

**PROPORTION AND FACTORS ASSOCIATED
WITH BROUGHT-IN-DEAD (BID) AMONG
COVID-19 MORTALITY IN KELANTAN FROM
2020-2022**

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by

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**Thesis submitted in fulfilment of the requirements
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LIST OF SYMBOLS

$>$	More than
$<$	Less than
$=$	Equal to
$\geq$	More than and equal to
$\leq$	Less than and equal to
α	Alpha
β	Beta
$\%$	Percentage
P	P -value
$>$	More than
$<$	Less than

LIST OF ABBREVIATIONS

EW	Epidemiological Week
BID	Brought-in-dead
CAC	COVID-19 Assessment Center
CMCO	Conditional Movement Control Order
COVID-19	Coronavirus disease 2019
CPRC	Crisis Preparedness and Response Centre
ICU	Intensive Care Unit
KKM	Ministry of Health of Malaysia
MERS	Middle East respiratory syndrome coronavirus
MOH	Ministry of Health
PASC	Post-acute sequelae of SARS-CoV-2 infection
PICK	National COVID-19 Immunization Programme
PS	Power and sample size calculation
QS	Quarantine Station
RMCO	Recovery Movement Control Order
RNA	Ribonucleic acid
rRT-PCR	Reverse Real-Time Polymerase Chain Reaction
RTK-Ag	Antigen Rapid Test Kit
SARS	Severe Acute Respiratory Syndrome
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SD	Standard Deviation
SPSS	Statistical Package for The Social Science
USM	University Sains Malaysia
WHO	World Health Organization

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**KADARAN DAN FAKTOR YANG BERKAITAN DENGAN
KEMATIAN DI LUAR FASILITI KESIHATAN (BID) DI KALANGAN
KEMATIAN COVID-19 DI KELANTAN DARI 2020-2022**

ABSTRAK

Latar Belakang: Pandemik COVID-19 telah mengambil nyawa di seluruh dunia dan kes BID dalam kematian COVID-19 adalah petunjuk sejauh mana wabak ini menyebar di komuniti. Walau bagaimanapun, faktor-faktor yang berkaitan dengan kes BID dalam kematian COVID-19 masih tidak didedahkan.

Objektif: Kajian ini bertujuan untuk menentukan perkadaran BID dan faktor yang dikaitkan dengan BID di kalangan kematian COVID-19 di Kelantan dari 2020 hingga 2022.

Metodologi: Semakan rekod retrospektif data tanpa nama telah dijalankan pada November 2022 menggunakan data sekunder yang diperoleh daripada Pangkalan Data Kematian COVID-19, Jabatan Kesihatan Negeri Kelantan bagi tempoh Mac 2020 hingga Disember 2022. Sebanyak 1255 kes kematian telah dipilih untuk analisis deskriptif dan regresi analisis. Regresi logistik mudah dan berganda telah dilakukan untuk menentukan faktor yang dikaitkan dengan BID dalam kalangan kematian COVID-19 di Kelantan.

Keputusan: Sebanyak 1,255 kematian akibat COVID-19, dengan 356 kes (28.4%) BID dan 899 kes (71.6%) kematian pesakit dalam. Umur purata kes kematian COVID-19 semasa diagnosis adalah 67.44(15.2) tahun, dengan 652 kes (52.0%) wanita dan 603 kes (48.0%) lelaki. Kebanyakan kes adalah daripada etnik Melayu (n=1,195, 95.2%) dan warganegara Malaysia (n=1,231, 98.1%). Dalam kes BID, majoriti adalah

individu berumur 60 tahun ke atas (n=283, 79.5%), diikuti oleh kumpulan umur 18-59 (n=71, 19.9%). BID tertinggi berlaku di Pasir Mas (90, 25.3%), diikuti oleh Tumpat (n=52, 14.6%) dan Pasir Puteh (n=50, 14.0%). Kebanyakan kematian COVID-19 adalah mereka yang tidak divaksinasi (n=746, 59.4%). Dalam kes BID, lebih tinggi peratusannya bagi mereka yang tidak divaksinasi (n=222, 62.4%) berbanding dengan mereka yang lengkap vaksinasi (n=108, 30.3%) atau mempunyai vaksinasi tidak lengkap (n=26, 7.3%). Banyak kes BID bergejala (n=293, 82.3%), memiliki komorbid (n=264, 74.1%), dikelaskan sebagai Kategori 2 semasa didiagnos (n=156, 43.8%), tidak berkaitan dengan kluster (n=337, 94.7%) dan tidak memiliki sejarah perjalanan (n=255, 71.6%). Analisa regresi logistik berganda mendedahkan kes BID secara signifikan dikaitkan dengan mereka yang mempunyai komorbiditi (Adj. OR: 2.66; 95% CI: 1.89, 3.73; $p<0.001$), tidak berkaitan dengan kelompok COVID-19 (Adj. OR: 2.19; 95% CI: 1.20, 4.01; $p=0.011$), tanpa gejala (Adj. OR: 9.17; 95% CI: 5.20, 16.17; $p<0.001$) dan dikategorikan sebagai Cat 1 pada diagnosis (Adj. OR: 4.99; 95% CI: 1.89, 13.59; $p<0.001$).

Kesimpulan: Kesimpulannya, BID memberi impak yang besar kepada kematian COVID-19 di Kelantan, menambah beban yang dihadapi negeri ini. Kemudahan fasiliti kesihatan yang boleh diakses, meningkatkan pemantauan kuarantin di rumah, mendidik tentang tanda amaran, dan mengembangkan keupayaan ujian dapat mengurangkan risiko.

KATA KUNCI

COVID-19, kematian luar fasiliti kesihatan, kematian pesakit dalam

**PROPORTION AND FACTORS ASSOCIATED WITH BROUGHT-IN-
DEAD (BID) AMONG COVID-19 MORTALITY IN KELANTAN FROM
2020-2022**

ABSTRACT

Background: The global COVID-19 pandemic has led to many deaths, and BID cases among COVID-19 mortality indicate the local outbreak's severity and the virus's community spread. However, the factors linked to BID cases in COVID-19 mortality remain unclear.

Objectives: To determine the proportion of BID and factors associated with BID among COVID-19 mortality in Kelantan from 2020 to 2022.

Methodology: A retrospective record review of anonymous data was conducted in November 2022 using secondary data obtained from the COVID-19 Mortality Database, Kelantan State Health Department for the period from March 2020 to December 2022. Total of 1255 death cases was selected for descriptive analysis and regression analysis. Simple and multiple logistic regression was performed to determine the factors associated with BID among COVID-19 mortality in Kelantan.

Results: A total of 1,255 deaths were recorded due to COVID-19, with 356 cases (28.4%) classified as Brought-In-Dead (BID) and 899 cases (71.6%) as inpatient deaths. The average age at diagnosis for COVID-19 mortality cases was 67.44 years old (SD: 15.2), with 652 cases (52.0%) being female and 603 cases (48.0%) being male. Among these cases, the Malay ethnic group accounted for 1,195 cases (95.2%), and the majority of these cases, totaling 1,231 (98.1%), were Malaysian individuals. In the BID cases, the largest proportion consisted of individuals aged 60 and above

(n=283, 79.5%), followed by the 18-59 age range (n=71, 19.9%). Majority of these BID cases were from the Malay ethnic group (n=334, 93.8%). It is worth noting that the majority of these BID cases were in Pasir Mas (90, 25.3%), followed by Tumpat (n=52, 14.6%) and Pasir Puteh (n=50, 14.0%). The majority of COVID-19 deceased individuals were not vaccinated (n=746, 59.4%). Among BID cases, a higher percentage were unvaccinated (n=222, 62.4%) compared to those who completed vaccination (n=108, 30.3%) or had incomplete vaccination (n=26, 74.1%). Most BID cases presented with symptoms (n=293, 82.3%) and had comorbidities (n=264, 25.0%). The majority of BID cases were classified as Category 2 (n=156, 43.8%), not related to COVID-19 clusters (n=337, 337%) and had no travel history (n=255, 71.6%). The multiple logistic regression analysis revealed BID cases were significantly associated with presence of comorbid (Adj. OR: 2.66; 95% CI: 1.89, 3.73; $p<0.001$), not related to COVID-19 cluster (Adj. OR: 2.19; 95% CI: 1.20, 4.01; $p=0.011$), being asymptomatic (Adj. OR: 9.17; 95% CI: 5.20,16.17; $p<0.001$) and categorized as Cat 1 at diagnosis (Adj. OR: 4.99; 95% CI: 2.90,8.59; $p<0.001$).

Conclusion: In conclusion, BID had a significant impact on COVID-19 mortality in Kelantan, adding to the burden faced by the state. To mitigate the risks, it is crucial to ensure accessible healthcare facilities, enhance home quarantine monitoring, educate about warning signs, and expand testing capabilities.

KEYWORDS

COVID-19, brought-in-dead, inpatient death

CHAPTER 1

INTRODUCTION

1.1 Coronavirus disease (COVID-19)

Since the onset of the COVID-19 outbreak, there has been an upsurge in the overall tally of reported cases across all global regions. This contagious ailment, stemming from the SARS-CoV-2 virus, was initially detected in China's Hubei province, where it was associated with numerous instances of pneumonia and respiratory failure that were documented in that area. This virus was able to be isolated, and further research revealed that it belonged to the coronavirus genus, family, and Nidovirales order of viruses. Coronaviruses are known to have single-stranded RNA (Pal *et al.*, 2020). This virus has the ability to mutate multiple times to different variants. Mutations in its genome are changing its pathogenic potential, which can complicate treatment, vaccine development, and even containment of a pandemic (Perez-Gomez, 2021). A significant proportion of individuals infected with SARS-CoV-2 experienced no symptoms, and the virus naturally resolves without intervention. Nonetheless, approximately 2% of COVID-19 cases progress to a severe form of the illness (Abdullahi *et al.*, 2020).

Since the beginning of the pandemic in 2020 until December 20 of 2022, a total of approximately 650 million cases of COVID-19 were reported worldwide, with an estimated 6.6 million fatalities. Towards the end of 2022, there was a rise observed in the number of fresh COVID-19 cases as well as an increase in the number of fatalities attributable to COVID-19 (PAHO/WHO, 2022). In Malaysia, the onset of infection initiated on January 24, 2020, when cases were first detected. Among these cases, a few individuals had recently travelled to countries and regions that were impacted by the virus. The first wave of infection was characterized by a high mortality rate. Two

cases were from people who had been on humanitarian missions, while the other eight cases involved close contacts. By January 20, 2021, a cumulative count of 169,379 confirmed cases of COVID-19 had been documented, accompanied by 630 recorded fatalities. (WHO, 2020a).

Over the past few years, COVID-19's presentation style has undergone startling transformations. During the initial stages of the pandemic, the commonly reported symptoms were loss of smell and taste, followed by difficulty breathing and coughing, and subsequently, complications related to blood vessels. Those affected by earlier variants typically experienced significant cardiorespiratory or primarily respiratory symptoms during the acute phase, accompanied by additional manifestations such as cognitive impairment. With the earlier variants, a considerable proportion of patients were hospitalized. Since that time, a transformation in the grouping of symptoms and the emergence of various manifestations have been observed across different variants. These changes have been influenced by the evolution of the virus, advancements in vaccines, the landscape of vaccination, the utilization of alternative treatments, and the occurrence of repeated infections. Consequently, there has been a decrease in hospital admissions and a shift in the frequency of each symptom. (Looi, 2023).

1.2 COVID-19 mortality

The COVID-19 pandemic has claimed numerous lives all over the world. All deaths from the pandemic disease, including high risk groups should be considered preventable during a pandemic (Pathak *et al.*, 2021). The number of deaths attributed to COVID-19 is an important indicator for tracking the progression of the pandemic. Nevertheless, numerous countries still face a significant absence of fully operational civil registration and vital statistics systems capable of delivering precise, inclusive,

and current information on births, deaths, and causes of death (WHO, 2022). Malaysia also facing a difficulty in managing the COVID-19 death when the cases started to peak in 2021. It was reported that over 6.5 million deaths have been due to COVID-19 globally (WHO, 2020b).

Previously, a high case fatality rate of 9.5% was observed for cases of Severe Acute Respiratory Distress Syndrome and a much higher rate of 34.4% was reported for patients with Middle East Respiratory Syndrome (MERS). COVID-19, on the other hand, has only a 2.13 percent fatality rate among confirmed cases (Pustake *et al.*, 2022). Case fatality rates are low, but the high infectivity rate poses a risk to some demographics, including the elderly, the chronically ill, and the immunocompromised group (Mohapatra *et al.*, 2020). Possible causes for the high mortality rate observed during the initial stages of the COVID-19 outbreak include the extreme virulence of SARS-CoV-2 and a lack of understanding of how to properly care for infected patients (Zhou *et al.*, 2022).

On March 17, 2020, Malaysia reported its first two fatalities, which occurred one week following the official declaration of the global pandemic by the World Health Organization (WHO) (Cucinotta and Vanelli, 2020). In Malaysia, as of November 1, 2020, COVID-19-related deaths are categorized according to the COVID-19 Death Classification Guidelines, released by the World Health Organization (WHO) on April 16, 2020. These classifications include "Death Due to COVID-19" and "Death with COVID-19" (WHO, 2020b). To prevent the infection from spreading and reduce mortality and morbidity, Malaysia issued a Movement Control Order (MCO) on March 18 that would be enforced in four stages over the course of two months, from March 18 to May 12 (Hashim *et al.*, 2021).

1.2.1 Brought-in-dead (BID) of COVID-19

In the context of healthcare, a BID case pertains to a patient who has been brought to the hospital under the supervision of the attending physician, displaying no observable indications of life that can be documented (MOH, 2022). Concerns have been raised over this number because some individuals with COVID-19 show no symptoms or late presentation and then rapidly worsen. Those with no symptoms might not know they were COVID-19 positive until it was too late, which is a distinct possibility (Arvinder, 2022). According to Arvinder (2022), BID was found to be higher among foreigners compared to Malaysians which could be due to limitation in healthcare access. This study also found that many BID cases were among the younger age group when compared with in patient death. Another study on COVID-19 in Malaysia done by (Lim *et al.*, 2022) revealed that one in five (20%) of COVID-19 mortality were BID cases.

Worldwide, there were challenges to find out why the number of BID were increasing. There are countries that unable to provide the data on BID due to limitation in resources. WHO emphasized the importance of having the data on mortality as it is essential component to understand the impact of the pandemic (WHO, 2022). In Malaysia, the excess mortality during the COVID-19 pandemic contributed to a 34.5% increase in the death toll in 2021 from 2020's 166,970 deaths. Among of the confirmed deaths in Malaysia in 2021, majority were attributable to COVID-19 infection (due to). This represents 19.8 percent of all deaths (DOSM, 2021; DOSM, 2022). Deaths due to COVID-19 can typically be separated into two groups, those that occur in hospitals and those that are out of hospitals or brought in dead (BID) (MOH, 2022).

1.3 Problem statement

BID among COVID-19 patients can severely impact a country's socioeconomic condition. This is the reason why many countries have voiced alarm over their increasing numbers amid the ongoing COVID-19 pandemic. When undiagnosed COVID-19 patient died at home, it indicates a potential a larger outbreak of COVID-19 in that area and resulting measures taken to control its spread can have significant economic impacts. The government and health authorities will need to mobilize resources quickly to identify and treat infected individuals, implement preventive measures, and conduct thorough investigations to determine the source of the disease. This can involve establishing testing facilities, increasing healthcare capacity, and developing strategies for disease containment. Businesses may suffer due to reduced consumer spending, travel restrictions, and disruptions in supply chains. Industries such as tourism, hospitality, and transportation are particularly vulnerable. Additionally, the costs associated with public health responses and medical treatment can strain government budgets and lead to economic instability.

Furthermore, BID also will give a negative impact on healthcare system. When deceased was found dead due to infectious disease like COVID-19 at home, it reflects our healthcare system management. It showed that there was a delay in case detection and management. As more closed contacts to the deceased who are infected or who may be infected seek treatment at hospitals and clinics, there is a possibility that the healthcare system will become overburdened. There is a chance that the existing healthcare system will be unable to keep up with the unexpectedly high demand for services such as hospital beds, personal protective equipment, and medical professionals. As a direct consequence of this, patients who do not have infectious

diseases may be required to wait for treatment for longer periods of time or have fewer treatment options to choose from.

The finding of a deceased person who died of BID due to COVID-19 raises concerns about the state of public health and also can give a psychological impact to the community or population involved. It is possible that this will result in increased fear and anxiety among the population, particularly given the fact that COVID-19 was known to be a disease with a high risk of transmission before this. It is possible that the government and the health authorities will need to immediately implement quarantine procedures, conduct contact investigations, and raise awareness among the general public in order to stop the disease from spreading further. There is a possibility that communities will stigmatize and discriminate against individuals or groups connected to COVID-19. Because people worry so much about their own health and the health of their families, they may also struggle with anxiety, stress, and other issues related to their mental health.

A pandemic, especially one involving an infectious disease, always carries the risk of BID, especially if the disease in question is highly contagious or virulent. Accordingly, this will serve as a starting point for research into not only COVID-19 but also similar future infectious diseases. Although there were a few studies on BID among COVID-19 had been published, the present investigation is still vital due to the disease's relative obscurity. Understanding this illness calls for a broader lens. Furthermore, there are still many unanswered questions about COVID-19 specifically on BID.

BID is a critical issue in public health as its prevalence suggests a broken healthcare system and unmet medical needs. It is critical to have reliable mortality data

for policymaking in order to successfully meet local requests related to a wide range of public health issues.

1.4 Rationale of study

The COVID-19 pandemic is not fully ended yet and remains a threat. There is a possibility of a resurgence with the new variant. Thus, all available information regarding this pandemic is still relevant to be gathered and analysed to get the overall views for future preparedness. Understanding the BID situation in Kelantan will help the policymakers and stakeholders to plan a proper solution on handling similar problems that might occur in other outbreaks in the future.

Even though there were other studies have published researches related to BID among COVID-19 in Malaysia in general, it is still relevant to conduct this study at the state level because the COVID-19 pandemic presents a unique challenge due to its novelty, resulting in a scarcity of comprehensive knowledge, and the management strategies are continually evolving. The implementation of COVID-19 management for all states also were different depends on their current situation. In order to understand this disease, more information needed and shared at all levels. Until now, there are still unanswered questions related to COVID-19. In Malaysia, information related to COVID-19 was kept updated all the time. Consequently, it is essential for each state to collect, analyses and disseminates its own data for the purposes of evaluation, improvement, and management.

This research will help fill in some of the blanks in our knowledge of COVID-19 mortality, and specifically the BID situation in Kelantan, and may help pinpoint a management flaw. Finding out what causes BID instances in Kelantan will help in targeting prevention efforts toward at-risk populations and developing public health

measures to intervene as soon as possible. This study could help to increase awareness among the Kelantan population about BID and help reduce the burden of COVID-19 mortality and BID in Kelantan.

1.5 Research questions

1. What is the proportion of BID among COVID-19 mortality in Kelantan?
2. What are the associated factors of BID among COVID-19 mortality in Kelantan?

1.6 Objectives

1.6.1 General objective

To study the proportion and factors associated with BID among COVID-19 mortality in Kelantan from 2020 to 2022

1.6.2 Specific objectives

1. To determine the proportion of BID among COVID-19 mortality in Kelantan from 2020 to 2022
2. To determine the factors associated with BID among COVID-19 mortality in Kelantan from 2020 to 2022

1.7 Null hypothesis

There are no associations between sociodemographic factors, clinical factors, epidemiological factors and immunization status with BID among COVID-19 mortality in Kelantan.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

COVID-19, a viral illness known as coronavirus disease 2019, is caused by the SARS-CoV-2 virus. Its ability to rapidly spread among individuals contributes to its highly contagious nature. While COVID-19 primarily presents respiratory symptoms similar to those of the common cold, influenza, or pneumonia, it can affect various bodily systems beyond the respiratory system. This disease can impact organs and systems throughout the body. Although most individuals experience mild symptoms, there are cases that progress to severe illness. It is crucial to recognize that some individuals, including those with mild or unnoticeable symptoms, may experience a condition known as "Long COVID," which refers to persistent health issues following a COVID-19 infection. These conditions encompass a range of health issues that can persist beyond the acute phase of the illness (CDC, 2023).

Based on available information, it appears that the transmission of the virus primarily occurs through close interpersonal contact, such as during face-to-face conversations. When an infected individual coughs, sneezes, speaks, sings, or breathes, tiny liquid particles containing the virus can be emitted from their mouth or nose. In close proximity, another person may inhale these infectious particles, which are referred to as short-range aerosols or short-range airborne transmission. Additionally, transmission can occur if infectious particles directly contact the eyes, nose, or mouth, commonly known as droplet transmission (WHO, 2021b).

As per information provided by the World Health Organization (WHO), there have been reports of SARS-CoV-2 incubation periods spanning from 1 to 14 days. The

duration of this incubation period can differ among individuals due to various factors, including those associated with the host's characteristics (WHO, 2023).

The virus presents varied clinical manifestations. Around 80% of cases are asymptomatic or have mild upper respiratory symptoms. However, approximately 20% of patients develop pneumonia with symptoms like fever, cough, difficulty breathing, and fatigue. In some instances, this can lead to respiratory failure and multiple organ failure. The severity and outcome of the disease differ based on age and other health conditions (Rashedi *et al.*, 2020). More severe disease is seen in elderly patients with COVID-19 (Liu *et al.*, 2021). Comorbidities associated with advancing age are a likely contributor to the higher mortality rates seen in people of this age (Ismail *et al.*, 2022). Findings regarding young adults are subject to debate. The authors hypothesize that decreased adherence to social distancing measures among this age group could potentially influence the specific rates of morbidity and mortality (Dudley and Lee, 2020).

2.2 COVID-19 burden

The surge in COVID-19 cases has directly led to healthcare systems becoming overwhelmed. This influx of patients has placed a heavy burden on hospitals, affecting their capacity to provide adequate resources such as available beds, staff availability, and the ability to effectively treat patients (Emanuel *et al.*, 2020). COVID-19 exhibits a broad range of symptoms, spanning from mild to severe respiratory illness. Mild cases typically exhibit symptoms akin to those seen in common respiratory infections like the cold or flu, including cough, fever, sore throat, and body aches. However, in severe instances, the disease can give rise to more critical complications (Guan *et al.*, 2020).

After recuperating from COVID-19, certain individuals might encounter enduring health challenges referred to as "Long COVID" or "post-acute sequelae of SARS-CoV-2 infection" (PASC). These complications encompass persistent fatigue, breathlessness, cognitive impairments, and an array of other symptoms (Blomberg *et al.*, 2021; Huang *et al.*, 2021). The unpredictable nature and prolonged duration of Long COVID can present challenges when it comes to diagnosing, managing, and treating the condition (Nalbandian *et al.*, 2021). Many individuals who are dealing with Long COVID face obstacles in accessing the necessary healthcare and support services, which further compounds their burden (Alwan and Johnson, 2021). Additionally, the impact of Long COVID on society, healthcare systems, and the economy is a significant concern. Long COVID is linked to long-term healthcare requirements and the potential for disability, which can strain healthcare resources and contribute to increased healthcare costs (Mirin, 2022).

The enduring global pandemic has deeply affected the mental well-being of individuals, leading to a noticeable increase in levels of anxiety, depression, and stress. Several underlying factors contribute to this substantial impact on mental health (Taquet *et al.*, 2021). The implementation of measures like physical distancing, quarantine, and lockdowns has resulted in a rise in social isolation. The reduction in social interactions and limited access to support networks can contribute to a sense of loneliness, sadness, and psychological distress (Brooks *et al.*, 2020). The experience of profound emotional distress has affected numerous individuals due to the experience of grief and loss during COVID-19. These losses may encompass the loss of loved ones, employment, or a sense of normalcy. Coping with these significant

losses has imposed a substantial psychological burden (Blomberg *et al.*, 2021; Eisma *et al.*, 2021)

The impact of COVID-19 on mortality has been notably severe in areas characterized by high population densities, limited healthcare infrastructure, and populations that are vulnerable, such as the elderly and individuals with pre-existing health conditions (Din *et al.*, 2021; Ganasegeran *et al.*, 2021). The COVID-19 case fatality rate in Malaysia is comparatively lower than the global average, primarily due to the effective implementation of early preparedness measures, strategic planning, a robust public health and hospital system, comprehensive contact tracing efforts, active case detection, and strict adherence to enhanced Movement Control Order (MCO) guidelines (Hashim *et al.*, 2021).

2.3 Brought-in-dead (BID) cases in COVID-19

Brought-in-dead (BID), Dead on arrival (DOA), dead in the field, out-of-hospital death, are terms used to indicate that a patient was found to be already clinically dead upon the arrival of professional medical assistance, often in the form of first responders such as emergency medical technicians, paramedics, or police (Kumar and Agrawal, 2016).

From the onset of the COVID-19 pandemic until July 2021, the Ministry of Health (KKM) in Malaysia has observed that approximately 70% of deaths were attributed to the virus. Out of these cases, 91.2% have been reported solely in the year 2021. Among the deaths recorded in 2021, 13.8% were individuals who unfortunately passed away before reaching medical facilities, referred to as BID cases. The trajectory of BID mirrored that of COVID-19 cases and mortality, with a peak coinciding with the second wave fueled by the Delta variant. Approximately six months after the

initiation of the National COVID-19 Immunization Programme (PICK), the number of cases began to decline. It is worth noting that an analysis conducted by the National Crisis Preparedness and Response Centre (CPRC) has highlighted an escalating trend in BID deaths, indicating a significant sevenfold increase from April to June 2021 (Figure 2.1) (MOH, 2021).

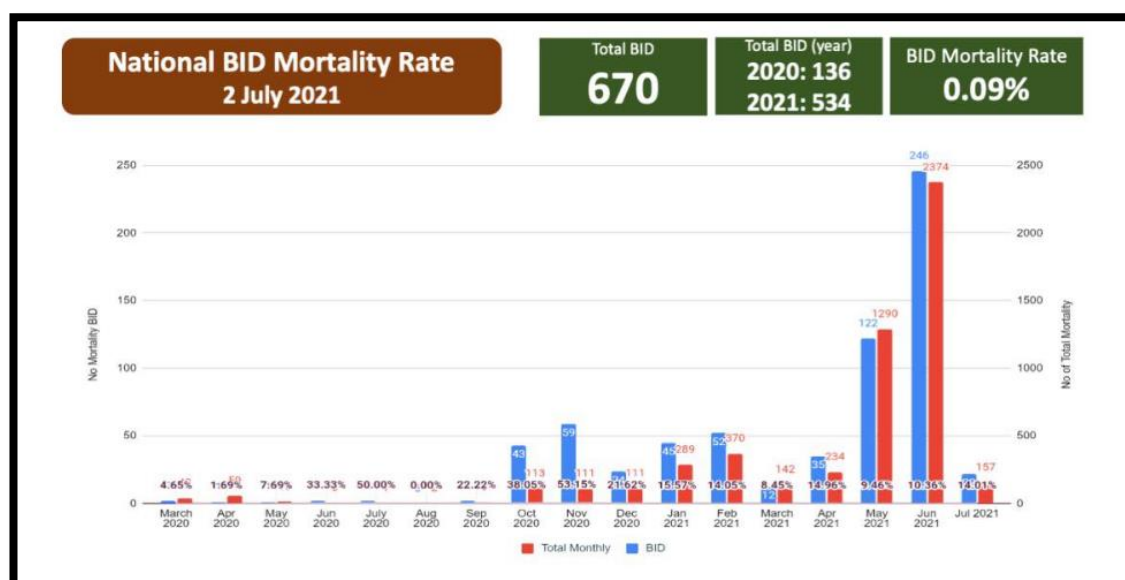


Figure 2.1: The Distribution of National BID Mortality Rate from March 2020 till July 2021

2.3.1 Sociodemographic factors

Many studies on risk factors of COVID-19 mortality were significantly higher in male compared to female (Biswas *et al.*, 2021). KKM had reported that till July 2021, the majority of BID deaths are from the age group of 50 to 70 years old (amounting to 76.7 percent) with at least one comorbidity present (Figure 2.2) (MOH, 2021). Nevertheless, two studies conducted in Malaysia examining BID found no notable disparity in terms of risk between males and females (Arvinder, 2022; Lim *et al.*, 2022). This study's findings indicating the vast majority of BID cases in Malaysia during the study period occurred in the young (18–59-year-olds). This trend may have arisen because of the disproportionate number of elderly patients in hospitals. There is

a disproportionately high number of young people among Malaysia's BID victims, although the reasons for this are not well understood.

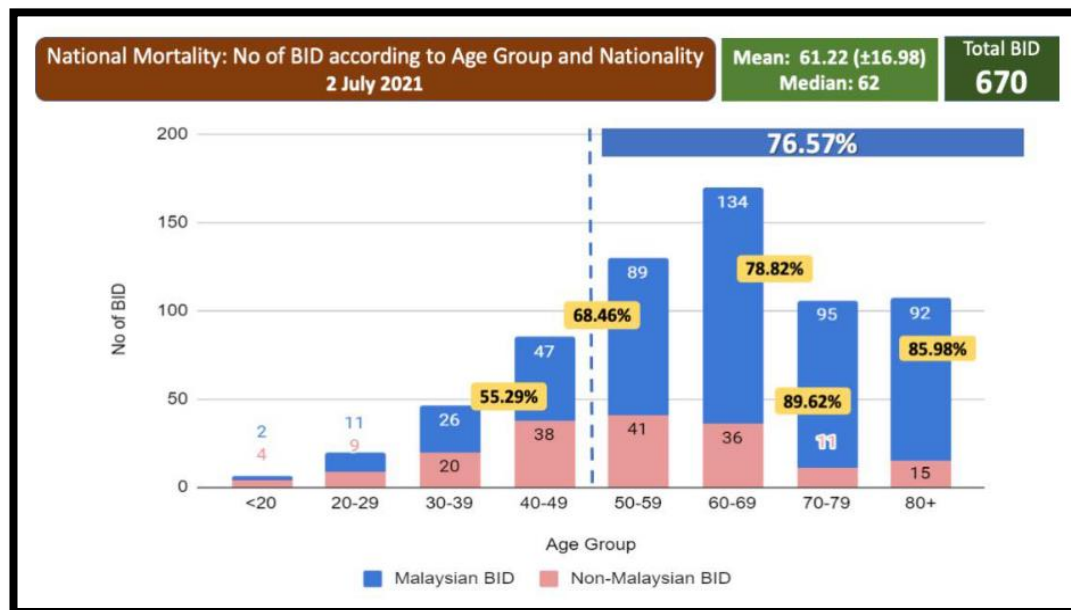


Figure 2.2: Distribution of BID mortality according to age group and nationality from March 2020 till July 2021

Research conducted utilizing data from Malaysia revealed that nationality emerged as a significant risk factor for BID. Non-Malaysians exhibited a higher likelihood of experiencing BID compared to Malaysians. These can be contributed by many factors, such as financial constraint for medical care, authority issues for the illegal workers or migrants and others. Even though, government had exempted all COVID-19 positive or suspected cases from paying the fees at government facilities, they might have access barrier to government healthcare facilities (Arvinder, 2022; Lim *et al.*, 2022).

2.3.2 Clinical factors

COVID-19 is a huge threat to those with comorbidities and immunocompromised group. It can cause severe complication which can lead to fatal. COVID-19-related mortality in Malaysia is exacerbated by the prevalence of coexisting conditions such

hypertension, diabetes, stroke, and cardiovascular disease (Ismail *et al.*, 2022). Other local studies also stated that COVID-19 death was higher among those with comorbidities (Sim *et al.*, 2020; Din *et al.*, 2021; Awang *et al.*, 2022). In Indonesia, the risk for COVID-19 death also higher among those with more than one comorbidities (Surendra *et al.*, 2022). This is similar to BID as reported in the Malaysian study about 60.8% BID cases had comorbid (Lim *et al.*, 2022).

The number of deaths attributed to COVID 19 is an important indicator for tracking the progression of the pandemic. By the end of the 2021 calendar year, the number of deaths attributable to COVID-19 will have reached 665,029 YLL, making it the leading cause of death in the country, surpassing the toll caused by ischaemic heart disease (IHD) before the pandemic (Tan *et al.*, 2022). There were challenges in monitoring the global data on COVID-19 death as different countries use a variety of methods to test for and report COVID-19 deaths, comparisons are difficult to make. Many nations have begun to rely on excess mortality as a means of overcoming these challenges because it is a more accurate measurement of the true impact that the pandemic is having.

2.3.3 Environmental factors

The number of COVID-19 cases in Malaysia witnessed a rise in 2021 in comparison to the preceding year. This heightened incidence in 2021, as opposed to 2020, can be attributed to the shorter duration of the mobility control order implemented in 2021 compared to 2020 (Lim *et al.*, 2022). During MCO, most of people were staying at home and no gathering, social activities, schools, business activities were allowed. In Kelantan, the number of cases shoot up in July 2021, which was after the Raya Haji. As the number of cases increase, the death also increases. Mass gathering and cluster might be related with COVID-19 death. Out of all reported mortalities, 15% were

related to mass gathering and 23% of COVID-19 death were cluster related (Wahil *et al.*, 2021).

The role of ventilation in the spread of airborne infections is widely recognized. The outbreak of SARS in 2003 served as a reminder of this crucial aspect (Yu *et al.*, 2004). There is scarce publication available discussing the connection between ventilation and BID. Nevertheless, there are existing studies that explore the relationship between ventilation and COVID-19 mortality. It was found that in higher income countries, many individuals spend a significant amount of time indoors, whether it be in offices or homes. These indoor spaces are often equipped with central heating or air conditioning, which may expose them to a greater concentration of viruses. This risk is particularly heightened when there are asymptomatic individuals infected with COVID-19 present in close proximity. In such situations, the virus can persist in respiratory droplets or in the surrounding environment for extended periods. Consequently, individuals may experience continuous and regular exposure on a daily basis, leading to an accumulation of the virus in the nasal cavity and nasopharynx. This heightened viral load is associated with the development of severe respiratory ailments, such as acute respiratory distress syndrome, and increases the risk of mortality (Aggarwal *et al.*, 2020; Khedr *et al.*, 2022).

2.3.4 Immunization status

The global prevalence of COVID-19 infections and fatalities is impacted by a multitude of interconnected factors. One crucial determinant is the effectiveness of vaccination campaigns across different regions and populations. The successful distribution and administration of vaccines can significantly contribute to reducing the overall burden of COVID-19 by mitigating the transmission of the virus and lowering the severity of illness (Jabłońska *et al.*, 2021).

The COVID-19 vaccination programme is one of the measures the Malaysian government has taken to prevent the spread of COVID-19. In February of 2021, Malaysia started immunising frontline workers against COVID-19 (WHO, 2021c). It was found that a significant number of COVID-19-related deaths occurred among individuals who had not received the recommended vaccination. Vaccines against COVID-19 were made available across the country of Malaysia at no cost to the recipients. In early October 2021, only a few months after the campaign began, about 90% of the adult population had received at least one dosage of the COVID-19 vaccine, proving the programme a success. As a result, the number of fatalities caused by COVID-19 plummeted. (Lim *et al.*, 2022).

2.3.5 Behavioral factors

Negative health outcomes may occur when people engage in insufficient health-seeking behaviour, such as delaying or avoiding necessary medical attention. Health outcomes, such as illness severity, recovery time, and the development of complications, may worsen if people put off getting medical care until they absolutely need it. Inadequate health-seeking behaviour has also been associated with higher rates of illness and death. Failure to seek treatment for an illness or injury in a timely manner can increase the risk of the disease progressing to a more serious stage, or even death. (Chileshe *et al.*, 2020).

There were very few publications discussing about health seeking behaviour and BID. Research conducted in Zambia established a connection between the increased occurrence of Brought in Dead (BID) cases among COVID-19 patients and inadequate health-seeking behavior. Numerous studies have consistently demonstrated a pattern of suboptimal health-seeking behavior within the population. This behavior has been observed also among patients with other infectious diseases such as

tuberculosis, HIV and others. Consequently, delayed hospital visits have been observed as individuals often perceive their symptoms as mild or unrelated to the virus. Therefore, they will just rely on home remedies or self-medication (Chileshe *et al.*, 2020).

2.3.6 Health service factors

The healthcare systems have faced immense pressure during the pandemic, resulting in overwhelmed hospitals, restricted bed availability, and a shortage of medical personnel. As a consequence, accessing healthcare services in a timely manner has become more challenging for individuals (French *et al.*, 2021; Neilson and Leatherman, 2021; Nguyen *et al.*, 2021; Babalola *et al.*, 2022; Doubova *et al.*, 2022). In an effort to give precedence to the COVID-19 response, many healthcare facilities have adjusted their schedules, delaying or rescheduling non-essential procedures, surgeries, and routine appointments (WHO, 2021a). Although telemedicine has emerged as a viable option for remote healthcare consultations, it is essential to acknowledge that not all individuals possess the necessary technology or dependable internet access. This limitation can impede some people from availing healthcare services remotely.

Additionally, fears of contracting the virus in healthcare facilities have resulted in certain individuals completely avoiding seeking medical care. The fear of contracting COVID-19 has led to hesitancy and unwillingness to visit hospitals or clinics, even, when necessary, treatments or emergency care are required (Lazzerini *et al.*, 2020). Additionally, the implementation of lockdowns, travel restrictions, and disrupted transportation systems has posed challenges for individuals to physically reach healthcare facilities, particularly in regions with limited healthcare infrastructure

or remote areas (Filip *et al.*, 2022). Furthermore, the economic repercussions of the pandemic have resulted in financial hardships for many individuals, making it difficult to afford healthcare services, medications, or COVID-19 testing, especially for those who have experienced job loss, reduced income, or lack health insurance coverage (Kaye *et al.*, 2021).

2.4 Conceptual framework

During the process of reviewing literature, various factors were identified that are linked to an increased risk of BID cases in relation to deaths associated with COVID-19. Factors that were discovered included socio demographic characteristics such as gender, age, ethnicity, occupation, ethnicity, nationality, educational level, socioeconomic status, travelling history, cluster related, mass gathering related; clinical factors including comorbidities, presence of symptoms, clinical categories at diagnosis, admission to Intensive Care Unit (ICU), environmental factors; seasonal or climate change, ventilation, housing condition, immunization status and type of vaccines, health seeking behaviour and access to healthcare facilities. However, due to limitation of secondary data that were used in this study, educational level, socioeconomic status, mass gathering related, admission to Intensive Care Unit (ICU); environmental factors, health seeking behaviour and access to healthcare facilities were excluded as those data were not available. The outcome of this study either BID or inpatient death.

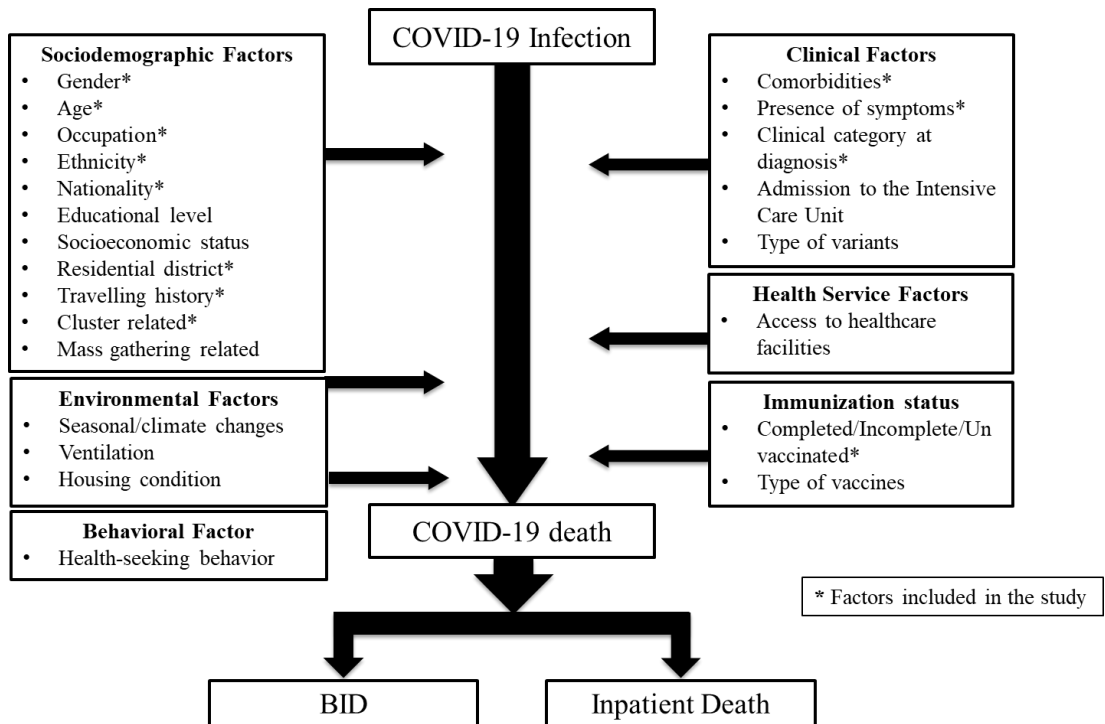


Figure 2.3: Conceptual framework

CHAPTER 3

METHODOLOGY

3.1 Study design

This study was a retrospective record review of anonymous data from the COVID-19 Mortality Database, Kelantan State Health Department dated from March 2020 to December 2022.

3.2 Study duration

This study was conducted from November 2022 till Jun 2023.

3.3 Study location

The research took place at the Surveillance Unit of the Kelantan State Health Department, located in the north eastern region of Peninsular Malaysia. Kelantan consists of ten distinct districts, namely Kota Bharu, Pasir Mas, Pasir Puteh, Machang, Kuala Krai, Gua Musang, Bachok, Tumpat, Tanah Merah, and Jeli. The Crisis Preparedness and Response Centre (CPRC) and Surveillance Unit of the Kelantan State Health Department received death notifications from the medical team and all district health offices in Kelantan. Consequently, the data utilized in this study represents the comprehensive surveillance report encompassing all districts in Kelantan.

3.4 Reference population

The reference population was COVID-19 mortality cases in Kelantan

3.5 Source population

The source population was COVID-19 mortality cases registered in Kelantan COVID-19 Mortality Database, Kelantan State Health Department.

3.6 Sampling frame

The sampling frame was COVID-19 mortality cases registered in Kelantan COVID-19 Mortality Database, Kelantan State Health Department from March 2020 to December 2022.

3.7 Study sample

Confirmed cases of COVID-19 who were died due to COVID-19 registered in Kelantan from March 2020 to December 2022 whom fulfilled the inclusion and exclusion criteria were included in the study.

3.8 Study criteria

3.8.1 Inclusion criteria

1. Death that occurs in Kelantan from March 2020 to December 2022
2. Confirmed cases that were registered in Kelantan by the Kelantan State Health Department
3. Death that was notified as 'died due to COVID-19'

3.8.2 Exclusion criteria

1. Incomplete data > 20% of variables

3.9 Sample size determination

Sample size was calculated based on the study objectives as follow:

3.9.1 Objective 1

Using single proportion formula

- Z_{α} value based on 95% CI = 1.96
- $d = 0.05$
- $P = 0.2$ (Lim et al., 2022)
- So, $n = 246$

Anticipating a 10% missing data, the required sample size for this study needed a total of $246 / (1-0.1)$

~ 273 cases

3.9.2 Objective 2

Sample size determination and calculated using PS Software to compare two independent proportion

Po = proportion of event/outcome in non-exposed subjects (from literature review)

P1 = estimated proportion of event/outcome in exposed subjects

m = ratio of Po: P1

$\alpha = 0.05$, **Power** = 80%

Associated Factor	Po*	P1	m	n	N (x 2)	N (x 2 + 20%)	Literature Review*
Gender (Male)	0.42	0.60	1	120	240	300	(Lim <i>et al.</i> , 2022)
Young adult (18-59 years old)	0.45	0.60	1	173	346	433	(Lim <i>et al.</i> , 2022)
Had comorbid	0.39	0.49	1	386	772	965	(Lim <i>et al.</i> , 2022)
Presence of symptom	0.13	0.19	1	585	1170	1463	(Lim <i>et al.</i> , 2022)

Po = proportion of BID in non-exposed subjects (from literature review)

P1 = estimated proportion of BID in exposed subjects

The sample size required for this study was 1463

3.10 Sampling method

Sampling was not employed as the combined data available was insufficient to meet the required sample size. The Kelantan COVID-19 Mortality Database, maintained by the Kelantan State Health Department, contained a total of 1425 COVID-19 mortality cases, while the calculated sample size requirement was 1463. Consequently, all available data were included in the study due to the limitations in obtaining a larger sample size.

3.11 Research tools

3.11.1 Kelantan COVID-19 Mortality Database, Kelantan State Health Department

The Surveillance Unit of Kelantan State Health Department managed the Kelantan COVID-19 Mortality Database, from which all the necessary data for this study was gathered. This database was developed by Kelantan State Health Department in 2022 during pandemic COVID-19 in view of the high numbers of mortality cases in Kelantan. The database was in Microsoft Excel 2019 format and consists of many variables such as sociodemographic data, clinical data, immunization, cause of death, and laboratory results. However, only important required information will be included.

Notification of all deaths involving confirmed cases of COVID-19, whether occurring in hospitals or as inpatient deaths, is mandatory for every district in Kelantan to report to the Kelantan State Health Department. The Environmental Health Officer in each respective district conducts investigations to gather additional information about these death cases. The reports on COVID-19 deaths are then submitted to the Kelantan State Health Department for review. Expert panels, including public health physicians, clinicians, infectious disease physicians, and forensic medicine specialists will discuss regarding the cause of death. Subsequently, the reports are forwarded to