health protocols in dealing with infected cases, especially in terms of home quarantine.

On the other hand, the technique of wearing a mask comprised the following eight steps where health standards must be included in the use of personal protective equipment. The use of masks was not just when caring for sick people at home, which was essential, but also by those who have symptoms and signs of disease: (1) wash your hands before putting on the mask; (2) choose the correct mask scale; (3) make sure the mask's colored side is facing outward (for colored masks), or the folds are facing downward and outward (for folded masks) (for uncolored masks); (4) keep in mind that the metal strip is on the upper side of the element; (5) ensure that the elastic bands or cords are in the right place; (6) press the steel strip tightly so that it molds according to the nose and face bridge shape; (7) cover the nose, mouth, and chin with a face mask; and (8) avoid rubbing the mask on the face until it has been covered and wash your hands before and after touching the mask. The following four procedures should be followed before removing a mask properly: (1) before removing the mask, wash your

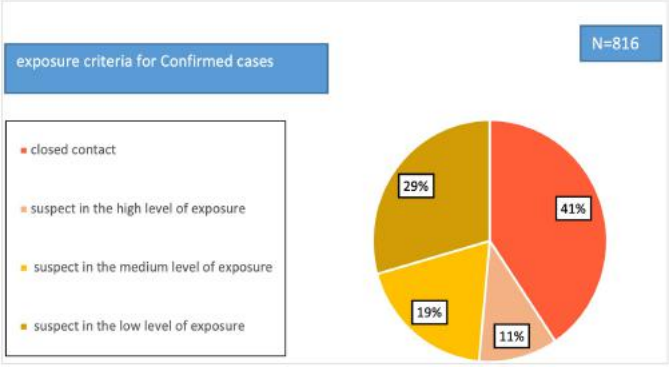

Figure 2. Identify Exposure Criteria of COVID-19 from March to November 2020 in Situbondo District

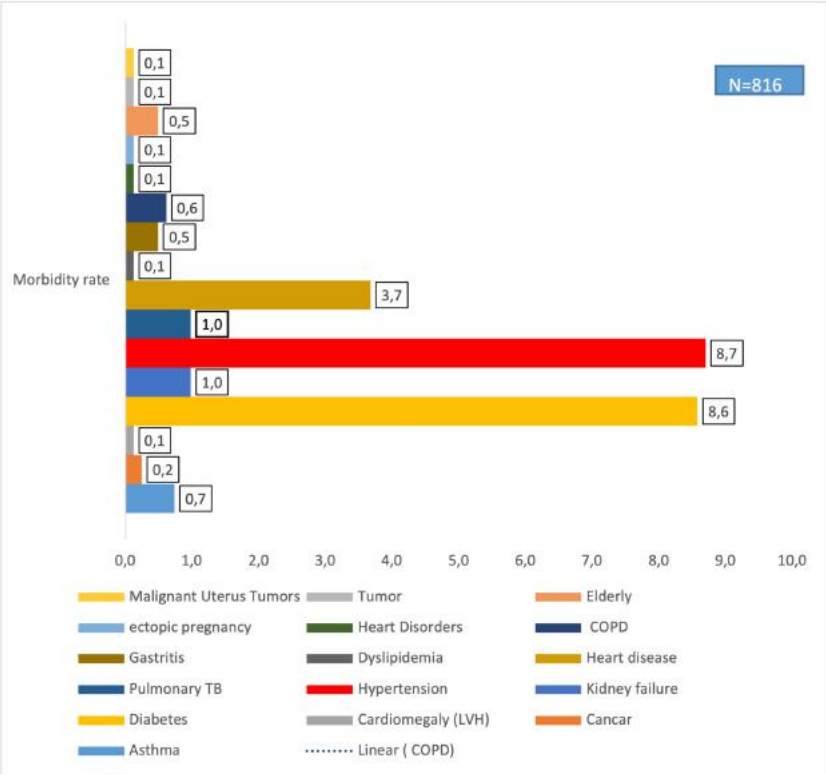

Figure 3. Comorbidities of COVID-19 from March to November 2020 in Situbondo District

hands; (2) only the elastic bands can be touched; (3) place the used mask in a plastic or paper bag or a trash can with a lid; and (4) after removing the mask, wash your hands.[24]

According to the total number of COVID-19 positive cases in the Situbondo District, some of the deaths were accompanied by comorbidities such as diabetes, heart disease, malignant uterine tumor, cancer, asthma, pulmonary TB, cardiomegaly, hypertension, COPD, and renal failure (Figure 3).

Comorbidity is a medical term used to describe a condition present simultaneously in those with a related medical condition. Comorbidity basically refers to the impact of any additional conditions, physiological or psychological, that a patient may have, and the primary condition of concern. Combining a long-term illness and a severe viral infection such as COVID-19 thus presents a difficult challenge to the medical community in saving lives.[25] The results of this epidemiological study in Situbondo District showed the features and comorbidity in COVID-19 patients. The five highest reported comorbidities in the Situbondo District were hypertension with a percentage of 8.7%, diabetes (8.6%), heart disease (3.7%), kidney failure, and COPD, each by 1%. Other diseases with low prevalence rates included asthma, pulmonary tuberculosis, tumors, and cancer. Diabetes, cardiovascular disease, and hypertension were the most prevalent chronic comorbidities among persons with severe asthma, according to research by Barron *et al.*[26]

Hypertension is a prevalent condition that affects the elderly. This group of persons appears to be at a higher risk of contracting the SARS-CoV-2 virus and developing severe COVID-19 symptoms and consequences. Older age is often associated with weakened immunity, which is thought to increase vulnerability to COVID-19 infection.[25] It is yet uncertain if uncontrolled blood pressure is a risk factor for COVID-19 infection; nonetheless, even if it does not influence susceptibility to the illness, managing blood pressure is an essential concern for reducing the disease burden when infected with the SARS-CoV-2 virus.[27] Diabetes was the second most common comorbidity in the Situbondo District. The host's defenses, particularly granulocyte and macrophage function, are known to be harmed by this condition. People with diabetes are more susceptible to a variety of dangerous illnesses. Poor glycemic control has been linked to major infections and hospitalization and is thought to increase the hyperimmune response related to severe COVID-19 infection.[28]

Conclusion

The study results showed that the spread of infection within the community is occurring mainly because the community is still not disciplined in carrying out social distancing and independent isolation. In several public places, such as traditional markets, the use of masks is

still not completely obeyed. Additionally, in certain confirmed positive cases with mild symptoms, some had not carried out independent isolation according to the protocol for various reasons, one of which was earning a living according to the people's daily activity. Additionally, people with comorbidities such as hypertension and diabetes are more susceptible to being infected with COVID 19. Thus, early discovery, diagnosis, treatment, and quarantine, as well as limiting secondary infections among close contacts, are all necessary steps in preventing COVID-19 from spreading from person to person.

Abbreviations

SARS-CoV-2: severe acute respiratory syndrome coronavirus 2; WHO: World Health Organization; PHEIC: Public Health Emergency of International Concern; ICTV: International Committee on Virus Taxonomy; ACE2: angiotensin-converting enzyme.

Ethics Approval and Consent to Participate

This study was conducted based on secondary data from the epidemiological surveillance system in the Situbondo District Health Office.

Competing Interest

The authors state no conflict of interest.

Availability of Data and Materials

The result of this study depends on the COVID-19 data from the epidemiological surveillance system department at the Situbondo District Health Office, East Java, Indonesia. The data was gathered from the daily epidemiological activities and follow-up of the pattern of the disease spread in Situbondo District. The data derived supporting the findings of this study are available from the corresponding author on request.

Authors' Contribution

MG collected, processed, and analyzed the data, and wrote the discussion. ACH analyzed the data and wrote the discussion. MG and ACH have accepted responsibility for the entire content of this manuscript and approved its submission.

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Knowledge, Attitude, and Practice Regarding COVID-19 among Residents of *Pesantren*

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Abstract

Islamic boarding schools (*pesantren*) run the risk of COVID-19 transmission. The *pesantren* learning system is generally carried out collectively, with an all-day-long interaction between teachers and students. This paper presented a lesson on controlling COVID-19 outbreak in *pesantren* through Community Service Activities (CSA). The CSA was designed to empower the *pesantren* to prevent and control COVID-19 to become a safe place protected from COVID-19 spread. This was a relevant case study in a traditional Islamic boarding school (*salafiah*) in Lebak District, Banten. The study population (a total of 97 participants) consisted of the *pesantren* leader, the teachers *("Ustaz/Ustazah")*, and the students, ushered by the community service partners, namely the Sub-district Public Health Center and COVID-19 Task Force. This study showed that controlling COVID-19 in *pesantren* requires the leaders' commitment to establishing an internal COVID-19 Task Force and partnerships with community stakeholders. Health literacy needs to be improved, especially by implementing health protocols and information on clean and healthy behavior. There are obstacles in handling COVID-19, especially related to social distancing, infrastruc-ture, and funding. This study recommends the empowerment of *pesantren* residents related to health literacy. It is necessary to make people realize that COVID-19 is everyone's responsibility. The Government should pay serious attention to *pesantren* as boarding educational institutions with a high level of in-teraction and prevent them from becoming clusters of COVID-19 spread.

Keywords: COVID-19, empowerment, Islamic boarding school, pesantren

Introduction

Islamic boarding schools ("*Pesantren*" in Indonesia) constitute one of the educational settings that are a potential source of COVID-19 transmission. Many religious practices and learning patterns pertaining to the *pesantren* system make them a risk of becoming clusters for COVID-19 spread. The practice of shaking hands between "*santri*" and "*Kiai/Ustaz/Ustazah*" (students and *pesantren* leader/teachers, respectively) and teaching procedures carried out collectively, such as congregational prayer, the study of Qur'an, and classical literature, are standard everyday procedures in pesantren. Furthermore, the busy activities of the *"santri"* and their interaction on a day-long basis make the boarding school environment vulnerable to the spread of COVID-19.[1–3]

Controlling COVID-19 transmission in *pesantren* is crucial. According to the DataBase of Islamic Boarding Schools of the Ministry of Religion in 2021, the number of *pesantren* is 27,722 with a total of 4,175,555 students.[4] A considerable number of the institutions are located in the red zone districts and cities in Indonesia.[4] According to data from LaporCOVID-19, there were 8,291 positive cases of COVID-19 in *pesantren*.[5] These data do not represent the actual condition because not all *pesantren* have reported the cases of COVID-19.[5]

In an effort to confront the COVID-19 pandemic, the Indonesian Government issued Presidential Decree No. 11 of 2020 regarding "Stipulation of Public Health Emergencies for Corona Virus Disease 2019 (COVID-19)" that requires countermeasures,[6] one of which was at home or at-distance online education. This regulation applies to all educational institutions. *Pesantren* as education provider institutions responded to this policy differently. Some *pesantren* decided to return all or some of the students home, while others continued to study in *pesantren*. Ministry of Religious Affairs (MORA) has surveyed 1,262 *pesantren*. About 9.12% did not encour-age the students to return home because the *pesantren* environment was considered safer

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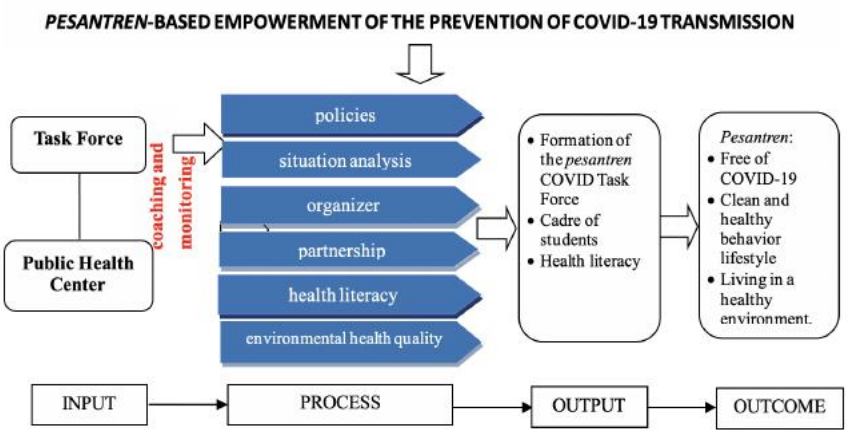

Figure 1. The Community Empowerment Stages[9]

(77.6%) and studying there was better (14.7%); to a lesser degree, it was the wish of the parents (7.7%).[7]

Apparently, online education was not an option for pesantren. When the Indonesian Government issued a policy called the New Normal, i.e., several adjustment policies during the pandemic, the majority of the *pesantren* (85%) asked their students to return to presential classes. While the remaining 15% decided to continue the online modality,[7] even though they face various obstacles when implementing at-distance learning. Generally, *pesantren* in Indonesia are located in rural areas, especially the traditional *salafiah pesantren*, where internet access is limited, and many students come from various regions.[2,8] Furthermore, most learning processes in *pesantren* are carried out in groups, especially worship practice. This makes the online processes difficult to implement. Therefore, many *pesantren* have remained or started new presential learning, even though the spread of COVID-19 in Indonesia is not under control.[8]

The Indonesian Government has issued the Decree of Minister of Health Number HK.01.07/MENKES/2322/2020 regarding "Guidelines for Empowering Islamic Boarding School Communities in the Prevention and Control of Coronavirus Disease 2019 (COVID-19) in Islamic Boarding Schools".[9] The decision, which should be followed without exception by the whole country, stipulates the health protocols that *pesantren* should apply that run presential activities. Based on this background, the researchers felt the need to investigate the efforts of *pesantren* in preventing and controlling COVID-19 so that they can be places of learning protected against COVID-19 transmission. This paper aimed to describe the stages of the *pesantren*-based empowerment process for controlling COVID-19, its challenges, and obstacles. This study was expected to be a source of information for *pesantren* in Indonesia, especially traditional *pesantren* preparing them for the return to presential courses.

Method

This is a case study on the empowerment of Islamic boarding schools (*pesantren*) in preventing and controlling COVID-19. The pesantren chosen was a traditional Islamic boarding school (*salafiah*) in Lebak District, Banten. Lebak District is a region with a large number of pesantren, where almost every village has at least one. Therefore, Lebak District is one of among COVID-19 spread high-risk regions. On March 9, 2021, the number of confirmed positive cases for COVID-19 was 2,767 people in total, with 56 deceased people, 1,970 recovered cases, and 740 people in isolation.[10]

The Community Services Activities (CSA) were carried out in six months, from July to December 2020. The study group consisted of the *pesantren* leaders, the teachers ("*Ustaz/Ustazah*"), and the students ("*santri/santriat*"), a total of 97 people (30 women and 67 men). Meanwhile, community service partners consisted of the Sub-district's Public Health Center and the COVID-19 Task Force. The empowerment of *pesantren* in controlling COVID-19 is organized in the community service stages described in Figure 1. These stages were adapted from the COVID-19 Control Guidelines in pesantren issued by the Ministry of Health of the Republic of Indonesia.[9]

The empowerment strategy was carried out through the following activities: 1) issuing policies for the prevention and control of COVID-19 in *pesantren*; 2) analyzing the situation inside the *pesantren*; 3) organizing the prevention and control of COVID-19; 4) building partnerships to optimize activities; 5) increasing health literacy; 6) improving the quality of *pesantren*'s environmental health, and 7) guidance and monitoring.[9] The situation analysis was applied to collect data on teachers' knowledge, attitudes, and behavior through online surveys (Google Forms) via cellphones. In contrast, student data were collected through the computers of the *pesantren* since they are not allowed to carry cellphones while living in the pesantren.

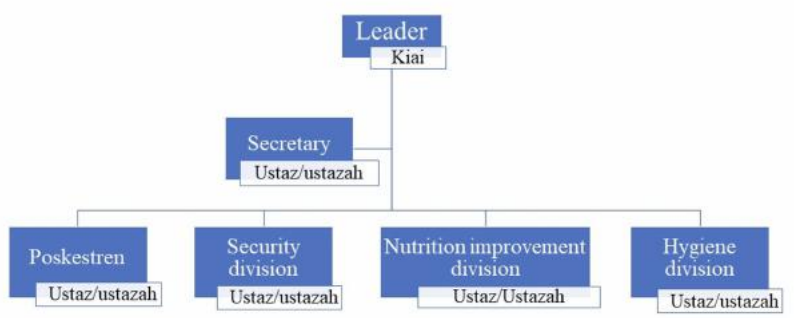

Figure 2. The *Pesantren* COVID-19 Task Force

Table 1. Knowledge of *Pesantren* Residents about COVID-19 (%)*

Knowledge Statement	Teachers (n=11)	Students (n=86)	Total (n=97)
Everyone infected with the coronavirus will show symptoms	90.9	76.7	78,4
The coronavirus is transmitted through droplets/fluids that come out when someone sneezes/coughs	100.0	100.0	100.0
The coronavirus is transmitted through physical contact with an infected person (touching/shaking hands)	100.0	100.0	100.0
The coronavirus is transmitted through the air	100.0	100.0	100.0
You can be infected with COVID-19 if you touch your mouth/nose/eyes with your hands previously exposed to the coronavirus	90.9	100.0	99.0
Washing hands with soap and running water can prevent transmission of the coronavirus	100.0	100.0	100.0
People infected with the coronavirus without symptoms can still transmit the virus to other people	100.0	97.7	97.9
The use of masks is an effective measure to prevent transmission of the coronavirus	100.0	100.0	100.0
Staying at home is an effective measure to prevent the spread of the coronavirus	100.0	100.0	100.0
COVID-19 infection can be prevented with spices/herbs (*"empon-empon"* in Indonesia)	100.0	100.0	100.0
Avoiding shaking hands is effective in preventing transmission of the coronavirus	100.0	100.0	100.0
Maintaining a physical distance of at least one meter can prevent transmission of the coronavirus	100.0	100.0	100.0

*Percentage of the respondents that answered correctly

Results

Several stages of activities were applied to the COVID-19 empowerment, prevention, and control strategies in Figure 1. Next, each one is laid out.

Policy Development and Organizing the Prevention and Control of COVID-19 in *Pesantren*

The first step was to encourage the *pesantren* leader to issue policies related to the prevention and control of COVID-19. This policy was carried out by forming a Pesantren COVID-19 Task Force where the leader of *pesantren* acts as the Chairman of Task Force. The structure of the Task Force can be seen in Figure 2. The Task Force has four divisions, namely: 1) Poskestren (*pesantren* Health Post), 2) nutrition improvement, 3) hygiene, and 4) security. The four sectors have their respective duties and functions. An "*Ustaz/Ustazah*" chairs each field," and each sector is assisted by the "santri/santriat" of the pesantren.

Pesantren Situation Analysis Assistance

Next, the *pesantren* COVID-19 Task Force applied a situation analysis that aimed to obtain primary data on the current situation and condition of the *pesantren*. The data collection was carried out by "*santri*," containing: 1) the profile of the *pesantren* (the building area, the number of "*santri/santriat*," the number of "*Ustaz/Ustazah*," the number of employees, the number and condition of facilities such as study rooms, dormitories, worship area, living room, kitchen, toilets, bathrooms, number of basins with soap and running water); 2) the learning system; 3) analysis of the potential resources, opportunities, and constraints; and 4) knowledge, attitudes, and behavior of the *pesantren* residents related to the prevention of COVID-19. Data collection was carried out regularly using instruments that havebeen prepared specifically for the COVID-19 situation.

Data concerning the knowledge, attitudes, and behavior of the *pesantren* residents related to COVID-19 were collected. In Table 1, it is illustrated that the relevant knowledge was generally of good level. However, some areas were still to be improved, especially concerning the statement that "not all infected people will show symptoms but can transmit the COVID-19 virus".

Table 2 shows a tendency for a positive attitude of the students toward COVID-19. However, some attitudes need to be improved, i.e., wearing masks, maintaining distance, and avoiding physical contact. Some students did not agree to keep their distance in congregation prayer at mosques, prayer rooms, or other public places. Regarding the use of masks, some students did not agree to wear masks when meeting with other people (e.g., relatives, friends, neighbors, other students) and practicing congregation prayer. The attitude of students toward physical contact should also be improved. Some students did not agree to avoid shaking hands or having physical contact when meeting with the "*Kiai*" or other social circle members. Besides, a stigma of disagreement over the bodies of those who died of COVID-19 should be accepted like other Muslims or not must be discussed and rectified.

The attitude of the *pesantren* residents toward COVID-19 appears to be in line with their behavior, as seen in Table 3. Over the last two weeks, many of the

Table 2. Attitudes of *Pesantren* Residents towards COVID-19 (%)*

Attitudes	Teachers (n=11)	Students (n=86)	Total (n=97)
Wearing masks only when sick	9.1	2.3	3.1
Maintaining a distance during congregational prayers in mosques/prayer rooms or other public places	90.9	94.2	93.8
Wearing a mask during congregational prayers	54.5	64.0	62.9
Wearing a mask when attending recitation/religious study/prayer	100.0	100.0	100.0
Wearing a mask when meeting relatives/friends/neighbors/other students/etc.	100.0	100.0	100.0
Maintaining a distance when attending recitation/religious study/prayer	100.0	97.7	97.9
Avoiding shaking hands/physical contact when meeting with relatives/friends/other students etc.	100.0	100.0	100.0
Avoiding damage takes precedence over taking benefits	100.0	97.7	97.9
Those infected with COVID-19 need independent isolation for 14 days	100.0	95.3	95.9
Those who come in direct contact with sufferers must isolate independently for 14 days	100.0	98.8	99.0
Families infected with COVID-19 need assistance in providing food during isolation	100.0	100.0	100.0

*Percentage of the respondents that answered "agree"

Table 3. The Behavior of *Pesantren* Residents in the Last Two Weeks (%)*

Behaviors	Teachers (n=11)	Students (n=86)	Total (n=97)
Leaving the house only for certain purposes	18.2	1.2	3.1
Wash your hands with soap and running water after traveling	81.8	96.5	94.8
Carry a hand sanitizer outside the house	63.6	95.3	91.8
Wear masks when leaving the house/meeting with other people	90.9	100.0	99.0
Shake hands when meeting other people	27.3	54.7	51.5
Wear masks during congregational prayer at the mosque/prayer room	63.6	70.9	70.1
Keep a distance during congregational prayer at the mosque/prayer room	100.0	91.9	92.8
Wear masks while attending recitation at the mosque/prayer room	90.9	97.7	96.9
Keep a distance while attending recitation at the mosque/prayer room	100.0	96.5	96.9

*Percentage of the respondents that answered "often"

students stated that they often shook hands (52%), did not wear masks (30%), and did not keep their distance during congregational worship (7%). This suggested that students' adherence to health protocols should be increased through routine education.

Building Partnerships with the Regional Public Health Center and the Local COVID-19 Task Force

Partnerships were built to collaborate in the prevention and control of COVID-19 to optimize community service activities. The collaboration partners consisted of the regional Public Health Center and COVID-19 Task Force. They acted as supervisors and monitor for COVID-19 control activities in *pesantren*. All the parties coordinated if a positive case of COVID-19 was present in the *pesantren*, the 3T procedure (testing, tracing, and treatment) or independent isolation could follow up.

Improving Health Literacy for *Pesantren* Residents

Based on the description of knowledge, attitudes, and behavior, increasing health literacy about the prevention and control of COVID-19 must be promoted among the *pesantren* residents. Literacy improvement is carried out through counseling and information dissemination through leaflets, flyers, posters, and banners. Counseling was carried out in the *pesantren* with local partners and *pesantren* leaders as resources' person. Educational material was provided from a health perspective and a religious (Islamic) perspective, aiming at reducing misperceptions regarding the coronavirus, the methods of transmission and prevention, and correcting misunderstandings about the COVID-19 outbreak. Apart from counseling, literacy was carried out by providing IEC COVID-19 material in the form of leaflets and standing banners containing information on health protocols. The material was adapted from the same materials issued by the Ministry of Health of the Republic of Indonesia in 2020.

Discussion

Studies related to handling COVID-19 in boarding schools have not been widely conducted. The findings of this study were in line with previous studies showing that the main challenge is social distancing and infrastructure-related issues.[11,12] The boarding schools must consider the capacity of bedrooms, bathrooms, social activities areas, and alternatives for the supplies (e.g., meals). The social distancing recommended by the WHO protocol and the available spaces should take into account the increasing transmissibility of the coronavirus.[13] WHO recommended the distance of two meters between individuals, or one meter where extra precautions are in place (such as covering the face or applying extra indoor ventilation).[13] These protocols can be problematic for boarding schools.

This CSA received good responses from the pesantren residents as well as the Sub-district Public Health Center and the Sub-district COVID-19 Task Force. Indirectly, CSA supported their primary duties and functions to strengthen the control of COVID-19 in educational institutions in their region, including *pesantren*. The commitment of the *pesantren* leaders was an initial and important step in controlling COVID-19 inside the boarding institution. They encouraged the active involvement of *pesantren* administrators, students, and other residents to prevent and control COVID-19. Leaders must incite and monitor the *pesantren* residents' adaptation to the "new normal" era's new habits. The monitoring was done by applying health protocols by ensuring the availability of supporting infrastructures such as basins with soap and running water, suitable dormitories, and independent isolation rooms according to the health protocol. The biggest challenge in *pesantren* was physical distancing. The learning schemes of *pesantren* are generally carried out collectively/in a congregation. The interaction between students is almost 24 hours a day, and the santri dormitory inhabited by several santri in the same room needs to be adjusted to the COVID-19 health protocol.[2]

Partnerships and collaboration between *pesantren*, the Sub-district COVID-19 Task Force, and Public Health Center must be built and fostered. This supports the 3T efforts to be carried out optimally. The involvement of local partners was an essential factor since the adoption of health information by the community was determined by the trust in the local community.[14] Through partnerships and collaboration, the chain of transmission of COVID-19 can be broken, and positive cases can be handled quickly. Increasing health literacy among the *pesantren* residents needs to be carried out continuously with guidance and monitoring from the two partners. This effort aimed to change wrong assumptions regarding the prevention of COVID-19, especially the physical distancing, the advice not to shake hands, and maintain a distance during worship.

Increasing health literacy needs to continue on a regular basis to change wrong opinions of the community, which often contradict government policies, such as the case of the fatwa of the Indonesian Council of Ulama No. 14 of 2020 concerning the implementation of worship in the COVID-19 pandemic.[15] Several common ritual practices, such as prayer congregation, are recommended to be replaced with praying at home. This recommendation is related to preventing the gathering of people in mosques. It prohibits people from praying in mosques, not from neglecting their religious obligations. It is not forbidden to pray in congregation at the mosque, nor is it forbidden to gather in congregation recitation, but it acts toward the personal and community protection from the dangers of COVID-19.[16]

Education to prevent social stigma against residents of *pesantren*, "*santri*," and surrounding communities

positive for COVID-19 needs to be applied, including managing the bodies of COVID-19 patients. The spirit of cooperation in overcoming the transmission of COVID-19 in the community also needs to be built in the literacy of *pesantren*. Controlling COVID-19 requires the collaboration of all parties. Many lessons were learned from the empowerment process at the Al Marjan Lebak Islamic Boarding School in Banten concerning challenges, obstacles, and opportunities.

Implementing health protocols in the *pesantren* environment must be strict. Health protocols include wearing masks, maintaining a minimum physical distance of two meters from other people, avoiding the crowds, and washing one's hands frequently with soap and running water to ensure compliance with the health protocols. It was necessary to impose sanctions on the *pesantren* residents who violate them. No less important was imple-menting Clean and Healthy Behavior such as personal hygiene and cleanliness of the pesantren environment. Some examples of behaviors that needed to be encouraged to increase students' immunity were physical exercise, consumption of nutritious food, keeping the living environment clean. The COVID-19 Task Force, along with cadres, must monitor the compliance of students to health protocols.

Pesantren learning settings that adapt to the "new normal" era must be implemented. The application of physical distancing by keeping the students' seats at a distance impacted the classrooms' capacity. The classrooms now have only half or one-third of the original capacity. The entrance pattern of the students in the classroom could be organized in shifts and the practice of worship.[17] A one-gate system policy that limited the mobility of people in and out of the pesantren environment made the interaction between the students and the outside community easier to monitor. This rule should apply to all the *pesantren* residents, including "*Ustaz/Ustazah*" (teachers) and other staff.

Furthermore, the number of visits needs to be limited. It aimed to reduce the frequency of the meetings between the residents and outside community running the risk of transmitting the coronavirus. The visiting schedule for the "*santri*" guardians also needs to be limited. When a student's guardian meets their child, maintaining a safe distance and prohibitions on physical contact must be enforced. In addition, the guardian delivery of packages for "*santri*" must also be limited in frequency (for example, once a month), and the reception should be regulated through a sterilization process. All students must test for COVID-19 before entering the *pesantren* area through rapid tests or swab tests. If the tests were positive, the "*santri*" must undergo independent isolation. This is applied to limit the risk of COVID-19 transmission within the school's facilities.

It is necessary to routinely update records related to the risk factors for COVID-19, including the physical condition complaints by all the *pesantren* residents. This can serve as an initial detection of COVID-19 cases, making it efficient to handle and trace possible transmission quickly. The *pesantren* work together with local health centers and the COVID-19 Task Force so that case handling and transmission control could be carried out. This routine data collection was carried out by the *pesantren* COVID-19 Task Force, specifically the *pesantren* Health Post (Poskestren).[18]

Controlling COVID-19 in pesantren while they adapt to the "new normal" era certainly has implications for the provision of modified learning infrastructure, such as classroom and dormitory capacity changes, toilets, and basins soap.[17] Generally, these facilities are limited in *pesantren*.[19] In addition, the pesantren must ensure access to disinfectants and independent isolation rooms, separate from dormitories and study rooms. As a result, it has an impact on the operational burden of the *pesantren*. This is an obstacle, especially for salafiah *pesantren* with limited funding sources. This obstacle has been met by the MORA by providing financial support through *Pesantren* Operational Assistance (BOP) for a total of 21,173 pesantren.[20] This assistance allows the provision of facilities and equipment for handling COVID-19.

Weaknesses and strengths of the study

This was a case study in a salafiah Islamic boarding school, so it only describes the situation and conditions of handling COVID-19 in *pesantren* with the same characteristics. Despite its limitations, this study can provide information about the stages of empowering *pesantren* in controlling COVID-19 and the obstacles faced by local governments and related stakeholders (Sub-district Public Health Center, COVID-19 Task Force, related institutions). Furthermore, this stage of empowerment can hopefully be replicated in other traditional Islamic boarding schools since their number represents 53.1% of all Islamic boarding schools in Indonesia.[21]

Conclusion

Controlling the transmission of COVID-19 through the implementation of health protocols in *pesantren* is not an easy matter, but it must be implemented. It requires awareness and enthusiasm from all internal *pesantren* ("*Kiai*," "*Ustaz/Ustazah*," "*santri*") and external (public health center, local Task Force of COVID-19, and local government) parties to collaborate on breaking the chain of transmission of COVID-19. Empowerment of *pesantren* is expected to be one of the means to pre-vent the formation of a COVID-19 cluster.

The present findings can be used as a lesson to prevent and control COVID-19 in *pesantren* of other regions to prepare presential courses.

This study recommends the empowerment of the *pesantren* residents (teachers and students) related to health literacy, especially the implementation of health protocols, which must be improved. It is necessary to make people aware that COVID-19 is everyone's responsibility. In addition, the government should pay serious attention to Islamic boarding schools where interaction among students is a 24/7 issue and promote the prevention of *pesantren* from becoming clusters of COVID-19 spread. This way, the continuity of *pesantren* as educa-tional institutions that form the character and instill val-ues in students will not stop due to the COVID-19 pan-demic.

Abbreviations

Poskestren: Pos Kesehatan Pesantren (Pesantren Health Center); BOP: Bantuan Operasional Pesantren (Pesantren Operational Assistance); IEC: Information Education Communication; 3T: Testing, Tracing, and Treatment; URPM: UI Research and Community Service Unit

Ethics Approval and Consent to Participate

The authors' informed consent was obtained from all subjects involved in the study.

Competing Interest

The authors declare no conflict of interest.

Availability of Data and Materials

The authors clarify sources of data or information used as study materials.

Authors' Contribution

MH designed the study and wrote the manuscript. B gave the expert opinion in the design study and critically analyzed the data and input in the manuscript drafting. J examined and drafted the manuscript.

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Analysis Implementation of COVID-19 Prevention Policy for Disability in Social Institution (Case Study: Jakarta Capital City)

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Abstract

One of the most vulnerable groups in the current COVID-19 pandemic situation is people with disabilities. Generally, people with disabilities have more health care needs, both everyday needs and needs related to the disorders/limitations. As part of human beings and citizens of Indonesia, constitutionally, people with disabilities have the same rights and position before the law and government. This study aimed to analyze the implementation of COVID-19 prevention policies at the social institutions for disability in Jakarta Capital City, provide information about the implementation, find out the obstacles, and recommend policymakers to prevent COVID-19 in social institutions with disabilities. This study used an exploratory study design with a rapid assessment survey approach, using a secondary data analysis method supported by interviewing stakeholders at the Social Institutions in Jakarta Capital City handling disabilities. The results of this study concluded that the overall implementation has been going well. The socialization and coordination process related to the COVID-19 prevention policy at the Social Institution for Disabilities in Jakarta Capital City has gone well among fellow officers but has communication barriers with residents.

Keywords: COVID-19 prevention policy, disability, implementation

Introduction

One of the most vulnerable groups in the current coronavirus disease 2019 (COVID-19) pandemic situation is people with disabilities.[1] The word "disability" means the inability or lack of physical and mental so that there are limitations in doing something.[2] With various disabilities, some people with disabilities cannot apply rules for social distancing or physical distancing. People with disabilities need a companion in their daily lives, meaning they must constantly interact with other parties to carry out their activities to meet their daily needs.[3]

The COVID-19 pandemic is still a problem in the world today. It is known that the origin of the SARS-CoV-2 originated from Wuhan, China which was discovered at the end of December 2019. The increase in the number of COVID-19 cases occurred in a short time and required immediate treatment. Coronavirus can quickly spread and infect anyone regardless of age, gender, and another social status. The COVID-19 pandemic also created changes in community activities.[4]

Based on the global data in 2019, it was estimated that 15% of the world's population has a disability.[5] One in every five women is likely to experience a disability in their lifetime, while one in every ten children is children with disabilities. Of the one billion population with disabilities, 80% live in developing countries.[5] According to the National Socio-Economic Survey/*Survei Sosial Ekonomi Nasional* (SUSENAS) conducted by the Central Statistics Agency/*Badan Pusat Statistik* (BPS) in 2012 was recorded that the number of people with disabilities in Indonesia was 6,008,661 people.[6]

In 2017, the United Nations Department of Economic and Social Affairs (UNDESA) estimated that around 13% of the world's population are elderly, and of that number, 44% were people with disabilities. Currently, the COVID-19 has a significant impact on residents of nursing homes. In May 2020, in Europe, there is an estimated 45-57% risk of death experienced by residents. In the UK, around 30,296 of the 50,888 deaths from COVID-19 from January to November 2020 were people with disabilities. This also represents a three times greater risk of death for persons with more severe disabilities.[7]

According to the Communication Team of the

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Committee for the Handling of COVID-19 and the National Economic Recovery in Indonesia, there are several causes of the vulnerability of a population to be exposed to COVID-19.[8] First, the vulnerability will increase in crowded and inappropriate places. Second, low access to clean water and a healthy environment. Third, high dependence on daily wages resulted in required to have high mobility. Fourth, low access to health services. Fifth, food vulnerability and malnutrition. Sixth, being in an armed conflict and violent environment, and seventh, part of marginalized and minority communities.[9]

As part of human beings and citizens of Indonesia, constitutionally, people with disabilities have the same rights and position before the law and government.[10] Through Law No. 8 of 2016 concerning Disabilities, the rights to health for people with disabilities is an integral part of the Social Welfare Law No. 11 of 2009 concerning the government's efforts in implementing social welfare through services, rehabilitation, guarantees, empowerment, and social protection for all citizens. The existence of this policy means to realize equal rights and opportunities for people with disabilities towards a prosperous, independent, and non-discriminatory life.[11] One of these efforts is carried out through a Social Institution system that organizes integrated rehabilitation under one roof in the form of medical, educational, training, and social rehabilitation.[12]

Disabilities still face significant barriers in exercising their rights.[13] There is a greater marginalization in some types of disability, for example, in people with intellectual and psychosocial disabilities and people who are deaf. They are more likely to be treated as ostracized in service, live or detained in social institutions, and experience higher levels of violence, neglect, and harassment.[14]

The situation of the COVID-19 pandemic is a concern, especially for people with disabilities who live in tiny rooms, densely populated, closed places, and minimal access, such as in Social Institutions. In Jakarta Capital City alone, around 3,500 people with mental disabilities and 1,500 elders are confined to social institutions managed by the Regional Government. The inadequate conditions of the Social Institutions, such as one room containing 30 people and not allowing social distancing or physical distancing.[15] The need for health care, especially during this pandemic situation, is part of the type of service that must be met in service standards in Social Institutions, as stated in Article 12 of Law No. 8 of 2016 concerning Disability regarding the right to health for people with disabilities.[16]

In addition, following Article 20 of Law No. 8 of 2016 concerning People with Disabilities mandates that they have the right to obtain information, knowledge about disaster risk reduction, to receive priority in the rescue and evacuation process in a disaster situation, and to get easily accessible rescue and evacuation facilities and means.[16] As stated in the Jakarta Capital City Regulation No.10 of 2011 concerning the Protection of People with disabilities, Article 71 stated that in times of emergency and disaster, the Regional Government, the National and Regional Disaster Management Agency, and the community must prioritize rescue and/or help and evacuation of people with disabilities.[17]

The implementation of all policies to ensure the protection and safety of people with disabilities in risky situations such as the current non-natural disaster of the COVID-19 pandemic is urgently needed.[18] With the existence of various policies as a form of the local government's rapid response to the COVID-19 pandemic, the researchers were interested in analyzing the policy implementation process using the model of a figure or policy expert named George C. Edward III. Given this model, it is often used to explore and understand the factors that shape the relationship between policy and policy performance in public policy.[19]

Therefore, the various policies regarding the COVID-19 pandemic situation created by the government need to be analyzed. Moreover, local governments are responsible for empowering their people in a riskier health threat, including people with disabilities. Jakarta Capital City is the area with the highest distribution of positive COVID-19 cases out of 34 other provinces in Indonesia, with a total of 794,937 cases (24.9%).[20] In realizing the equality and rights of people with disabilities, the local government, especially Jakarta Capital City, has an essential role in learning the mandate of the law to provide adequate accessibility for people with disabilities. The implementation of the COVID-19 outbreak prevention in social institutions for disability is part of government policy in the current non-natural national disaster situation. This impact can be minimized if stakeholders take appropriate protective actions and measures.

Method

This study aimed to analyze the implementation of COVID-19 prevention policies for disability at the social institutions in Jakarta Capital City. This study used an exploratory study design with a rapid assessment survey approach, using a secondary data analysis method supported by interviewing stakeholders at the Social Institutions in Jakarta Capital City that handle disabilities. Secondary data was obtained from several books, national and international journals, relevant government regulations and policies, as well as selected news regarding the COVID-19 prevention policies for people with disabilities, especially those in Social Institutions. Furthermore, interviews were conducted with stakeholders referring to Edward III's theory of policy implementation analysis as an enrichment of secondary data.

According to Edward, analysis of the implementation process of a policy/program can be done by looking at four aspects; 1) Communication, 2) Resources, 3) Attitudes or Disposition, and 4) Organizational Structure.[19] So that in this study, an analysis of these four aspects was carried out in the implementation of the COVID-19 prevention policy for people with disabilities. The benefit of this research is to provide information about the implementation of COVID-19 prevention policies at the social institutions for disability in Jakarta Capital City. Provide useful input to continue improving COVID-19 prevention services for people with disabilities for the Ministry of Health, Ministry of Social, Regional Government Health Office and Social Service of the Jakarta Capital City, and other government agencies. For the community are to increase family knowledge and health concern, especially for people with disabilities, and increased awareness of the role of empowerment and community involvement in supporting inclusion during the COVID-19 pandemic.

Results

Policy Overview

Since the World Health Organization (WHO) statement regarding a public health emergency of international concern related to COVID-19, on February 27, 2020, 38 countries have reported to WHO about this outbreak in their country.[21] In Indonesia, COVID-19 was declared a public health emergency in Presidential Decree No. 11 of 2020 on March 31, 2020, and then on April 13, 2020, it was declared a non-natural national disaster through Presidential Decree No. 12 of 2020.[22,23]

Secondary data was obtained through search results from the official website of the Information Management and Documentation Officer (IMDO) of the Provincial Government of the Jakarta Capital City. The policies that apply to the prevention of COVID-19 at the Social Agencies in Jakarta Capital City referred to the Circular Letter of the Head of the Office Social Affairs of the Jakarta Capital City No. 04/SE/2020 concerning Prevention of the Coronavirus in the Social Service Agency/UPT of the Jakarta Capital City.[24] Following up on the COVID-19 situation and condition, the Head of the Social Service issued seven points of attitude or action taken in response to preventing and anticipating the emergence of COVID-19 cases through the Circular Letter of the Head of the Social Service Office of the Jakarta Capital City No. 06/SE/2020, about Precautions against the COVID-19.[25]

Circular Letter is indeed not a statutory regulation (regeling), nor is it a state administrative decision (beschikking), but a policy regulation (beleidsregel) or pseudo-legal regulation (pseudo wetgeving).[26] In the Regulation of the Minister for Empowerment of State Apparatus and Bureaucratic Reform of the Republic of Indonesia No. 80 of 2012 and Regulation of the Head of the National Archives of the Republic of Indonesia No. 2 of 2014, circulars are classified as official document products. Therefore, procedures, ideally circulars, are only limited to official communication tools in the form of notifications to internal circles. Due to its informative nature, circulars may not regulate matters that exceed the authority and conflict with the laws and regulations.[27]

The Circular Letter policy issued by the Head of the Social Service refers to the Instruction of the Governor of the Jakarta Capital City No. 16 of 2020 concerning Increasing Awareness of the Risk of Transmission of the COVID-19 Infection. Based on information obtained from the Social Service, the Head of the Social Institutions, or the Officer, there has been no new policy issued by the Social Service regarding the prevention of COVID-19 for the Social Institution. Likewise, the Health Service stated no particular policy for people with disabilities during the pandemic. This is because the policy is still considered effective until now.

Policy Implementation

As referred to in the Circular Letter of the Head of the Social Service of the Jakarta Capital City No. 04/SE/2020 concerning Coronavirus Prevention in Social Institutions/*Unit Pelaksana Teknis (UPT)* of the Social Service, Jakarta Capital City, the Head of the Institution is obliged to disseminate information about the symptoms, signs, and methods of preventing COVID-19, maintain health, limit activities outside the Social Institution, coordinate with the Primary Health Care (*Puskesmas)* if there are symptoms/symptoms of fever, flu (cold and cough), and coordinate with the Social Service through the Social Rehabilitation Sector.[24] This includes the 3T Program, which the government socialized as one of the main efforts to deal with COVID-19. The 3Ts have the act of conducting a COVID-19 test (Testing), tracing close contacts (Tracing), and follow-up in the form of care for COVID-19 patients (Treatment). In addition to that, wearing masks correctly, keeping a distance and avoiding crowds, washing hands with soap regularly, and being ready to be vaccinated must be carried out.[28]

Implementing the COVID-19 prevention policies in Social Institutions is not easy enough, like what happened in Bina Laras Harapan Sentosa 2 Social Institution for people with mental disabilities, which experienced the most positive confirmed cases of COVID-19 from the other six institutions, with the number of cases at 21 officers and 221 Social Institution residents. As a result of this incident, an evaluation of the health protocol standard operational procedure was carried out. Developing

policies such as minimizing visits to hospitals for immediate treatment by utilizing telemedicine and implementing strict health protocols were carried out to prevent the spread of COVID-19. The following is evidence of the interview excerpt:

> "*In November 2020, 21 officers were affected including the beachhead, but all of them were in without symptoms and in the first wave of covid infected 221 residents were affected by COVID-19 because residents had to go back and forth to the hospital for immediate treatment, such as tuberculosis, HIV and diseases that must be examined in person…After this incident, all SOPs were evaluated, including treatment carried out by telemedicine.*" (P2)

People with disabilities generally have more health care needs, both everyday needs and needs related to the disorders/limitations.[29] Compared to non-disabled people, people with disabilities are more likely to have poor health among 43 countries. The ratio is 42% of people with disabilities versus 6% of non-disabled people who think their health is bad. Accordingly, more than 100 advocacy-related organizations, disability rights coalitions, and emergency management experts in each country urge to respond quickly in addressing the special needs of people with disabilities to maintain their health, safety, dignity, and independence in society during the COVID-19 pandemic.[30]

In the study of policy implementation, Edwards' work has been cited the most by researchers and observers of implementation in Indonesia compared to the model developed by Van Meter and Van Horn. Edwards' explanation of the forms of the concepts he discussed was much more profound and operational. However, his proposed variables were almost similar, even more straightforward than the variables presented by his predecessors.[31] Here is a review of aspects Edward models in this study:

a) Communication

Around the world, activists and people with disabilities have highlighted common concerns in the COVID-19 pandemic situation, focusing on three main areas: medical ableism, cost of living, and communication importance. In these broad areas, specific issues include the availability of ventilators, ethical decision-making in medical emergencies, the need for clear communication, and additional funding.[32] Communication is an important part that must be considered in many developing countries, among others, to reduce the level of panic and the number of infections significantly. Information shared through 'informal' platforms is usually unverified and inaccurate and can contribute to a sizable infodemic that could exacerbate the situation. In fact, as the COVID-19 crisis spread, social media communications expanded significantly, providing fertile ground for communicating unverified information that could potentially harm, among other things, public and population health. Trust and credibility in authorities and government can be eroded. Thus, "the communication process must contain elements of trust, credibility, honesty, transparency, and accountability of information sources."[33]

Communication and coordination for socialization are essential for the achievement of goals. The implementation of face-to-face meetings is directly changed to online meetings or communicated through WhatsApp Groups, E-mails, and other online media, as an effort to maintain coordination of stakeholders in preventing COVID-19 at Social Institutions. This is the interview statement:

> "*The leadership meeting is routine once a month. There is no need to do it verbally, then proceed with writing, it is done as needed via Zoom.*" (P2)

> "*For information, the leadership (Head of the Social Institutions) directly gives it via WhatsApp group and also shares it with his staff.*" (P1)

Regarding the relationship of communication with resources, immediate action is needed in the current COVID-19 pandemic situation, one of which is providing accessible information.[34] From the interview results, it was found that the sources of information and communication have an interdependent relationship. Communication and coordination, as well as socialization, will be more effective if it is aligned with existing resources. The absorption of information is highly dependent on the level of reasoning of the recipient. People with disabilities have limitations in absorbing information, so communication must be built repeatedly and continuously. Officers are required to have an attitude that can apply patience and lead to a better understanding. The following is evidence of the interview excerpt:

> "*We take a personal approach… Let's wear masks, and residents must be told repeatedly to sunbathe every morning. We must be able to educate because there are various types of WBS/residents. Some are aggressive, and some are calm, so we must be able to communicate personally with them.*" (P1)

Likewise, the use of communication technology must be properly digested and practiced by every user to be utilized effectively. At the level of the Social Institutions organization, that the absorption of communication is based on the needs that apply routinely, especially the bond on the part of the Civil Servant/*Aparatur Sipil Negara (ASN)* in collaboration with the honorary em-

ployee/*Penyedia Jasa Lainnya Perorangan (PJLP)* under the operational standards set by the head of the institution. This is the interview statement:

> "*Reports on special conditions are always carried out, and the condition of WBS is reported monthly to the DKI Social Service. Likewise, coordination with other institutions related to tasks and handling is reported regularly.*" (P2)

> "*There is a picket for 24 hours…the officer is a social servant or PJLP, before we take off the picket to report the latest condition of each resident, that condition will be reported to the coaching staff (ASN) whether or not there is a violation of the regulations in force at this Social Institutions.*" (P6)

b) Resources

In dealing with the COVID-19 outbreak quickly, the government must be able to manage the potential that exists in the community. Social power, known as social capital, is expected to be a prominent instrument for the government's success in dealing with the COVID-19.[35] Resources are a determinant of the success of an organization, regarding the readiness of the system to be able to succeed in a mission or goal. The implementation of each policy and information is highly dependent on the readiness of existing resources. In the current pandemic situation, social workers in the Social Institutions are expected to implement COVID-19 prevention policies for residents of the Social Institutions who are people with disabilities. Likewise, there is a need for facilities that can support the operation of the policy, as stated by an officer at Bina Daksa Budi Bhakti Social Institution for people with physical disabilities. The following is evidence of the interview excerpt:

> "*Rooms are limited so we can't keep a distance between one room, there are 20 or 15 or only six, so it's not the same, depending on the room…the problem is there are some rooms that can't be used…only half of them can be used because the condition of the building is damaged.*" (P6)

In addition, aspects of knowledge, attitudes, and practices in COVID-19 were varied based on sociodemographic factors.[36] Characteristics of disabilities that have limitations are a challenge, and social institutions must be able to implement regulations without compromising humanitarian principles. Human resources in social institutions always strive to provide services; usually, human resources are mostly taken from community members. The drawback is that no health care provider can analyze the health condition of Social Institution residents. Psychologists are also needed in certain Social Institutions because psychologists can provide an overview of the development of psychiatric problems experienced by Social Institution residents. This is the interview statement:

> "*There is also a need for psychological human resources assistance at certain institutions because the presence of psychologists can provide an overview of the development of psychiatric problems experienced by residents.*" (DS)

c) The disposition or attitude

Disposition or Attitude of the implementer is the third important factor in the study approach to implementing public policy. Suppose the implementation of a policy is expected to be effective. In that case, the implementers of the policy are required to know what they must do and be able to implement the policy. Most implementers use the possible authority in implementing a policy. One reason for this is that they are independent of policymakers. Another reason for this is the complexity of the policy. However, although the other ways that the implementers take through the authorities depend on the disposition of the policy, in the end, it is their behavior that influences their view of the policy and how they perceive the policy, which is significant to its urgency, from themselves and their organizations.[35]

Like efforts to prevent COVID-19, teach social inmates to wash their hands at Bina Grahita Social Institution was implemented. One of the social inmates in Bina Netra Runggu Wicara Social Institution for people with speech-deaf-blind disabilities stated that restrictions on Social Institution residents' activities inside and outside the Social Institution were carried out. The learning process is still carried out but is limited in number per room.

> "*One example…teaching children to wash their hands…taught by officers…soap is given by officers so that it is orderly and not easy to run out.*" (P4)

> "*The difference during a pandemic is restricted movement, no going out, no crowds, and activity becomes non-existent. For friends, PJJ is still done but is limited to three people per room.*" (D1)

Goggin and Ellis[32] stated in their research that for people with disabilities, such as people with intellectual disabilities and various other communities such as the Deaf community, keeping a distance is not always an option. In fact, the Deaf community cannot communicate without touch and for those who need help in their daily lives. This is experienced at Bina Grahita Social

Institution that handles people with intellectual disabilities in Jakarta Capital City. The Social Institution staff's efforts in preventing COVID-19 have had several obstacles due to the disability conditions of the socially assisted residents. Such as difficulty to implement social distancing, discipline in using masks, and maintaining cleanliness for themselves.

> "*Our resident is a bit difficult to teach to keep a distance… Residents are here for Children with Special Needs, intellectual disabilities…they have an IQ below 60. If they are given a mask, they don't feel comfortable wearing a mask, throw away the mask.*" (P4)

d) Bureaucratic Structure

Issues of institutionalization, lack of services for the community, and inadequate health care for people with disabilities have been exacerbated by the COVID-19 pandemic. Development and implementation of de-institutionalization plans, including emergency de-institutionalization; providing immediate access to essential community supplies and support, including food, medicine, and personal assistance; adopting special policies to protect people with disabilities is urgently needed.[37]

In Jakarta, the bureaucracy related to handling COVID-19 for people with disabilities is generally associated with agencies, such as the Social Service, Health Office, and others, to synergize. If there is no good cooperation between leadership and staff or across sectors, it can hinder implementation. Among them are carrying out the duties and obligations according to the Main Duties and Functions and efforts to divide the responsibilities of activities between several work units. Regional apparatuses have adjusted their respective functions and duties. Social Service is more focused on basic services for neglected people, not only people with disabilities. They usually have a special unit for health, such as Mental Health (Kesehatan Jiwa) by the Health Office. The following is evidence of the interview excerpt:

> "*Regional apparatuses already have their respective functions and duties. It is following the corridors and duties of each...Social Service is more towards basic services for the neglected people, not only people with disabilities. We provide services that are in our orphanage. For health, it usually has a special unit, such as Mental Health.*" (DS)

The statement is in line with Edward III's theory that implementers not only know what actions to take but are also willing to act. Inefficient bureaucratic structure factors still hamper policy implementation. Organizational fragmentation can hinder the coordination needed for the successful implementation of complex policies that require the cooperation of many people.[38,39]

In practice, the head of the Social Institutions has implemented an anticipatory attitude since the outbreak of COVID-19 in Indonesia. The application of the use of masks to all officers and Social Institution residents. There are periodic checks of temperature pressure, oxygen saturation, and blood pressure for all Social Institution residents. The provision of hand sanitizer must include the results of the antigen swab for every guest who enters the nursing home area. Bina Laras Harapan Sentosa 1 Social Institution is the home with the least number of COVID-19 cases with strict health protocols. The following is evidence of the interview excerpt:

> "*We have an SOP for the nurse to check temperature pressure, oxygen saturation, blood pressure, then give hand sanitizer, application of the use of masks to all… For guests, it is currently required for guests who come to have an antigen swab. Then the health protocol must be maintained in our Social Institutions, at least for those affected by Corona, so for All officers before re-entering after taking leave they are obliged to swab.*" (P1)

Inclusive Services

Reflected in the 'Shared Responsibility, Global Solidarity' report on the socio-economic impact of the COVID-19 pandemic, it is not just a health crisis but a direct attack on society. The pre-existing social and economic inequalities responses to disability are in danger of getting worse. Some people with disabilities feel a higher probability of death during the pandemic because of their disability. Health care should not be a by-product of privilege or exclusivity reserved for the rich or upper class in society.[40]

Infection in people with disabilities is more likely to happen in the COVID-19 pandemic situation. Other factors can be attributed to inaccessible physical environment and infrastructure and poor accessibility to health care facilities.[41] The interview results also showed that there were efforts from the nursing home staff to respond to Social Institution residents who had symptoms of COVID-19. The Social Institution also provides special rooms for sick residents, so it is not combined with healthy Social Institution residents. Overall service is quite good. This is the interview statement:

> "*If someone is sick, we have a separate isolation room for handling the covid pandemic as it is today.*" (P1)

In addition, Social Institution residents with disability category are also empowered to be independent. When residents return to their family or community, at least they can take care of themselves and have the habit of

living clean. The Health Office also strives to provide inclusive services for people with disabilities. Such as the priority of vaccines for the elderly and vulnerable groups of people with disabilities. Vaccination has been carried out from the start of April 2020. This is the statement:

> "*When they have managed to meet their family or return to the community, at least they can take care of themselves…one of them is taught to take a bath, so it is an orientation for personal hygiene.*" (P1)

> "*Also making efforts to provide priority vaccine services to the elderly and vulnerable groups such as people with disabilities. Currently, the vaccine is accelerating. It's been done since early April or around the end of March.*" (DK1)

Conclusion

Based on the results of this study, the researchers concluded that the implementation of the COVID-19 prevention policy at the Social Institution for Disabilities in Jakarta Capital City has been going well. The socialization and coordination process related to the COVID-19 prevention policy at the Social Institution for Disabilities of Jakarta Capital City has gone well among fellow officers. However, they have communication barriers with Social Institution residents because of their type of disability, such as those with mental and intellectual disabilities who are difficult to understand.

The resources at each Social Institution have supported the implementation of the SE policy from the head of the Social Office. Human resources with a psychologist educational background are urgently needed to assist residents with mental and intellectual disability categories. The existence of damaged room facilities can be an obstacle to the progress of implementing COVID-19 prevention in nursing homes, such as increasing the density of residents (WBS) in other rooms.

The disposition or attitude of every officer in a disability home has correctly understood the procedures contained in the SE Head of Service policy for the Social Institution environment and the handling of residents. Residents' conditions that have different levels of severity make it difficult to discipline because of their limitations. It becomes a challenge for facilitators to adjust the right attitude. The attitude in implementing the COVID-19 prevention policy for disability at the social institutions in Jakarta Capital City can be stated to be quite good.

In the bureaucratic structure, regional apparatuses generally have adjusted their respective functions and duties. The Social Service is more focused on basic services for neglected people and people with disabilities, while for health, it has a special unit for physical health and mental health at The Health Office. Cross-sectoral coordination and collaboration have been carried out, such as priority vaccine services for people with disabilities as a form of inclusive services.

Recommendations

Based on the results of the analysis of the implementation of COVID-19 prevention at the Social Institutions for Disabilities in Jakarta Capital City in 2021, the researchers provide the following suggestions or recommendations:

For Regional Governments and The Social Services: There is a need for tailored policies for people with disabilities. A psychologist in the Social Institutions is needed so that residents will get better attention. Required repair of damaged facilities, provide bulkheads or room dividers to facilitate occupant control and minimize the possibility of transmitting diseases such as COVID-19. Socialization, both digital and printed, is needed from The Social Service and other government sectors to the community so that there will be no more rejection of people with disabilities.

For the society: after returning to the community, residents with disabilities should be empowered according to the skills they got while in social institutions, with the support of community leaders in realizing inclusion during the COVID-19 pandemic. Promote disability-friendly villages or sub-village/neighborhoods *(RT/RW)* to create inclusiveness for people with disabilities in society.

For the other researchers: more studies on disability can be developed, especially in Indonesia, to make it more inclusive by enlarging the sample or on a larger scale or using other research methods.

Abbreviations

COVID-19: coronavirus disease 2019; IMDO: Information Management and Documentation Officer; SE: Surat Edaran/Circular letter/Circular; WHO: World Health Organization; RT/RW: Neighborhood/sub-village; ASN (Aparatur Sipil Negara): Civil Servant; PJLP (Penyedia Jasa Lainnya Perorangan): Other Personal Service Provider/ Honorary employee; WBS: Warga Binaan Sosial/Residents in Social Institutions.

Ethics Approval and Consent to Participate

This study has been approved by the Commission for Research Ethics and Public Health Service, Faculty of Public Health, University of Indonesia Number: Ket-312/UN2.F10.D11/PPM.00.02/2021.

Competing Interest

The author declares that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

The data that support the findings of this study are available from the

corresponding author upon reasonable request.

Authors' Contribution

CM and DA were involved in the design study, analyze data, compile, and revise the script. All authors read and approved the final manuscript.

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Spatial-Temporal Analysis of Solar Radiation Exposure and COVID-19 Cases in Jakarta 2020

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Abstract

To date, coronavirus disease 2019 (COVID-19) is still a threat to public health systems around the world. As of July 25, 2021, the numbers were still increasing in most countries, and the total confirmed cases reached 194,582,750 with 4,171,672 deaths (CFR 2.1%). In Indonesia, 3,166,505 cases were reported with 83,279 deaths (CFR 2.7%) in all provinces and dominated by cases from Jakarta. Therefore, this study aimed to find a correlation and the duration of solar radiation exposure spatially on the pattern of COVID-19 cases. An ecological design was used based on time and place with the integration of geographic information systems and statistical techniques. The correlation test results between solar radiation exposure and COVID-19 cases in Jakarta showed a significant relationship (p = 0.000) with a strong closeness and positive pattern (r = 0.666). Furthermore, the spatial map overlaying solar radiation exposure and COVID-19 cases showed urban villages with high radiation tend to increase in cases earlier than areas with moderate and low. The differences in geographical and temporal conditions are a concern for the Provincial Health Office. This can be a consideration in strengthening more specific prevention and control programs according to the risk level and characteristics of each region.

Keywords: COVID-19, solar radiation exposure, spatial-temporal

Introduction

Until now, COVID-19 is still a threat to public health systems around the world.[1] As of July 25, 2021, the numbers were still increasing, reaching 194,582,750 confirmed cases with 4,171,672 deaths (CFR 2.1%) in 222 countries.[2] In Indonesia, the first confirmed case was reported on March 2, 2020, then increased rapidly and spread throughout the region.[1] As of July 25, 2021, the reported positive cases were 3,166,505 with 83,279 deaths (CFR 2.7%) from all provinces dominated by Jakarta (786,882 cases), West Java (563,768 cases), and Central Java (348,675 cases). Through this relatively high number, Indonesia ranked 14, eclipsing China as the original country of this disease and was the highest in Southeast Asia.[2,3]

Climatic factors such as solar radiation exposure (Ultraviolet light) are thought to affect the viability of the SARS-CoV-2.[4] The sun emits light that naturally contains Ultraviolet (UV) light, but some are absorbed by the ozone layer and water vapor in the atmosphere, hence, only a small portion reaches the earth's surface.[4,5] The UV lights reaching the earth's surface still have harmful effects on viruses and other micro-organisms.[4] Sloan *et al.* (2021) showed the survival of SARS-CoV-2 decreased significantly and rapidly when exposed to solar radiation exposure.[6] A study in the United Kingdom showed higher exposure to UV lights in spring 2020 increased viral inactivation potential outdoors.[7]

The effect of solar radiation exposure on SARS-CoV-2 was proven by Ratnesar-Sumate *et al.* (2020)[8], that simulated radiation exposure rapidly inactivated the virus suspended in either saliva or culture media and dried with stainless steel coupons. Furthermore, as much as 90% of infectious viruses were inactivated every 6.8 mins in simulated saliva and every 14.3 mins in culture media when exposed to simulated solar radiation exposure representing the summer solstice at 40° North Latitude at sea level on the same bright day. Significant inactivation also occurs, albeit at a slower rate, under lower simulated radiation exposure levels. The study provided the first evidence that solar radiation exposure rapidly inactivates SARS-CoV-2 on surfaces. Also, it showed that persistence and subsequently the risk of exposure can vary significantly between indoor and outdoor environments. Besides, these data suggested that natural solar radiation exposure is effective as a disinfectant for contaminated

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Regional environmental problems are not the same between regions, therefore a spatial approach is needed in the development of environmental health. This approach describes the relationship between an incident phenomenon and all objects existing on the earth's surface with a relationship with each other.[9] Therefore, this study aimed to determine the correlation patterns and spatial relationships of solar radiation exposure to the pattern of cases in Jakarta. It can then be used as consideration for formulating programs or policies regarding COVID-19 prevention and control.

Method

This study used a quantitative method with an ecological design based on time and place that is descriptive observational with the integration of geographic information systems and statistical techniques. The population was weekly data of COVID-19 cases recorded at the Jakarta Provincial Health Office from March to September 2020. In this study, all population members were sampled (total sampling). Besides, daily solar radiation exposure data in Jakarta Province were also collected and converted into weekly data for seven months (March-September 2020). The timing was due to the limited availability of data at the study time. The location covered the entire Jakarta Province consisting of 267 urban villages.

The secondary data were obtained from several related agencies for the period March-September 2020. This consisted of data on COVID-19 cases obtained from the Jakarta Provincial Health Office and solar radiation exposure data were accessed online through the Meteorological, Cilmatology, and Geophysical Agency/ *Badan Meteorologi, Klimatologi, dan Geofisika (BMKG)* website at https://dataonline.bmkg.go.id/home. Furthermore, the basic map of Jakarta with urban village boundaries was downloaded directly from the GADM (Global Administrative Areas) Maps and Data website at https://gadm.org/. Also, were accessed online via https://www.gps-latitude-longitude.com/.

Bivariate analysis with a correlation test was carried out to determine the relationship between the independent and dependent variables using SPSS 21 software. In addition, spatial analysis was carried out to determine the relationship pattern between two variables using the QGIS 3.0 program.

Results

The average solar radiation exposure from March to September 2020 tended to fluctuate, which ranges from 3.29 to 7.66 hours per week. This tended to increase from March and reached its peak in August and September. Meanwhile, the highest average from March-September 2020 period occurred in the 26th week of 7.66 hours and the lowest average occurred in the 9th week of 3.29 hours.

Statistical Analysis on Relationship

Statistical analysis of the relationship was performed using the Pearson moment correlation test. The analysis was used to state the relationship ($p < 0.05$), closeness (r), and direction (positive/direct or negative/opposite direction). In addition, the data were processed during March-September 2020.

The correlation test results showed a significant relationship ($p = 0.000$) with a strong and positive pattern ($r = 0.666$). This means the higher the solar radiation exposure, the more COVID-19 cases, and vice versa.

Graphical/ Time Trend Analysis on Relationship

In Figure 1, it appears that the duration of solar radiation exposure tends to show a pattern in the same direction as the COVID-19 case. The opposite pattern in the duration of radiation exposure with the cases occurred at weeks 3, 6-8, 11, 16, 19, 23, 24, and 27-29.

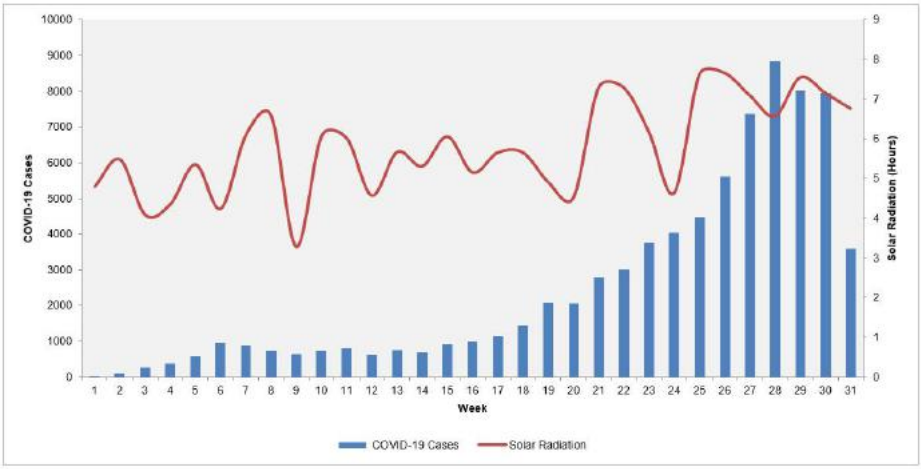

Figure.1 Duration of Solar Radiation Exposure and COVID-19 Cases by Week in Jakarta[10,11]

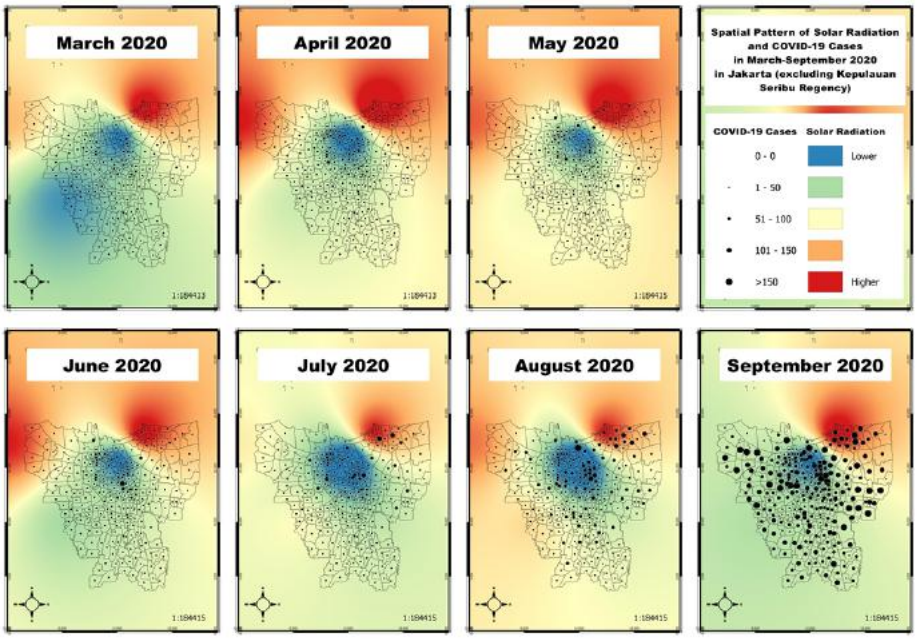

Figure 2. Spatial Patterns between Duration of Solar Radiation Exposure with COVID-19 Cases in March-September 2020[10,12]

Spatial Analysis on Relationship

The spatial analysis by urban villages was shown by a map overlay of the COVID-19 cases per urban village. This was done with a map of the variable duration of solar radiation exposure in Jakarta as the result of interpolation from weather observation stations. The variable duration was described by color gradation and the cases were represented by a dot symbol. Furthermore, interpolation was conducted to predict the relationship of solar radiation exposure with cases in each urban village.

In this spatial analysis, besides making a high-low comparison of the variable duration on the size of cases, it also showed the movement pattern from March to September 2020. There were incomplete case data per village in Jakarta, which was only obtained from March 25, 2020. This affected the pattern of case distribution in March, which tended to be evenly distributed and were in a low category.

The spatial pattern of solar radiation exposure in each month was relatively the same. Also, it was high in the Northeastern area of Jakarta including the villages of Tanjung Priok, Kebon Bawang, Koja, Lagoa, Kali Baru, Rawabadak Utara, Rawabadak Selatan, Warakas, Papanggo, Tugu Utara, Semper Barat, and Cilincing. Meanwhile, solar radiation exposure was happening in almost all areas of the southern part of Jakarta, which included urban villages in South and East Jakarta. Low radiation exposure happened in almost all areas of the Jakarta center, which included the villages of Pasar Baru, Kemayoran, Senen, Gambir, Kebon Kelapa, and the surrounding. However, it can be seen that sub-districts with high solar radiation exposure tended to experience an earlier increase in cases compared to areas with moderate and low. There was also a fairly high spike in cases in July covering Kebon Bawang (101 cases) and Lagoa (101 cases), and in August which included Lagoa (144 cases), Cilincing (131 cases), Semper Barat (109 cases), Rawabadak Selatan (105 cases) compared to other villages in the vicinity.

Discussion

The average radiation exposure from March to September 2020 tended to fluctuate, in a range of 3.29 to 7.66 hours. The correlation analysis between the duration of radiation exposure and COVID-19 cases in Jakarta showed a significant, direct, and strong relationship.[13] This means the higher the radiation exposure, the more the cases. Gupta *et al.* (2020) in India, showed a significant relationship with a positive correlation between solar radiation exposure and COVID-19. In other words, the higher the radiation exposure, the higher the cases.[14]

There are differences in the results of several studies showing that solar radiation exposure plays a role in the inactivation process of SARS-CoV-2.[6,7,15] An epidemiological study by Rosario *et al.* (2020) examined the relationship of solar radiation exposure with COVID-19 cases in Rio de Janeiro. It was stated that solar radiation exposure showed a strong negative correlation with the cases, in other words, high radiation suppressed the virus spread.[16]

Various arguments can be put forward for a unidirectional relationship between radiation exposure and COVID-19 cases in this study, one of which is the hypothesis that people are more vulnerable. This happens when they violate the call to

stay at home and the sun is shining.[17] Due to solar radiation exposure conditions that require a certain time in the virus inactivation on different media, the transmission process may take place before inactivation is achieved.[8] Based on a survey by the Central Statistics Agency in September 2020, it was shown that around 26.46% of the population still did not correctly implement health protocols when outside the house. This condition made the virus transmission more uncontrollable.[18]

Based on a graphic analysis, the fluctuations in the duration of solar radiation exposure tended to show a unidirectional relationship with COVID-19 cases. The spatial map overlay also showed that urban villages with high solar radiation exposure tended to increase in cases earlier than those with moderate and low. This strengthened the significance of radiation exposure influence in increasing the number of cases in Jakarta.

Conclusion

There is a strong and significant relationship between solar radiation exposure and COVID-19 cases ($r = 0.666$; $p = 0.000$). Furthermore, the graphic analysis showed a unidirectional relationship pattern between radiation exposure and the cases. These results are reinforced by an overlay spatial map showing that urban villages with high solar radiation exposure tend to experience an increase in cases earlier than areas with moderate and low.

Therefore, tightening of health protocols, maximum capacity, and rules for operating hours should be implemented in crowded places, especially coastal areas. This can be a consideration for the Jakarta Provincial Health Office in strengthening more specific prevention and control programs according to the risk level of each region.

Abbreviations

BMKG: Badan Meteorologi, Klimatologi, dan Geofisika (Meteorology, Climatology, and Geophysics Agency); CFR: Case Fatality Rate; COVID-19: Coronavirus Disease 2019; QGIS: Quantum Geographic Information System; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; SPSS: Statistical Product and Service Solutions; UV: Ultraviolet.

Ethics Approval and Consent to Participate

This study was approved by the Research and Community Engagement Ethical Committee, Faculty of Public Health, Universitas Indonesia, No. 210/UN2.F10.D11/PPM.00.02/2021.

Competing Interest

The authors declare that there is no competing interest.

Availability of Data and Materials

Data on COVID-19 cases are available on the Jakarta Provincial Health Office at https://corona.jakarta.go.id/id. Furthermore, data on the duration of solar radiation exposure can be accessed through the website of Meteorology, Climatology, and Geophysics Agency at https://dataon-line.bmkg.go.id/home. The base map for Jakarta is available on the GADM Maps and website at https://gadm.org/. In addition, coordinate data for weather monitoring stations can be accessed via https://www.gps-latitude-longitude.com/.

Authors' Contribution

YAS contributed substantially to the concept, work design, data analysis, interpretation, and drafting of the manuscript. DS made critical revisions of important intellectual content, raised funding, and finalized approval of the version to be published.

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Large-Scale Social Restriction (LSSR) Policy and Dengue Hemorrhagic Fever Cases during the COVID-19 Pandemic in Indonesia: A Case Study of Five Subregions of East Java Province

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Abstract

The first case of coronavirus disease 2019 (COVID-19) in Indonesia was announced in March 2020. Since then, the number of COVID-19 cases has continued to rise. This prompted the government to adopt *Pembatasan Sosial Berskala Besar* (PSBB) or large-scale social restrictions (LSSR). Certain areas within dengue fever endemic regions face two challenges: simultaneously tackling COVID-19 and dengue hemorrhagic fever (DHF). Five economic growth centers (a city and four districts) in East Java Province (Gresik, Bangkalan, Surabaya, Sidoarjo, and Lamongan) were affected by the COVID-19 pandemic and a dengue fever outbreak. This is a quantitative research with a comparative study design that used the Wilcoxon test to compare cases of DHF pre-COVID-19 versus during the COVID-19 pandemic. The Wilcoxon test result showed no significant difference at a p-value of 0.319 (p-value > 0.05). It can be concluded that DHF still became a challenge in five regions in East Java Province, even though LSSR were implemented. Additional effort is required to tackle DHF. A method of preventing and controlling DHF during the COVID-19 pandemic is to build community independence through the "one house, one health cadre movement."

Keywords: COVID-19, dengue hemorrhagic fever, large-scale social restrictions

Introduction

On March 11, 2020, the World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) a global pandemic.[1,2] In Indonesia, public health emergency status was announced on March 31, 2020, through Presidential Decree No. 11 of 2020. On the same day, the Indonesian government adopted *Pembatasan Sosial Berskala Besar* (*PSBB*) or a large-scale social restrictions (LSSR) policy as a form of government intervention to prevent the spread of COVID-19. The policy was issued through Government Regulation No. 21 of 20203 and implements LSSR to reduce the spread rate of COVID-19.[3,4] The LSSR policy leads to limited community activity and mobility, including efforts to control dengue hemorrhagic fever (DHF).[2,5]

Dengue hemorrhagic fever is an infectious disease caused by the dengue virus and is transmitted through mosquito vectors of the *Aedes aegypti* and *Aedes albopictus* species, which attack approximately 400 million people worldwide annually. Dengue fever is caused by four closely related dengue virus serotypes (which contributes to its endemicity as serotypes tend to mutate over time) and morbidity due to secondary and subsequent dengue infection has a higher likelihood of developing into dengue fever.[6] As of June 25, 2021, there were 2,072,867 confirmed cases of COVID-19 in Indonesia, with a death toll of 56,371 people, across 510 cities and districts in 34 provinces. The provinces with the highest cases of COVID-19 are Jakarta, West Java, and Central Java.[7] As of April 19, 2021, there were 6,122 cases of dengue fever, with a death rate of 65 people. The cases were spread over 252 cities and districts in 20 provinces.[8]

The LSSR have the effect of limiting community activities due to measures such as social distancing, imposing work from home (WFH) arrangements on workers, school from home, closing offices, and limiting religious activities.[9,10] Regarding DHF, East Java Province is one of ten provinces with a high case fatality rate (CFR). The CFR is considered high when a province has an CFR above 1%, and East Java Province's CFR is approximately 1.34%. The other nine provinces are Gorontalo (2.18%), North Sulawesi (1.55%), Southeast Sulawesi (1.47%), Central Kalimantan (1.37%), Central

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Java (1.24%), West Papua (1.23%), Riau Islands (1.20%), West Kalimantan (1.16%), and Papua (1.12%).[11] A high CFR indicates that steps must be taken to improve the quality of health services in that province.

The Surabaya Metropolitan Area, known locally as *Gerbangkertosusila* (an acronym of Gresik-Bangkalan-Mojokerto-Surabaya-Sidoarjo-Lamongan), is the country's second-largest metropolitan area, after the Jakarta metropolitan area.[12] It is the most crowded area in the East Java Province and its subregions of Gresik, Bangkalan, Surabaya, Sidoarjo, and Lamongan have become the center of economic growth in East Java Province. The government implemented the LSSR to prevent the spread of COVID-19, considering the various activities that typically take place in the area. However, no study has been conducted to determine whether LSSR impacts the spread of endemic communicable diseases, such as DHF. Hence, this research was undertaken to determine whether there is a significant difference between the number of DHF cases in the year before the COVID-19 pandemic (2019) and during the COVID-19 pandemic (2020). This research concentrated on the impact of the LSSR on the prevalence of DHF in five subregions of East Java Province (Gresik, Bangkalan, Surabaya, Sidoarjo, and Lamongan).

Method

This is a quantitative research with a comparative study design. This study compared the number of DHF cases in five subregions of East Java Province (Gresik, Bangkalan, Surabaya, Sidoarjo, and Lamongan) during a pre-COVID-19 pandemic period (2019) against the COVID-19 pandemic period (2020). The data used in this research include monthly DHF data for 2019 as data for the pre-LSSR period and monthly DHF data for 2020 as DHF data for the period during which the LSSR was implemented. This data was obtained from the health offices of each district and city: the Health Office of Gresik District, Health Office of Bangkalan District, Health Office of Surabaya City, Health Office of Sidoarjo District, and the Health Office of Lamongan District. The data obtained was ratio data, which was edited, processed, cleaned, and then described. Next, the normality of the data was determined to select a suitable statistical test. The normality test was performed to assess the condition of the data and ascertain what tests could be performed. Because the data is not a normal distribution (Table 1), the Wilcoxon test was used. The Wilcoxon test was performed to determine whether there is a significant difference between the prevalence of DHF cases in 2019 (before the COVID-19 pandemic) and in 2020 (during the COVID-19 pandemic). The results of the analysis are presented as tables and narratives.

Table 1. Normality Test for the Data

Data	Cities/Districts	DHF Cases	Normality Test
2019	Gresik	441	0.000
	Bangkalan	172	
	Surabaya	277	
	Sidoarjo	367	
	Lamongan	381	
2020	Gresik	84	0.003
	Bangkalan	104	
	Surabaya	73	
	Sidoarjo	148	
	Lamongan	111	

Table 2. Wilcoxon Test

Data	Cities/Districts	DHF Cases	Wilcoxon Test (α = 0.05) p-value
2019	Gresik	441	0.319
	Bangkalan	172	
	Surabaya	277	
	Sidoarjo	367	
	Lamongan	381	
2020	Gresik	84	
	Bangkalan	104	
	Surabaya	73	
	Sidoarjo	148	
	Lamongan	111	

Data sources: a.) Bangkalan District Health Office, b.) Lamongan District Health Office, c.) Gresik District Health Office, d.) Sidoarjo District Health Office, e.) Surabaya City Health Office

Results

The Wilcoxon test returned a p-value score greater than α (0.05). The result indicated that there was no significant difference between the prevalence of DHF cases during the pre-COVID-19 pandemic period (2019) and the COVID-19 pandemic period (2020).

Discussion

The COVID-19 pandemic has become the major health focus for all countries because of its high mortality and morbidity rates. The health care system in Indonesia has been affected, with most of the available resources diverted to tackling COVID-19. Consequently, LSSR were implemented to prevent a rise in the number of COVID-19 cases.[13] The LSSR policy was issued by the central government through the Ministry of Health of the Republic of Indonesia to overcome the COVID-19 pandemic.[14] This policy is stated in the Regulation of the Minister of Health of the Republic of Indonesia No. 9 of 2020 concerning Guidelines for Large-Scale Restrictions in Handling Coronavirus Disease 2019 (COVID-19). Regarding government policies linked to the COVID-19 pandemic, the government of the Lamongan District also adopted policies to reduce the spread of the disease. The Lamongan District Government issued Lamongan District Government Regulation No. 35 of 2020 concern-

ing Guidelines for Preventing and Controlling the COVID-19 in the Emergency Transition to Recovery, which established a COVID-19 Acceleration Handling Task Force/*Gugus Tugas Percepatan Penanganan (GTPP)* to accelerate the handling of COVID-19.[15]

The Ministry of Health projected that the spread of COVID-19—with the number of cases and deaths increasing— across the globe would impact the political, economic, social, cultural, and defense and security facets of the Indonesian nation, as well as the welfare of the people in Indonesia.[16] In East Java Province, Greater Surabaya has a relatively high COVID-19 spread rate. As a critical business center in the East Java Province, Surabaya has direct regional interaction with Sidoarjo and Gresik Districts.[17] Mutation of the causative pathogen cannot be discounted in an epidemic, nor should conditions that facilitate its adaption to new behaviors such as limiting people's activity to prevent the spread of the virus. For example, the era of the new normal, during which the people of Indonesia are unignorably impacted by a DHF epidemic and have to adjust to the epidemic. This was also done in the face of the global COVID-19 pandemic.[18]

There is a cyclical pattern, with DHF virus transmission increasing during the rainy season. The interaction between temperature and rainfall is an essential determinant of dengue virus transmission because colder temperatures improve the survival rate of adult mosquitoes, which in turn affects the rate of dengue virus transmission.[19] In addition, rainfall and temperature affect diet and mosquito reproduction and increase the density of vector mosquitoes.[20] In the COVID-19 pandemic situation—currently being experienced—the model of the independent *juru pemantau jentik (jumantik)* program (one house, one health cadre movement) is the most effective method for preventing DHF. The success of this dengue fever prevention effort is determined primarily by the cohesiveness and awareness of the community as a whole, because mosquitoes—as disease vectors—have high mobility to move from place to place, spreading disease. Therefore, it is hoped that through the activities of the independent jumantik program, participants can socialize and proliferate their respective areas in their neighborhoods with mosquito repellent plants.[21]

Conclusion

It can be concluded that DHF is still a challenge in five sub-regions of East Java Province. Adopting LSSR have no impact on resolving the spread of DHF because there is no significant relationship between the prevalence of DHF prior to the COVID-19 pandemic and during the COVID-19 pandemic. The COVID-19 pandemic did not make the prevalence of DHF any different from the rates recorded in the previous year. Therefore, additional effort is required to reduce the number of dengue cases occurring during the COVID-19 pandemic. An effective method for lowering the growing prevalence of DHF is to build community independence through the one house, one health cadre movement.

Abbreviations

COVID-19: coronavirus disease 2019, CFR: Case Fatality Rate, WHO: World Health Organization, DHF: Dengue Hemorrhagic Fever, LSSR: Large-Scale Social Restrictions, WFH: Work from Home, GTPP: Gugus Tugas Percepatan Penanganan (Acceleration Handling Task Force)

Ethics Approval and Consent to Participate

Permission to use the data used in this study was granted by the Research Center, Faculty of Dental Medicine, Universitas Airlangga Ethical Clearance Commission (number: 276/HRECC.FODM/VI/2021).

Competing Interest

The authors declare that there are no competing interests to disclose.

Availability of Data and Materials

The data used in this study are available in the COVID-19 Task Force database of the Ministry of Health, Republic of Indonesia, and existing literature related to DHF data during the COVID-19 Pandemic.

Authors' Contribution

The research design was developed jointly by AYT and MAM. MFDL and HBN performed the analysis, and RY drafted the manuscript.

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Public Health Priority in Handling the Ongoing Pandemic

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The occurrence of an influenza pandemic a century ago did not cause the global community, particularly the public health sector, to be vigilant and take preventive measures to reduce the impact or mitigate the ongoing pandemic. Understandably, there were so many victims in the previous century because science and technology were not as advanced as they are today, especially in medicine, communication, and public health. Today, it seems that scientists have neglected the great problems that occurred in the past, such as the stuttering response to the coronavirus disease 2019 (COVID-19) pandemic that started in 2019, during which the entire world appeared stunned in the face of the viral attack, which emerged so quickly and in waves.[1] Furthermore, it is not incorrect to consider this pandemic event to be the third world war, involving the use of biological weapons that cannot be identified from where and against whom the attack was launched.

Around the 1950s, Leavell and Clark developed the concept of disease stages as "five levels of disease prevention," which included "health promotion, specific protection, early diagnosis and prompt treatment, disability limitation, and rehabilitation."[2] Meanwhile, advances in medical technology and the role of economics in health have resulted in the development of medical science and a strong economy, which are solutions to deal with today's health problems. However, the issue arises when deciding which of these two major issues should be prioritized or mainstreamed. Specifically, aren't these two issues interconnected?

Some countries prioritize the economy in their policies, while others prioritize medicine in dealing with the pandemic. According to research conducted in three Asian countries, these two factors are indeed related. However, a firm decision derived from a single study is insufficient in choosing between both factors to produce a better result and conclusion since many other variables contribute to the different conditions of countries in many ways.

In the race against the pandemic, various parties and scientists are looking for ways to overcome it through research based on their abilities and thoughts. Some are focused on the host, investigating how humans can maintain their body strength and immunity to destroy the virus already inside the body, alongside avoiding viral exposure. Meanwhile, others intervene in the physical environment, either by attempting to kill the virus or avoiding it through social distancing. Conversely, others are attempting to find a way to disable the causal agent of the virus. Consequently, it appears that the virus has remained at the forefront so far since its inception because no effective treatment of choice has been discovered to eradicate the virus, and it continues to mutate, producing more virulent variants.

In addition, to ensure that these efforts are not in vain and meet ethical standards, they must be supported by evidence obtained through research. Meanwhile, many studies are focused on treatment and vaccination, which involves curing the sick and preventing people from getting sick, rather than preventing people from becoming infected. Unfortunately, some may view the situation as a business opportunity and develop research in its material aspects. Vaccines, plasma, drugs, or medical devices, such as oxygen and its tubes, or even medical services and facilities, are some of the aspects exploited in this regard because sick people are helpless consumers with no choice. The same is true for preventive equipment such as masks, face shields, and personal protective equipment (PPE). However, these may not matter to wealthy countries or people because they can afford them even if they are expensive.

Conversely, for emerging countries or people, this will worsen debt and economic difficulties, and social problems in the present and future years since the world's situation after the pandemic is over cannot be figured out. Meanwhile, many countries experienced malaise during the pandemic a century ago, which caused new problems, including in the health sector. In addition, this could lead

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to a rise in mental health issues, which are known to be harmful to sufferers, their families, communities, and even the country. Is it expected?

Therefore, research and efforts to solve the pandemic problem must go hand in hand. When compared, research related to physical aspects is more appealing than that associated with the non-physical aspects, such as agent, host, and environmental factors.[3] Furthermore, non-physical research, such as policy analysis, behavioral research, communication, information, and others, are less prevalent and can play a critical role in preventing the onset of the pandemic. Factors such as the discovery of appropriate policies and the behavior of policymakers, health workers, and the public, alongside effective communication patterns in dealing with crises, and useful information for the community and its control, all contribute significantly in reducing activities such as work at the specific protection, early diagnosis, and prompt treatment stages.

It can be concluded that the majority of the countries globally are attempting to overcome the pandemic, which is a public health domain requiring medical and economic interventions. At the same time, medicine and economics are the determinants of public health, though there are others. Also, the international community has ignored research on how to avoid viral-human contact and the capability to keep viruses at bay, which explains why health promotion has been neglected since the onset of the pandemic.[4]

Abbreviations

COVID-19: coronavirus disease 2019; PPE: personal protective equipment.

Ethics Approval and Consent to Participate

Not applicable.

Competing Interest

The author declares that there is no competing interest.

Availability of Data and Materials

The data were obtained from some of the articles in Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal) Vol. 16, Special Issue No. 1 as this review was supposed to be the editorial.

Authors' Contribution

ZT is responsible for all the writing and concepting the article.

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Burundi's 'Worst Enemy': the Country's Fight Against COVID-19

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Abstract

Coronavirus disease 2019 (COVID-19) has proved to be a severe global public health threat, causing high infection rates and mortality worldwide. Burundi was not spared the adverse health outcomes of COVID-19. Although Burundi's initial response to the COVID-19 pandemic was criticized, hope arose in June 2020 when the new government instituted a plan to slow virus transmission that included public health campaigns, international travel restrictions, and mass testing, all of which proved effective. Burundi has faced many challenges in containing the virus, the first of which was the lack of initial preparedness and appropriate response to COVID-19. This was exacerbated by factors including shortages of personal protective equipment (PPE), limited numbers of life-saving ventilators (around 12 ventilators as of April 2020), and the presence of only one COVID-19 testing center with less than ten technicians in July 2020. Moreover, as Burundi is amongst the poorest countries in the world, some citizens were unable to access necessities such as water and soap, required for compliance with government recommendations regarding hygiene. Interestingly, Burundi did not implement a nationwide lockdown, allowing mass gatherings and public services to continue as usual due to a firm belief in God's protection. As the daily confirmed cases have tripled since December 2020, Burundi must prepare itself for the threat of a new wave. Establishing precautionary measures to contain the virus and strengthening the health surveillance system in Burundi would significantly positively impact the prevention and management of COVID-19.

Keywords: Burundi, challenges, COVID-19, health policy, strengths

Introduction

Coronavirus disease 2019 (COVID-19), caused by the novel coronavirus, had spread rapidly worldwide since December 2019, when it was first detected in China. The World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020. African countries were severely affected and struggled to cope with the new challenges presented by this unprecedented outbreak. The landlocked country of Burundi is amongst the poorest countries in Sub-Saharan Africa and the world, with a dense population of around 12 million.[1] Burundi reported its first two COVID-19 cases on March 31, 2020. The virus was thought to originate from Rwanda and Dubai, with the infected individuals testing positive on March 30, 2020.[2] As of May 24, 2021, Burundi has had 4,494 cumulative confirmed cases with six deaths.[3] Burundi has made great efforts and faced significant challenges in its response to COVID-19, and the authors aimed to comment on both these aspects in this paper critically.

Efforts

Burundi started the fight against COVID-19 on March 18, 2020, when testing and limited preventive measures were implemented by the Ministry of Public Health and the Fight Against AIDS. The preventive measures to contain the virus included handwashing with soap and clean or chlorinated water and avoiding physical contact through handshakes or hug.[4] Burundi continued to run elections and other activities in the midst of the pandemic, and the limited preventive measures instituted under the presidency of Peter Nkurunziza (who died on June 8, 2020, a few days after the elections) in response to the COVID-19 pandemic were criticized by the global health community as downplaying the outbreak and underestimating its risks.

Fortunately, the new president, who came into power in June 2020, devised a new plan for instituting preventive measures and declared COVID-19 as Burundi's 'worst enemy.'[5] This act moved the narrative away from the in-action of the previous government, creating a sense of urgency and issuing a call to action.

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An essential step in the fight against the novel coronavirus was achieved by initiating public health campaigns and mass public testing, including 30,000 students residing in boarding schools.[6] The impact of these measures in containing the virus is indisputable. As of May 18, 2021, 302,488 tests have been performed in public testing centers and health districts. The testing campaigns covered suspected cases, contact tracing, and international travelers. The treatment was provided in hospitals to symptomatic individuals free of charge. Positive cases were managed in isolation rooms in public health facilities while some asymptomatic patients isolated themselves at home.

Interestingly, on April 20, 2021, Burundi inaugurated the public health emergency operations center, coordinating activities and responses to health emergencies.[7] Its campaign included advice on social distancing, self-isolation in case of symptoms, wearing masks, and handwashing. Furthermore, stricter preventive measures were announced, including the closing of all borders. This measure was the second time reinstated this year as COVID-19 cases begin to rise in some parts of Africa, with a seven-day quarantine requirement for anyone arriving in the country. Finally, communicating information about the virus, such as the numbers of newly confirmed cases and deaths and news about the state of the pandemic locally and worldwide, gained importance in raising awareness and promoting public health through the education of Burundi's citizens.[8] As a result, more cases were detected and quarantined, preventing others from acquiring avoidable infections (Figure 1).

Challenges

COVID-19 hit Burundi when leaders were mainly concerned with communal, legislative, and presidential election campaigns. In addition, Burundi previously faced challenges in coping with other epidemics, including measles, malaria, and cholera, as well as floods that severely damaged the country.[9,10] With a low health index score of 8.9 on the Global Health Security Index and insufficient health infrastructure, Burundi was not initially well prepared to respond to the outbreak. It is not surprising that cases went unreported because residents of Burundi struggled to get tested for COVID-19 in the early months of the outbreak despite showing COVID-19-like symptoms.[11]

Burundi's response to COVID-19 from March to June 2020 was controversial, though the outcomes could have been worse. Two presidents passed away, each of whom ruled the country for at least ten years. The former president, Pierre Buyoya, died outside Burundi, with the cause of death officially documented as COVID-19 infection.[12] Of note, the cause of death of President Peter Nkurunziza, who ruled from August 2005 until his death on June 8, 2020, was officially documented as a heart attack. Thus, Burundi lost two presidents during the COVID-19 era in a matter of months.

Although the first case of COVID-19 was reported at the end of March 2020, no clear response plan was set in motion until June of the same year. The government was accused of not providing fact-based information on COVID-19.[13] This led to the circulation of false rumors about the disease, contributing to widespread misconceptions about COVID-19 and creating an air of uncertainty and fear amongst the population. During this period, healthcare workers noticed an increase in the number of patients presenting with COVID-19-like symptoms. However, few cases were reported. This may be related to a limited testing capability, as only one testing center with less than ten technicians analyzed test samples taken all over the country.[14] Similarly, many healthcare professionals faced infrastructural problems

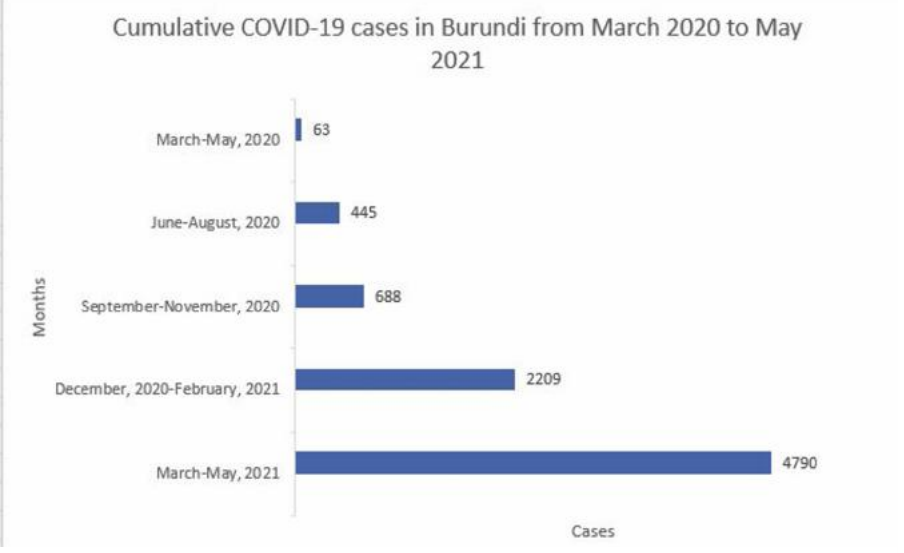

Figure1. Progress of COVID-19 Cumulative Cases in Burundi from March 2020 to May 2021

within hospitals, such as shortages of personal protective equipment (PPE) and availability of only 12 life-saving ventilators.[11] Burundi also faced challenges to COVID-19 testing when case numbers were on the rise. The paucity of reagents required for the polymerase chain reaction (PCR)-based COVID-19-specific tests has been a barrier to providing reliable results.[15] Furthermore, lack of cooperation with WHO representatives expelled from the country after be-ng accused of spreading false information formed a barrier to a global partnership and response.[9]

As Burundi is amongst the poorest countries in the world, some of its residents were unable to access necessities such as water and soap required to comply with the preventive measures.[16,17] Interestingly, Burundi did not implement a nationwide lockdown, allowing mass gatherings and public services to continue as usual. This unpopular measure is related to the authorities' firm belief that God protects Burundi.[9] Moreover, one can assume that this measure was taken to preserve the country's already vulnerable economy and citizens, most of whom depend on daily wages. It was estimated that 80% of the population relies on subsistence agriculture without any social support.[18,19]

Furthermore, some COVID-19 treatment centers were overloaded and could not admit additional patients, resulting in inequitable management of people who tested positive for COVID-19.[20] Crucially, residents blame local public health leaders for failing to implement strict measures to contain the virus.[21] The infection rate has tripled since December 2020, and COVID-19 has spread all over the country as of today. Burundi has also not yet received the COVID-19 vaccine. The WHO declared Burundi ineligible for the global vaccine sharing scheme COVAX (COVID-19 Vaccines Global Access) and did not provide any COVID-19 vaccine thus far.[22]

In addition, instead of presenting to healthcare centers, people with COVID-19 symptoms chose traditional "food medicines," including ginger, lemon, and eucalyptus leaves.[23] Though such traditional "food medicines" are crucial tools of cultural importance in communities' response to health crises, their usage has public health implications. It can prevent people from consulting healthcare professionals and receiving the necessary and appropriate treatment, thus contributing to higher mortality rates and the uncontrolled spread of COVID-19. Developing an unambiguous evidence-based use of such remedies in the prevention and treatment of COVID-19 would greatly benefit the people who choose traditional food medicines or cannot afford modern healthcare.

Discussion

Given the current situation, the government of Burundi and public health leaders need to take responsibility for this pandemic and aim to adopt the WHO's preventive measures while adjusting them to an appropriate and practicable level for the country.[24] Reinforcement of the committee in charge of the COVID-19 pandemic response at different health system levels is also needed. Moreover, it is necessary to ensure the availability of laboratories for screening, adequate PPE, and enough trained personnel to lead pandemic preparedness initiatives and form an appropriate body to monitor the implementation of public health measures and testing.[25] Involving community health workers (CHWs) can be essential in responding to the surge in cases. They can raise awareness in their communities regarding effective response measures to slow the COVID-19 transmission. CHWs play a crucial role in ensuring clinical and community care by reducing the healthcare delivery time as they are present locally, contact tracing and supporting the continuation of the health system.[26]

Notably, specific national public health measures must be established. For example, social events should be minimized, travel into and out of the country reduced, and church services and meetings be given clear guidelines, including increased capacity for contact tracing any positive cases of COVID-19. Moreover, Burundi should embrace vaccination campaigns to ensure that the population is immunized against the virus, like other African countries.[27] Finally, it is critical to establish a country-specific database regarding COVID-19 management as a platform for independent clinical research to provide evidence-based information for public health policies and political decision-making for further improvement in out-break management.[28] Additional global considerations to support and strengthen Burundi's economy and health system could help devise a comprehensive national response plan to tackle COVID-19 and other epidemics.

Conclusion

Burundi's response to the COVID-19 pandemic during the first four months of the outbreak was controversial. However, Burundi has made notable progress from June 2020, expressing urgency and taking significant action against the outbreak. Furthermore, measures including public health campaigns and control of international travel alongside mass testing have had a substantial positive impact. However, Burundi has to face challenges with other preventive measures, such as the availability of soap and handwashing, due to the financial limitations of its citizens. The establishment of specific public health measures will be indispensable in containing the virus.

Abbreviations

COVID-19: Coronavirus disease 2019; WHO: World Health Organization; COVAX: COVID-19 Vaccines Global Access; CHWs: Community Health Workers.

Ethics Approval and Consent to Participate
Not applicable.

Competing Interest
The authors declare no conflicts of interest.

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Not applicable.

Authors' Contribution
EM: Conceptualization and design. HR, EM, EU, TU, AK, SAP, SSR: Data collection and literature review, writing- Original draft preparation and visualization. AA, BN, SMSI, DELP: Supervision, writing- reviewing, editing and proofreading.

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Outdoor Activity: Benefits and Risks to Recreational Runners during the COVID-19 Pandemic

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Abstract

Running has become one of the most popular recreational sports worldwide. It is an easily accessible form of exercise as there are minimal equipment and sport structure requirements. Aerodynamic simulation experiments showed a risk of droplet exposure between runners when two people run in a straight line at a close distance (slipstream). Thus, running activities require a safe physical distance of 10 meters to avoid droplet exposure, which can be a source of transmission of COVID-19 infection. However, running outdoors during the COVID-19 pandemic is still often done in pairs and even in groups without wearing a mask. Open window theory stated that changes in the immune system occur immediately after strenuous physical activity. Many immune system components showed adverse changes after prolonged strenuous activity lasting more than 90 minutes. These changes occurred in several parts of the body, such as the skin, upper respiratory tract, lungs, blood, and muscles. Most of these changes reflected physiological stress and immunosuppression. It is thought that an "open window" of the compromised immune system occurs in the 3–72-hour period after vigorous physical exercise, where viruses and bacteria can gain a foothold, increasing the risk of infection, particularly in the upper respiratory tract. Outdoor physical activity positively affects psychological, physiological, biochemical health parameters, and social relationships. However, this activity requires clear rules so that the obtained benefits can be more significant while simultaneously minimizing the risk of transmission of COVID-19 infection.

Keywords: COVID-19, outdoor physical activity, recreational runner, running behavior

Introduction

In recent years, running has become one of the most popular recreational sports worldwide. It is an easily accessible form of exercise as there are minimal equipment and sport structure requirements. According to data from different regions of the world, running is one of the top 5 adult sports and leisure-time physical activities.[1] In the Netherlands, it was found that about 12.5% of the Dutch population engage in running activities regularly.[2] Running offers various health benefits, including feelings of happiness during and after running, reduced risk of chronic disease,[3,4] and improved mental health,[5] making this type of exercise an attractive health behavior for the general population. Additionally, runners can choose to train alone or in groups, thus introducing a good social aspect to the activity.[6]

Running in an open public space seems to be very enjoyable for most runners. However, during the COVID-19 pandemic, the possible risks when running outdoors need to be taken seriously. Running is not just a sport. It can entail social interaction with a partner who is not family-related. The runner in those casual meetings may have been infected with the COVID-19 virus even though they may be asymptomatic or only have mild symptoms that allow them to continue participating in outdoor activities. However, running outdoors during the COVID-19 pandemic is still often done in pairs and even in groups without wearing a mask. When running, masks are not recommended because of the increased oxygen demand, so runners feel a shortness of breath if they wear a mask while running.[7,8] Thus, the risk of exposure to the virus in runners increases.

Previous studies have typically focused on the benefits and recommendations of physical activity,[4,9] exercise, and the immune system,[10] and droplet exposure between runners.[11] A more complete picture of the benefits and risks of running outdoors during the COVID-19 pandemic is needed to provide policymakers and recreational runners with helpful information and a good understanding of the risks and the necessary preventive measures

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for outdoor running activities. The goals of this review article were three-fold: 1) to highlight whether outdoor activities for runners provided more benefits or risks during the COVID-19 pandemic; 2) to address the harm associated with the virus outbreak that runners are exposed to when running outdoors; and 3) to recommend some practical strategies to mitigate the potential risk.

Method

The literature search was conducted using the following keywords: "COVID-19", "outdoor physical activity," "recreational runner," "running behavior," and "immune system." If multiple documents reporting participation data were found, only the most recent article was retrieved. The publication date was limited to the past ten years from the date of the search. Articles identified by the search engines were assessed by title and abstract. Full-text articles identified as appropriate based on title and abstract were retrieved and assessed for eligibility.

This review began with a brief overview of the comparison between indoor and outdoor physical activities, including why most runners prefer running outdoors rather than running indoors on a treadmill. It then explained recommendations for physical activity for adults and the response of the immune system to moderate or strenuous physical activity. A special section will be devoted to explaining the impact of exposure to viruses and bacteria due to shared outdoor activities. Finally, some recommendations for running outdoors will be given to reduce the risk of exposure to the virus to avoid the trans-mission of viral infections. Recommendations for running outdoors are explained in Table 1, consisting of risk source groups, activities, types of risks, and important recommendations.

Outdoor Activity versus Indoor Activity

Physical activities, such as sports, can be done indoors and outdoors. The indoor environment consists of a closed room, such as a house, gym, or sports hall. The outdoor environment consists of open space, such as a park, field, or an environment with many trees. Engaging in exercise and moving one's body helps a person avoid having a sedentary lifestyle and improves physical health. Sports that are carried out using the correct exercise principles will have a good biological influence and adaptation on the body.[12] Exercise is the best and most affordable option to increase one's immunity and improving one's health status. The benefits of this sport can be directly felt in the immediate effects of feelings of pleasure and happiness after exercising and the long-term effects of increasing physical fitness, improving the immune system, and reducing the risk of cardiovascular disease.[13–15]

Moreover, during the COVID-19 pandemic, it is highly recommended to stay active and exercise to adequately maintain the body's immune system to prevent COVID-19 infection.[16] Exercising can be done at home with various moderate-intensity physical activities, such as walking, strength training, flexibility training, cardiopulmonary endurance training, and a combination of these sports. However, exercising at home has several drawbacks because these activities are sometimes monotonous or done without the company of friends, so it is possible to get bored easily. Consequently, some people choose to engage in more varied outdoor sports and prefer to exercise with friends or the running community they belong to. Outdoor sports are done in open spaces, such as parks, fields, or environments with many trees.

Several studies have shown that engaging in outdoor sports has good psychological, physiological (lowering heart rate and blood pressure), biochemical (noradrenaline, adrenaline, and cortisol) effects on people and enhances their social relationships.[17,18] A green environment has also been shown to reduce stress levels and mental fatigue, improve concentration, attention, cognitive function, and mood, and have positive physiological effects, such as lowering blood pressure.[19] In comparison to indoor exercise, outdoor exercise has a more significant impact in revitalizing positive feelings, reducing depression, and increasing energy.[20]

To participate in physical activity outdoors during the COVID-19 pandemic, runners must understand the principles of how COVID-19 is transmitted. A person infected with COVID-19 can transmit this virus to others 48 hours before the onset of symptoms (presymptomatic) and up to 14 days after the onset of symptoms.[7,21] A study reported that this presymptomatic transmission was 12.6%. This presymptomatic period is critical to understand because the virus can spread through droplets or contact with contaminated objects from someone who is not yet symptomatic. Asymptomatic confirmed cases are also possible sources of transmission, although the probability is very small.[22–24] However, based on a current epidemiological and virological study, it has been proven that COVID-19 is mainly transmitted through droplets from symptomatic people to other people who are in proximity.[24]

Physical Activity Recommendations

According to the World Health Organization (WHO), physical activity is defined as any movement produced by skeletal muscles that require energy expenditure.[25] Physical activity includes sports and other activities that involve bodily movement and are performed as part of play, study, work, active transportation, household chores, and active recreational activities (e.g., dancing, yoga, tai chi).[26] Physical activity can be categorized as light, moderate, and heavy. Light physical activity or

sedentary activity is a physical activity that expends <3 metabolic equivalents (METs) of energy, such as sitting in a relaxed position or lying down but not sleeping. Moderate physical activity expends 3 to 6 METs of energy; it includes walking (4.8 km/hour), brisk walking (6.4 km/hour), cycling (16–19 km/hour), climbing stairs, gardening, dancing, or carrying items with moderate weight (<20 kilograms). Heavy/strenuous physical activity requires a minimum expenditure of >6 METs of energy. Examples of strenuous physical activity include running (≥9 km/hour), cycling (≥19 km/hour), aerobic exercise, mountain climbing, swimming, carrying goods with heavy loads (>20 kilograms), and competitive sports, such as soccer, basketball, and volleyball.[25,27,28]

World Health Organization (WHO) recommends that all adults aged 18 to 64 years should engage in regular physical activity. Every week, adults should do at least 150–300 minutes of moderate-intensity aerobic physical activity or at least 75–150 minutes of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate and vigorous activity, to reap substantial health benefits. Adults should also engage in moderate or higher intensity muscle-strengthening activities involving all major muscle groups two or more days each week for health benefits. Additional health benefits can be obtained by increasing moderate-intensity aerobic physical activity to >300 minutes or do >150 minutes of high-intensity aerobic physical activity, or an equivalent combination of moderate-intensity and vigorous-intensity activity per week.[9,25]

How Physical Activity Becomes a Protective Measure or an Open Window for URTI/COVID-19

Physical exercise has positive and negative effects on the immune response, depending on the intensity and workload of the activities performed.[29,30] Evidence from randomized controlled trials and epidemiological studies supports the theory that regular physical activity can reduce the number of sick days and suggests that the risk of upper respiratory tract infections (URTI) is reduced in people who engage in regular physical activity.[10,31]

During periods of moderate physical activity, it was found that there was no increase in immune-suppressing stress hormones and pro and anti-inflammatory cytokines that showed intense metabolic activity.[10] It is thought that although the immune system returns quickly to pre-exercise levels at the end of the workout session, each session is believed to increase immune control, thereby reducing the risk of infection in the long term.[21] During moderate-intensity aerobic exercise with a duration of <60 minutes, the antipathogenic activity of tissue macrophages occurs in parallel with an increase in circulating immunoglobulins, anti-inflammatory cytokines, neutrophils, natural killer (NK) cells, cytotoxic T cells, and immature B cells, all of which play important roles in immune system defense activity and metabolic health.[10,32]

Therefore, considering the available scientific evidence, it is reasonable to assume that training status influences the level of immunity and URTI incidence. Based on the similarities between the transmission method and the focus of URTI and COVID-19 infection, there may be a relationship between runners' training status and the incidence of COVID-19. However, it cannot be concluded that trained individuals are more protected from COVID-19 infection than untrained individuals. The COVID-19 pandemic has provided an opportunity to evaluate a patient's contaminated sports training history to provide data for further investigation of the protective effect of training status against COVID-19.

However, intensive physical activity, such as strenuous exercise, tends to be detrimental in changing some immunological indices, especially if the activity is accompanied by environmental stress or competition.[10] This can lead to an increased risk of infection, especially in athletes who participate in competitive endurance training or train excessively.[21] Open window theory stated that changes in the immune system occur immediately after strenuous physical activity. Many immune system components showed adverse changes after prolonged strenuous activity lasting more than 90 minutes. These changes occurred in several parts of the body, such as the skin, upper respiratory tract, lungs, blood, and muscles. Most of these changes reflected physiological stress and immunosuppression. It is thought that an "open window" of a compromised immune system occurs within 3 to 72 hours after vigorous-intensity physical exercise, where viruses and bacteria can gain a foothold, increasing the risk of infection, particularly in the upper respiratory tract.[10,32,33]

According to the J-curve model proposed by Nieman and Wentz (2019), the relationship between physical exercise and the risk of respiratory tract infections can be explained as follows: there is a 40–50% reduction in the risk of URTIs in someone who routinely does moderate-intensity physical exercise. Conversely, someone who does heavy-intensity physical exercise will have a 2–6-times more significant risk of URTIs.[10,33]

Based on indirect evidence and a conservative approach, the open window theory and the hypothesis that strenuous exercise sessions will acutely increase the risk of URTI/COVID-19 are still speculative. However, as previously mentioned, strenuous exercise sessions can lead to greater immunodepression. Thus, it is recommended that runners engage in short (≤90 minutes) low- or moderate-intensity training sessions. Thus, moderate-intensity exercise (and not high-intensity exercise) should be recommended as a non-pharmacological, inexpensive, and viable way to cope with URTI/COVID-19.

Exposure to Viruses and Bacteria due to Shared Outdoor Activities

An aerodynamic simulation experiment showed that there was a risk of droplet exposure between runners when two people are running in a straight line at a close distance (slipstream). It makes running activities require a safe physical distance of 10 meters to avoid droplet exposure that could potentially be a source of transmission of COVID-19 infection.[11,29] However, running outdoors during the COVID-19 pandemic is still often done in pairs and even in groups without wearing a mask. When running, wearing masks is not recommended because of the increased oxygen demand, so runners feel a shortness of breath if they must wear a mask while running.[7,8]

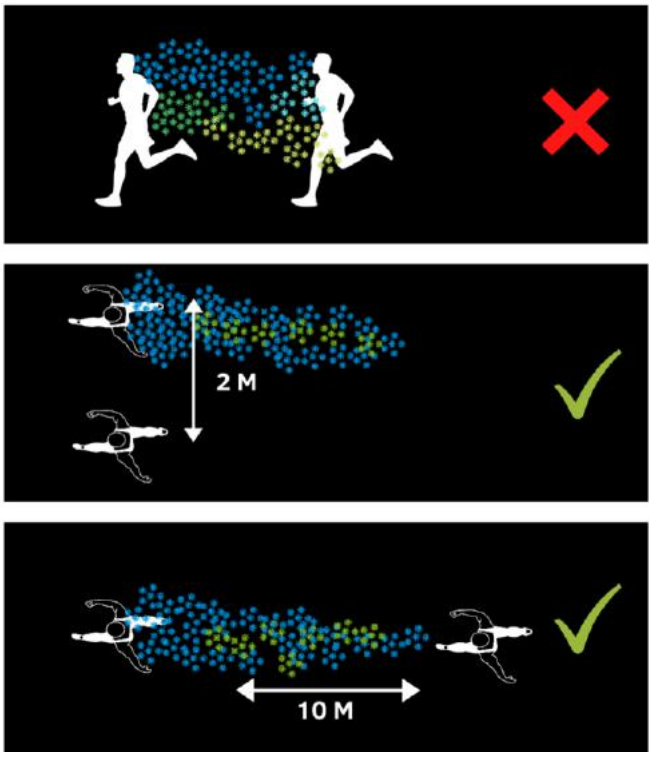

Figure 1. Droplet Spread Pattern when Running Outdoors

Blocken *et al.* (2020) showed that droplet exposure could be avoided by walking or running side-by-side and maintaining a safe distance of 2 meters;[11] however, this is virtually impossible on public roads. The most significant droplet exposure from people walking or running together occurs when two people run in a straight line at a close distance (slipstream). Droplet exposure increases as the distance between the person in front and the person behind decreases. This shows that avoiding droplet exposure can be done by one of two actions: by avoiding walking and running inline at a close distance or by maintaining sufficient physical distance to prevent exposure to droplets due to a person's walking or running speed. The equivalent physical distance for walking and running in a line (slipstream) is defined as the distance that must be maintained between the front walkers/runners and the walkers/runners behind them to avoid droplet exposure, which is equivalent to the condition when two people are

Table 1. Type of Risk and Recommendations for Running Outdoors

Risk related to	Activities	Type of Risk	Recommendation
Types of Exercises	Long runs of more than 90 minutes	Lowers the immune status (3 to 72 hours after strenuous exercise)	Prefer low-moderate intensity exercises rather than strenuous exercise[10,29]
	Hill training, interval training, or endurance training	Lowers the immune status (3 to 72 hours after strenuous exercise)	Prefer low-moderate intensity exercises rather than strenuous exercise[10,29]
Running Behavior	Running in open public spaces	Increases the risk of exposure to viruses and bacteria	Running activities require a safe physical distance of 10 meters to avoid droplet exposure that could potentially be a source of transmission of COVID-19 infection[11,29]
	Running through a crowd	Increases the risk of exposure to viruses and bacteria	Keep wearing your mask properly until you pass the crowd of people[8]
	Running with partners without wearing a mask	Increases the risk of exposure to viruses and bacteria	Avoid running inline (slipstream) at a close distance; it is preferable to run side-by-side to avoid droplet exposure from the runners in front[11]
Social Interaction	Training with a partner who is not a family member	Increases the risk of exposure to viruses and bacteria	Avoid sharing water bottles, exercise mats, towels, and other sports equipment[29]
	Warm-up and cool-down exercises	Increases the risk of exposure to viruses and bacteria	Avoid activities that involve bodily contact, such as shaking hands, warming-up or cooling-down in pairs, and team sports[29]
	Take a photo with friends by removing masks	Increases the risk of exposure to viruses and bacteria	Keep wearing masks properly if you take photos with friends[8]

standing still at a distance of 2 meters. If there is no strong wind, for fast walking at a speed of 4 km/hour, the safe distance is about 5 meters behind the person in front; for running at a speed of 14.4 km/hour, the safe distance is about 10 meters, which may become a problem if there are many people nearby.[11,29] It is possible to run easily with a mask while doing low-intensity exercise/running. However, with moderate/high-intensity exercise/running, it may become difficult to run with a mask, triggering shortness of breath.[8]

In another study,[34] the probability of collision between a runner and micrometric respiratory droplets suspended in the air and rest (from the environment) was discussed within a raindrop collisional model framework. It was shown that, as expected from this theory, the probability of collision does not increase indefinitely with the approaching velocity of the runner; instead, there is a maximum peak or threshold velocity after the efficiency of the collision decreases.[34] However, this theory is only limited to doubting the collision speed between the droplets released by the front runner to the runner behind them; it has not well explained the recommendations for two runners who run together to avoid possible droplet exposure between them.

Furthermore, running outdoors can create risks related to the type of exercise, running behavior, and social interaction performed by runners (Table 1).

Strengths and Limitations

A strength of this review is that the study topic is actual, and it will probably remain important in the future. This is significant because running has become one of the most popular recreational sports worldwide. However, running outdoors during the COVID-19 pandemic is still often done in pairs and even in groups without wearing a mask.

This review has several limitations. This paper only analyzed various theories to produce a conclusion. The real-world condition of the population should be investigated by researching running behavior and COVID-19 infections in recreational runners during the COVID-19 pandemic. Another limitation is that research on running behavior during the COVID-19 pandemic is still very limited, so the analysis of existing theories is still not optimal.

It is important to note that this review is an initial step towards understanding the risks of running outdoors during the COVID-19 pandemic. Further research in the runner population is needed to explore changes in run-ning behavior due to the COVID-19 pandemic, assess the impact of COVID-19 infections on runners, and identify whether there is an association between running habits/running behavior and COVID-19.

Conclusion

Outdoor physical activity positively affects people's psychological, physiological, biochemical health parameters, and social relationships. However, this activity requires clear rules so that the obtained benefits can be more significant and the risk of transmission of COVID-19 infection can be minimized. Moderate-intensity physical activity with an exercise duration of <60 minutes can increase the body's immunity to infection. Heavy-intensity physical activity that lasts >90 minutes tends to decrease the immune response, especially 3 to 72 hours after strenuous activity.

Running behavior can be a potential risk of COVID-19 transmission for recreational runners. This requires a commitment to general health protocols and paying special attention to the risk of droplet exposure among runners. Running during the COVID-19 pandemic is ideally done alone in a quiet place to avoid the potential for exposure to the virus. However, if running activities must be carried out in groups, then the position between the two runners must be side-by-side instead of inline, and runners should maintain a safe distance of 2 meters. Furthermore, if the running positions are parallel (in a line), a safe physical distance of 10 meters is required between the two runners in front and behind.

Abbreviations

COVID-19: coronavirus disease 2019; WHO: World Health Organization; METs: metabolic equivalents; APCs: antigen-presenting cells; NK: natural killer; URTI: upper respiratory tract infection.

Ethics Approval and Consent to Participate

Not applicable.

Competing Interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

Not applicable.

Authors' Contribution

AM and DHR conceptualized, designed, and prepared the manuscript. Furthermore, both authors contributed to reviewing the manuscript and also read and approved the submitted version.

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The Psychological and Sleep-Related Impact of Coronavirus Disease 2019 (COVID-19): A Systematic Review

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic has had a global impact on mental health and sleeps quality that is unprecedented in the 21st century. This systematic review aimed to assess the psychological impact of COVID-19 and its effect on people's sleep. Systematic searches were conducted via PubMed, ScienceDirect, and ProQuest from 2019 to August 2020, following PRISMA guidelines. Articles were selected based on eligibility criteria such as having a cross-sectional study design, assessing the general public's mental health status or sleep problems, medical workers and non-medical workers during the COVID-19 pandemic, and using standardized and validated scales for measurement. The keywords: COVID-19 OR SARS-CoV-2 AND Mental health OR Psychological health AND General population OR General public AND sleep AND Impact of Coronavirus disease 2019. A total of 23 articles were selected after being assessed. During the period of the COVID-19 pandemic, medical workers were found to have psychological problems such as anxiety, depression, stress, Post-Traumatic Stress Disorder (PTSD), psychological distress, somatization symptoms, suicidal ideation, high risk of severe mental illness, worry, and insomnia. Non-medical workers experienced symptoms of depression. The general public experienced psychological problems: depression, anxiety, stress, bad mood, inability to stop thinking about COVID-19, panic, and experiencing sleep problems such as changing sleep patterns, sleep disturbances, sleep quality, difficulty with sleep initiation, and shortened sleep duration. The COVID-19 pandemic has been associated with psychological problems and sleep disorders for medical workers, non-medical workers, and the general public.

Keywords: COVID-19, medical workers, mental health, psychological impact, the non-medical

Introduction

The viral outbreak of coronavirus disease 2019 (COVID-19) has become a major global issue and the most severe threat to public health worldwide in the 21st century.[1] The disease was named by the World Health Organization (WHO) as coronavirus disease 2019 (COVID-19) in February 2020.[2] The disease reportedly started in Wuhan, China, in December 2019,[3] and spread to other countries.[4] On March 11, 2020, WHO declared this virus outbreak as a global pandemic spreading rapidly, and more than 20,000,000 cases have occurred globally.[2]

The COVID-19 disease has caused many deaths. As of February 11, 2020, a total of 44,672 reported cases of COVID-19 in Henan Province, China, including 1,716 among health workers, resulting in 1,023 deaths, including at least five among health workers.[5] According to WHO, 6,040,609 confirmed cases and 370,657 deaths had been reported globally as of June 1, 2020.[6] The COVID-19 epidemic has become a life-threatening pandemic that causes many deaths quickly.

Pandemics cause drastic changes to the lives of people in global, public, and private economic aspects.[3] To control the spread of COVID-19, quarantine and lockdown were carried out.[7] This situation causes economic recession and unemployment. COVID-19 has also had psychological consequences.[1,3] The viral outbreak created uncertainty and fear, which can lead to an increase in suicide as well as mental disorders associated with suicide.[3] In the US, France, India, Pakistan, Italy, and Germany, there was an increase in the trajectory of suicides due to the pandemic.[8] The study of Thakur and Jain has reported that there has been increased psychological distress among the general population during this pandemic, people with pre-existing mental disorders, and healthcare workers.[8]

Literature review studies on the general population in China, Spain, Italy, Iran, the US, Turkey, Nepal, and Denmark showed that levels of anxiety symptoms during the COVID-19 pandemic are relatively high (6.33% – 50.9%), as are levels of depression (14.6% – 48.3%), post-traumatic stress disorder (7% – 53.8%), psycholo-

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gical stress (34.43% – 38%), and stress (8.1% – 81.9%).[3] In addition to the general public, COVID-19 also has a psychological impact on health workers. They are directly involved in the treatment and care of COVID-19 patients.[9] Healthcare workers who work in a SARS unit, or have family and friends infected with SARS, have much more significant psychological problems than those who do not have similar experiences.[10] The COVID-19 pandemic has led to increasing psychological problems that can disrupt lives.

The COVID-19 outbreak has caused sleep problems among the general public, medical workers, and non-medical workers. Sleep problems have also occurred among healthcare workers.[11] To combat COVID-19, health workers have been burdened substantially and have had their sleep patterns disturbed. Sleep problems can affect the body's immune status and mental health, quality of life and productivity of a person, may have negative implications on health, quality of work and increase the risk of adverse events and behavior that endanger safety, as well as the risk of work-related accidents or injuries.[12] The COVID-19 pandemic has caused unprecedented mental health hazards as well as sleep problems globally.[3] Serious attention must be given to the public's mental health and sleep needs in general, including medical workers and non-medical workers. Appropriate policies are needed to overcome these problems.

Although there is a great deal of literature on psychological impacts, little information is available regarding the psychological and sleep-related effects on the general public, medical workers, and non-medical workers during the COVID-19 outbreak. Therefore, a review was needed that will reveal the impact systematically. This systematic review aimed to assess the psychological impact of COVID-19 and its effect on people's sleep for the general public, medical, and non-medical workers.

Method

Search Strategy

This study used the PICO (Population, Interest, Comparison, and Outcome) approach to develop keywords. Population: general public, medical workers, and non-medical workers. Interest: impact of COVID-19. Comparison: -. Outcome: mental health, sleep. The met-hod and results of this systematic review were based on PRISMA (Figure 1).[13] Systematic searches were conducted via PubMed, ScienceDirect, ProQuest from 2019 to August 2020 following PRISMA guidelines (Figure 1). The search terms used were: (COVID-19 OR SARS-CoV-2) AND (Mental health OR Psychological health) AND (General population OR General public) AND Medical workers AND Non-medical AND sleep AND Impact of Coronavirus Disease-2019 using three databases by using the same search strategy in all the databases.

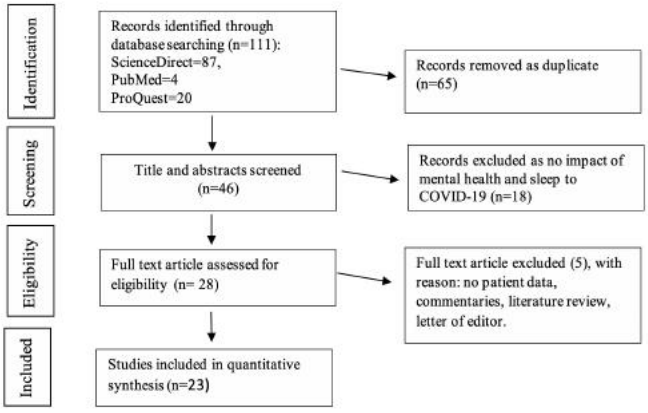

Figure 1. PRISMA 2009 Flow Diagram

Study Selection and Eligibility Criteria

Two reviewers independently rated titles and abstracts obtained from electronic searches according to inclusion criteria to identify articles that could potentially qualify for the study. After removing articles that did not match the inclusion criteria, a complete article was obtained, then read by the same reviewers to determine which articles met the inclusion criteria requirements. However, if there was a dispute between the two reviewers, the third and fourth reviewer examined the article. The title and abstract of each relevant publication were screened. Full-text articles were eligibility assessed after the initial screening.

The research criteria included in this study were: 1) followed a cross-sectional study design; 2) assessed the mental health status of the general public, medical workers, and non-medical workers during the COVID-19 pandemic; 3) assessed the sleep problems of the general public, medical workers, and non-medical workers during the COVID-19 pandemic; 4) used standardized and validated scales for measurement. The study was excluded if: 1) it was not written in English, 2) it did not have full-text availability.

Data Extraction

Relevant data taken from the study were extracted, including 1) main author and year of publication, 2) category, 3) country of the population studied, 4) study design, 5) sample size, 6) sample characteristics, 7) assessment tool, 8) prevalence, 9) summary.

Quality Appraisal

The Joanna Briggs Institute's (JBI) critical appraisal checklist tool for prevalence study was used to assess the quality of this study.[14] The checklist consists of nine questions: the appropriate sample frame, sampling method justification, sample size justification, explanation of the study subjects and the setting, data analyzed using sufficient samples, statistical analysis suitability, reliable action for all participants, validity methods, and robust response rate. The checklist consists of four answer categories: yes, no, unclear, and not applicable. The answers for

"yes" were given a score of 1, and for "no," they were given a score of 0. Total study quality scores ranged from 0–8. In this review, the average score was above 5, which means that the article was eligible for inclusion in the analysis.

Results

Search Results

This review revealed the impact of COVID-19 on mental health and sleep among the general public, medical workers, and non-medical workers. A total of 111 publications were identified. After the initial screening, 65 articles were removed due to duplication and leaving 46 articles. Eighteen articles were issued based on titles and abstracts. The remaining 28 full-text articles were assessed. Five articles were excluded because there were no patient data, commentaries, literature reviews, or editor letters. After the full-text screening, only 23 studies met the inclusion criteria.

Study Characteristics

The study characteristics and the main study findings of this study are summarized in Table 1. There were 23 studies conducted in 11 different countries; China (n = 13), Singapore and India (n=1), Saudi Arabia (n = 1), India (n=1), Turkey (n = 1), Iraq (n = 1), South Africa (n = 1), Bangladesh (n = 1), Hong Kong (n = 1), Algeria (n = 1) and Australia (n = 1). The majority of research was carried out on medical workers (n = 12) and the general public (n = 10), with less carried out on with non-medical workers (n = 1). The majority of studies had a cross-sectional study design (n=22), and the rest was a survey (n=1). Sample sizes ranged from 140 to 14,825 participants. The majority of study participants were over 18 years old. The main results selected in the studies were found to vary widely across studies. Sixteen studies found psychological problems, two found sleep problems, and six found psychological and sleep problems.

The Impact of COVID-19 on Psychological Problems and Sleep

The selected articles were analyzed one by one. Sixteen studies found psychological problems, two studies found sleep problems, and six studies found problems in psychology and sleep.[7] This showed that COVID-19 has a real impact on psychological problems and sleep for the general public, medical workers, and non-medical workers.

The Impact of COVID-19 on Psychological Problems and Sleep among Medical Workers

Medical workers suffered from psychological and sleep disorders. Psychological disorders included anxiety, psychological distress, depression, PTSD, somatic symptoms, high risk of mental illness, stress, and suicidal ideation. Of the total articles that reviewed psychological disorders experienced by medical workers, just under 50% of medical workers experienced severe anxiety, severe stress, and major depression. Thus, if this psychological disorder in medical workers is not handled properly, it will affect healthcare quality. Some of the research results below indicate psychology and sleep disturbances.

Medical workers experienced psychological disorders (anxiety and depression) and sleep disorders in two out of 12 studies.[15] Psychological distress, anxiety, and depression were found in eight of the 12 articles studied.[16] Depressive symptoms and PTSD were found in a study conducted by Song *et al.*[17] Medical workers also feel stress.[18] Likewise, there was one study that reveals the existence of suicidal ideation.[19]

The Impact of COVID-19 on Psychological and Sleep Problems among Non-Medical Workers

The results showed that non-medical workers experienced psychological disorders, including depression. There were even participants who experienced significant depression, although the number was not large. In detail, the psychological disorders experienced by non-medical workers were as follows: 50.3% of participants reported clinically significant symptoms of depression. Among them, 33.0% of participants had mild depression, 10.5% of participants had moderate depression, 5.8% had moderate depression, and 1.0% had severe depression.[3,20]

The Impact of COVID-19 on Psychological and Sleep Problems on the General Public

The results of the selected article review showed that the general public also experienced psychological disturbances and sleep disorders due to COVID-19. Psychological disturbances make a person panic. The general public experienced sleep disturbances in two of the ten articles reviewed.[21] The impact of COVID-19 on the disorder was found in two of ten articles.[22] The general public experienced depression, anxiety, and stress in six out of ten articles reviewed.[23]

Discussion

This review explored medical workers' psychological and sleep status, non-medical workers, and the general public during the COVID-19 pandemic. In general, there was a higher prevalence of adverse psychology and sleep problems among medical workers, non-medical workers, and the general public. COVID-19 has a severe acute impact on psychological health and sleep quality for medical workers, non-medical workers, and the general public. The difference in the status of roles in society as medical workers, non-medical workers, and the general public affected the background causes of the problems that led to adverse psychology outcomes and sleep problems.

The Impact of COVID-19 on Psychological Problems and Sleep among Medical Workers

The COVID-19 pandemic had a severe psychological impact on medical workers and the general public,[1] whe-

Table 1. Summary of Study Sample Characteristics, Study Design, Assessment Tools, Prevalence of Psychological and Sleep-Related Impact

Author	Category	Country	Study Design	Sample Size (n)	Sample Characteristics	Assessment Tool	Prevalence	Summary
Wang, *et al.*, 2020[24]	Medical workers	China	Cross-sectional	274 medical workers	Age = 33-40 years	GAD-7, PHQ-9, PSQI, PSS-14, and CD-RISC-1	Anxiety = 13.9% Depression = 16.1% Insomnia = 19.7%	The higher the probability and intensity of being exposed to COVID-19 patients, the greater the risk that medical staff will suffer from mental disorders.
Song, *et al.*, 2020[17]	Medical workers	China	Cross-sectional	14,825 doctors and nurses	The mean age = 34	PSS, CES-D, DSM-5	Depression symptoms = 25.2% PTSD = 9.1%	Many of the medical staff in the emergency department suffer from symptoms of depression and PTSD. Nurses were associated with a higher risk of PTSD.
Juan. *et al.*, 2020[16]	Medical workers	China	Cross-sectional	456 doctors and nurses	The mean age = 30.67 ± 7.48 years (range: 17-64 years)	IES-R, GAD-7, PHQ-9, OCS, PHQ-15	Psychological distress = 37.5%, Somatization symptoms = 33.3% Anxiety symptoms = 31.6%, Depression symptoms = 29.6%	Negative psychological distress on hospital staff.
Temsah, *et al.*, 2020[25]	Medical workers	Saudi Arabia	Cross-sectional	811 healthcare workers of a tertiary care teaching hospital	Mean age = 36	GAD-7	Worried about COVID-19 = 41.1%, Similarly worried about both COVID-19 and MERS-CoV= 41.4%, Stressed about MERS-CoV = 17.5%	COVID-19 and MERS-CoV pose significant levels of anxiety and stress to healthcare workers caring for infected patients especially at the risk of passing the infection to their families.
Xiaoming, *et al.*, 2020[26]	Medical workers	China	Cross-sectional	8,817 hospital workers	The median age = = 31	PHQ-9, GAD-7	Depression = 30.2%, Anxiety = 20.7%, Somatic Symptoms = 46.2%, SSI = 6.5%	High level of psychological impact and suicidal and self-harm ideation on hospital staff.
Chew, *et al.*, 2020[27]	Medical workers	Singapore and India	Cross-sectional	906 healthcare workers	The median age = 29 (Interquartile range: 25-35) years	DASS-21, IES-R	Moderate to very severe depression = 5.3%, Moderate to extremely severe anxiety = 8.7%, Moderate to extremely severe stress = 2.2%, Moderate to severe levels of psychological distress = 3.8%	The prevalence of physical symptoms was related to psychological outcomes for health workers during the COVID-19 outbreak.
Hong, *et al.*, 2020[19]	Medical workers	China	Cross-sectional	4,692 nurses	>19 years	PHQ-9, GAD-7, PHQ-15	Depression symptoms = 9.4%, Represented anxiety = 8.1%, Somatic symptom = 42.7%, Suicidal ideation = 6.5%	Overall the mental health of frontline nurses during the COVID-19 outbreak was generally poor.
Zhu, *et al.*, 2020[28]	Medical workers	China	Cross-sectional	5,062 health workers	>19 years	IES-R, PHQ-9, GAD-7	Stress = 29.8% Depression = 13.5% Anxiety symptoms = 24.1%	Health workers have a more significant stigma against mental problems than the general public, so it was essential to provide them with psychological support.
Korkmaz, *et al.*, 2020[29]	Medical	Turkey	Cross-sectional	140 healthcare workers (30 physicians, 70 nurses, 40 assistant healthcare)	18-65 years	PSQI, PSI, WHOQOL-BREF, BAI	Without anxiety = 29% Mild anxiety = 38% Moderate anxiety = 20% Severe anxiety = 13% Nurses PSQI and PSI scores, statistically higher than doctors and other staff	Healthcare workers may experi ence anxiety and sleep distur bances that adversely affect healthcare workers' problem-solving skills and decrease their quality of life.
Sahu, *et al.*, 2020[18]	Medical workers	India	Survey	611 orthopedic surgeons	< 30 years - more than 70 years	Questions that were shared with orthopedic surgeons	Definitely stressed out = 22.5%, Mildly stressed out = 40.5%	The psychological impact on the orthopedic surgeon can be a potential concern that requires discussion through open discussion.

Author	Category	Country	Study Design	Sample Size (n)	Sample Characteristics	Assessment Tool	Prevalence	Summary
Abdullah & Musa., 2020[15]	Medical workers	Iraq	Cross-sectional	268 physicians	33 - 70 years	AIS, ICD-10 The ladder technique (0-10)	Sleepless = 68.3%, Stress = 93.7%	Doctors serving COVID-19 patients have a negative effect on sleep quality.
Fang, *et al.*, 2020[30]	Non-Medical workers	China	Cross-sectional	191 frontline non-medical workers	age > 20 years	PANAS, SRQ, PHQ	Symptoms of depression = 50.3%	Frontline non-medical workers to women and younger individuals are more susceptible to depression.
Pillay, *et al.*, 2020[21]	General public	South African	Cross-sectional	692 elite and semi-elite athletes	> 18 years	Validated questionnaires on maintenance of activity, nutrition, and mental state.	Changed sleep pattern = 79%, Depression = 52%	COVID-19 has psychological consequences on athletes that can impact safe returns to sport and general health.
Wang, *et al.*, 2020[7]	General public	China	Cross-sectional	6,437 residents	Mean age = 31.4 years	PSQI	Sleep disturbances = 17.65%	Almost one-fifth of residents had sleep disorders
Huang & Zhao, 2020[31]	General public	China	Cross-sectional	7,236 Chinese public	6 - 80 years	PSQI, Chinese version of GAD-7 and CES-D	Generalized anxiety disorder = 35.1%, Depression symptoms = 20.1%, Worsened sleep quality= 18.2%	Younger people spend too much time thinking about the plague.
Duan, *et al.*, 2020[23]	General public	China	Cross-sectional	359 children and 3254 adolescents	7 - 18 years	Spence Child Anxiety Scale, Child Depression Inventory, and Coping Style Scale	Depression symptoms = 22.28%	COVID-19 has a psychosocial impact on children and adolescents
Ahmed, *et al.*, 2020[32]	General public	China	Cross-sectional	1,074 people	14 - 68 years (M = 33.54 years)	BAI, BDI-II, AUDIT WEMWBS	Anxiety = mild 10.1%, Moderate 6.0%, Severe 12.9%, Depression = Mild 10.2%, Moderate 17.8%, Severe 9.1%, Mental well-being = lower 32.1%, average 49.4%, higher 18.4%	The psychological problems of society were interconnected in many ways related to COVID-19.
Islam, *et al.*, 2020[33]	General public	Bangladesh	Cross-sectional	1,311 community dwelling individuals	13 - 63 years	GAD-7	Panic = 79.6%, Generalized anxiety = 37.3%	Panic and generalized anxiety have a large proportion in the general population.
Ping, *et al.*, 2020[34]	General public	China	Cross-sectional	1,139 people	Mean age of 38.3 years (12-78 years)	EQ-5D scale	Anxiety/depression = 17.6%	Anxiety/depression in people aged, suffers of chronic diseases, worries about contracting COVID-19, and low income increases significantly.
Madani, *et al.*, 2020[35]	General public	Aljazair	Cross-sectional	678 people	14 - 74 years	Global questionnaire measuring the impact of confinement during COVID-19	Anxiety = 50.3% Feels stressed = 48.2% Bad mood = 46.6% Do not stop thinking about epidemic = 47.4%	Containment due to COVID-19 has raised anxiety in the general public.
Newby, *et al.*, 2020[36]	General public	Australia	Cross-sectional	5,070 adults	18 - >75 years	DASS-21, The-Whiteley-6	Depression = 62% Anxiety = 50% Stress = 64%	COVID-19 has a severe acute impact on people's mental health.
Wu *et al.*, 2020[37]	Medical workers	China	Cross-sectional	548 medical staff and medical students	Average age = 28 years	The Kessler 6 Psychological Distress Scale	High risk of severe mental ilness=37.23%	The medical team was suspectible to severe mental illness.
Branda Yee-Man Yu *et al.*, 2020[22]	General public	Hong Kong	Cross-sectional	1,338 young adults	> 18 years	ISI	Worsened sleep quality = 38.3%, Difficulty sleep initiation = 29.8% Shortened sleep duration = 29.1%	Most Hong Kong people feel that their sleep has gotten worse since the COVID-19 outbreak due to a lack of adequate masks.

Note: Beck Depression Inventory-II (BDI-II), Beck Anxiety Inventory (BAI), Center for Epidemiologic Studies Depression Scale (CES-D), Connor-Davidson Resilience Scale (CD-RISC)Depression, Anxiety, dan Stress Scale-21 item (DASS-21), Generalized Anxiety Disorder 7/2-item (GAD-7/2), Impact of Event Scale-(Revised) (IES (-R), Kessler Psychological Distress Scale (K6 / 10), Insomnia Severity Index (ISI), Patient Health Questionnaire-9/2 (PHQ-9/15), Pittsburgh Sleep Quality Index (PSQI), Problem Solving Inventory (PSI), Perceived Stress Scale (PSS), World Health Organization Quality of Life (WHOQOL), EuroQoL Quality of Life Scale (EQ-5D)

re medical workers have a more significant stigma against mental problems than the general public.[28] Medical workers who work on the frontline are vulnerable to psychological problems. Those who work in hospitals, respiratory departments, emergency departments, intensive care units, and infection departments are prone to anxiety, depression, PTSD, and negative psychological distress.[17] The overall mental health of frontline nurses during the COVID-19 outbreak was generally poor.[19] This happened because they are the personnel who directly handle COVID-19 patients at high risk of contracting the disease from their patients. These infected medical workers will have a high risk of transmitting the disease to their families. This situation becomes a burden for them; on the one hand, medical workers must help their patients while on the other hand, they must protect themselves and their families from the threat of COVID-19 transmitted from the patients they care.

Psychological problems can also occur due to the sharp increase in COVID-19 cases, which causes the workload of medical workers to increase as they try to take care of the patients. Meanwhile, the personal protective equipment (PPE) used to prevent medical workers from contracting the COVID-19 virus is inadequate for medical workers.[10] The higher the probability and intensity of being exposed to COVID-19 patients, the greater the risk that medical workers will suffer from mental and sleep disorders.[24] This means that workers who have a high risk of COVID-19 need attention, anticipation, and intervention to overcome the impact of COVID-19, namely mental and sleep disorders.

This study found that profession type and gender influenced the risk of psychological problems. Healthcare workers who are nurses and women are vulnerable to psychological stress. One review found that women and nurses have higher psychological distress than men and doctors.[38] Health workers, especially nurses who work on the frontline, have the most contact with the most at risk of contracting COVID-19.

Similar to psychological problems, medical workers also experience vulnerability to sleep disorders. Medical workers who work on the frontline experience more sleep disturbances than non-medical professionals.[39] An Iraqi study found that doctors serving COVID-19 patients experienced a negative effect on the quality of their sleep.[15] Another study in China found that about 14% of doctors and nearly 16% of nurses showed symptoms of depression and insomnia.[9] This may occur due to the increased mental and work pressures for medical workers. So that health workers are more at risk of exposure to psychological and sleep disorders.

Psychological and sleep problems experienced by medical workers can have a negative impact on their skills in solving healthcare workers' problems and may cause a decrease in their quality of life.[29] Thus, their duties as professionals who work at the forefront of dealing with COVID-19 patients will undoubtedly be disrupted. A decrease in quality of life can make a person feel insignificant and leading to suicidal events. A high level of psychological impact can lead to suicide and self-harm ideation among medical workers.[26] Given the high vulnerability of medical workers to psychological problems and sleep disorders, psychiatric intervention is needed to improve their mental health and sleep quality to resolve and terminate their problems.

The Impact of COVID-19 on Psychological Problems and Sleep in Non-Medical Workers

The impact of the psychological problems caused by the pandemic on non-medical workers is also increasing. They have the same risk of contracting the virus as medical workers, although not as much as the risk of transmission to medical workers. Medical workers and non-medical workers were subject to psychological stress during the pandemic.[40] In this literature review study, only one study was found examining the impact of psychological problems and sleep due to pandemics on non-medical workers. However, the results of these studies can at least describe the problems they are experiencing during this pandemic.

The same principle applies to others: the younger the non-medical workers, the more susceptible they are to experiencing psychological problems. In terms of sex, female non-medical workers were more prone to experiencing psychological problems. A study in China showed that frontline non-medical workers, younger individuals, and women were more inclined to experiencing depression.[30] However, there is still little research on the impact of psychology and sleep problems on non-medical workers during the pandemic. It may be necessary to perform more analysis in this field so that the proper intervention will be found to overcome the psychological problems they experience, considering that the profession of non-medical workers is also vital in dealing with problems caused by COVID-19.

The Impact of COVID-19 on Psychology and Sleep Problems among the General Public

In the general public, the various levels of outbreak severity, the stages of the outbreak in each region, the national economy, the government's readiness, the availability of medical facilities, and the dissemination of information related to COVID-19 can affect the psychological response of the community.[3] Symptoms of psychological problems were more frequently seen at the start of an outbreak when individuals were required to undergo compulsory quarantine, sudden unemployment, and the uncertainty associated with the outbreak.[41] Quarantine causes people who are usually free to carry out activities to become isolated to feel lonely in their li-

ves. This can be a trigger for anxiety and depression. Social isolation and loneliness were closely linked to anxiety and depression.[42] Job loss and uncertainty caused by the COVID-19 pandemic can be very stressful for a person.[3] It left a feeling of shock and not ready to face the existing reality, resulting in panic and generalized anxiety. Containment due to COVID-19 has raised anxiety in the general public.[35] In addition, the frequent exposure of a person to news related to COVID-19, misinformation, and fake news can cause symptoms of anxiety and stress.[43]

The impact of COVID-19 when viewed from an age perspective, the younger the age, the more susceptible to psychological effects that cause psychosocial problems. The findings were found in Duan *et al.*'s study, where COVID-19 has a psychosocial impact on children and adolescents.[23] This was likely because most individuals under 40 were students who may experience more emotional distress. Usually, due to school closures, cancellation of social events, and lower learning efficiency only with online distance courses resulting in more homework assignments and postponement of exams.[44] The pressures they experience can trigger PTSD and symptoms of depression. Several studies have found that student status is associated with higher levels of PTSD and depression symptoms during the COVID-19 outbreak than before.[45] In addition, individuals who are less than 40 years old dwell on COVID-19 more. The younger population spends more time thinking about the pandemic, which impacts psychological problems and worsens sleep quality.[31] Apart from young people, those with old age with chronic comorbidities are also susceptible to the psychological impact. Research on Chinese society has found that the level of anxiety/depression in aging people and people with chronic illnesses has increased significantly.[34]

Psychological problems and other problems experienced by the general public during the COVID-19 pandemic can cause sleep disturbances. The lack of availability of medical facilities as a preventive tool to protect the public from COVID-19 transmission has caused anxiety which has implications on sleep disturbances. For example, due to the lack of adequate masks, most Hong Kong people feel their sleep has worsened since the COVID-19 outbreak.[16] Psychological problems and public sleep disorders are interconnected in many ways related to COVID-19.[32] COVID-19 have become a nightmare for the society that afflicts the wider community. Research conducted on Chinese residents has found that almost one-fifth of respondents had sleep disorders.[7] Seeing the impact of psychological problems and sleep disorders on society, an adequate evidence-based intervention is required, accompanied by continuous and routine monitoring of the community's psychological consequences and sleep disorders.

A psychological response is actually needed when facing a problem, including a pandemic problem due to COVID-19. Acute psychological responses to stressful or traumatic events were sometimes protective and evolutionarily important,[46] which will mobilize someone and force them to take precautions to protect themselves.[3] However, psychological responses that have a bad impact must be avoided to worsen the problem. Follow-up studies after a pandemic are needed to assess the long-term psychological impact of the COVID-19 pandemic.

Efforts to Reduce Symptoms of Psychological Disorders and Sleep Disorders

The government needs to enforce strict policies on everything related to COVID-19 and explain procedures in an effort to alleviate the COVID-19 pandemic's psychological impact and the effects of sleep disturbance on medical workers, non-medical workers, and the general public. Attention and assistance should be prioritized for vulnerable groups such as females, those aged under 40, the elderly with comorbidities, and those suffering from chronic diseases. The government must ensure that disseminating information related to COVID-19 has been conveyed accurately and transparently. The existence of validation from the government regarding news related to the pandemic was fundamental to avoid panic from incorrect information and update every time on information regarding preventive measures by health authorities to reassure people who fear infection.[47] The government must also ensure that mental health services were easily accessible during the quarantine period, especially for those who desperately need psychological support.[47] The government can also provide remote mental health services in online consultations and hotlines,[48] due to quarantine. In addressing unemployment due to quarantine, the government can seek monetary support following the state budget and open new job opportunities for those who experience financial difficulties or lose their jobs during the pandemic.[3]

Apart from the government, individuals also have a fundamental role in helping to overcome psychological disorders and sleep disorders. Individuals can engage in positive activities that can relieve symptoms of psychological distress and their sleep disorders, such as regular exercise and maintaining a healthy diet. This has been shown to be effective in relieving and preventing symptoms of stress and depression.[49] Individuals can also carry out distraction activities to divert attention from observing news related to COVID-19. This is done to avoid potential information that is not true.[3] Distraction can be done by doing activities such as listening to songs, watching movies, painting, gardening, and cooking. If individuals want to get developments in information related to COVID-19, they must obtain it from news agencies

and official organizations and only seek medical advice from trained healthcare professionals.[3] Individuals must also continue to apply social distancing and health protocols.

Strengths and Limitations

The strength of this study is that it may be the first systematic review to examine and summarize the literature on psychological health and sleep disorders in medical workers, non-medical workers, and the general population during the COVID-19 outbreak. The weakness of this study is that most of the articles were obtained from Asian countries, so it is necessary to also disclose articles from European and American countries to determine the impact of COVID-19 on them.

Conclusion

This systematic review examines medical workers' psychological status and sleeps quality, non-medical workers, and the general public during the COVID-19 pandemic. A high prevalence of various psychological problems and sleep disorders is reported in most studies, both for medical workers, non-medical workers, and the general public. The COVID-19 pandemic represents an unprecedented threat to mental health and sleep needs in countries around the world. To overcome this problem, an intervention that focuses on preventing mental and sleep disorders is needed, and psychiatric interventions to improve mental health and sleep quality. Post-pandemic cognitive and behavioral follow-up studies are required to assess the long-term psychological impact of the COVID-19 pandemic on medical workers, non-medical workers, and the general public. Also, ascertain whether training and support strategies can reduce their psychological morbidity and sleep disorders is also needed. Government policies are required to reduce the incidence of disease due to the COVID-19 virus, improving health facilities to protect themselves from contracting COVID-19, the need for continuous monitoring of the psychological consequences, and sleep disorders as a worldwide preparedness effort.

Abbreviations

COVID-19: Coronavirus Disease 2019; WHO: World Health Organization; SARS: Severe Acute Respiratory Syndrome; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analysis; PTSD: Post-Traumatic Stress Disorder.

Ethics Approval and Consent to Participate

Not applicable.

Competing Interest

Not applicable.

Availability of Data and Materials

The data is publicly available from PubMed, ScienceDirect, ProQuest from 2019 to August 2020. The data of this study can be obtained from 23 eligible articles that have been included in the references.

Authors' Contribution

TS contributed to the overall design and article selection, conducted the data curation and formal analysis, wrote the original draft review, and prepared the manuscript. TS, CEK, HSM, and YH contributed to valida-tion, study quality appraisal, review, and editing of the draft. All other authors contributed to reviewing, editing, translating, and submission.

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COVID-19 and the City: A Healthy City Strategy for Pandemic Challenges, from Planning to Action

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Abstract

COVID-19 is a respiratory disease caused by SARS-CoV-2, a new coronavirus discovered in 2019. WHO declared COVID-19 is a respiratory disease caused by SARS-CoV-2 as a pandemic that the detection level of cases changed daily, and it can track almost in real-time. This paper used a narrative literature review to address issues of urban quality and lack of exercise. The specific aim was to discuss the concept of a healthy city, indicate a new urban model, and advocate for the increased use of bicycles, outdoor gym/outdoor exercise, walking to reducing pollution, and improving physical, psychological, and social fitness. A healthy city can improve residents' health by improving conditions of life to face COVID-19 pandemics. It needs the local capacity to prevent the spread of the diseases and design public health concepts concerning the built environment and contemporary towns in a new urban model. Dialogue opportunities in public health can provide essential guidance for designers (architects and town planners), decision-makers, public health experts, and health agencies locally, promoting the actions and policies to transform the city into a healthier neighborhood and salutogenesis.

Keywords: city by bike, COVID-19, healthy city, new urban model

Introduction

COVID-19 is a respiratory disease caused by SARS-CoV-2 (coronavirus 2019; previous 2019 - nCoV), a new coronavirus discovered in 2019. The virus is transmitted from person to person through respiratory secretions and contact, mainly through sneezing and coughing.[1] The novel coronavirus outbreak has spread to many other countries. On January 30, 2020, the Committee of Emergency World Health Organization (WHO) announced a global health emergency based on notifications of cases that continued to increase in China and other international locations. It was declared a pandemic by the WHO.[2] The detection level of issues changes every day and can be tracked almost in real-time on the website provided by Johns Hopkins University and others forums. WHO has recorded more than 96 million cases of pandemic COVID-19 occurring globally, with the possibility of doubling and more than two million deaths confirmed.[3] Globally, as of 4:52 p.m. CEST, June 9, 2021, there have been 173,674,509 confirmed cases of COVID-19, including 3,744,408 deaths, reported to WHO. As of June 7, 2021, a total of 2,092,863,229 vaccine doses have been administered.[4]

Pandemics in the 20th and 21st century are primarily transmitted through direct contact with body fluids (AIDS, Ebola) or breathing (pandemic influenza, SARS-CoV-2 Mers), in contrast to the past, when the oral-fecal (Cholera) or vectorial (Malaria, Plague) routes predominated and could be controlled by public health sanitation. It has led to dramatic action in many countries, e.g., China, Singapore, Japan, Italy, Spain, and many other countries. In those areas, lockdown, social distancing, hand sanitizing, and wearing masks have been and, in some, still are mandatory.[5]

On the other hand, urban density, population, and housing favor the spread of COVID-19 in living quarters and at meetings, and on public transport. One of the studies aimed to understand the urban-centric nature of the infection found that transit mediums, especially rail and aviation, were positively associated.[6] The risk of transmission COVID-19 is enhanced by the proximity of people, inequality of economic and social conditions, which in turn, are associated with housing the poor and uncertain conditions of life.[7,8] Currently, according to the United Nations, 55% of the world's population live in cities, and this is expected to rise to 68% by 2050.[9] To

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take effective measures in addressing urban health, the various sectors need to be integrated (i.e., a holistic intersectoral approach). Stakeholders include the health and other government departments, non-government organizations, the private sector, and the public. A Healthy City project aims to bring together public, private, and voluntary partnerships to focus on urban health problems in a participatory manner broadly and improve residents' health by improving conditions of life. Thus, developing a cross-sectoral approach integrated with community participation is an essential feature of healthy cities.

In addition, environmental planning and design for public health are essential. Data from several sources have identified that airborne viruses are carried on fine particles spreading into the environment. Deforestation, global warming, and atmospheric pollution can accelerate the spread of viruses such as SARS-CoV-2.[10] Another study investigated the relationship between air pollutants and COVID-19 spread in Jakarta, Indonesia, during the impact of large-scale social restriction (LSSR). During the LSSR period, the air pollution index (API) of $PM_{2.5}$, PM_{10}, CO, SO_2, and NO_2 decreased by 9.48%, 15.74%, 29.17%, 6.26%, and 18.34%, respectively. In contrast, O_3 increased by 4.06%. Another study discovered significant positive correlations between SO_2, CO, and $PM_{2.5}$ and COVID-19 cases. The area has become vulnerable to COVID-19 infection due to SO_2, CO, and $PM_{2.5}$ exposure.[11]

The health of city populations depends on the condition of life and style of living. Factors in the day-to-day life, which significantly affect health status, are referred to as "determinants of health." These include the availability of water, sanitation, nutrition, food safety, health care, housing and working conditions, education, lifestyle, demography, and changes in income. In addition, environmental, physical, social, and economic factors are included. Improving the determinants of health is not easy in many situations. Encouraging increased use of bicycles, outdoor gym/outdoor exercise, walking to reducing pollution, and improving physical, psychological, and social fitness is a continuing concern within a healthy city's concept.

For this reason, it needs comprehensive action to deal with the COVID-19 pandemic, not only in implementing the health protocol of COVID-19 but also applying the concept of a healthy city, which reduces environmental pollution and also provides health benefits to people. For example, outdoor gym/outdoor exercise, walking, and cycling contribute to reducing air pollution and improving the community's physical, psychological, and social fitness. Therefore, this article aimed to discuss the concept of a healthy city, suggest a new urban model, and advocate for increased outdoor exercise, including bicycle use and walking, and providing activity that reduces air pollution. This study also offered a strategic direction with some focus on Indonesia.

Method

This article conducted a narrative literature review using ScienceDirect search engine. The inclusion criteria were literature searched from 2020 to 2021 (the last two years) based on keywords relevant to the topics of interest. The searches included the terms of: "healthy city strategy," "new urban model," and "city by bike" in connection with COVID-19. The kind of article was recorded, for example, if it was a review or a research article and if available with Open Access. Articles that were not available in Open Access were excluded. The articles selected were analyzed qualitatively based on the information about healthy city strategy, new urban model, and city by bike and in the context of COVID-19.

Results

The recent paper using a narrative literature review by ScienceDirect engine, found 61 articles, 51 in 2021 and 10 in 2020, with seven review articles and 54 research articles. There were 22 kinds of Open Access articles, 19 in 2021 and 3 in 2020 selected based on exclusion and inclusion criteria. These included one review article and 21 research articles in a range of areas

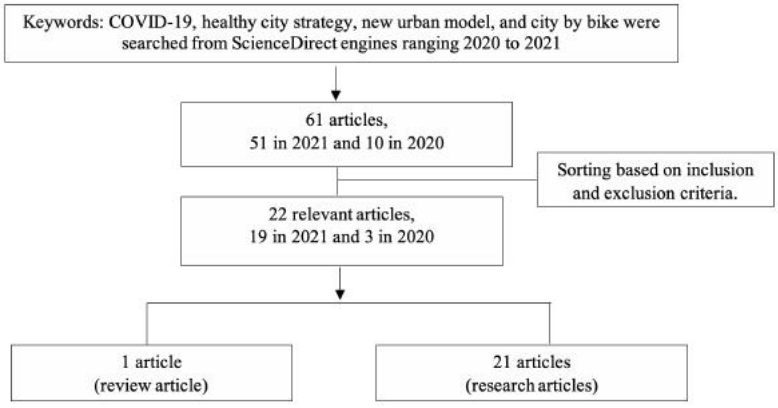

Figure 1. A Literature Search from ScienceDirect Engines

including Social Sciences, Engineering, Environmental Science, Decision Sciences, Medicine and Dentistry, Economics, Econometrics and Finance, and Energy.

Finally, the articles were reviewed and discussed using a comprehensive, critical, and objective analysis of the current knowledge to lead to a healthy city strategy to minimize COVID-19 and improve the community's general health. The literature search strategy from ScienceDirect engines is shown in Figure 1.

Critical articles reported in the scoping review helped identify lessons learned for cities from the COVID-19 pandemic in the post-pandemic era. Moglia *et al.* outlined three urban missions to guide a green urban recovery. These are to speed up the changes to urban mobility, achieve sustainable urban development, and build resilient urban infrastructure. They defined six transition pathways for urban mobility, energy, food, housing, health, and nature. These pathways can provide a roadmap for green recovery in cities while also increasing resilience.[12] Given that recent evidence predicts that urban cycling will continue to grow in Latin American cities, it is critical to implement policies and educational/training improvements to improve cyclist safety and health in the cities.[13] To become sustainable, cities are experiencing transformative changes. Identifying and describing the increasing adoption of big data technologies can assist policymakers and planners in assessing the benefits and costs when implementing sustainable urban transformations.[14]

Discussion

Exploring a Healthy City strategy to deal with a pandemic is a challenge from planning to action. This section discusses the following areas: a healthy city, a new urban model, and a city by bike (increased exercise and pollution reduction).

Healthy City

World Health Organization (WHO) published a manifesto for healthy and green recovery from COVID-19, including building healthy and decent habitation. Creating a healthy city is important during Pandemic COVID-19, which requires support and investment. Healthy cities are defined as cities that constantly develop and improve the physical and social environment and expand the power base of communities that enable people to support each other to carry out all life functions mutually. Healthy Cities is a global attempt to prioritize the agenda for a social, economic, and political government town. For the past 30 years, the WHO European Healthy Cities Network has included approximately 100 major cities and about 30 national networks.

Population growth in urban areas is a global phenomenon, and countries in the Pacific West area are no exception. It is great to make cities carbon neutral, more habitable, and healthier by transport and city planning. Recently, the WHO for the Region Pacific West has been working together with its members, developing several Healthy City initiatives to improve the health of urban areas. However, it is not easy to measure the results: an index is required, standards set, and the impact of each component of health needs to be determined. It further supports the idea that rating the effect of fitness is required to develop public policy.

Furthermore, the main features of the Healthy City project include a political commitment with high levels of collaboration amongst the cross-sectoral community; community participation; integration of activities; development of urban health profiles and local action plans; monitoring and evaluation periodically. In addition, there needs to be participatory research and analysis, sharing information, media engagement, the incorporation of views from all groups in the community, sustainability mechanisms, connection with society and the development of human beings, and national and international networks. The measurement involves ten metrics of healthy lifestyles, including the rate of obesity and pollution levels. Each metric is assigned a score, which is then added to yield a score out of 100. The Spotahome Healthiest Cities Index showed that Amsterdam was number one in 2018.[15]

Information about public health can provide valuable rules and guidance for designers (architects and town planners), decision-makers, expert public health, and health agencies locally, promoting holistic policies and actions to transform the city into more healthy neighborhoods.[16] These factors may explain the relatively good correlation between a multidisciplinary approach to develop systemic operational skills capable of dealing with complexity and a paradigm for assessing the effects of the current pandemic. The contemporary challenge is how to re-design public health concepts concerning the built environment and new cities? The following section considers this question, with examples from cities that have implemented a healthy city approach and standards of human behavior to minimize COVID-19 transmission.

New Urban Model

Urbanization can reduce human hardship and suffering, so urban health development must create sustainable urban communities, promoting healthy living, cross-sectoral approaches and political will, and comprehensive urban renewal programs.[17] Previous studies have demon-strated that urbanization has taken place rapidly in the past two decades.[18] Urbanization is expected to continue in the years to come, particularly in developing countries. While urbanization provides opportunities for employ-ment, education, and socio-economic development, it also raises several issues of health detriment related to determinants of health (intro-

duced above). Health is related to the adequacy of medical health services. However, it is also associated with the urban physical, social, and economic environment, and society's lifestyle and behavior. Planning can remediate some of the health problems caused by poor quality in the determinants. Therefore, the solution to the problem of urban health areas requires the effective involvement of the non-health sector (e.g., industry, transport, energy work, education, commerce, utilities, and services the City, planning the City, and other similar items). Besides, it included the organization of non-governmental, private sector, and community.

In some cities, a new planning concept has been introduced to overcome planning problems, and it includes the condensed City, large blocks, 15-Minute City away, car-free, or a combination of them. Condensed (or 'solid') cities are characterized by a high density of settlements and shorter travel distances. They have lower emissions of CO_2 than extensive cities and are healthier because of the diverse land use, briefer travel trips, and the opportunity for healthier mobility options. For example, Barcelona (Spain) plans to make more than 500 superblocks to reduce vehicle motor traffic and provide more space for people, traveling is active, and green space.[19] This superblock will reduce air pollution, noise levels, and heat islands effects while increasing green space and physical activity. It is estimated that they can prevent nearly 700 premature deaths in the city each year.

Similar principles were applied in other countries. France introduced a model of the 15-Minute City so that places of work, school, entertainment, and activities of others can be reached within 15 minutes walking. The 15-Minute City concept is a quite radical approach and will require monitoring.[20] It also provides the possibility of reducing inequality as it is a model that involves the mixing of groups of the population that differs from a model zoning settlement related to the status of the social economy. It also will reduce travel distance and thus reduce both CO_2, air pollution, and noise level. Hamburg (Germany) plans to be free from cars by 2034 to overcome the climate crisis.[21,22] A car-free city reduces personal motor vehicle use and can provide easy access to public transport and increase physical activity. Another successful example is Vauban in Freiburg, Germany, with a neighborhood without cars and sustainable housing. To conclude this section, the healthy city strategy reduces air pollution and noise levels, increases physical activity, and creates space for green areas - the new urban models of urban reverse the planning pyramid for transport.

As well as planning, other measures are needed to minimize disease transmission in particular circumstances. For COVID-19, most countries imposed national lockdowns and social distancing policies to control its rapid dispersion. Several studies investigating the lockdown effectively managed and prevented the spread of the pandemic. Nevertheless, the study's findings were reminders to continue addressing air pollution issues to protect human health.[23] As a result, the critical regions with widespread confirmed cases of COVID-19 should be urged to maintain lockdown. It is encouraging to compare pre COVID-19 air pollution with that found during the lockdown period. Industrial and mobility activities were reduced, and selected pollutants: NO_2, $PM_{2.5}$, and PM_{10} emissions were reduced by approximately 20 - 40% in 2020.[24] It is essential to measure atmospheric chemistry, emission trends, and meteorology lockdown effects on pollutant concentrations.[25] In addition, Hypoxia is observed in COVID-19 patients; however, patients exhibit a distinct phenotype. Intracellular nitric oxide (NO) levels are essential in the vasodilation of small vessels.[26]

From the previous discussion, it is recommended that planners generally prioritize public transportation, walking on foot, and cycling instead of prioritizing the car. Expanding bicycle use and increasing the cycling speed is one way to reduce the cross-vehicle motor and emissions of CO_2 and increase people's activity. Increased physical activity also improves public health. Mobility actively gives people the opportunity to physically build a movement in everyday life during daily trips because they often do not have enough time to go to the gym. Progress has been achieved in creating and expanding bike tracks, but this will only succeed if the tracks are well marked, secure, and part of the network. Besides, in the concept New Urban Model, physical activity (PA) and the use of digital facilities by citizens increased during the COVID-19 pandemic; the first increased fitness and reduced close personal contacts.[27,28] The next section focuses on alternative transportation, especially the use of bikes.

City by Bike

It has been demonstrated that implementing the health protocol of COVID-19 and applying the concept of healthy city results in preventing or reducing COVID-19. Here the focus is on bicycles (bikes). Cycling, in general, can help usher in a post-coronavirus society.[29] The Netherlands is known as a cyclist-friendly city. Citizens more often choose to travel by bicycle, the foot or using public transport. Cycling is a cost-effective solution. These results were consistent with those of other studies and suggest that bike-sharing advantages help respond to the COVID-19 pandemic and reduce air pollution.[16,30]

The effects of COVID-19 on the transportation sector are being studied extensively. Transport policies (e.g., for the use of bikes) can lead to reducing social contact to limit infection rates by using online platforms to deliver materials and food).[31,32] The COVID-19 pandemic has resulted in a dramatic shift in the demand for safe and physically segregated outdoor walking, cycling and com-

merce spaces. Cities worldwide have responded by enacting various policies and programs aimed at addressing these changes.[33] In Switzerland, cycling is increasing, especially if there is an increase in traffic congestion, and is becoming a habit.[34] Bike-sharing can help respond to the COVID19 pandemic.[30] It has been found that the possibility of infection occurs in public transportation, so that, in a COVID-19 situation, bikes are a recommended alternative, if possible.[30,35] There is a significant potential for e-bikes as a substitute for public transportation in post-pandemic cases. These findings can develop appropriate first policy interventions in future urban transport strategies to promote and strengthen bicycle sharing.[36,37] The COVID-19 pandemic is revealed from the pattern of urban mobility. Green Europe offers a 'road map' of a comprehensive strategy that aims to create a more frugal European Union with power and sustainability and a great opportunity to make cities carbon neutral.[38] As well, cities can be more habitable and healthier through better urban and transport planning.

More details about bikeways are provided in the following, with examples of implementation. One of the ways that can be taken is properly assigning tracks (bike lanes). The width of the bike track in Bangkok, Thailand, is about 1.4 meters. Hiking is given the color green with a picture of people riding bicycles on it. Bike tracks are explicitly made in between asphalt and pavement. The dividing lines for bikes use a separator colored yellow as high as 30 cm. In Singapore, through the Land and Transport Authority (LTA) body and several bodies, the Ministry of Transport organizes the City. It equipped it with bike tracks targeting the 700 km track bike that covers the entire country. Bicycle lanes in Singapore were made by reducing and managing the pedestrian footpath. In the settlement area, particular pathways come with signs mainly for cyclists. Some lines mark the park connector network (PCN) or network that can move from park to park and other city gardens. Each lane is equipped with manual directions to facilitate cyclists getting to the desired location. Singapore is widely equipped with areas for parking bicycles. The Netherlands is referred to as one of the cities most friendly to cyclists. Amsterdam was called a paradise for cyclists in the world. The development of bicycles took some time. Previously, after the second world war, the existence of bikes was eroded by cars. The Netherlands has started to implement the Woonerf system or share the joint road for a variety of users.[39]

The Woonerf system is designed to slow the driver as cars, bicycles, and pedestrians share the same space. There is no special separator that limits bicycle lanes to motorized vehicles, only a white line, both of which are confined. Göttingen, Germany, is considered cyclist-friendly. Some regulations prohibit the honking (harassing) of cyclists by cars and motorcycles. The bike path in the city is only about three meters wide. Typically, bike tracks were given a different color from the pedestrian lanes. In Germany, bike trails are not restricted to the City but may have intercity links. Bikes are safe and comfortable, and cyclists' facilities, including places to park bikes, are also reasonably plentiful.

Bike paths in Moscow, Russia, are similar to those in Singapore. The bicycle paths in Moscow, nicknamed a thousand parks, almost connect the entire City. One of them is in Gorky Park, in which the bike path can be connected to the metro or stations. Locating bike tracks on the pavement beside roadways eliminates the possibility of collision with vehicles such as cars or motorcycles. For additional safety, closed-circuit television (CCTV) constantly monitors every street corner in case there is a violation. There are many bicycle rental locations in Denmark. In the town, bike tracks are located on the right of the asphalt road. There is a bit of pavement between bike lanes and the road - highway. During busy times in Copenhagen, 62% of the population travels by bicycle to work or study. At each intersection, the bike path is colored blue. There are also traffic and other lights that are specifically for the bike. Electric bicycles are also allowed to use the bike tracks. Every building must have a bicycle park. The number of parked bicycles is not small as in Indonesia. There are dozens of bikes parked in buildings. Motor vehicle riders prioritize pedestrians, so this should minimize harm to walkers. Many bridges are reserved for the bike rider.

Strategyc Direction (Indonesia)

All the concepts discussed above emphasize access to green space, which is essential for various reasons, including mental health, cognitive function, and hope for the future. Strategies are needed to create green spaces such as gardens and to introduce more vegetation in the streets. Where feasible, it needs to dig up the asphalt and plant many trees, which will reduce the urban heat effect, contribute to the absorption of CO_2, and is a health benefit. The Jakarta Provincial Government is stepping up bike lanes to reduce traffic congestion and air pollution. A 200-kilometer build bicycle lane with a pattern of "35," i.e., every 5 meters of white-lined bicycle lanes, there will be a 3-meter-long green marking block. The comprehensive proposal of around sixty-two billion (IDR) is to construct an advanced bicycle path. Previously, Jakarta was also awarded the Sustainability Transportation Awards (STA). Jakarta was the first City in Southeast Asia to get the award in the area of transportation.[40]

Conclusion and Recommendation

A healthy city strategy to manage the COVID-19 pandemic is a challenge and must cover planning and action. Healthy city concepts provide a multidisciplinary approach for involving people such as architects and city

designers, decision-makers, public health experts, and local health authorities, promoting measures and procedures to transform the city into a healthier place, with more amenable neighborhoods during the COVID-19 pandemic. Some cities have introduced a New Urban Model that includes managing population density, green space, and transport. Planning for a car-free city that reduces air pollution will create a healthier environment. Promoting walking and outdoor exercise outdoor gym/outdoor exercise encourages safe physical activity and increases existing green space. Cycling is an inexpensive form of exercise and contributes to reducing pollution and improving physical, psychological, and social fitness/health to increase endurance necessary for the COVID-19 pandemic.

Abbreviations

COVID-19: coronavirus disease 2019 caused by SARS-CoV-2; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2 previously provisionally named 2019 novel coronavirus or 2019-nCoV (Lai, Shih 2020); CCTV: closed-circuit television; EU: European Union countries; IDR: Indonesian Rupiah; LTA: Land and Transport Authority; Mer's: Middle East Respiratory Syndrome; PA: the physical activity; PM10: Particulate Matter of 10 Microns in diameter or smaller People-in-Monitoring; WHO: World Health Organization.

Ethics Approval and Consent to Participate

Not applicable.

Competing Interest

The authors declare no competing interests.

Availability of Data and Materials

The authors have full access to all the data in the study and take responsibility for the data integrity.

Authors' Contribution

HH conceived the study. HH and PD wrote the main manuscript text, and all authors contributed to interpreting the results. All authors read and approved the final manuscript.

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Impact of Climate Variables on COVID-19 Pandemic in Asia: A Systematic Review

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Abstract

COVID-19 has become a global pandemic and threatens public health systems worldwide. Virus transmission can be influenced by several factors, one of which is climatic conditions. Temperature, humidity, precipitation, wind speed, and solar radiation play an important role in the transmission of infectious diseases and are variables that can determine the resistance of the SARS virus. This paper aimed to critically assess and provide evidence-based on the impact of climate variables on COVID-19 cases in Asia based on current knowledge to form the basis of guidelines for health care and prevention efforts. This systematic review used Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The articles were searched from ProQuest, Scopus, PubMed, and Springerlink databases. The reviewers had screened 2.784 abstracts, 103 full-text publications, and ultimately included 11 systematic reviews. The review found a consistently positive relationship between climate variables and COVID-19. Average temperature, maximum temperature, minimum temperature, and humidity (r = 0.83, 0.94, 0.93, 0.30) were significantly correlated with COVID-19 cases. Temperature, maximum humidity, and population density (adjusted R2 = 0.53, p<0.05), can be used as references in planning interventions during potential future pandemics. Linear regression framework, high humidity, and high temperature (p<0.05) significantly reduce the transmission of COVID-19. This systematic review shows that climate plays a role in the spread of the COVID-19 pandemic in Asia.

Keywords: climate change condition, COVID-19, humidity, precipitation, temperature

Introduction

Coronavirus Disease 2019 (COVID-19) has become a worldwide pandemic and threatens public health systems worldwide. There are many dynamics regarding the causative agent of COVID-19. Currently, SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) was determined to be the cause.[1] The COVID-19 is currently the third disease caused by the coronavirus transmitted from animals to humans. It was identified as a zoonotic coronavirus, similar to the SARS-CoV (Severe Acute Respiratory Syndrome Coronavirus) and MERS-CoV (the Middle East Respiratory Syndrome Coronavirus), which results in a severe respiratory syndrome after twenty years.[2,3] As of August 31, 2020, a total of 24,854,140 confirmed cases were reported worldwide, with 838,924 deaths (CFR 3.4%) with cases reported in 216 countries/regions.[4]

Experts believe in the influence of seasons on viral epidemiology. Low temperature is the most optimal condition for viruses such as a respiratory syncytial virus (RSV), influenza virus, and human metapneumovirus (hMPV) to cause infection in humans. This season causes RSV and influenza cases to increase in winter, while hMPV cases occur most of the year and peak in winter and spring.[5] The significant increase in the incidence of influenza at low temperatures and high humidity points to the potential impact of climatic conditions on the distribution and transmission of COVID-19, amid consideration of other non-climatic factors.[6–9]

Climatic conditions are the essential factors that affect COVID-19 because they can be a direct cause of biological interactions between agents and humans. Climatic elements such as temperature, humidity, rainfall, wind speed, and sunlight are significant factors in disease transmission and are parameters that can determine the survival of the SARS virus.[10–12] Therefore, this systematic review aimed to critically assess and provide evidence-based on the impact of climate variables on COVID-19 cases in Asia based on current knowledge to form the basis of guidelines for health care and preven-

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tion efforts.

Method

Search Strategy

For this review, articles were sourced from four science databases; ProQuest, Scopus, Pubmed, and Springerlink. The systematic review was adjusted using the PRISMA guidelines.[13] The searching process utilized two main keywords, which include climate and COVID-19. The population was people diagnosed with COVID-19. The comparison was countries, study characteristics, climate variables, the outcome was COVID-19, and the type of research using qualitative methods.

The search strategy in ProQuest: climate AND covid-19 as keywords. Full text, peer review, the source is an academic journal, date of publication last 12 months, English language are included in the filter. In Scopus: TITLE-ABS-KEY climate AND covid-19 AND (LIMIT-TO (ACCESSTYPE(OA))) AND (LIMIT-TO(PUBYEAR,2020)) AND (LIMIT- TO(DOCTYPE, "ar")). In Pubmed: (("climate"[All Fields]) AND ("covid-19"[All Fields]). Full text, type of article is a journal article, date of publication last one year, English language are included in the filter. The search strategy in Springerlink: climate AND covid-19 as a keyword.

Inclusion and Exclusion Criteria

All original articles in English, academic or research articles, ecological and time-series research, and the articles looking at the correlation between climate (temperature, humidity, precipitation, wind speed, and sunlight) and COVID-19 cases were included. The study about the relationship between climate and COVID-19 recovery rates, COVID-19 reproduction rates, and variables related to COVID-19 in addition to the number of cases, review articles, case reports, outbreak reports, and qualitative method were excluded.

Study Selection

Three reviewers selected the research based on the eligibility of the articles to be reviewed from the title, abstract, and full text. Three reviewers were selecting the articles based on their area of expertise.

Data Extraction

Data taken based on the conditions met, among others, the author, the study period, the year of publication, the country carried out, the research design and research method, the research area, and the correlation between climate (temperature, humidity, precipitation, wind speed, and sunlight), and COVID-19 cases.

Data Synthesis

Data synthesis was carried out using narrative synthesis. The research area included countries in the Asian continent. The variables of climate reviewed were based on the local state meteorological and climatological agency. The number of COVID-19 cases was reviewed based on the diagnosis of COVID-19 cases recorded at the local state health department. To reduce the risk of bias, the three reviewers worked independently. It would be done through an online discussion process and reading all the selected articles if they have different opinions. The eligible articles were then analyzed qualitatively based on the five variables: temperature, humidity, precipitation, wind speed, and sunlight exposure. The review used a PRISMA guideline; a checklist has been carried out using the PRISMA Checklist 2020.

Results

The studies included in this review were 11 articles. From 11 studies, three studies were from India, two studies were from Turkey and Japan, and Bangladesh, Indonesia, Iran, China, and Gulf Countries each. The results were resumed in Table 1. Based on studies reviewed, temperature (average, minimum, maximum, ambient), humidity, wind speed, average precipitation, number of sunny days with COVID-19. The Average temperature was at 2 m (r = 0.83), maximum tempera-

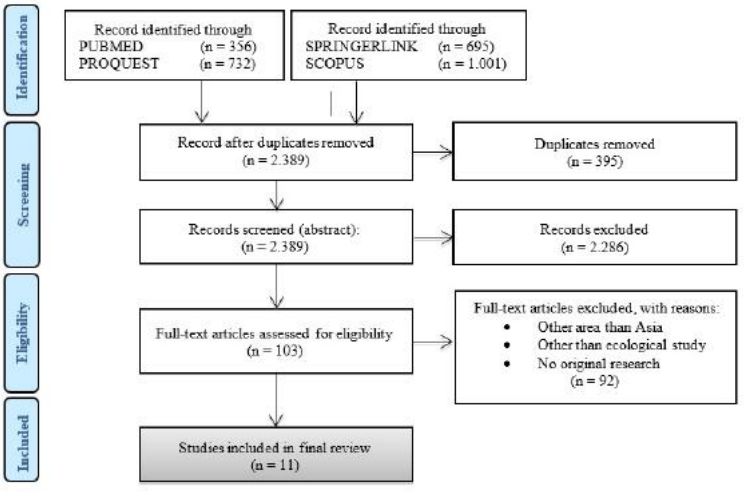

Figure 1. Systematic Review Flowchart

Table 1. Journals in Review[14-24]

Title	Author	Year of Publish	Variable	Analysis	Result	Suggestion
Correlation between weather and COVID- 19 pandemic in India: An empirical investigation	Prayas Sharma, Ashish Kumar Singh, Bharti Agrawal, Anukriti Sharma	2020	Temperature, Humidity	Pearson Product Moment Correlation Spearman's rank correlation	Minimum temperature (r = 0.93), maximum temperature (r = 0.94), average temperature (r = 0.83), and humidity (r = 0.30) were significantly correlated with cases of the COVID-19 pandemic with two-tailed 99% significance level.	The results of this study might use for further researchers in this field and formulate a policy in reducing the spread of COVID-19 in India.
Influence of Absolute Humidity, Temperature and Population Density on COVID-19 Spread and Decay Duration: Multi-Prefecture Study in Japan	Essam A. Rashed, Sachiko Kodera, Jose Gomez-Tames, Akimas Hirata	2020	Population density, spread and decay duration, Maximum temperature, Absolute humidity	Rank correlation, A correlation matrix with partial correlation probabilities, Linear regression	Population density with social distance is one of the main factors influencing the distribution and damage pattern, with R2 = 0.39 ($p < 0.05$) and 0.42 ($p < 0.05$). Maximum humidity affected decay duration, which was normalized by population density ($R2 > 0.36$, $p < 0.05$). Based on multivariate analysis, it is known that the estimated duration of pandemic spread, maximum humidity, ambient temperature, and population density (adjusted R2 = 0.53, p-value < 0.05), is used to plan interventions during a potential future pandemic.	For similiar potential pandemics, especially a potential second wave COVID-19 pandemic, population density, spread and duration of decay, temperature, humidity should be considered, and multi-city comparisons to develop different protection policies.
The spread of COVID-19 virus through population density and wind in Turkey cities	Hamit Coşkun, Nazmiye Yıldırım, Samettin Gündüz	2020	Temperature, Humidity, Number of sunny days, Wind intensity	Regression analysis, Meditation analysis	Population density and wind are at risk of spreading the virus, with an estimated percentage of 94% Temperature, humidity, sun brightness, and air pollution did not affect the number of cases. The number of COVID-19 cases is affected by the influental population density and wind speed. The Sobel test showed a significant decrease (Sobel z=17.23, p=0.0001). There was a relationship between wind speed, density, and the case of COVID-19.	SARS-CoV-2, which is not visible in the air, spreads faster in windy weather, indicating that SARS-CoV-2 in the air is one factor that threatens humans with wind speeds that increase air circulation.
Association between temperature, humidity, and COVID-19 outbreaks in Bangladesh	Syed Emdadul Haque, Mosiur Rahman	2020	Temperature average, Humidity, Summer and rainy season	Linear regression test	The peak spread of COVID-19 occurred at an average temperature of 26○C. A high temperature (p = 0.038) and high humidity (p = 0.005) significantly reduced COVID-19 transmission from the multiple linear regression results. This climate factor indicates that the hot season and rainy season in Bangladesh can reduce COVID-19 cases.	Social distancing as a community intervention aims to prevent the spread of the virus is still important. Further laboratory studies are needed to determine the mechanism.
Correlation between weather and COVID-19 pandemic in Jakarta, Indonesia	Ramadhan Tosepu, Joko Gunawan, Devi Savitry Effendy, La Ode Ali Imran Ahmad, Hariati Lestari, Hartati Bahar, Pitrah Asfian	2020	Minimum temperature, Maximum temperature, Temperature average, Humidity, Amount of rainfall	Spearman-rank correlation	Based on the analysis results, a significant relationship was found between the average temperature (°C) and COVID- 19 (r = 0.392; p = 0.001). Other variables such as minimum temperature, maximum temperature, humidity, and rainfall were not significantly correlated with COVID-19.	The findings can be used as input for the government to reduce COVID-19 disease in Indonesia.
Investigation of effective effective climatology parameters on COVID-19 outbreak in Iran	Mohsen Ahmadi, Abbas Sharifi, Shadi Dorosti, Saeid Jafarzadeh Ghoushchi, Negar Ghanbari	2020	Infected people with COVID-19, density, Intra-provincial movement, Infection days to end of the study period,	The Partial Correlation Coefficient (PCC), Sobol Jansen methods, Analyzing the effect and correlation of	The sensitivity analysis shows that population density, intra-provincial movement have a significant correlation with COVID-19. Areas with low humidity, wind	Researchers should pay attention to the presence of this type of virus every ten years by providing results based on previous experimen-

Table 1. Journals in Review[14-24]

Title	Author	Year of Publish	Variable	Analysis	Result	Suggestion
			temperature, precipitation, Humidity, Wind speed, Average solar radiation	variables with the COVID-19 spreading rate	speed, and solar radiation can support the viability of the virus, causing high infection rates. Provinces with a high population density, intra-provincial movement, and high humidity levels in Tehran, Mazandaran, Alborz, Gilan, and Qom are more susceptible to infection.	tal and observational studies and considering how these factors may affect the spread of COVID-19. In addition, a long-term study of the world's climate can anticipate the possibility of a similar pandemic occuring.
Impact of weather on COVID-19 pandemic in Turkey	Mehmet Şahin	2020	Temperature, Dew point, Humidity, Wind speed, Population	Spearman's correlation test	Temperature associated with the number of COVID-19 cases. The effect of humidity is the highest on the day of the COVID-19 cases. Wind speed correlates with COVID-19 cases. The population is a prominent indicator of determining or estimating COVID-19 cases.	The results of this study can be a guide for authorities and decision-makers in taking specific steps for pandemic control.
Effect of temperature on the infectivity of COVID-19	Mugen Ujiiea, Shinya Tsuzukib, Norio Ohmagari	2020	Temperature, Number of COVID-19 cases	Poison regression analysis	The old-age dependency ratio, visitors arriving from China in January 2020, and the average temperature in February 2020 associated with the cumulative number of COVID-19 cases as of March 16, 2020	There may be a link between low temperatures and an increased risk of COVID-19 infection. Further evaluations will be carried out at the global level.
Effect of temperature and humidity on the dynamics of daily new cases and deaths due to COVID-19 the outbreak in Gulf countries in Middle East Region	S.A. Meo, A.A. Abukhalaf, A.A. Alomar, N.M. Alsalame, T. Al-khlaiwi, A.M. Usmani	2020	The mean temperature and humidity were recorded from the appearance of the first case of COVID-19 in the region. The ratio by which quantity overcomes itself overtime; it is the same as the daily cases divided by the cases on the previous day	The data were recorded and analyzed; Mean and Standard Error of Mean (SEM) were calculated. A correlation calculated between meteorological factors and daily new cases and deaths of COVID-19. The growth factor, in which the quantity beats itself over time, was calculated.	The daily basis mean temperature was 29.20±0.30°C, and humidity was 37.95±4.40%. There was a negative correlation in the number of daily cases and deaths with the increase of the humidity in Oman, Kuwait, Qatar, Bahrain, United Arab Emirates, and Saudi Arabia. There was a correlation between increasing the temperature and the increase in daily cases and deaths due to COVID-19. The growth factor result for daily cases were 1.09±0.00, and daily deaths were 1.07±0.03 for COVID-19. This result showed the declining trends in the GCC region.	These findings can be used to reference policy makers and health officials based on the epidemiological trends of the impact of temperature and humidity of daily new cases and deaths from COVID-19.
Association of Environmental Parameters with COVID-19 in Delhi, India	Nikhilesh Ladha, Pankaj Bhardwaj, Jaykaran Charan, Prasenjit Mitra, Jagdish Prasad Goyal, Praveen Sharma, Kuldeep Singh, Sanjeev Misra	2020	The number of tests, temperature, relative humidity on the number of COVID-19	Daily maximum temperature, mean temperature, and average relative humidity data were entered into excel and cross-checked. Then a linear regression test was performed to model the data using SPSS 21.	This model was significantly able to predict the number of COVID-19 cases, $F(4.56) = 1213.61$, $p = 0.001$, with a value of 99.4% of the variation of COVID-19 cases with adjusted $R2 = 98.8\%$. Maximum temperature, temperature, and average relative humidity did not show statistically significance.	This research indicates that the COVID-19 pandemic may not be suppressed by increasing temperatures and humidity. However, it is critical to increase testing capacity to achieve epidemiological understanding and guide policy determination for COVID-19.

Table 1. Journals in Review[14-24]

Title	Author	Year of Publish	Variable	Analysis	Result	Suggestion
Significance of geographical factors to the COVID-19 outbreak in India	Amitesh Gup, Sreejita Banerjee, Sumit Das	2020	Air temperature, Rainfall, Actual evapotranspiration, Solar radiation Specific humidity, Wind speed with topographic altitude, The population density at the local level to investigate the spatial relationship with the number of COVID-19 infections	Pearson product-moment correlation Partial least square regression Generalized additive model	The spatial distribution of COVID-19 cases in India shows that maximum transmission occurs in countries with fewer wet conditions. However, provinces with the wet and very wet categories were less likely to be infected by the transmission. The bivariate analysis found no significant relationship with the number of infected cases in 36 provinces in India. The Variable Importance Projection (VIP) through the Partial Least Square (PLS) technique signifies the higher importance of SR, T, R, and AET. However, a general additive model that is equipped with the log transformation values input variables and applying spline fix to PD and E, there is a very high prediction accuracy (R2 = 0.89); therefore, there is a well-explained complex heterogeneity among parameter associations in the region with COVID-19 cases in India.	The positive relationship with SR and temperature and the negative relationship with humidity and rainfall indicate that areas with high temperature and arid in lowland areas are advised to be more stringent in following up on emergency precautions.

ture at 2 m (r = 0.94), minimum temperature at 2 m (r = 0.93), and humidity at 2 m (r = 0.30) were significantly correlated with cases of the COVID-19 pandemic with two-tailed 99% significance level. Ambient temperature, maximum absolute humidity, and population density (adjusted R2 = 0.53, p-value<0.05), proved useful for planning interventions during potential future pandemics, including the second COVID-19 outbreak. Average temperature (°C) correlated significantly with the COVID-19 pandemic (r= 0.392; p<0.01). Linear regression framework, high humidity (p = 0,005) and high temperature (p = 0,038) significantly reduce the transmission of COVID-19. These results show that the arrival of the hot summer and rainy season in Bangladesh can effectively reduce the transmission of COVID-19. In Iran, regions with low wind speed values, average precipitation, humidity, and solar radiation exposure to a high infection rate support the virus's survival.

Discussion

Temperature

In the studies reviewed, the temperature was significantly associated with the incidence of daily COVID-19 with and without time lag. Therefore, it was concluded that temperature drives the spatial and temporal correlation of the COVID-19 outbreak in China. It should be considered the optimal climate predictor for the incidence of COVID-19.[25] Several flu viruses that occur in northern states are caused by flu viruses of the same family type. This flu has a cyclic pattern of events known as "flu season." The flu virus was widespread during fall and winter and reached its peak between December and May.[26] Worldwide, cases of human morbidity and mortality from COVID-19 continue to increase in the "flu season," but COVID-19 was not the flu. Data obtained from the China National Meteorological Center and the Hong Kong Observatory, China, shows that the COVID-19 outbreak occurred during winter, similar to the previous SARS epidemic outbreak.[9]

Research conducted in 122 cities in China found a significant relationship between average temperature and the number of positive cases of COVID-19.[27] Also, the relationship between temperature and COVID-19 covering all countries affected by COVID-19, showed the result of an increase in daily temperature by an average of one degree Fahrenheit reduced the number of cases by about 6.4 cases/day. There is a negative correlation between the average temperature per country and the number of SARS-CoV-2 infection cases. This association remains strong even incorporating additional variables and controls (maximum temperature, average temperature, minimum temperature, and precipitation) and fixed state effects.[10]

The study explained that temperature was significantly associated with daily COVID-19 incidence with and without lag time. In addition, the researchers also found that the rate of transmission decreased as the temperature increased and that the increase in temperature contributed to a further decrease in infection rates and outbreak size. Therefore, it is concluded that temperature

drives the spatial and temporal correlation of the COVID-19 outbreak in China and should be considered as the optimal climate predictor for the incidence of COVID-19.[25] A research conducted by Bashir *et al.* (2020) in New York, USA, confirms that there are significant results between the mean temperature and the total cases and deaths from COVID-19.[28]

Humidity

High humidity, associated with low temperature, is an essential factor in influenza virus transmission, either by maintaining virulence or weakening the host by cooling the body or drying out the respiratory tract.[29] The literature shows that SARS-CoV transmission is similar to the influenza virus in terms of climate fluctuations.[30] The relationship between humidity and COVID-19 cases can be proven by the research conducted by Liu *et al.* (2020) in 30 provincial capitals in China that show a statistically significant relationship between absolute humidity and the number of COVID-19 cases. In addition, the association increased with the accumulated time duration up to 14 days. The study concluded that meteorological factors, particularly absolute humidity, played an independent role in the transmission of COVID-19 after controlling for population migration. Local weather conditions with low temperatures, mild diurnal temperature ranges, and low humidity tend to favor transmission.[31]

A similar study was conducted by Oliveiros *et al.* (2020) in 31 provinces in Mainland China, whose results show that humidity has a negative correlation with the doubling time of COVID-19 cases. This result means that, when humidity is low, the doubling time of COVID-19 cases will be longer, so the rate of progression of COVID-19 is expected to be slower. However, humidity and temperature variables only contributed up to a maximum of 18% of the variation. In comparison, the remaining 82% was related to other factors such as controlling population mobilization, public health policies, population density, transportation, and cultural aspects.[8]

Precipitation

Precipitation was one of the climatic factors which seem to be an essential factor to consider. Based on research conducted by Sobral *et al.* (2020), covering all countries affected by COVID-19 showed a positive correlation between precipitation and transmission of SARS-CoV-2. Countries with higher rainfall measurements show an increase in disease transmission. For every inch of increase in mean/day rainfall, there was an increase of 56.01 cases/day.[10]

In contrast to research conducted by Menebo (2020) which examined the relationship between temperature and precipitation with daily new cases of COVID-19 in Norway, it was shown that among the seven weather variables studied, maximum temperature and the normal temperature had a positive and significant correlation with COVID-19. On the other hand, the rainfall measured at 7.00 a.m. has a negative and significant correlation with COVID-19, which means that the higher the rainfall, the lower the cases of COVID-19. Various arguments can be given for the negative relationship between rainfall and new cases. One of them was the hypothesis that people will avoid going out if it rains. On the other hand, people are more prone to breaking the 'stay at home' rule when the sun is shining outside, thus becoming exposed to the virus.[32]

Wind Speed

The wind was implied as a critical climatic factor for the transmission of COVID-19. However, studies on this factor were still minimal.[33] Based on research conducted by Rosario *et al.* (2020), who conducted a study on the relationship between weather and COVID-19 cases in tropical countries showed that wind speed had a negative correlation ($p<0.01$). Therefore, high temperatures and wind speed were potential factors to reduce the spread of COVID-19.[34]

Research conducted by Coşkun *et al.* (2020) has had a different result. Research conducted by collecting climate values (temperature, humidity, number of sunny days, wind intensity) from 81 provinces in Turkey in March 2020 shows that population density and wind effectively spread the virus. These two factors explain 94%of the variance in the spreading virus. In addition, population density mediates the effect of wind speed (9%) on the number of COVID-19 cases. The finding that the invisible COVID-19 virus in the air spreads more in windy weather suggests that airborne viruses threaten humans with wind speeds that increase air circulation.[16]

Sunlight Exposure

The results of research conducted by Rosario *et al.* (2020) in Rio de Janeiro, Brazil, showed a strong negative correlation between solar radiation and the incidence of COVID-19 ($r = 0.609$, $p < 0.01$). This result means that high solar radiation can reduce the incidence of COVID-19.[34] This research is in line with the study conducted by Ratnesar-Sumate *et al.* (2020), who proved that sunlight could kill SARS-CoV-2 on the surface. This study also demonstrated the effectiveness of natural sunlight as a disinfectant for contaminated non-permeable surfaces.[11]

Based on research conducted by Asyary and Veruswati (2020), it was found that a higher duration of sunlight exposure was also associated with more case recovery from COVID-19 in patients. Sunlight can maintain the health condition of COVID-19 patients so that they have a chance to recover. Sunlight boosted the immune system, which slows down the development of influenza and SARS agents in the human body.[35,36]

Limitations

This systematic review had some limitations. There were only 11 articles that met the inclusion criteria, and most of the articles did not examine the climate element thoroughly, thus affecting the results of the analysis. Due to the lack of controlled studies, a meta-analysis was not performed. This study could only see the relationship/ correlation and did not analyze the causal relationship. In addition, this study used secondary data so that the level of bias is less controllable.

Conclusion

This systematic review found a positive association between temperature (average, minimum, maximum, ambient), humidity, wind speed, average precipitation, number of sunny days with COVID-19. This systematic review shows that climate plays a role in the spread of the COVID-19 pandemic in Asia. The results of this review might be used as a reference for researchers to conduct further research. In addition, it can also be used as input for policymakers as a reference for the preparation of the COVID-19 pandemic prevention program.

Abbreviations

AET: Actual Evapotranspiration; T: Temperature; COVID-19: coronavirus disease 2019; hMPV: Human Metapneumovirus; MERS-CoV: Middle East Respiratory Syndrome Coronavirus; PRISMA: Preferred Reporting Items for Systematic Review and Meta-Analyses; PCC: Partial Correlation Coefficient; PLS: Partial Least Square; PD: Population Density; R: Rainfall; RSV: Respiratory Syncytial Virus; SARS-CoV: Severe Acute Respiratory Syndrome Coronavirus; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; SR: Solar Radiation; SH: Specific Humidity; SEM: Standard Error of Mean; VIP: Variable Importance Projection; WS: Wind Speed.

Ethics Approval and Consent to Participate

This study was approved by the Research and Community Engagement Ethical Committee, Faculty of Public Health, Universitas Indonesia, No. 210/UN2.F10.D11/PPM.00.02/2021.

Competing Interest

The authors declare that there is no competing interest.

Availability of Data and Materials

For this review, articles were sourced from four science databases: ProQuest, Scopus, Pubmed, and Springerlink.

Reporting Guidelines

The PRISMA Flowchart has a temporary link https://doi.org/10.6084/m9.figshare.14977866.v1[37] and the PRISMA Checklist in the link https://doi.otg/10.6084/m9.figshare.14977926.[38]

Authors' Contribution

DS contributed substantially to the concept, work design, acquisition of the funding, and submitting the reporting guidelines to Figshare.com. YAS conducted data analysis, data interpretation, and drafting of the manuscript. VYS revised it critically for the important intellectual content of YAS, DS, and final approval of the version to be published.

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Economic or Public Health? Southeast Asia's Tackling of COVID-19 a Year Later

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Abstract

The world has been challenged by rapidly spreading COVID-19 outbreaks for a year now. Southeast Asian countries have had different strategies to deal with the pandemic. This review aimed to elaborate on Southeast Asian countries' strategies in managing the trade-off between economic and public health, with further consideration of how such approaches were associated with the dynamics of the number of cases and the speed of economic recovery. This review evaluated the COVID-19 mitigation efforts spanning one year in the Southeast Asian (SEA) countries listed based on the Bloomberg COVID Resilience Ranking. As of May 24, 2021, three SEA countries (Thailand, Malaysia, and Indonesia) were chosen from the better (27th), moderate (35th), and worst (42nd) SEA country rankings. Peer-reviewed articles were obtained from Google Scholar and PubMed databases, and news articles were retrieved from Google News. The data from government websites were also included. Sources were limited to those in the English and Indonesian languages that could be accessed between January 2020 and May 2021. Thailand, Malaysia, and Indonesia were found to have significantly prioritized consideration of the economy in handling the pandemic. Malaysia and Thailand had more stringent policies of imposing national lockdowns, while Indonesia had a partial lockdown. It was found that a weak pandemic response may result in substantial economic loss.

Keywords: COVID-19, policy, Southeast Asia

Introduction

Countries have taken varying approaches to control the coronavirus disease 2019 (COVID-19) pandemic. With these approaches, various indicators can be observed to classify how well a country or government has handled the pandemic. Daily case and death rates have been the most commonly used metrics to determine how each country has addressed the pandemic.[1] However, it is still difficult to draw any conclusions from the trends of new cases until today. SEA countries showed an increasing pattern in the number of daily cases in the beginning period when the World Health Organization (WHO) first declared COVID-19 as a global pandemic.[2] Then, the numbers decreased gradually in later periods[2] as certain countries, with extensive data and experience shared between countries and scientists, which allowed for recognition of the nature of the virus and the formulation of more effective measures.[3] Following the decrease of new cases, several countries started to loosen restrictions. After the case rate plateaued at the end of 2020, some countries experienced a second wave of the pandemic.[4] The dynamics of COVID-19 cases worldwide have prompted the question of what measures governments have taken to consistently control community transmission as the number of daily cases remained low for months but then increased once again.

COVID-19 has challenged government leaders to come up with strategies to control disease transmission at the country level with consideration of the economic impact of such measures. Leadership is an essential aspect of handling a crisis,[5] and it has been demonstrated to define the course of steps taken during such difficult events.[5] Accordingly, the actions of leaders concerned about political or business matters have contributed to the fall of their respective nations during times of crisis.[6] The decision to implement strategies that rely on trade-offs between the economy and public health might affect the dynamics of the number of cases and the speed of economic recovery.[7]

The Bloomberg COVID Resilience Ranking has tracked 53 countries according to their most negligible

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impact on the social, economic, and mortality impact. It was assessed by COVID status (i.e., cases per 100,000 in one month, the one-month fatality rate, total deaths per one million, positive test rate, and percentage of people covered by a vaccine) and quality of life (i.e., lockdown severity, community mobility, 2021 GDP growth forecast, universal health care coverage, and human development index). Southeast Asian (SEA) countries are distributed in the list from the upper to the lower rankings,[8] which indicates that, aside from their regional and social backgrounds, leadership plays a significant role in controlling the pandemic. Therefore, this review evaluated the progress of one year after the advent of the COVID-19 pandemic by looking at the leaders' decision to enact strategies based on a trade-off between economic interests and public health for COVID-19 mitigation among the SEA countries listed on the Bloomberg COVID Resilience Ranking. Specifically, this paper discussed the efforts of three SEA countries' governments, listed in the ranking as representative of better, moderate, and worse stages during the course of the ongoing pandemic.

Method

This review included SEA countries on the Bloomberg COVID Resilience Ranking (available online at https://www.bloomberg.com/graphics/COVID-resilience-ranking/). This ranking was chosen because it comprehensively provides an indicator of COVID-19 status and quality of life. The COVID-19 indicators consist of cases per 100,000 in one month, the one-month fatality rate, total deaths per one million, positive test rate, and the percentage of people covered by the vaccine. The quality of life indicators included lockdown severity, community mobility, 2021 GDP growth forecast, universal health care coverage, and human development index.

The Bloomberg COVID Resilience Ranking tracks 53 countries that are divided into three stages of resiliency: better (rank 1–29), moderate (rank 30–41), and worse (rank 42–53). As of May 24, 2021, three SEA countries were chosen as representatives from each stage. Thailand was selected from the better stage (27), Malaysia from the moderate stage (35), and Indonesia from the worse stage (42).

This review drew upon the information related to the countries' strategies in handling the trade-off between economic interests and public health; it then examined how these approaches affected the dynamics of the number of cases and the speed of economic recovery. An Internet search was conducted in May 2021. Peer-reviewed articles were obtained from the Google Scholar and PubMed databases, and news articles were retrieved from Google News. The data from government websites were also included. Sources were limited to those in the English and Indonesian languages that could be accessed between January 2020 and May 2021.

The keywords used in Google Scholar and PubMed were "(Country name)" AND "COVID-19" AND "policy" OR "economy." The search on Google News was performed with the following keywords: "Indonesia," "Malaysia," "Thailand," "COVID-19," "lockdown," "Minister of Health," "policy responses," "law enforcement," and "health-budgeting." The search on government sites was performed to obtain information about policy responses and updates regarding the pandemic's development. A narrative explanation was generated for the discussion. The discussion focused on how three countries managed the trade-off between economic interests and public health from January 2020 to May 2021.

Results

COVID-19 Situation

Thailand was the first country outside China to report the novel coronavirus on January 8, 2020.[9] The cases gradually increased in the following weeks of January to February 2020. COVID-19 rapidly spread in the community in March 2020, with hundreds of cases detected daily.[9] Thailand had successfully contained the first wave of COVID-19 in July 2020, with total cases of about 3,000. However, the total number of cases had skyrocketed to more than 170,000 by June 2021.[10]

The COVID-19 pandemic started in Malaysia due to imported cases in January 2020.[11] This phenomenon resulted in the first wave, with the number of positive cases rising to 22 by February 16, 2020. Since then, the second wave has followed, mainly due to local transmission. The second wave occurred roughly between February and June 2020 and involved a religious gathering at a mosque in Seri Petaling, Kuala Lumpur.[12] The two waves were handled relatively well, and Malaysian people enjoyed periods of relaxation. Unfortunately, the third wave began in September 2020. With a population of 32,750,801, Malaysia has so far recorded 616,815 positive cases and 3,378 deaths due to COVID-19 (as of June 8, 2021).[13]

Since its first case in March 2020, the number of cases in Indonesia has been increasing rapidly. While Thailand and Malaysia have faced a second or even third wave, the first wave in Indonesia has yet to cease. As of June 2021, the total number of confirmed cases was 1,831,773 or 6,697 cases per one million people, with the daily new case rate averaging around 5,000.[14] The daily positive rate is the second-highest in Southeast Asia after the Philippines.[14] This number is considered high in the region, probably due to the lower testing rate.[14]

Healthcare Capacity

The Thai government required that all confirmed cases be admitted to the hospital.[9] This policy would have backfired without a strong healthcare capacity. Fortunately, Thailand's healthcare system is one of the most robust globally, which is ranked second among 195 countries.[9] In the last four decades, Thailand has been hugely invested in expanding its health care infrastructure.[15] In 2019, the total number of hospital beds was about 158,026 from 1,370 hospitals across Thailand, which equals 2.2 beds per 1,000 citizens.[15] This hospital bed-to-patient ratio may be lower than the average of OECD countries, but it was still sufficient to accommodate all COVID-19 patients during the first wave.[9,15] With the demand for care has increased in the recent outbreak; the medical services department set up field hospitals to admit patients with mild or no symptoms.[9] This strategy successfully reduced the fatality rate to a very low level.

Malaysia has 135 public hospitals, 210 private hospitals, nine special medical institutes, and 61,158 doctors in terms of healthcare capacities. To improve COVID-19 case treatment, the Ministry of Health added 800 new units of medical ventilators to 926 ventilator units already in intensive care unit (ICU) facilities, together with 152 non-invasive ventilators and 142 transport ventilators.[16] However, the demand may exceed the present resources required to control current and future transmission.[17]

The challenge faced by the Indonesian government in handling COVID-19 has been influenced by health facilities availability in the country. Before the pandemic, Indonesia had one hospital bed per 1,000 people.[18] Thankfully, the implementation of the large-scale social restrictions (LSSR)/*Pembatasan Sosial Berskala Besar* (*PSBB*) has been effective enough to delay hospital admission due to COVID-19 by 20 days.[19] However, ICUs availability is also needed to handle critical care patients, which is predicted to be 30% of the total number of hospital admissions due to COVID-19. Meanwhile, Indonesia had 2.7 ICU beds per 100,000 people, which is the fourth-lowest number in Southeast Asia.[20]

Government Response

The government of Thailand declared a state of emergency on March 26, 2020. The government then implemented strict public health measures, such as promoting personal hygiene, canceling public gatherings, and limiting international and domestic flights. The government also imposed a national lockdown starting on April 3, 2020.[9] As of July 2020, the COVID-19 transmission curve was successfully flattened, with around 3,000 cumulative cases being recorded.[9] The recent surge of COVID-19 can be traced to the nightclub clusters in Bangkok in March 2021. Unlike in the first wave, the Thai government is trying to avoid another national lockdown at all costs to save the economy.

In Malaysia, health examinations at each entry point were among the initial measures enacted to prevent the spread of illness. The next critical steps were to continuously screen and test high-risk individuals and trace and quarantine the contacts. The government also worked hard to increase the number of facilities capable of treating COVID-19 cases.[21,22] A limited lockdown called a Movement Control Order (MCO) was first announced by Malaysia's Prime Minister on March 18, 2020.[23] This order was enacted under the Prevention and Control of Infectious Diseases Act 1988, and the Police Act 1967.[22] The education, religious, and secondary sectors were closed, and interstate travel was banned. Only the head of the family could purchase groceries within a 10-kilometer radius. Police and military were deployed to monitor the movements of people. Recently, the government announced a total lockdown amid the COVID-19 surge.[24] However, it should be noted that many people supported the initial decision to deploy an MCO considering the casualties of the outbreak.[25]

In Indonesia, the national strategy to handle the COVID-19 outbreak has been led by a special committee named *Komite Penanganan COVID-19 dan Pemulihan Ekonomi Nasional* (Committee for Handling COVID-19 and the National Economic Recovery) ruled by Presidential Regulation No. 82 of 2020. This committee has been led by the Coordinating Minister of the Economy. The Minister of Health serves as the vice head of the committee. During the pandemic, the Minister of Health had been replaced on December 22, 2020. Previously, it has been widely known that the president had been critical of the low COVID-19 actual budget absorption, which was only at 20%, as allocated by the Ministry of Health under the former minister.[26] Indonesia implemented a partial lockdown under the LSSR policy. This consisted of large-scale social regulations, including the closure of public places, schools, restrictions on public transport, and limiting travel.[27,28] In July 2020, Indonesia entered a new normal period with loosening restrictions in public places. Presidential Instruction No. 26 of 2020, issued on August 4, encouraged regional leaders to enforce sanctions for not obeying public health protocols. The sanctions included reprimands, social work, administrative fines, or business closures.

Current Economic Situation

Thailand's economy has been severely impacted by COVID-19, especially since it was in a delicate position even before the global pandemic.[29] The World Bank estimated that Thailand's economy shrunk by 6.5% in 2020.[29] Thailand's economy heavily relies on international tourism, contributing to approximately

12.0% of the total GDP.[29] The tourism sector may not be fully recovered in the near future as the pandemic is still far from over. Private consumption also significantly contracted in 2020 despite the government providing 5,000 THB per month in direct cash transfer to individuals affected by the pandemic.[29] Mobility restriction and physical distancing measures make it increasingly difficult for the private sector to boost the economy.[29] Therefore, the government could not afford to impose another national lockdown, which would inevitably sink the economy.

Most of Thailand's health budget for the fiscal year 2022 is planned to be allocated to fund universal health coverage and to curb the COVID-19 pandemic.[9] All COVID-19 medical services are paid by one of three health insurance schemes, including the Civil Servant Medical Benefit Scheme, Social Security Scheme, and Universal Coverage Scheme.[9] In recent weeks, the Thai parliament agreed to allocate THB 295.7 billion for the health sector in the fiscal year of 2022. Most of this funding would be given to the universal healthcare coverage program, which would account for approximately THB 202 billion.[30]

The lockdown has had a significant socio-economic impact on Malaysia's economic performance. In 2020, the GDP was estimated to have contracted 5.6 percent, mainly because of MCO implementation.[31] To combat the pandemic, the government allocated RM 31.9 billion for the health budget in 2021, which was an increase of 4.3% from the previous year. The scheme to strengthen the domestic supply chain and boost the production of locally manufactured medical devices will be derived from the new budget, which includes a RM 1.4 billion national development plan.[32]

According to the data provided by the Ministry of Finance of the Republic of Indonesia, the country's health budget was planned to be 5% of the total government budget of 2020.[33] Due to COVID-19, the government released Presidential Regulation No. 54 of 2020 as a response to the pandemic to increase the funding in the health sector. It was stated that the change of budget plan should direct the country to focus on controlling the pandemic by sharpening the strategy for health and economic recovery due to the impact of COVID-19.[34] The government's consideration to also think about the effects of COVID-19 on the economy has been reasonable. The pandemic has affected broad sectors, including the economy, and the decline of tourism and the high unemployment rate are indications of this effect.[35-37] In 2020, the GDP contracted by 2.07%,[38] slightly better than the situation in Thailand and Malaysia.

Discussion

The economy became a significant consideration in formulating COVID-19 response policies in Thailand, Malaysia, and Indonesia. In the short term, there may be a trade-off between economic damage and loss of life.[39] However, the economy may not fully recover without adequately handling the pandemic. In addition, a weak pandemic response has led to substantial economic loss due to premature deaths and "long COVID" related disabilities.

Historically, international tourism has always played a vital role in Thailand's economy.[40] This sector relies heavily on physical mobility and social interaction. Physical distancing policies enacted during the pandemic have inevitably hurt the tourism industry. Although the tourism sector's contribution has been significant, the Thai government is not in a hurry to fully open the border for international arrivals and loosen physical distancing measures. Public health has remained the top priority in any policymaking during this pandemic. However, a recent Phuket sandbox model proposed by the Tourism Authority of Thailand (TAT) has elicited some critique. This model is the pilot project for re-opening Phuket Island for international vaccinated tourists without mandatory quarantine.[41] As of June 7, 2021 many issues have not yet been clarified concerning this plan.[41] Moreover, the Center for COVID-19 Situation Administration (CCSA) has required a minimum of 70% of Phuket's residents to be vaccinated before tourism can re-open. However, only 60% of the Island's target vaccination population of 466,587 have received the first shot, and only about 98,795 have been injected with the second shot.[42]

To help patients with financial difficulties, Malaysia's Ministry of Health established a special fund known as the COVID-19 Fund. The government and private sectors contributed RM 1 million to this initiative, while NGOs and individuals were also welcome to donate. These funds have also helped those who had no income source during the quarantine and were used to support medical expenses and treatment processes.[43] Malaysia has viewed this COVID-19 crisis as a public health crisis first and an economic crisis second. Thus, the economic policy was mainly focused on supporting public health measures to combat the pandemic while also protecting people's and businesses' wellbeing.[44]

Strategies designed to boost the tourism sector also received the Indonesian government's attention at the beginning of the pandemic. In February 2020, when other countries decided to close the border because of the outbreak, the Indonesian government decided to provide a 30% discount for domestic and overseas tourists to boost the weakened tourism sectors due to the economic impact of COVID-19 worldwide.[45] Similar

tourism policies have gained criticism from the public. Currently, the Indonesian government is focusing on economic recovery, including the provision of stimulus payments for the tourism sector. These stimuli include IDR 3.3 trillion in grants for hotels and restaurants.[46]

Speeding up vaccination rollouts is a win-win solution for public health and economic recovery. Nevertheless, vaccination rollouts have been relatively slow in Thailand. The Bloomberg Resilience Ranking recorded only 2.1% of the Thai population as being vaccinated as of June 7, 2021.[8] The low vaccination rate may hinder the control of COVID-19 transmission in Thailand, which has been stagnant. COVID-19 cases have been reported at around 2,000 per day in the past month.[10] The government currently relies on the Sinovac and Oxford-AstraZeneca vaccines. Therefore, the government plans to speed up mass vaccination by injecting THB 3.59 billion into vaccination procurement and management.[47] In addition, a total of THB 2.379 billion would be allocated to the National Vaccine Institute for the development and manufacturing of locally made COVID-19 vaccines.[47]

Only 7.3% of the Malaysian population have received at least one dose of the COVID vaccine.[48] Accordingly, the government plans to accelerate its national vaccination program. It is expected to reach the 80% vaccination target by August 2021.[49] The total RM 5 billion federal COVID-19 vaccine program allocation has not been taken out from the country's budget. Yet, it was taken from the Pemerkasa economic stimulus package and the National Trust Fund (KWAN)—a savings fund built from Malaysia's natural resources, primarily through a donation from the oil and gas company, Petronas. This policy has been implemented to avoid a GDP deficit.[50]

In Indonesia, the total health budget in 2021 has been focused on the vaccination program. As the vaccination program became a priority, by June 2, 2021, 6% of the total population had received at least one dose of a vaccine.[14] This is a notable effort for a country with a large population. However, the education of the community regarding the concept of herd immunity needs to be improved. People need to be educated that wearing masks, washing hands, and avoiding crowds are still required even after completing two vaccination shots. Education with effective communication strategies is essential during outbreaks since well-educated citizens contribute to the collective approach of optimizing government regulations.[51] Moreover, the target vaccination rate in Indonesia has been set at 70% of the total population. Looking at the current achievement, the number of people vaccinated is still far from this goal.

Thailand was recognized as one of the best countries in curbing the COVID-19 spread in 2020.[9] However, the situation may differ in 2021. A recent surge of COVID-19 cases began in the Greater Bangkok Area,[10] as the virus was transmitted rapidly to all provinces after the Songkran holiday.[10] Although the street water fight was banned this year, many Thais still took a trip to their hometowns.[52] Policy responses have included issuing a nationwide mask mandate, closures of entertainment venues and businesses, and limits on restaurant and store operations.[52] Despite the daily confirmed case number being equal to all cases during the entire first wave period (January–July 2020), the Thai government is hesitant to impose a strict national lockdown to avoid more profound economic damage.

At the beginning of the pandemic, Malaysians were unaware of the virus's lethality and unprepared to deal with the pandemic, mainly because of the simultaneous political crisis and the conviction that the virus would not spread quickly in Malaysia.[21] However, Malaysian people began to panic when the first two deaths were reported in mid-March, less than a week after Malaysia's positive COVID-19 cases jumped from 99 to 200 at the start of the second wave.[53] As a result, the government has taken numerous actions to assuage public concern and safeguard Malaysian citizens' health.

The dilemma regarding the prioritization of the economy or health in Indonesia has led the nation to be ill-prepared in taking all the necessary measures to strictly limit public mobilization, even though the number of daily cases has increased steadily compared to neighboring countries.[54] Instead of a total lockdown, Indonesia implemented a partial lockdown under the LSRR policy; a large-scale social restriction including the closure of public places and schools and limitations on public transport and other travel.[27,28] In July 2020, Indonesia entered a new normal period with loosening restrictions on public places. This has encouraged the mindset in the public that COVID has ended. Moreover, there is a lack of positive laws regulating fines for not wearing masks, washing hands, or keeping distance. The decline of *PSBB* restrictions came in line with the occurrence of long holidays. From October to November 2020, there were several public holidays, and the daily number of new cases increased after these days. For instance, it can be seen from the data that the number of confirmed cases increased steadily after the public holiday on November 5, 2020.[14]

Conclusion

At the beginning of the pandemic, Malaysia and Thailand implemented strict national lockdowns. These policies had successfully contained the spread of COVID-19 in 2020, but Indonesia's health system was on the brink of collapse at the same time. However, the performance of the economic indicator was slightly

better in Indonesia, while Malaysia and Thailand's economies hit rock bottom.

No country could afford a strict lockdown forever because the pandemic may not disappear soon. Therefore, the authors recommend a combination of moderate control with solid law enforcement and the provision of cash transfers and other social assistance programs as a strategy to save lives and livelihoods. Second, complacency, the loosening of public health restrictions, and slow vaccination rollouts may have contributed to the recent surge of COVID-19 in the region. All Southeast Asian countries have been relatively slow to provide COVID-19 vaccinations. Therefore, speeding up vaccination rollouts is the crucial solution to flatten the COVID-19 infection curve in Thailand, Malaysia, and Indonesia.

Abbreviations

COVID-19: coronavirus disease 2019; SEA: Southeast Asia; WHO: World Health Organization; GDP: Gross Domestic Product; ICU: intensive care unit; LSSR: large-scale social restrictions/Pembatasan Sosial Berskala Besar; MCO: Movement Control Order; OECD: Organization for Economic Co-operation and Development.

Ethics Approval and Consent to Participate

This research does not involve humans or other living creatures as samples. No formal ethical scrutiny was required or undertaken.

Competing Interest

The authors declare there is no conflict of interest.

Availability of Data and Materials

Not applicable.

Authors' Contribution

IA conceptualized the review objective and framework. RF, MA, and MB conducted a literature search. All authors work together on synthesizing information.

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Preventing and Controlling COVID-19: A Practical-Based Review in Offshore Workplace

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Abstract

An offshore platform is a workplace with complex facilities and limited space due to the complex installed equipment and components. Therefore, the offshore as enclosed area platform is more likely to have a high risk of COVID-19 outbreak. Furthermore, a company must strictly follow health protocols to prevent workers from being exposed to COVID-19 in the offshore workplace. However, workers are often forced to onboard without proper health protocols because of operational needs and production targets. This paper aimed to explore the essence of the steps in preventing and controlling COVID-19 in the offshore workplace and the challenges. The analysis found that the company must take preventive measures against COVID-19 before workers are on board and in the workplace and control it using the hierarchy of control: engineering control, administrative control, and personal protective equipment (PPE).

Keywords: COVID-19 prevention, offshore workplace, the hierarchy of control

Introduction

Since COVID-19 was declared as a global pandemic by the Director-General of the World Health Organization (WHO) on March 11, 2020, the number of confirmed cases of COVID-19 continues to increase. The COVID-19 has impacted industries, including international travel, tourism, hospitality, food and beverages, mining, and small or medium enterprises.[1] The workers become unsafe because they can be exposed to SARS-CoV-2, a virus that causes COVID-19 and infects co-workers. It was reported that thousands of health workers and other public service workers were exposed to SARS-CoV-2 in the United States of America due to interactions with patients and fellow workers.[2] Further, 255 million working hours were lost in 2020 due to COVID-19.[3] Therefore, the COVID-19 pandemic has impacted workers and productivity.

Limited space (enclosure area), such as in oil and gas offshore platforms and supporting boats, are vulnerable sites of COVID-19 outbreak due to their high person on board (POB) density, constrained internal workplace and accommodation, and relatively concentrated mess hall.[4] Offshore facilities are complex workplaces due to their large diversity of equipment and components that should be installed for drilling activities, oil and gas processes, and accommodation.[5] The accommodation in offshore facilities is highly airtight. Cabins are divided into workers' accommodations and public areas, such as mess hall, galley, recreation room, gym room, meeting room, and praying room. A worker might be exposed to COVID-19 in an offshore workplace due to close contact (less than 1.8 meters) with other workers and touching their mouth, nose, and eyes after frequently contacting touched surfaces and work equipment.[6] Consequently, the offshore workplace is among the workplaces prone to COVID-19 outbreak.

The company is obligated by law to provide and maintain a safe workplace from any hazards, such as a virus that causes COVID-19.[7] Measures must be taken to minimize the probability of viruses' exposure to the workers and avoid the virus spread from an already exposed worker.[8] Thus, protection against COVID-19 transmission in the enclosure workplace, such as offshore platforms, must be carried out through comprehensive and systematic prevention and controlling efforts before onboard and at the workplace. The main goal is to minimize the health risk in the workplace, if not eliminated.

This paper presented an article review to explore the essence of preventing the COVID-19 outbreak in the offshore workplace and controlling it using a hierarchy of control.

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Method

Related articles in preventing and controlling COVID-19 at the workplace, especially practical-based studies on the offshore platform, were searched and analyzed. The discussion was then divided into three categories: prevention, control, and challenges. All best practices from the WHO and Centers for Disease Control and Prevention (CDC) were also considered. Furthermore, the steps in preventing and controlling COVID-19 in the offshore workplace were identified.

Results and Discussion

COVID-19 Prevention in Offshore Workplace

The first and most crucial aspect of preventing COVID-19 at the offshore workplace is pre-employment and periodic medical check-ups (MCUs). A company doctor reviews the results to determine whether the workers are fit for work, following the minimum requirements for each type of job position (job risk base).[9] MCU is a clinical preventive service carried out on workers lacking signs and symptoms of disease[8] to ensure that only healthy workers can work according to their roles and responsibilities. MCU implementation is part of the company and employee compliance with Law No. 1 of 1970 concerning Occupational Safety, Government Regulation of the Republic of Indonesia No. 50 of 2012 concerning Implementation of Occupational Health and Safety Management Systems (OHSMS), and Regulation of the Minister of Manpower and Transmigration Number Per.02/Men/1998 concerning Health Examination for Workers in the Implementation of Occupational Health and Safety. The types of examination parameters are determined according to the risk of each job.[9-11] The final results of the MCU become the baseline data for further health assessments related to COVID-19 comorbidities.

Several diseases, such as diabetes mellitus, chronic obstructive pulmonary disease (COPD), cardiovascular disease, hypertension, liver disease, obesity, kidney disease, and malignancy, are COVID-19 comorbidities.[12] Workers with comorbidities have a higher susceptibility to COVID-19, more severe complications, and even death.[13] Therefore, the company must determine that every comorbid worker can only work from home (WFH). The company can grant work permit exemptions to essential workers whose physical presence is necessary to maintain company business continuity. For this purpose, the company must first conduct a risk assessment and mitigation plan (RAMP) and medical recommendations for workers with comorbidities. Supervisors must ensure that workers with comorbidities permitted to work will follow the RAMP document's recommendations. Companies can give warnings to workers who do not follow health recommendations or revoke their work permits.

The company needs to facilitate workers in carrying out a self-health evaluation before onboard to offshore.[14] Self-health evaluation can be done through an online questionnaire or application to assess potential COVID-19 exposure before onboard. The company with several workers who live outside the company's operational area, such as workers in mining, oil, and gas companies with on-and-off schedules, where some of them travel by themselves using public transportation modes (air or land) from their domicile to the company premises, must provide a quarantine facility for at least one day before antigen-detecting rapid diagnostic tests (Ag-RDTs) test[15] or seven days before reverse transcription-polymerase chain reaction (RT-PCR) test.[16]

A COVID-19 test must be conducted on every worker with no potential exposure to SARS-CoV-2 based on the health self-evaluation. The COVID-19 test is conducted as part of programs to reduce COVID-19 spread, especially for travelers and those entering work areas, such as the offshore workplace.[17] COVID-19 test is effective in preventing COVID-19 in the workplace. However, some people with COVID-19 have no symptoms (asymptomatic) or are still in the incubation period, making it difficult to identify them by physical examination.[18] Body temperature screening and self-health assessment must be performed daily when they are at the offshore workplace.

The COVID-19 test by nucleic acid amplification test (NAAT), such as RT-PCR, is highly recommended because of its high sensitivity[19,20] for workers working in enclosure areas, such as oil and gas offshore platforms. A negative result is required to get a permit to work offshore.[20] Ag-RDTs with a sensitivity of 94%, slightly lower than RT-PCR, are the second choice with lower cost and faster results. Ag-RDTs can also diagnose COVID-19 when RT-PCR assays are unavailable.[19] Antibody assay (serology) with low sensitivity is the last option when RT-PCR and AgRDTs are unavailable.[19] A positive IgM titer from an antibody test reflects an acute (current) infection, while a positive IgG titer indicates a previous infection.[19,20]

Workers' transportation to and from the offshore workplace is the next critical point. Public transportation from home to jetty is permitted only when health protocols can be implemented, such as maintaining physical distance, providing barriers/partitions between drivers and passengers, and disinfecting after each use. The use of one's own transportation is highly recommended. If resources are sufficient, the company can provide transportation for all workers from home to jetty. If the company offers transportation, then the seats must be arranged at a minimum distance of one meter. The frequency of transportation must be adjusted because the

number of workers in one vehicle is reduced.[21] Partitions/barriers between the driver and passengers must be provided; workers must wear masks and forbid talking to each other and disinfect their vehicle after each use. Disinfection is necessary because one of the SARS-CoV-2 characteristics is that it can survive on inanimate surface objects for 2–9 days at room temperature.[22] Passengers' name logs and seat numbers must be recorded to anticipate if a confirmed case of COVID-19 is found, so it will be easy to trace close contacts from one vehicle.

A protocol for managing confirmed COVID-19 cases needs to be drawn up to ensure proper handling if confirmed cases of COVID-19 are found in the workplace and to trace their close contacts. Every worker who has symptoms of COVID-19 must be immediately isolated and confirmed by the NAAT test at the nearest health facilities. Standard operational procedures to evacuate infected workers to the closest health facilities should be established to ensure that there is no exposure to other workers. Companies must provide temporary isolation and quarantine facilities at the workplace, especially if the workplace is far from healthcare facilities such as offshore oil and gas and coal mining. Temporary isolation and quarantine rooms must be equipped with N95 masks, telephones, water for bathing and washing, latrines, disposable soaps and tissues, and medical telephone numbers for emergency contact.[14]

Close contact tracing should be carried out immediately by involving the relevant functions/departments through an interview with confirmed caseworkers and their co-workers or CCTV footage if available in the workplace. The transmission of COVID-19 starts about two days before workers show symptoms, so close contact tracing must be carried out from two days before symptoms until 14 days after the onset of symptoms. For confirmed cases of COVID-19 with no symptoms, close contact tracing is carried out from three days before NAAT sampling until 14 days after. This procedure considers the average incubation period of COVID-19 at 5.2 days and a maximum of 14 days.[23]

Through related functions, such as the occupational health function, the company must monitor every confirmed case of COVID-19, probable case, suspected case, and close contact. Heads of related functions can coordinate with workers to ensure compliance with quarantine or isolation protocols. Confirmed case monitoring is imperative as part of the return to work assessment. Workers who have completed the quarantine and isolation period with a negative NAAT test can then be allowed to return to work.

COVID-19 Control in Offshore Workplace

Control of COVID-19 in the offshore workplace can be developed using a control hierarchy. The elimination of SARS-CoV-2 is more useful than other control measures. However, it may be complicated, even impossible, to eliminate or substitute COVID-19 from the workplace.[24] The engineering controls, administrative controls, PPE, or the combination are the most effective ways to control COVID-19 in the offshore workplace. Engineering controls are aimed at isolating the worker from the hazard of SARS-CoV-2. Workstations in the offshore workplace need to be adjusted so that workers do not face each other. If possible, physical barriers can be established to ensure that workers are not in close contact with others, especially in public areas such as workshops, coffee break areas, galley, restroom, locker room, meeting room, and entrance/exit. Physical barriers/partitions can be made of strip curtains, plastic barriers, or similar materials as an impermeable divider.[6,14] Considering that offshore has limited space, it is necessary to signal worker traffic in a single direction in narrow areas, such as stairwells, aisles, incoming and outgoing registration points, entrance/exit doors, and entrance/exit helideck. Physical distance signs must be created in most public areas, such as shared workstations, galley, and coffee break areas.[6]

Handwashing stations with soap or hand sanitizer dispensers that contain at least 60% alcohol should be provided in many work and public areas at offshore facilities. WHO and US CDC recommend frequent handwashing as their topmost COVID-19 prevention advice for the public.[25] Frequent handwashing with soap and alcohol-based hand rub is proven to be the best and most effective way to reduce the spread of respiratory infection.[26,27]

Another critical point as part of engineering control is to ensure that offshore facilities have good ventilation by maintaining the maximum amount of fresh air delivered to the workplace and keeping humidity at a level of 40%–60%. Most of the spread of respiratory diseases can be reduced in any circumstance by good air ventilation.[28,29] Heating, ventilation, and air conditioning (HVAC) filters can be increased to the highest acceptable level. Also, portable high-efficiency particulate air (HE-PA) filtration units can be installed to remove any biological contaminants in the air when open ventilation is not well established.

For administrative control, it is important to minimize the exposure of SARS-CoV-2 to workers in the offshore workplace by changing work procedures. Online meetings and shift arrangements are part of administrative control to avoid face-to-face interaction and communication. Training and written company policies in controlling COVID-19 are other administrative controls that the company must carry out. The training may be focused on physical distancing, frequent handwashing, wearing appropriate PPE, and how to dispose of used masks.[24]

The last control uses PPE as an integrated part of COVID-19 control strategies in the offshore workplace. Wearing a 3-ply cloth mask is considered sufficient for most workers, while others will need additional PPE based on their risks, such as respirators, face shields, goggles, gloves, and gowns. A health worker offshore (medical doctor or nurse) must wear all the PPEs mentioned above because of their risk when handling patients. All types of PPE must be inspected, maintained, and used properly to provide adequate protection to users.

Challenges in Preventing and Controlling COVID-19

Limited facilities for self-quarantine for workers before screening tests and before onboarding and the facilities for self-isolation for confirmed caseworkers are often a challenge in COVID-19 prevention and control programs. In addition to costs, this problem arises because of the limited area to add isolation and quarantine rooms at company premises. Alternatively, the company can work with hotel service providers to provide self-isolation and self-quarantine rooms upon approval from local health authorities. However, when self-quarantine rooms before on board are equipped at company facilities, it is common to be an issue because quarantine will increase the number of days workers spend.

The next challenge is workers' compliance with implementing the health protocol during self-quarantine before onboard. Workers are required to carry out 14 days of self-quarantine at home before onboard. Note that the company cannot fully control the quarantine protocols carried out by workers and has not provided room for self-quarantine in company facilities that can be monitored. Providing a surveillance application with geotagging is one solution, but it needs to be appropriately communicated to every worker because of the possibility of resistance related to privacy issues.

Conclusion

Preventing and controlling COVID-19 in the offshore workplace is essential for a company's business continuity. Periodic MCUs can carry out the COVID-19 prevention, comorbid review, self-health evaluation, self-quarantine, and COVID-19 test before onboard, arrangement of workers' transportation modes, case management of confirmed caseworker, probable case, suspected case, and close contacts in the workplace. The COVID-19 control can be carried out through a hierarchy of control. The elimination is more useful than other controls, but it may be difficult or even impossible. The most effective ways are engineering control, administrative control, PPE, and their combination.

Abbreviations

Ag-RDTs: Antigen-detecting rapid diagnostic tests; COVID-19: Coronavirus Disease 2019; MCU: Medical Check-Up; NAAT: Nucleic Acid Amplification Test; SARS-CoV: Severe Acute Respiratory Syndrome Coronavirus; OHSMS: Occupational Health and Safety Management Systems; PPE: Personal Protection Equipment; RAMP: Risk Assessment and Mitigation Plan; RT-PCR: Reverse Transcription Polymerase Chain Reaction; WFH: Work from Home.

Ethics Approval and Consent to Participate

No ethics approval since this article is not experimental research.

Competing Interest

The authors declare that no competing financial interest, professional, or personal interest affected the manuscript.

Availability of Data and Materials

No additional data and materials are available.

Authors' Contribution

HS and DHR were involved in the conception of the manuscript. HS wrote the first draft, then reviewed and edited by DHR. Both HS and DHR read and approve the final manuscript.

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