IJID Regions 3 (2022) 54–67

Contents lists available at ScienceDirect

IJID Regions

journal homepage: www.elsevier.com/locate/ijregi

Review

Factors associated with differential COVID-19 mortality rates in the SEAR nations: a narrative review

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A B S T R A C T

Objectives: Since December 2019, the world has been grappling with the COVID-19 pandemic, which has caused severe loss of lives, the breakdown of health infrastructure, and disruption of the global economy. There is growing evidence on mortality patterns in high-income countries. However, similar evidence from low/middle-income nations is lacking. Our review aimed to describe COVID-19 mortality patterns in the WHO-SEAR nations, and explore the associated factors in order to explain such trends.

Methods: A systematic and comprehensive search was undertaken in PubMed and Google Scholar to obtain maximum hits on COVID-19 mortality and its determinants in the SEAR, using a combination of MeSH terms and Boolean operators. The data were narratively synthesized in detail under appropriate themes.

Results: Our search identified 6411 unique records. Mortality patterns were described in terms of important demographical and epidemiological indicators. Gaps in available evidence and paucity of adequate research in this area were also highlighted.

Conclusions: This review examined significant contributors to COVID-19 mortality across SEAR nations, while emphasizing issues relating to insufficient studies and data quality, and reporting challenges and other concerns in resource-constrained settings. There is a compelling need for more work in this area, to help inform decision making and improve public-health response.

INTRODUCTION

Since the first reported coronavirus disease 2019 (COVID-19) case in China on December 31, 2019, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has caused severe social and economic disruptions, and an incalculable health and human toll worldwide. The effects of COVID-19 have been both direct in terms of infections and fatalities, and indirect through impacts on constrained health systems across the world, including developed countries. Furthermore, subsequent waves of the pandemic are currently underway across most countries globally.

Based on the evidence, COVID-19 mortality has exhibited a wide range of variability across different nations. A surprising observation is that disease prevalence and case fatality for COVID-19 have shown a higher trend in the high-income countries as compared to the low- and low–middle-income countries, even though high-income countries have higher gross domestic product (GDP) and human development index (HDI) figures, with better access to healthcare facilities, hygiene, and sanitation.

While multiple factors can contribute to the outcome, this review attempted to explore the elements that explain these differential patterns across countries. Thus, COVID-19 mortality was described across 11 countries in the South-East Asia region (Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand, and Timor-Leste), while identifying factors that may account for any observed differentials in mortality rates, such as population demographics, population health, epidemiology of the disease, and the role of COVID-appropriate measures.

Research question

Our study aimed to estimate the factors relating to the differential nature of mortality associated with COVID-19 patients in countries of the South-East Asia region.

METHODS

Information sources

A systematic search was undertaken in MEDLINE via PubMed and Google Scholar from January 2020 to June 2021, using combinations of search terms joined by Boolean operators (AND; OR), as applicable. An initial search was conducted to curate a list of suitable keywords corresponding with the novel coronavirus or COVID-19 and the associated explanatory variables related to COVID-19 mortality, such as epidemiological features, disease severity, underlying comorbidities, and

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https://doi.org/10.1016/j.ijregi.2022.02.010
Received 6 January 2022; Received in revised form 23 February 2022; Accepted 24 February 2022

public-health interventions. Corresponding MeSH terms were utilized to build a more comprehensive keyword library. A complete search string was created for each major explanatory variable and mortality as the outcome (joined by COVID-19 terms and using Boolean operators, as appropriate). Separate search strings were prepared for each of the 11 SEAR countries. Due to the overall inadequacy of COVID-19 literature from the majority of SEAR countries, broad search strategies (COVID keywords + country name) without exposure or outcome variables were created to ensure the maximum number of hits. The strategies were prepared by AK and reviewed by RM and TL to ensure their comprehensiveness.

Types of studies

Both primary and secondary research articles were eligible for inclusion in this review.

The inclusion criteria were as follows: studies that described demographics, comorbidities, symptoms and/or severity of COVID-19 patients; public-health interventions in the SEAR nations; articles published in the English language; studies published from January 2020 onwards.

The exclusion criteria were as follows: non-peer-reviewed articles, preprints, case series, case reports, opinion pieces, commentaries, editorials, and perspectives; studies describing the effect of treatment modalities; weather and climate correlation studies; studies not published in the English language.

Exposure variables

Explanatory variables that could account for COVID-19 mortality were considered as exposures for the purpose of this review. They included population demographics (age, gender, and urban/rural location), population health parameters (existence of comorbid conditions in the population), epidemiological features of the coronavirus infection (presenting clinical symptoms and severity of the illness), and public-health interventions (wearing masks, maintaining hand hygiene, and physical distancing).

Outcome variable

Mortality estimates for each nation were obtained from 'Our world in data', which was sourced from the COVID-19 Data Repository by the Centre for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU). The outcome was mortality attributed to COVID-19, which was presented as the proportion of COVID-related deaths reported across included studies, based on the availability of such data. Additionally, monthly deaths per million reported by the SEAR nations were also summarized.

Selection of studies

Articles were individually screened based on their title and abstracts by two reviewers (AK and RM, AK and TL). This was followed by an independent screening of their full texts by two reviewers to ascertain their eligibility. Any discrepancies in screening were resolved through mutual consensus within the team. Publish or Perish software was used to download results from Google Scholar, which were then compiled in Microsoft Excel. Search results from PubMed were downloaded directly in .CSV format. A master list of selected articles was created after removing the duplicates.

Data extraction and literature synthesis

A data extraction form was prepared in Microsoft Excel. Information was extracted on country, title, authors, year of publication, study setting, design, duration, population, sample size, demographic information, and major outcomes for each included study. The findings from each study were further categorized into demographics, disease severity, clinical symptoms, comorbidities, and practice measures of public-health interventions. Information was then summarized under appropriate themes, which are comprehensively described in the next section.

RESULTS

Our search identified a total of 6411 unique records. The number of studies identified in the search was highest for India, followed by Indonesia, Bangladesh, Nepal, and Thailand, with very small numbers from the other nations. Relevant published literature was almost negligible for the majority of countries.

After excluding preprints and non-peer-reviewed papers, 5352 articles were screened by title and 1106 by abstract. Following on this, the full texts of 465 articles were assessed for eligibility. In total, 106 studies were finally included in the narrative synthesis, with most papers from India, followed by Bangladesh and Indonesia, and a very small number of papers from Nepal and Thailand. Common reasons for excluding studies and the selection process are shown in the PRISMA diagram (Supplementary File S1).

Table 1 shows the country-based distribution of all studies identified and screened.

The following sections include a summary of mortality estimates across studies, and explore the major epidemiological indicators that could play a role in explaining COVID-19 associated deaths across the SEAR countries. Findings are reported for just five of the 11 SEAR countries (Bangladesh, India, Indonesia, Nepal and Thailand) due to a paucity of data from the other nations.

Mortality associated with COVID-19

The case-fatality rates (CFRs) measured across the included studies from various SEAR countries varied from 1–5% to more than 30%. Of all the studies reporting data on COVID-19-associated mortality in Bangladesh, almost 63% reported a CFR of 10% or less. In India, the proportion of studies reporting a CFR of 10% or less was lower (about 53%). Approximately 37% of Indian studies reported a CFR of 11–25%, while the corresponding proportion for Bangladeshi studies was 25%. The data from other countries were largely inadequate for comparisons.

The CFR in Bangladesh ranged from 4% to 25% across most of the included studies (Hossain et al., 2020f., 2020e, 2020d, 2020c; Mowla et al., 2020; Saha et al., 2020). In contrast, two studies reported higher mortality rates of 57% and 77% (Hossain et al., 2020b.; Saha et al., 2021). The Dhaka region reported a significant proportion of all deaths (Hossain et al., 2020c.; Mamun et al., 2020). For India, the CFR ranged widely, from 1% to 30%, across most studies (Agarwal et al., 2020; Borah et al., 2021; de Souza et al., 2021; Ghoshal et al., 2020; Gupta et al., 2021; Jain et al., 2020; Mahajan et al., 2020b; Malhotra et al., 2021; Mathew et al., 2021; Mazumder et al., 2020; Mehta et al., 2021; Mishra et al., 2020; Mohan et al., 2020; Mohandas et al., 2021; Pujari et al., 2021; Sharma et al., 2020; Soni et al., 2020; Tambe et al., 2020), with the rates being somewhat higher (30–50%) in two studies with mostly critical patients who succumbed to the disease (Singh et al., 2021.; Suresh et al., 2021). Very few studies from Indonesia reported mortality data, with two studies showing CFRs of 7% and 10% (Rozaliyani et al., 2020; Sutiningsih et al., 2021b), and one study conducted among elderly COVID-19 patients reporting a death rate of 23% (Azwar et al., 2020). Similarly, only two studies reported mortality data from Nepal (Khatri et al., 2021; Sherpa et al., 2021), with CFRs of 11% and 45%, respectively. A single retrospective cross-sectional study of confirmed COVID-19 cases from Thailand reported the proportion of deaths as 2.1% (Pongpirul et al., 2020) Table 2 describes the characteristics of included studies report-

Table 1
Country-based distribution of overall studies identified and screened

Country	Total records identified		Records after duplications removed	Screened by title	Screened by title and abstract	Full-text articles screened for eligibility
	PubMed	Google Scholar				
Bangladesh	379	844	897	698	186	82
Bhutan	12	15	15	14	4	2
India	2272	996	2763	2450	590	260
Indonesia	176	961	1761	1385	125	58
Maldives	10	16	19	12	1	1
Myanmar	24	64	71	25	8	7
Nepal	72	429	460	391	93	25
North Korea	0	3	3	3	1	0
Sri Lanka	32	135	146	120	23	8
Thailand	190	202	269	237	72	20
Timor Leste	2	8	7	7	3	2
Total	**3169**	**3673**	**6411**	**5352**	**1106**	**465**

ing CFRs for the SEAR nations. Their current community CFRs are shown in Table 3 (source: https://coronavirus.jhu.edu/data/mortality).

Factors explaining COVID-19 mortality in the SEAR nations

Some of the major determinants of COVID-19 related deaths commonly reported across studies are described below.

Age and sex

Older age and being male were significantly associated with mortality in confirmed SARS-CoV-2 cases across all hospital-based studies available from SEAR countries (Table 4).

Severity of disease

Disease severity was positively correlated with a worse prognosis and a greater likelihood of death. Among the SEAR nations, India reported the highest proportion of patients with severe COVID-19, followed by Bangladesh and Indonesia. Similar data from Nepal and Thailand were scarce (Table 5).

Comorbidities

The presence of multiple comorbidities, especially diabetes and cardiovascular conditions, had a strong significant association with infection severity, ICU support, and fatality (Table 6).

Clinical symptoms

The most common presenting symptoms among hospitalized COVID-19 patients, as reported in the available literature, were also summarized (Table 7).

Non-pharmaceutical interventions

Some knowledge, attitudes, and practices (KAP) studies conducted in certain SEAR countries, which provided information on the general population's adoption of public-health practices and adherence to the pandemic protocol, were also reviewed. Data on wearing masks, maintaining hygiene, and physical distancing behavior are summarized in Table 8.

DISCUSSION

The coronavirus pandemic that began in December 2019 continues to spread globally, claiming millions of lives, due to the high transmissibility of SARS-CoV-2 and its ability to mutate rapidly. COVID-19 disease mortality has thus become a major cause for concern, especially with countries grappling with multiple waves that have crippled healthcare systems and caused massive human and economic losses. It has become imperative to explore reasons for the differential mortality patterns observed across nations. This study attempted to explore factors that may account for these differences in death rates across the countries of the WHO-South-East Asia Region.

Between March and July 2020, India reported the highest deaths per million, followed by Indonesia and Bangladesh. Nepal reported low numbers, and Thailand reported none. Over the second half of 2020, Indonesia and Nepal showed increasing numbers, while India and Bangladesh fared better. There was a huge spike in mortality in India and Nepal during the deadly second wave in April–May 2021. By mid-2021, the situation had improved across these countries. However, Nepal and India continued to report higher estimates than the other nations (Figure 1).

CFRs reported across most studies included in this review were much higher than the national averages for the countries. This could be because most of the available literature reporting CFRs in the SEAR nations was from hospital-based studies. Small sample sizes and greater severity could substantially overestimate the actual mortality rates, since only the more serious cases tend to be hospitalized. Community-based studies, although very few, have reported lower CFRs (Table 2).

(Mortality trends were not described for the other nations due to the lack of sufficient published studies.)

Differential nature of mortality among the SEAR nations

Severity as a function of comorbidities

Although the proportions of severe COVID-19 patients ranged widely across studies, the available data showed that Bangladesh and Indonesia reported somewhat lower percentages of severe and critical cases. In comparison, the percentage was higher for India. A consistent finding across all studies was the strong association of older age and diabetes and other chronic conditions with indicators of disease severity and mortality (longer hospital stay, ICU admissions, ventilator support). The greater predisposition of the elderly and those with comorbidities to severe COVID-19 has been well established in the literature (Sanyaolu et al., 2020; COVID-19 High risk groups [WWW Document] 2022; Verity et al., 2020).

On exploring the presence of underlying comorbidities in studies included in the review, a high prevalence of diabetes and hypertension in COVID-19 patients across studies from all five countries (India, Bangladesh, Nepal, Indonesia, and Thailand) was observed. Cardiovascular disease, respiratory disorders, renal dysfunction, and cerebrovascular disease were also quite common. Interestingly, severe and critical patients were more likely to have multiple comorbidities (three or more) or have diabetes accompanied with other illnesses like hypertension and heart disease.

The prevalence of adult diabetes in India is 8.9% — the second-highest globally. Moreover, according to the International Diabetes Federation, of the 463 million people with diabetes worldwide, 88 million are in the South-East Asia Region (of whom 77 million are Indians) (IDF_Diabetes Atlas 2022). The high burden of non-communicable

Table 2
Descriptions of the included studies reporting CFRs for the SEAR nations

Title	Country and region	Source of included patients	Sample size	Severity definition	CFR	Reference
Clinical course, risk factors and health outcome of in patients with COVID-19: an evidence from COVID-19 dedicated Mugda Medical College and Hospital in Bangladesh	Dhaka, Bangladesh	Hospital-based study	384	Severity not defined	25.5%	Hossain et al., 2020
Clinical profile of 100 confirmed COVID-19 patients admitted in Dhaka Medical College Hospital, Dhaka, Bangladesh	Dhaka, Bangladesh	Hospital-based study	100	Severity not defined; severe cases excluded	10%	Mowla et al., 2020
Comorbidity and its impact on COVID-19 affected patients in COVID-19 dedicated hospital of Bangladesh.	Dhaka, Bangladesh	Hospital-based study	405	Severity not defined	24.2%	Hossain et al., 2020
Epidemiology and outcome of COVID-19: experience at a private set-up in Bangladesh	Dhaka, Bangladesh	Hospital-based study	125	Patients were categorized as asymptomatic, mild, moderate, severe, or critical based on clinical condition, oxygen saturation, chest X-ray findings, and other investigations, as described by national guidelines of Bangladesh Severe — cases meeting any of the following criteria: Respiratory distress (≥ 30 breaths/min); finger oxygen saturation ≤ 93% at rest; arterial partial pressure of oxygen (PaO_2)/fraction of inspired oxygen (FiO_2) ≤ 300 mmHg Critical — cases meeting any of the following criteria: respiratory failure and requiring mechanical ventilation	6.4%	Saha et al., 2020
Epidemiology distribution of 48 diagnosed COVID-19 Cases in Bangladesh: a descriptive study	Majority from Dhaka, Bangladesh	Official press briefing of IEDCR on behalf of Ministry of Health in Bangladesh, different newspapers and online news portals	48	Severity not defined	11%	Hossain et al., 2020
The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) In Bangladesh: a descriptive study	Various districts of Bangladesh	Official press briefings of IEDCR, DGHS, and MoHFW	1572	Severity not defined	3.9%	Hossain et al., 2020
Baseline characteristics, level of disease severity and outcomes of patients with COVID-19 admitted to intensive care unit in COVID-19 dedicated Mugda Medical College and Hospital, Dhaka, Bangladesh	Dhaka, Bangladesh	Hospital-based study	63	Severity not defined; hospital was a tertiary care center catering mostly for critically ill patients	76.2%	Hossain et al., 2020
Clinical characteristics and outcomes of COVID-19 infected diabetic patients admitted in ICUs of the southern region of Bangladesh	Chattogram, Bangladesh	Hospital-based study	168	The 2012 Berlin definition was used to describe acute respiratory distress syndrome (ARDS), while the sepsis-3 criteria was used to define shock	69%	Saha et al., 2021
Epidemiological information about COVID-19 outbreak in Bangladesh: a descriptive study	Bangladesh	Secondary data from IEDCR, DGHS, MoHFW, worldometer etc.	12 2660	Severity not defined	1.3%	Mamun et al., 2020
A retrospective observational study to determine the early predictors of in-hospital mortality at admission with COVID-19	New Delhi, India	Hospital-based study	425	Severity not defined	5.17%	Jain et al., 2020
An epidemiological study of laboratory confirmed COVID-19 cases admitted in a tertiary care hospital of Pune, Maharashtra	Pune, Maharashtra, India	Hospital based study	197	Severity not defined	29.4%	Tambe et al., 2020

(continued on next page)

Table 2 (*continued*)

Title	Country and region	Source of included patients	Sample size	Severity definition	CFR	Reference
Clinical course and outcome of patients with COVID-19 in Mumbai City: an observational study	Mumbai, Maharashtra, India	Hospital-based study	689	Severe acute respiratory infection defined as respiratory rate > 30 breaths/min, severe respiratory distress, SpO_2 < 90% on room air	22.7%	De Souza et al., 2021
Clinical review of COVID-19 patients presenting to a quaternary care private hospital in South India: a retrospective study	Chennai, India	Hospital-based study	3345	Severe — SpO_2 < 94% on room air at sea level; a ratio of arterial partial pressure of oxygen to fraction of inspired oxygen (PaO_2/FiO_2) < 300, respiratory frequency > 30 breaths/min, or lung infiltrates > 50% Critical — respiratory failure, septic shock, and/or multiple organ dysfunction	4.2%	Mohandas et al., 2021
Clinico-demographic profile and hospital outcomes of COVID-19 patients admitted at a tertiary care centre in North India	New Delhi, India	Hospital-based study	144	Severe disease defined as any of: RR > 24/min, SpO_2 < 94 per cent on room air, confusion, drowsiness, hypotension, sepsis, septic shock, or admission to ICU (WHO criteria)	1.4%	Mohan et al., 2020
COVID-19 mortality in cancer patients: a report from a tertiary cancer centre in India	New Delhi, India	Hospital-based study	186	Severity assessed as per Ministry of Health and Family Welfare (Government of India) guidelines	14.5%	Mehta et al., 2021
COVID-19-hospitalized patients in Karnataka: survival and stay characteristics	Karnataka, India	Hospital-based study	445	Severity assessed as per Ministry of Health and Family Welfare (Government of India) guidelines	5.1%	Mishra et al., 2020
COVID-19-related strokes are associated with increased mortality and morbidity: a multicenter comparative study from Bengaluru, South India	Bengaluru, Karnataka, India	Hospital-based study	62	Severity not defined	21%	Mathew et al., 2021
Demographic and clinical profile of patients with COVID-19 at a tertiary care hospital in North India	Chandigarh, India	Hospital-based study	114	Severe pneumonia was defined as fever, plus one of the following: respiratory rate > 30 breaths/min, severe respiratory distress, or SpO_2 < 90% on room air	2.6%	Soni et al., 2020
Diabetes mellitus and hypertension increase risk of death in novel corona virus patients irrespective of age: a prospective observational study of co-morbidities and COVID-19 from India	Kolkata, West Bengal, India	Hospital-based study	710	Severity not defined	7%	Gupta et al., 2021
Effect of age, comorbidity and remission status on outcome of COVID-19 in patients with hematological malignancies	11 centres (New Delhi, Mumbai, Bengaluru, Kolkata, Jaipur, Pune, Bhilai) in India	Hospital-based study	130	Severity defined as per the clinical management protocols of the Government of India	20%	Borah et al., 2021
Epidemiological determinants of COVID-19 infection and mortality: a study among patients presenting with severe acute respiratory illness during the pandemic in Bihar, India	Patna, Bihar, India	Hospital-based study	281	Severe acute respiratory illness was defined as presenting with an ARI requiring hospitalization, with measured body temperature ≥ 38°C or history of fever along with cough; onset within the last ~10 days	14.9%	Agarwal et al., 2020
Outcomes among 10,314 hospitalized COVID-19 patients at a tertiary care government hospital in Delhi, India	Delhi, India	Hospital-based study	10 314	Severe disease was defined as severe pneumonia (respiratory rate [RR] ≥ 30 per min and/or SpO_2 < 90%), or acute respiratory distress syndrome, or septic shock and those patients requiring intensive care	13.7%	Malhotra et al., 2021
Overview of early cases of coronavirus disease 2019 (COVID-19) at a tertiary care centre in North India	Jaipur, Rajasthan India	Hospital-based study	75	Severity not defined	4%	Sharma et al., 2020

(*continued on next page*)

Table 2 (*continued*)

Title	Country and region	Source of included patients	Sample size	Severity definition	CFR	Reference
Prevalence and clinical presentation of COVID-19 among healthcare workers at a dedicated hospital in India.	Mumbai, Maharashtra, India	Hospital-based study	3711	Full text unavailable	1%	Mahajan et al., 2020a
SARS-CoV-2 epidemic in India: epidemiological features and in silico analysis of the effect of interventions	India	Analysis of laboratory confirmed COVID-19 patient-based data collected from a crowdsourced database (https://www.covid19india.org)	1161	Severity was defined as respiratory rate of 30 breaths/min, blood oxygen saturation of 93%, a partial pressure of arterial oxygen to fraction of inspired oxygen ratio < 300, and/or lung infiltrates > 50% within 24–48 hours	2.5%	Mazumder et al., 2020
Coronavirus disease 19 among people living with HIV in western India: an observational cohort study	Pune, Maharashtra, India	Hospital-based study	86	Severity not defined	6.9%	Pujari et al., 2021
The spectrum of gastrointestinal symptoms in patients with coronavirus disease-19: predictors, relationship with disease severity, and outcome	Lucknow, Uttar Pradesh, India	Hospital based study	252	Severity was defined as needing oxygen	1.98%	Ghoshal et al., 2020
Predictors of mortality and the need of mechanical ventilation in confirmed COVID-19 patients presenting to the emergency department in North India	New Delhi, India	Hospital-based study	116	Severe — breathlessness as presenting symptoms, RR ≥ 30/min, SpO_2 ≤ 94% or ≥ 50% lung involvement on imaging with chest radiograph or lung sonography Critical — respiratory failure, shock, need of mechanical ventilation, or multi-organ dysfunction	51%	Suresh et al., 2021
Surgical outcome of COVID-19 infected patients: experience in a tertiary care hospital in India	Chandigarh, India	Hospital-based study	53	Severity not defined	37.7%	Singh et al., 2021
Clinical symptoms, comorbidities, and recovery period for covid19 patients in Central Java Province, Indonesia	Java, Indonesia	Data obtained from the health department	3383	Full text unavailable	7.7%	Sutiningsih et al., 2021
Factors associated with death in COVID-19 patients in Jakarta, Indonesia: an epidemiological study	Jakarta, Indonesia	Data collected from the ongoing recapitulation of epidemiological surveillance conducted by the Provincial Health Office of Capital Special Region of Jakarta	4052	Severity not defined	9.4%	Rozaliyani et al., 2020
Clinical profile of elderly patients with COVID-19 hospitalised in Indonesia's National General Hospital	Jakarta, Indonesia	Hospital-based study	44	Severity not defined	23%	Azwar et al., 2020
Clinical profile and outcome of COVID 19 patients at tertiary cardiovascular center of Nepal	Nepal	Hospital-based study	90	Severe — respiratory frequency > 30 breaths per minute, SpO_2 < 94% on room air at sea level, PaO_2/FiO_2 < 300, or lung infiltrates > 50% Critical — respiratory failure, septic shock, and/or multiple organ dysfunctions	11.1%	Sherpa et al., 2021
Prevalence of elevated D-dimer levels in confirmed COVID-19 Cases in intensive care unit of a tertiary care centre of western Nepal	Bhairahawa, Nepal	Hospital-based study	95	Severity not defined	45.3%	Khatri et al., 2021
Clinical course and potential predictive factors for pneumonia of adult patients with coronavirus disease 2019 (COVID-19): a retrospective observational analysis of 193 confirmed cases in Thailand	Bamrasnaradura Infectious Diseases Institute, Thailand	Hospital-based study	193	Severe — respiratory rate ≥ 30 breaths/minute, oxygen saturation ≤ 93%, PaO_2/FiO_2 ratio < 300, and/or lung infiltrates > 50% of the lung field within 24–48 hours Critical — respiratory failure, shock, and/or multiple organ failure (WHO criteria)	2.1%	Pongpirul et al., 2020

*Data collected from studies published up to June 2021

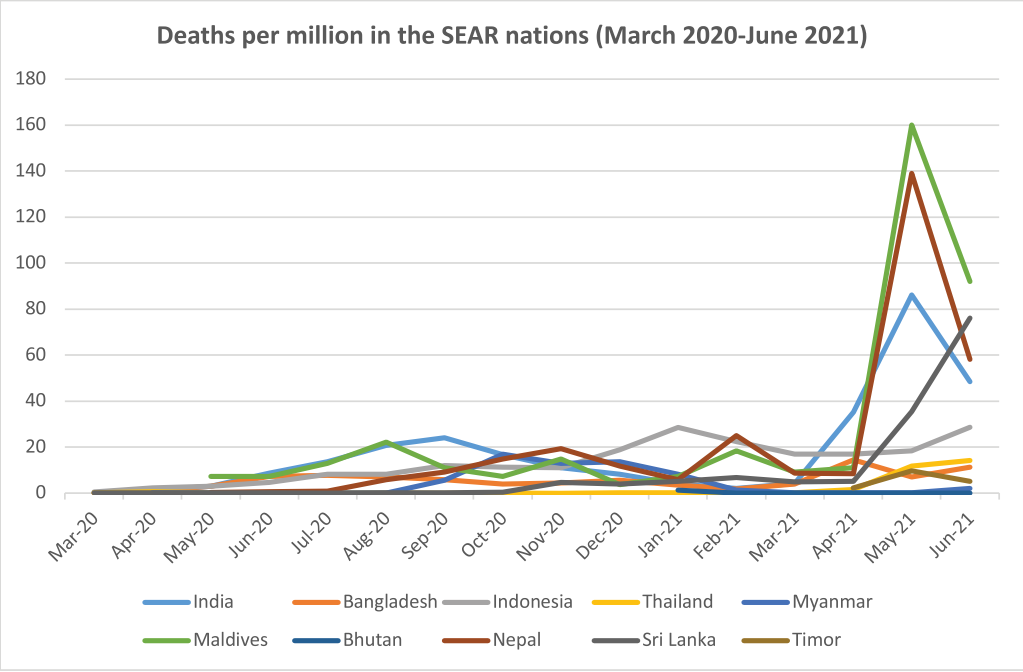

Figure 1. Monthly deaths per million for the SEAR countries, from March 2020 to June 2021

Table 3
Case-fatality rates for each of the included countries (as of March 23, 2022)

Country	Confirmed cases	Total deaths	Case-fatality rate
Bangladesh	1 950 725	29 117	1.5%
India	43 010 971	516 543	1.2%
Indonesia	5 967 182	153 892	2.6%
Nepal	978 196	11 950	1.2%
Thailand	3 398 792	24 417	0.7%

diseases (NCDs) in India and Nepal might have contributed to higher mortality in these countries. NCDs cause 60% of the overall mortality in India, of which almost 26% can be attributed to cardiovascular diseases (CVDs) (WHF_Cardiovascular Diseases in India Factsheet 2022). The prevalence of hypertension — a major risk factor for heart disease and stroke — is about 30% in India (Anchala et al., 2014). Nepal also has an alarmingly increasing burden of NCDs. NCD prevention and control in the country has been one of the WHO Key Priorities in the SEAR since 2014 (Persistent high prevalence of non-communicable diseases risk factors in Nepal [WWW Document] 2022).

Clinical symptoms

Regarding the common clinical symptoms of the SARS-CoV-2 infection, studies have shown that fever, cough, sore throat, and dyspnea were the most common presenting symptoms among infected patients. Dyspnea was more commonly reported in studies from Nepal and India, while cough was more common in Bangladesh, Indonesia, and Thailand, with fever being present across all countries. Dyspnea (shortness of breath) is considered one of the more severe symptoms of COVID-19. Evidence suggests that patients presenting with breathlessness are more likely to develop acute respiratory distress syndrome (ARDS) and have a poor prognosis ('COVID-19 basics', 2020; Wu et al., 2020).

Public-health practices

It is important to note the gaps in knowledge and awareness about COVID-19 highlighted in a few of these studies. Evidence from Indian studies suggests a sub-optimal understanding of various aspects of the disease, including the importance of physical distancing, coughing and

Table 4
Age and sex as determinants of COVID-19 mortality

Country	Explanatory variable — age and sex	References
Bangladesh	The older age groups (51–60 years and above), especially males, were at the greatest risk of death from COVID-19	Al-Bari et al., 2021; Hossain et al., 2020c.; Islam et al., 2020; Muyeed et al., 2020; Saha et al., 2021
India	Mortality was reportedly higher in the older age groups, i.e. those 60 years and above	Asirvatham et al., 2021; Borah et al., 2021; Gupta et al., 2020; Kumar et al., 2021; Mazumder et al., 2020; Mishra et al., 2020; Mohandas et al., 2021; Patel et al., 2021; Saurabh et al., 2021; Sharma et al., 2021; Sherwal et al., 2020; Singh et al., 2021.
	Older age was a risk factor for requiring intensive care too	Patel et al., 2021;
	Being male was found to be a greater risk factor for death	Agarwal et al., 2020; Asirvatham et al., 2021; Deshpande et al., 2020; Gaur et al., 2021; Kansara et al., 2021; Kumar et al., 2021; Mathew et al., 2021; Mehta et al., 2021; Mithal et al., 2021a; Mohandas et al., 2021; Saurabh et al., 2021; Sharma et al., 2021; Singh et al., 2021.; Tambe et al., 2020
Indonesia	Older age and being male were strong predictors of mortality	Rozaliyani et al., 2020; Sutiningsih et al., 2021a, 2021b
Nepal	Older age and being male were strong predictors of mortality	Khadka et al., 2021
Thailand	Older age and being male were strong predictors of mortality	Chailek et al., 2020

Table 5
Severity of disease as a determinant of COVID-19 mortality

Country	Explanatory variable — severity of disease	References
Bangladesh	The percentage of those with severe symptoms ranged from 13% to 41%, and those having critical symptoms ranged from 3% to 25% A hospital-based cross-sectional study from southern Bangladesh reported that among the ICU patients, the proportion of those in the 51–60 years age group was the highest (approximately 30%) compared with the younger age groups	Alam et al., 2020; Hasan et al., 2021; Hossain et al., 2020d.; Paul et al., 2020; Saha et al., 2020 Saha et al., 2021
India	The prevalence of severe symptoms among COVID-19 patients ranged from 3% to 50% The percentage of critical symptoms ranged from 3% to 35%	de Souza et al., 2021; Deshpande et al., 2020; Gupta et al., 2021.; Kayina et al., 2020; Kute et al., 2021; Mithal et al., 2021a; Mohan et al., 2020; Pujari et al., 2021; Saurabh et al., 2021; Soni et al., 2020; Suresh et al., 2021 Deshpande et al., 2020; Kayina et al., 2020; Soni et al., 2020
Indonesia	The percentage of severe symptoms ranged from 7% to 40%	Azwar et al., 2020; Rozaliyani et al., 2020; Surendra et al., 2021; Sutiningsih et al., 2021a, 2021b
Nepal	The proportion of severe cases in Nepal was reported as 11% and 22% in the two eligible studies from the country, while most patients presented with mild or moderate symptoms	Sedhain, 2021; Sherpa et al., 2021
Thailand	One study from Thailand reported 14% and 3% as the proportions of severe and critical cases of COVID-19, respectively	Pongpirul et al., 2020

sneezing etiquette, transmission risk through asymptomatic individuals, person-to-person viral spread, the role of respiratory droplets, and the definition of high-risk groups. The survey respondents listed several barriers to adopting appropriate prevention practices against COVID-19. These included sharing a common room, using common fomites, overcrowding, space constraints, frequent hand washing being cumbersome, and economic struggles. Studies from Nepal also showed limited awareness of appropriate COVID-19 protocols, misconceptions regarding quarantine, incorrect information on virus transmission through poultry, and belief in non-scientific practices (using antibiotics, hairdryers, mouthwash, rinsing the nose with saline, and sesame oil and garlic being protective against infection) among the participants across multiple surveys. In eastern Nepal, there was a common belief, especially in the rural population, that Nepalese were immune to SARS-CoV-2. Knowledge and awareness levels can be key drivers of behavioral change in the community (Kite et al., 2018). Lacunae in communication and inadequate knowledge could contribute to pandemic protocol violations, and thus affect public-health outcomes.

Other variables could explain why certain countries had a better pandemic response than others. Variations in mortality rates could result from differences in the number of confirmed cases and reported deaths due to different testing strategies and counting approaches. Similarities or differences in implementation of COVID-19 guidelines, such as handwashing, physical distancing, wearing of masks, and following lockdown/quarantine restrictions, could also be a function of the varying types of government regime across the nations, affecting the level of control over their populations. It is possible that countries with democratic governments like Nepal and India have found it more challenging to enforce preventive measures, in contrast to Thailand, which is a constitutional monarchy, or Bangladesh, which has a government with an authoritarian bent (Sorci et al., 2020).

Mortality in the SEAR nations vs the developed world

Scientists worldwide have been debating the disproportionately higher COVID-19 mortality burden in high-income countries compared with the low- and middle-income countries. Estimates from Johns Hopkins University and WHO have shown that high-income countries account for almost 70% of the COVID-19 mortality. This phenomenon has perplexed researchers globally, since one would expect the reverse, due to superior health infrastructure and resources in developed nations. Reasons put forward to explain this include younger populations in some of these LMICs (Supplementary File 2), warmer climate, less travel, and genetic and immunological differences in the profiles of Caucasians compared with other ethnic groups (Vigo et al., 2020). However, the situation is rather complex and involves other factors such as data management and quality issues, and weaker surveillance systems in the LMICs, leading to a possible underreporting of numbers (Feyissa et al., 2021).

Challenges with data reporting and quality in the SEAR nations

The SEAR nations have been facing various challenges regarding the estimation of COVID-19-associated mortality. These include the paucity of relevant data, a lack of research, and weak reporting systems for deaths, such as verbal autopsies. This has led to a significant underreporting bias in the available numbers (Star Desk 2020; Fears grow that Nepal's Covid-19 crisis could be even worse than India's [WWW Document] 2021; Indonesia surpasses 100,000 deaths amid new virus wave [WWW Document] 2021; The Hindu Data Team, 2021). Suggested reasons for the undercounting of deaths and the gaps in existing country-level data include: insufficient access to hospital beds, oxygen supplies, and other medical care in these regions due to an overwhelmingly high case load, especially during an infection surge; inconsistency in the definition of deaths from COVID-19; inadequacies in the reporting of age- and sex-disaggregated data on COVID-19 mortality from the health ministries; unavailability of testing facilities; and high false-negative rates for rapid antigen tests (Babu et al., 2021; Biswas et al., 2020; Hasibuan and Syarina, 2022; Number of COVID-19 deaths far higher than what the government claims, officials say [WWW Document] 2022; Zimmermann et al., 2021).

Epidemiologists and data scientists, along with journalists and volunteer groups, have been working tirelessly to access all possible sources and obtain credible data on COVID-19 mortality (Estimating COVID-19 fatalities in India [WWW Document] 2021; Rukmini, 2021). This is to ensure that the numbers reflect the real picture of the infections, hospitalizations, and deaths at any given point in time, and that predictions regarding the future trajectory of the virus can appropriately inform and aid government policy. However, despite their relentless efforts, lacunae in health systems, frail surveillance mechanisms, and concerns regarding the capturing and reporting of data have hindered the development of a more effective public-health response.

Data paucity and quality issues are major problems in assessing the differential severity and mortality in relation to COVID-19 in South-East Asian nations. While it is possible that real biological differences may explain the lower risk of severe COVID-19 in these nations, there may be alternative explanations, such as differences in the quality of COVID-19 data and the age structures of the populations. For example, people may be less likely to visit the hospital with COVID-19 due to stigma surrounding the virus, or they may be more likely to die at home in-

Table 6
Comorbidities as a determinant of COVID-19 mortality

Country	Explanatory variable — comorbidities	References
Bangladesh	The various comorbid conditions reported across studies were diabetes, hypertension, cardiovascular disease, cerebrovascular disease, asthma and respiratory conditions, renal disease, obesity, and neurological disorders, with diabetes and hypertension being the most common. The prevalence of diabetes ranged from 20% to 65% among the majority of the studies, with two studies reporting a rather high prevalence of more than 90%. The prevalence of hypertension was also similar and ranged from about 15% to 60%. The prevalence of respiratory conditions had a narrow range, i.e. around 8–18%. Blood vessel disorders (cardiovascular and cerebrovascular diseases) ranged from 5% to 30%. Patients with three or more comorbidities were more likely to present with severe/critical SARS-CoV-2 symptoms than the others The proportions of people with diabetes (both insulin-dependent and non-insulin-dependent) and hypertensives were significantly higher in the severe group and among those requiring ICU care; diabetes prevalence was also higher among older patients The prevalence of comorbidities was thus significantly higher among non-survivors, and there were more deaths in people with diabetes than among non-diabetics	Ahsan et al., 2020; Haque et al., 2020; Hasan et al., 2021; Hossain et al., 2020e., 2020d, 2020b; Islam et al., 2020; Malik et al., 2020; Mohiuddin Chowdhury et al., 2021; Mowla et al., 2020; Paul et al., 2020; Saha et al., 2021, 2020; Al-Bari et al., 2021; Haque et al., 2020; Hasan et al., 2021; Hossain et al., 2020e., 2020d, 2020b; Islam et al., 2020; Malik et al., 2020; Mohiuddin Chowdhury et al., 2021; Mowla et al., 2020; Paul et al., 2020; Saha et al., 2021, 2020; Yasmin et al., 2020); Al-Bari et al., 2021; Hossain et al., 2020d.; Islam et al., 2020; Malik et al., 2020; Mohiuddin Chowdhury et al., 2021; Mowla et al., 2020; Paul et al., 2020; Saha et al., 2020; (Hossain et al., 2020d.; Paul et al., 2020); Al-Bari et al., 2021; I Hossain et al., 2020e., 2020d; Islam et al., 2020; Malik et al., 2020; Paul et al., 2020; Saha et al., 2020; Yasmin et al., 2020; Al-Bari et al., 2021; Hossain et al., 2020b, 2020d, 2020e; Mowla et al., 2020; Paul et al., 2020; Al-Bari et al., 2021; Saha et al., 2020; Al-Bari et al., 2021; Hasan et al., 2021, Hossain et al., 2020d.; Saha et al., 2021, Islam et al., 2020; Saha et al., 2021
India	In India, diabetes, hypertension, cardiovascular disease, lung disorders, and renal disease were reported in a majority of the studies, with diabetes and hypertension being the most common. The prevalence of diabetes ranged from 15% to approximately 50–60% among the studies; hypertension had a similar prevalence, ranging from 28% to more than 60%. The proportion of patients with heart and respiratory illnesses was lower, i.e. around 5–20%. The presence of diabetes was accompanied with another chronic pre-existing condition like heart disease or hypertension in a few studies Diabetes and hypertension were more prevalent in the severe patient groups, with a greater risk of fatal outcomes, and in those requiring oxygen and ICU support Male diabetics with COVID-19 constituted a high-risk group, and were more prone to death as compared with others Hypertension was also found to be associated with severe cases of COVID-19	Asirvatham et al., 2021; Bhandari et al., 2020a; Deshpande et al., 2020; Goel et al., 2020; Gupta et al., 2021.; Gurtoo et al., 2020; Jain et al., 2020; Kayina et al., 2020; Koya et al., 2021; Krishnasamy et al., 2021; Kumar et al., 2020; Kute et al., 2021; Mahajan et al., 2020a; Mahto et al., 2021; Mathew et al., 2021; Mithal et al., 2021a, 2021b; Mohan et al., 2020; Mohandas et al., 2021; Patel et al., 2021; Pujari et al., 2021; Saluja et al., 2020; Saseedharan et al., 2020; Saxena et al., 2021; Sharma et al., 2021; Singh et al., 2021; Singla et al., 2021; Suresh et al., 2021; Verma et al., 2020); Asirvatham et al., 2021; Bhandari et al., 2020a; Deshpande et al., 2020; Goel et al., 2020; Gupta et al., 2021.; Gurtoo et al., 2020; Jain et al., 2020; Kayina et al., 2020; Koya et al., 2021; Krishnasamy et al., 2021; Kumar et al., 2020; Kute et al., 2021; Mahajan et al., 2020a; Mahto et al., 2021; Mathew et al., 2021; Mithal et al., 2021a, 2021b; Mohandas et al., 2021; Pujari et al., 2021; Saluja et al., 2020; Saseedharan et al., 2020; Saxena et al., 2021; Sharma et al., 2021; Singh et al., 2021; Singla et al., 2021; Suresh et al., 2021; Asirvatham et al., 2021; Bhandari et al., 2020a; Deshpande et al., 2020; Gupta et al., 2021.; Jain et al., 2020; Koya et al., 2021; Krishnasamy et al., 2021; Kute et al., 2021; Mathew et al., 2021; Mithal et al., 2021a, 2021b; Saluja et al., 2020; Saseedharan et al., 2020; Singh et al., 2021; Suresh et al., 2021); Deshpande et al., 2020; Goel et al., 2020; Gupta et al., 2021.; Gurtoo et al., 2020; Jain et al., 2020; Saluja et al., 2020; Suresh et al., 2021; Verma et al., 2020; Bhandari et al., 2020a; Gurtoo et al., 2020; Jain et al., 2020; Koya et al., 2021; Kute et al., 2021; Mithal et al., 2021a, 2021b; Saxena et al., 2021; Suresh et al., 2021; Verma et al., 2020 Asirvatham et al., 2021; Goel et al., 2020; Jain et al., 2020; Koya et al., 2021; Mahajan et al., 2020a; Mithal et al., 2021a Gurtoo et al., 2020; Mithal et al., 2021b; Sharma et al., 2021 Agarwal et al., 2020; Deshpande et al., 2020; Gaur et al., 2021; Kansara et al., 2021; Kumar et al., 2021; Mathew et al., 2021; Mehta et al., 2021; Mithal et al., 2021a; Mohandas et al., 2021; Saurabh et al., 2021; Sharma et al., 2021; Singh et al., 2021.; Singla et al., 2021; Tambe et al., 2020 Mithal et al., 2021b
Indonesia	The comorbid conditions reported were hypertension, diabetes, cardiovascular disease, lung disease, and renal disease, with hypertension being the most common. The prevalence of hypertension ranged from about 20% to 40%, whereas diabetes was in just over 10% of the patients. The proportion of these pre-existing chronic conditions was higher among the deceased group. These illnesses were correlated with the development of acute respiratory distress syndrome (ARDS); however, the number of studies reporting data on comorbidities was inadequate.	Rachmawati et al., 2021; Rozaliyani et al., 2020; Surendra et al., 2021; Sutiningsih et al., 2021b; Rachmawati et al., 2021; Rozaliyani et al., 2020; Surendra et al., 2021; Rachmawati et al., 2021; Rozaliyani et al., 2020; Surendra et al., 2021; Rachmawati et al., 2021; Rozaliyani et al., 2020; Surendra et al., 2021; Rachmawati et al., 2021; Rozaliyani et al., 2020; Surendra et al., 2021 Rachmawati et al., 2021; Rozaliyani et al., 2020
Nepal	The most commonly reported comorbid conditions among Nepalese patients were hypertension, diabetes, cardiovascular disease, and lung disease However, the number of studies reporting their prevalence was rather limited; one study showed a correlation between the presence of a chronic condition and COVID-19 mortality	Khadka et al., 2021; Khatri et al., 2021; Sherpa et al., 2021; Khadka et al., 2021; Khatri et al., 2021; Sherpa et al., 2021; Panthee et al., 2020; Sherpa et al., 2021; Khadka et al., 2021; Khatri et al., 2021 Khadka et al., 2021
Thailand	Diabetes, hypertension and dyslipidemia had the highest prevalence among COVID-19 patients in Thailand, but prevalence data for these conditions were reported by very few studies	Bruminhent et al., 2020; Chailek et al., 2020; Pongpirul et al., 2020; Sirijatuphat et al., 2021

Table 7
Clinical symptoms as a determinant of COVID-19 mortality

Country	Explanatory variable — clinical symptoms	References
Bangladesh	Fever was the most prevalent symptom, followed by cough. The proportion of patients presenting with fever was rather high, with around 60–90% prevalence across most studies. Cough was also seen in almost two-thirds of the patients. Dyspnea (shortness of breath) was prevalent in about 50% of cases.	Ahsan et al., 2020; Akhtar et al., 2021; Alam et al., 2020; Haque et al., 2020; Hasan et al., 2021; Hossain et al., 2020b, 2020d, 2020e; Islam et al., 2020; Malik et al., 2020; Mohiuddin Chowdhury et al., 2021; Mowla et al., 2020; Paul et al., 2020; Saha et al., 2021, 2020; Yasmin et al., 2020; Ahsan et al., 2020; Akhtar et al., 2021; Haque et al., 2020; Hasan et al., 2021; Hossain et al., 2020b, 2020d, 2020e; Islam et al., 2020; Malik et al., 2020; Mohiuddin Chowdhury et al., 2021; Mowla et al., 2020; Paul et al., 2020; Saha et al., 2021, 2020; Yasmin et al., 2020
India	Fever was the most prevalent symptom, followed by dyspnea. The prevalence of fever ranged from about 20% to 50% in some studies, while it was as high as around 90% in a few others. Dyspnea/breathlessness was reported by 30–70% of patients across most studies, and was even higher in some. The prevalence of cough ranged from 40% to 60%.	Areekal et al., 2021; Asirvatham et al., 2021; Bhandari et al., 2020a, 2020b; Borah et al., 2021; Chayal et al., 2021; Goel et al., 2020; Goyal et al., 2021; Gupta et al., 2021.; Gupta et al., 2020; Gupta et al., 2021.; Gurtoo et al., 2020; Jain et al., 2020; Jha et al., 2020; Kayina et al., 2020; Koya et al., 2021; Kulkarni et al., 2020; Kumar et al., 2020; Mathew et al., 2021; Mehta et al., 2021; Mohan et al., 2020; Mohandas et al., 2021; Patel et al., 2021; Pujari et al., 2021; Saxena et al., 2021; Sharma et al., 2021; Sherwal et al., 2020; Singla et al., 2021; Suresh et al., 2021; Tambe et al., 2020; Verma et al., 2020; Yadav et al., 2021; Asirvatham et al., 2021; Bhandari et al., 2020a, 2020b; Borah et al., 2021; Chayal et al., 2021; Goel et al., 2020; Goyal et al., 2021; Gupta et al., 2021.; Gurtoo et al., 2020; Jain et al., 2020; Kayina et al., 2020; Koya et al., 2021; Mathew et al., 2021; Mehta et al., 2021; Patel et al., 2021; Pujari et al., 2021; Saxena et al., 2021; Sharma et al., 2020; Sherwal et al., 2020; Singla et al., 2021; Suresh et al., 2021; Tambe et al., 2020; Verma et al., 2020; Yadav et al., 2021
Indonesia	Fever was the most prevalent symptom, followed by cough	Rozaliyani et al., 2020; Surendra et al., 2021; Sutiningsih et al., 2021b; Rozaliyani et al., 2020; Surendra et al., 2021
Nepal	Fever was the most prevalent symptom, followed by dyspnea	Khadka et al., 2021; Khatri et al., 2021); Khadka et al., 2021; Khatri et al., 2021; Panthee et al., 2020
Thailand	Fever was the most prevalent symptom, followed by cough	Bruminhent et al., 2020; Chailek et al., 2020; Pongpirul et al., 2020; Bruminhent et al., 2020; Chailek et al., 2020; Pongpirul et al., 2020

Table 8
Non-pharmaceutical interventions as determinants of COVID-19 mortality

Country	Explanatory variable — wearing of masks	References
Bangladesh	Approximately 70–90% of participants across the included studies from Bangladesh reported wearing masks when stepping out in public to prevent infection spread	Ahmed et al., 2020; Das et al., 2020; Ferdous et al., 2020; Hossain et al., 2020a.; Hossain et al., 2020.; Hossain et al., 2021.
India	Preventive practices adopted by the population were reported in just a handful of the studies. Almost 90% of the 904 participants in a community-based survey reported wearing masks. More than two-thirds of the respondents covered both their nose and mouth and avoided handshakes.	Chakrawarty et al., 2020
Indonesia	The proportion of Indonesian respondents wearing masks was reportedly less than 75%. Almost 65% of the participants in a survey reportedly used cloth masks only, and only around 12% used both cloth and surgical masks for protection.	Kristina et al., 2020; Pramana et al., 2020
Nepal	According to a cross-sectional survey among 1069 residents of eastern Nepal, preventive measures were reportedly followed by almost 98% of the participants. A survey of 427 healthcare workers on perceived risk and the enabling environment in a medical setting showed that 10–20% of the staff did not always have access to face masks, soap and water, and hand sanitizers	Chapagain et al., 2020; Sarraf et al., 2020
Country	**Explanatory variable — sanitation and hygiene**	**References**
Bangladesh	The proportion of people reportedly washing hands frequently with soap and water was almost 90%. An similar proportion reported that they disinfected items that could be easily touched by many people, like surfaces and door handles. Around 70% of the participants in a study reported cleaning and disinfecting their house regularly. Almost 94% used tissues for sneezing and coughing, before disposing of them in a waste bin. A small number of this study population supported using alcoholic rub for sanitizing purposes. Almost one-quarter of the participants in a study reported handwashing practices and disinfection of items every time they came home as inconvenient due to lack of facilities, economic constraints, and inadequate knowledge.	Ahmed et al., 2020; Hossain et al., 2020a.; Hossain et al., 2020a.; Hossain et al., 2020a.; Hossain et al., 2021.
India	Frequent handwashing was adopted by more than 60% of the respondents in a community-based cross-sectional survey from India. However, washing hands for at least 20 seconds was not commonly observed, with fewer than half of the respondents doing it.	Chakrawarty et al., 2020
Country	**Explanatory variable — physical distancing**	**References**
Bangladesh	The proportion of participants practicing physical distancing, and avoiding crowds, meeting up with friends, or eating out varied from 50% to 90%. An online cross-sectional survey on population-level preparedness for prevention against COVID-19 showed that a majority of the respondents found it inconvenient to live with older family members and to practice distancing with members showing COVID-like symptoms.	Ahmed et al., 2020; Das et al., 2020; Hossain et al., 2020a.; Hossain et al., 2020.; Hossain et al., 2021.
India	In a community-based cross-sectional survey of 904 participants, the proportion of individuals reportedly maintaining physical distancing in public spaces and workplaces was about 50%. Less than 20% had visited gyms, bars, restaurants, and cultural gatherings. On the contrary, another cross-sectional survey of 452 adults reported that almost 93% of the respondents practiced physical distancing.	Chakrawarty et al., 2020; Kumar et al., 2022.

stead of in a medical facility. This means that the cause of death may be less well documented in these countries, and the true number of people with severe COVID-19 may be underestimated. To date, no study has fully answered whether the severity of COVID-19 truly differs in these nations.

Strengths and limitations

To the best of our knowledge, this is the first narrative review that aims to describe the differential patterns of COVID-19 mortality among the WHO-SEAR countries, while exploring some of the epidemiological indicators that could explain the differences. Our study has several strengths and some limitations. A comprehensive and exhaustive search strategy was prepared to ensure a sensitive search that could identify as many relevant articles as possible. Additionally, efforts were made to elaborate on each indicator separately, to present a thorough summary of the findings obtained from many studies.

However, the indicators included in this review could only partially explain the variations in mortality. Other variables, such as population density, healthcare systems and medical infrastructure, economic status of the countries, and heterogeneity in estimating the number of deaths warrant further investigation. Moreover, the overall analysis is a narrative synthesis based on the available literature. Hence, the conclusions drawn cannot have causal inference. Also, relevant data for the remaining SEAR countries were insufficient or absent, which meant that they had to be excluded from the summary. Even countries included in the review did not have enough data to establish associations between the explanatory variables and mortality outcomes. Lastly, published literature from community surveys on COVID-19 mortality in the SEAR nations was rather inadequate for comparison with data from hospital studies. In the light of these issues, this review's findings warrant cautious interpretation.

CONCLUSION

Our review highlights important contributors to the burden of deaths associated with COVID-19 in SEAR nations. Resource-constrained settings are more fragile, which means that LMICs have taken a larger hit than the developed world. A greater understanding of factors associated with greater morbidity and mortality in developing countries, in order to combat some of them, is thus essential. This review also highlights the scope for further research that could add to our knowledge on the various epidemiological and environmental indicators that can drive COVID-19 infection and death rates across countries. There is a compelling need for more studies in this area (especially community based), specifically in the SEAR and other low- and middle-income countries.

RECOMMENDATIONS

The COVID-19 pandemic has exacerbated health inequities and exposed the fragility of healthcare systems, especially in the SEAR nations. Despite SEAR countries being more adversely affected by the pandemic than the developed world, there is limited literature from this region. Conducting and publishing further research on COVID-19-associated mortality and its determinants can inform public-health response. Details regarding caseloads, morbidity, and death rates can enhance our understanding of the actual scenario in the SEAR. This evidence base can drive better pandemic preparedness. In order to achieve this, impending issues relating to data capturing, data quality, and communication need to be addressed. Establishing a national health data repository for a robust and reactive surveillance platform that guides public-health efforts is necessary for all SEAR nations. Strengthening disease-control efforts, promoting research, and stepping up medical infrastructure are essential. These can can be accomplished by linking multiple platforms for data sharing, while maintaining privacy and implementing digital health measures. It is also crucial to encourage community participation and social engagement in order to strengthen public-health messaging approaches and to inform the public. This would help these nations to be better equipped to address health emergencies and tackle pandemics presently and in the future.

CONFLICTS OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

FUNDING SOURCE

This study was conducted as part of the Technical Support Unit established at the Public Health Foundation of India for the World Health Organization to strengthen regional support in technical analysis, inferences, and dissemination regarding COVID-19 responses in the SEAR.

ETHICAL APPROVAL

Ethical approval was not required for this study.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijregi.2022.02.010.

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