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Temporal Effects of Extended Holiday Periods on COVID-19 Transmission During First Wave of Pandemic in Medan, North Sumatera, Indonesia

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Abstract

Background: *COVID-19 transmission is known to be influenced by the duration and closeness of contact with infected cases. Evidence indicates a correlation between increases in case numbers and public holidays.*

Methods: *This study used a quantitative descriptive epidemiological design based on surveillance data, covering Medan City from March 2020 to March 2021, the first wave of the pandemic. The study population comprised all 13,748 COVID-19 cases reported from all sub-districts in Medan City during this period.*

Results: *The highest surge in COVID-19 cases in Medan City occurred on 8 October, coinciding with the Omnibus Law demonstration, representing a 2.55-fold increase relative to the cumulative case count over the preceding five days. By sex, the majority of COVID-19 patients in Medan City were female (52.2%; 95% CI 51.4–53.1). By age category, the majority were in the adult age range (52.3%; 95% CI 51.4–53.1). By isolation site, the majority underwent centralized isolation, i.e., in hospitals (53.9%; 95% CI 53.1–54.7). By travel history, the majority had no travel history (99.82%; 95% CI 99.7–99.9). By sub-district, the majority of patients originated from Medan Selayang sub-district (9.6%; 95% CI 9.1–10.1).*

Conclusion: *The single largest surge in COVID-19 cases coincided with the 8 October Omnibus Law demonstration, a mass-gathering event that increased public contact density and constituted a plausible source of transmission. Case counts were also visually elevated following extended public holidays, including Christmas and New Year, Indonesian Independence Day, and Eid al-Fitr, plausibly linked to increased community mobility, although this holiday-related pattern was assessed descriptively and requires confirmation through formal statistical testing.*

INTRODUCTION

At the end of December 2019, China reported an outbreak of pneumonia of unknown cause in Wuhan, Hubei Province. Most of the initial cases were epidemiologically linked to the Huanan seafood wholesale market, where live aquatic animals were sold [1]. This syndrome, now known as COVID-19, has since spread worldwide [2], with globally confirmed cases reaching 119,220,681 and deaths reaching 2,642,826 as of 14 March 2021 [3]. In Indonesia, as

of the same date, 1,419,455 confirmed cases and 38,426 deaths had been recorded [4], while North Sumatra Province had recorded 25,965 confirmed COVID-19 cases [4], and Medan City had recorded 13,421 confirmed cases with 430 deaths [5].

Coronavirus is a single-stranded RNA virus and among the principal pathogens affecting the respiratory system, with zoonotic transmission considered the initial source of COVID-19 spread [1,6,7]. Although the disease can affect all age groups, older adults and patients with comorbidities such as cardiovascular disease, diabetes mellitus, and hypertension are at higher risk of severe symptoms, whereas children and adolescents tend to present with milder disease [2,8]. By sex, males have been considered at higher risk of contracting COVID-19 than females [9,10,11]. These demographic risk patterns, together with the influence of contact duration and closeness, form the epidemiological basis for examining how person, place, and time factors—including public holidays—shape COVID-19 transmission in Medan City.

Since the emergence of the COVID-19 pandemic worldwide, numerous studies have examined transmission patterns and risk factors, including biological, demographic, and behavioral factors [12]. Transmission risk from infected cases increases with the duration and closeness of contact, with most transmission occurring within household and family contacts [13]. Several studies have found a correlation between increases in case numbers and public holidays [12]. However, evidence on this temporal relationship specific to Medan City, Indonesia, remains limited. This study therefore aims to describe the distribution of COVID-19 cases in Medan City by person, place, and time during the first wave of the pandemic (March 2020–March 2021), and to examine the temporal pattern of case counts in relation to extended public holidays and mass-gathering events occurring during this period.

METHODS

Data Source

This study was conducted in Medan City, covering the period from March 2020 to March 2021, corresponding to the first wave of the pandemic. The study population comprised all COVID-19 cases reported from all sub-districts (kecamatan) in Medan City during this period. The sample used in this study comprised all COVID-19 cases across all sub-districts in Medan City during the study period, totaling 13,748 cases. This study employed a total sampling technique. COVID-19 is an infectious disease caused by the SARS-CoV-2 virus [14]. The virus spreads primarily through respiratory droplets or nasal discharge when an infected person coughs or sneezes [14].

The data used in this study were secondary COVID-19 data obtained from daily reports issued by the Medan City Health Office. These data were collected and compiled by the Medan

City Health Office based on reports from all community health centers (puskesmas), hospitals, and clinics in Medan City. Aggregate daily reporting was conducted online through the Daily Reporting Online System operated by the Medan City Health Office.

Statistical Analysis

This study used a quantitative descriptive epidemiological design based on aggregate surveillance (secondary) data. Secondary data were used, comprising person (age, sex, patient status), place (sub-district), and time (weekly case counts, by month, from March 2020 to March 2021) variables among individuals with COVID-19. The research instrument consisted of daily COVID-19 reports by sub-district issued by the Medan City Health Office from March 2020 to March 2021. Reports from all community health centers, hospitals, and clinics in Medan City were compiled by sub-district. Case detection involved a case notification form completed by health facilities (community health centers, hospitals, clinics, and other facilities) upon identifying a COVID-19 case. Hospitals registered with the Hospital Information System Online (SIRS-Online) were required to ensure that notified case data were entered into the SIRS-Online application [15]. Health facilities that collected specimens were additionally required to enter case data into the All Record TC-19 system, in addition to completing a special notification [15]. The notification form was submitted daily to the Medan City Health Office for daily report compilation.

Univariate analysis was used to analyze the independent variables of person (age, sex), place (sub-district), and time (weekly and monthly cases from March 2020 to March 2021). All variables analyzed in this study were categorical or numerical in type. Temporal patterns, including the fold-change in case counts around specific dates, were assessed descriptively by comparing raw weekly and daily case counts against the timing of public holidays and mass-gathering events; no inferential time-series or regression model was applied to formally test statistical significance or to adjust for the incubation period, and this comparison should therefore be interpreted as descriptive/observational rather than causal.

RESULTS

A total of 13,748 covid-19 cases detected in Medan City during first wave of pandemics. Females constituted a slight majority of COVID-19 cases in Medan City (52.2%, 95% CI 51.4–53.1). Adults represented the largest age group affected (52.3%, 95% CI 51.4–53.1), followed by older adults (37.0%, 95% CI 36.2–37.8). Adolescents (4.6%, 95% CI 4.2–4.9), children (3.6%, 95% CI 3.3–3.9), and children under five (2.6%, 95% CI 2.4–2.9) accounted for substantially smaller proportions. More than half of patients underwent centralized isolation in

hospitals (53.9%, 95% CI 53.1–54.7), whereas 46.1% (95% CI 45.3–46.9) isolated at home. Nearly all patients reported no travel history (99.82%, 95% CI 99.7–99.9); domestic travel outside the city (0.15%, 95% CI 0.1–0.2) and international travel (0.04%, 95% CI 0.0–0.1) were exceedingly rare.

Table 1. Distribution of COVID-19 cases

Characteristics	n	%	95% CI
Sex			
Female	7,183	52.2	51.4 – 53.1
Male	6,565	47.8	46.9 – 48.6
Age Group			
Under-five (<5 years)	360	2.6	2.4 – 2.9
Children (6–11 years)	490	3.6	3.3 – 3.9
Adolescents (12–17 years)	626	4.6	4.2 – 4.9
Adults (18–45 years)	7,187	52.3	51.4 – 53.1
Older adults (>46 years)	5,085	37	36.2 – 37.8
Isolation Site			
Centralized (hospital)	7,409	53.9	53.1 – 54.7
Self-isolation	6,339	46.1	45.3 – 46.9
Travel History			
Domestic (outside city)	20	0.15	0.1 – 0.2
International	5	0.04	0.0 – 0.1
No travel history	13,723	99.82	99.7 – 99.9

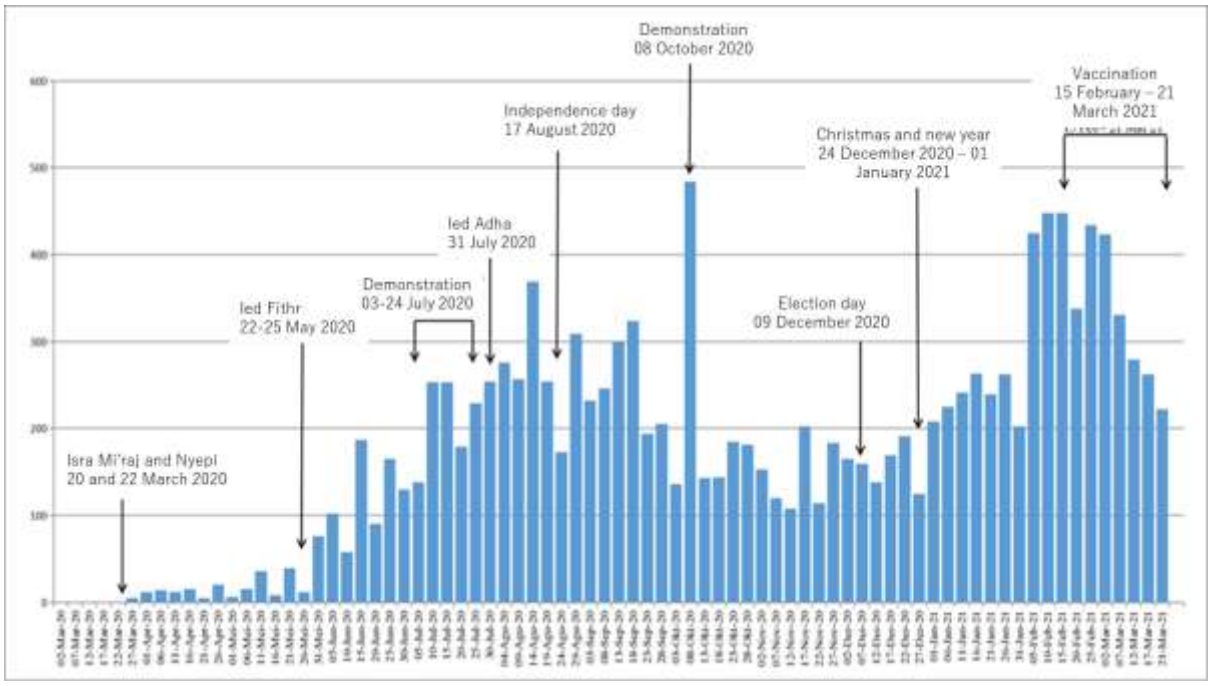
Several public holidays and national events during which mass gatherings were likely to occur included the Isra' and Mi'raj and Nyepi (Balinese Day of Silence) celebrations on 22 and 25 March 2020, followed by Eid al-Fitr from 22 to 25 May 2020. In addition to these celebrations and holidays, Indonesia was also affected by political developments, including the drafting of the Pancasila Ideology Guidelines Bill (RUU HIP), which triggered demonstrations held from 3 to 24 July 2020. This was followed by the Eid al-Adha celebration on 31 July 2020, Indonesian Independence Day on 17 August 2020, and demonstrations related to the Omnibus Law on 8 October 2020. Subsequently, simultaneous regional head elections were held on 9 December 2020, followed by the Christmas and New Year holidays from 24 December to 1 January 2021, and the vaccination program, which began on 15 February 2021.

DISCUSSION

The results indicate that the majority of COVID-19 patients in Medan City were adults

and older adults. This may be attributable to immunosenescence: during the aging process, the immune system undergoes changes such as a gradual decline in immune function [16].

Figure 1. Trend of COVID-19 Cases in Medan City, March 2020–March 2021



Susceptibility to infection in older adults is typically explained by immunosenescence; in old age, T-cell production declines, impairing pathogen surveillance [17]. These changes reduce the effectiveness of the antiviral response and increase the risk of a dysregulated immune response to the virus, which can subsequently contribute to the onset of a cytokine storm [18]. In addition, epigenomic dysregulation occurs with advancing age; the "chromatin modifier relocalization" theory posits that the symptoms of aging and immune decline result from the lifelong accumulation of epigenetic changes [19].

Although early reports indicated a predominance of male COVID-19 patients, more recent studies have shown that females are at higher risk of infection [20], consistent with the female predominance observed in Medan City and with studies from Qingdao City (66% female) [21] and South Korea (62.3% female) [22]. This pattern has been linked to cultural roles and gender norms that may influence exposure risk [23], although other studies report the opposite pattern, with an early Chinese review estimating 60% male patients [25] and another study finding males twice as likely to die from COVID-19 [26]; these discrepancies may partly reflect differences in sample size and testing access across settings.

The results also indicate that the majority of COVID-19 patients in Medan City had no history of domestic or international travel. To reduce local outbreaks, it is important to identify

imported cases during the incubation period before subsequent transmission occurs [27]. Rapid case identification is essential, as several studies have reported that the estimated pre-symptomatic infectious period occurs earlier than previously assumed [1,28], and transmission from imported cases typically occurs during the incubation period, before any symptoms appear [27]. However, some studies also indicate that COVID-19 patients experience fear and stigmatization when reporting their travel history [29]. Stigmatization and discrimination against COVID-19 patients have been present since the early stages of the outbreak [30]. Reporting travel history may lead an individual to be labeled a potential case, thereby reducing willingness to report [31]. The implementation of international travel restrictions has helped reduce new case occurrence in several countries [32]; for example, Australia restricted travelers from China during the pandemic [33]. Easing travel restrictions is an important decision associated with a high risk of transmission, particularly in areas with high case prevalence [32], and the gradual lifting of social restrictions has had negative effects, particularly with respect to cross-border COVID-19 transmission [32].

This study found that the highest surge in COVID-19 cases in Medan City occurred on 8 October, coinciding with the Omnibus Law demonstration, representing a 2.55-fold increase relative to the cumulative case count over the preceding five days. Unlike the extended religious and national holidays discussed below, this event reflects a concentrated, single-day mass gathering of a political rather than a holiday nature, and it should be interpreted as a distinct driver of transmission risk. This finding is nonetheless consistent with several studies indicating that mobility and gathering density can increase the risk of COVID-19 infection [39]. Increased mobility has contributed substantially to increases in COVID-19 cases [40], and local mobility in particular is strongly correlated with the COVID-19 reproduction number [41]. One study explaining why some countries have higher numbers of confirmed COVID-19 cases than others found a positive association between the scale of human mobility and the number of COVID-19 patients [42], and social, economic, or cultural factors specific to a given country may further influence the level of mobility in response to disease outbreaks [43]. Beyond this single-day demonstration, the case trend in Figure 1 also shows visually elevated case counts following several extended public holiday periods, including Eid al-Fitr (22–25 May 2020), Eid al-Adha and Indonesian Independence Day (July–August 2020), and the Christmas and New Year period (24 December 2020–1 January 2021). During these periods, increased inter-regional travel, family gatherings, and relaxed adherence to physical distancing are commonly reported behavioral changes that plausibly increase transmission risk [12]. Because these holiday-related increases were assessed descriptively rather than through formal lag-adjusted

statistical testing (see Limitations), they should be considered a hypothesis-generating observation rather than confirmed evidence of a holiday-specific effect; the political demonstration on 8 October, by contrast, produced the single largest and most abrupt case increase observed in this dataset.

This study has several limitations. First, the reliance on secondary aggregate surveillance data means case ascertainment depends on testing capacity and reporting completeness, which may have varied over the study period and could bias the apparent timing and magnitude of case surges. Second, the near-absence of reported travel history (99.82% with no travel history) is likely influenced by underreporting due to fear of stigmatization, as also noted in the Discussion, rather than reflecting the true absence of imported cases; this variable should therefore be interpreted with caution. Third, the association between public holidays, mass-gathering events, and case counts was assessed descriptively rather than through formal inferential statistical testing (e.g., time-series or regression analysis with lag adjustment for the incubation period), so causal or statistically significant temporal relationships cannot be confirmed from this analysis alone. Fourth, because testing volume data were not available, it cannot be ruled out that fluctuations in testing capacity, rather than transmission alone, contributed to the observed case trends. Future studies incorporating testing volume and formal statistical modelling are needed to address these limitations.

CONCLUSION

During the first wave of the pandemic (March 2020–March 2021), COVID-19 cases in Medan City were more frequent among females and adults, were predominantly managed through centralized hospital isolation, and showed almost no reported travel history. The single largest surge in cases coincided with the 8 October Omnibus Law demonstration, a concentrated mass-gathering event that increased the density of public contact and constituted a plausible source of transmission. Separately, the case trend also showed visually elevated counts following extended public holiday periods that are commonly associated with increased community mobility; however, unlike the demonstration finding, this holiday-related pattern was observed descriptively and warrants confirmation through formal statistical testing in future research.

DECLARATIONS

Ethical Approval: This study used secondary aggregate surveillance data routinely collected and reported by the Medan City Health Office and did not involve direct contact with human subjects or identifiable individual-level data. As the dataset contained no individually identifiable information,

formal ethical clearance was not required; an exemption letter is available from the corresponding author's institution upon request.

Competing Interests: The authors declare no conflict of interest.

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Author Contributions: Tri Bayu Purnama and Jojor Simamora: conceptualization and data curation. Dwichy Augie, Saidah Fatimah Sari Simanjuntak, and Bebby Alfiera Riyandina Hardja: formal analysis. Dini Pratiwi and Mahin Reza: writing – original draft and revision. All authors approved the final manuscript.

Data Availability: The data that support the findings of this study are available from the Medan City Health Office upon reasonable request.

AI Usage Disclosure: We have used artificial intelligence for English editing purpose

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