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The impact and variability of social determinants of health on the transmission and outcomes of COVID-19 across the world: a systematic review protocol

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The impact and variability of social determinants of health on the transmission and outcomes of COVID-19 across the world: a systematic review protocol

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STRENGTHS AND LIMITATIONS OF THIS STUDY:

- This review will address the impact of a wide range of social determinants of health (SODH) and the geographical variations that affect the transmission and outcomes of COVID-19.
- A multidisciplinary team is involved in this review and the search strategy was undertaken with the involvement of a library information scientist.
- A standard scientific reporting format will be used to summarize the review findings to avoid the shortcoming and biases of narrative synthesis.
- The influx of journal articles that were published over the last year in response to the current pandemic, without a scientific track record of previous studies, were reviewed in this manuscript

ABSTRACT

Introduction:

The COVID-19 pandemic has exacerbated health inequalities across the globe, disproportionately affecting those with poor social determinants of health (SDOH). It is imperative to understand how SDOH influences the transmission and outcomes (positive case, hospitalization and mortality) of COVID-19. This systematic review will investigate the impact of a wide range of SDOH across the globe on the transmission and outcomes of COVID-19.

Methods and analysis:

This review will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocol (PRISMA) guidelines. We searched articles published from January 1, 2019, to December 31, 2021, in three electronic bibliographic databases (MEDLINE via PubMed, Embase and Scopus), as well as the WHO COVID-19 Global Research on coronavirus disease database. We will consider observational studies that report statistical relationships between the social determinants of health (as listed in PROGRESS-Plus and Healthy People 2020) and COVID-19 transmission and outcomes. There will be no limitation on the geographical location of publications. The quality of included observational studies will be assessed using a modified version of the Newcastle Ottawa Scale (NOS). A narrative Synthesis without Meta-Analysis (SWiM) reporting standards will be used to report the review findings.

Ethics and dissemination:

This review will be based on published studies obtained from publicly available sources, and therefore, ethical approval is not required. We will publish the results of this review in a peer-reviewed journal, as well as present the study findings at a national conference.

PROSPERO registration number: CRD42021228818

Keywords:

Social determinants of health, COVID-19, transmission, outcomes, geographical variations

INTRODUCTION

In December 2019, a pneumonia case associated with SARS-CoV-2 was first identified in Wuhan, Hubei province, China. As of 24 April 2021, this emerging infection has caused 154,640,649 infections and 3,232,285 deaths globally.[1] The current experience of the COVID-19 pandemic

has taken the world by surprise, despite the modern advances in health sciences. Outcomes of the disease include not only an increased death toll but has put a spotlight on health inequalities.[2] According to the World Health Organization (WHO), social determinants of health (SDOH) are the non-medical factors that influence the health outcome of humans. They broadly define it by the conditions in which people are born, grow, work, live, and age and the wider set of forces and systems shaping the conditions of daily life.[3] All these conditions have a major impact on the health, wellbeing and quality of life of an individual.[4] The transmission of any communicable disease is highly dependent on these SDOH. The vast dynamics of disease transmission may result in symptomatic or asymptomatic disease outcomes, which may lead to hospitalization and/or death. Generally, people residing in socioeconomically underdeveloped areas are at least three times more likely to die of preventable diseases compared to those in developed areas.[5] The socioeconomically disadvantaged population also has limited access to healthcare services. Studies show that even those who live above the poverty line are more prone to be affected by chronic health conditions.[6]

This pandemic has made it clear that social determinants of health differentially affect disease transmission and outcomes globally.[2] Reports and studies generated from countries with high infection rates suggest that geographic variations were signifying higher transmission rates, hospitalizations and mortality in marginalized, densely populated, low-income, and crowded households.[7–12]. Populations living in crowded neighborhoods are at a higher risk of becoming ill and transmitting the virus at an increased rate, as social distancing may not be feasible.[13–15]

Access to health care services is described by the National Academies of Sciences, Engineering, and Medicine as the "timely use of personal health services to achieve the best possible health outcomes".[16] Access to healthcare is an influential SDOH that has gained attention during this COVID-19 pandemic.[17, 18] Accessibility to health care services may include geographic accessibility (within physical reach), economic accessibility (within financial reach) and cultural accessibility (acceptance and communication).[19–21] Health insurance is an important aspect of accessibility which is evident from several studies and reports. It has been demonstrated that there is unequal coverage of health insurance and access to services, leading to poorer health outcomes in marginalized groups. [22, 23] In a study by Gallup and West Health, it was found that 14% of adults in the U.S. do not seek healthcare when experiencing fever and dry cough due to the high cost of healthcare.[24] Given the fact that fever and dry cough are the most common symptoms of COVID-19, there is a high chance that many COVID-19 cases may go unnoticed or undiagnosed, which may result in unknowingly transmitting the disease. [25] Primary care visits may not be feasible, or people may hesitate to use health care resources without health insurance. This inability puts those without health insurance at risk of not being screened for chronic conditions, such as CVD (cardiovascular disease), hypertension, asthma, and diabetes. Therefore during this health emergency, access to health care may play a major role in whether an individual will test for COVID-19 and follow recommendations, such as social distancing and other preventive measures.[26] In terms of racial disparities, the United States has experienced disproportionate outcomes of infection, hospitalization and mortality among historically marginalized groups, such as African American, Hispanic and Asian populations. [27, 28] studies show that mortality due to COVID-19 is associated with socioeconomic class. [29–31] Black, Asian and minority ethnic (BAME) backgrounds represented one-third of the ICU admission in UK hospitals, while Somali immigrants living in Norway had a ten times higher rate of infection compared to the non-immigrants.[32, 33] Those who are minorities may not be aware of their underlying conditions due to barriers in accessing primary care and might be at high risk of developing more severe symptoms during this pandemic situation.[34, 35]

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It is imperative to focus on SDOH during the COVID-19 pandemic to better understand preventable health inequalities and to improve health outcomes. As such, there is an immediate need to comprehend the social determinants of COVID-19 transmission and outcomes to decrease human sufferings and save lives.[36] In addition to known clinical risk factors, knowledge of social risk factors will help policymakers and healthcare decision-makers to prioritize groups who are most at-risk during the COVID-19 pandemic and to formulate health messages according.

Objectives

1. To find the impact of social determinants of health (SDOH) on the transmission and outcomes of COVID-19.

2. To explore the geographic variations of SDOH on transmission and outcomes of COVID-19.

METHODS

This protocol is registered with the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42021228818 and follows the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines,[37] as shown in **Figure 1**.

Figure 1: PRISMA 2009 Flow Diagram

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Eligibility criteria

A summary of eligibility criteria is shown in Table 1.

Types of studies:

The types of studies that will be considered in this systematic review will include empirical quantitative studies following prospective and retrospective cohort, case-control, cross-sectional, pre-post designs, and modeling studies that report statistical relationships between exposures of interest (i.e., social determinants of health) and COVID-19 transmission and outcomes. We will only include studies published in the English language. Qualitative studies, reviews, narrative reviews, systematic reviews, meta-analyses, pharmacological and biochemical studies, animal model studies, conference abstracts, conference proceedings, and theses/dissertations will not be included in this systematic review. Simulation modeling, which does not report new empirical data, opinion literature, including commentaries, editorials, and analyses that discuss COVID-19 regarding equity, social determinants, and/or vulnerable populations, will also be excluded from the review.

Types of study population:

Studies in this review will include populations of all ages, ethnicity, gender, and geographic location. We will consider any population that has been tested positive for COVID-19.

Types of outcome measures:

Studies will be included if they use a measure for social determinants of health that affect the transmission and outcomes (confirmed positive case, hospitalization, and mortality) of COVID-19. We will use Healthy People 2020 and PROGRESS-Plus to classify our definition of social determinants of health.[38, 39] Healthy People 2020 addresses five SDOH; economic stability, education, social and community context, health and health care, neighborhood, and built environment. PROGRESS-Plus refers to the place of residence, race/ethnicity/culture/language, occupation, gender, religion, education, socioeconomic status, and social capital. Plus refers to

personal characteristics associated with discrimination (e.g., age, disability), features of relationships (e.g., smoking parents, excluded from school), and time-dependent relationships (e.g., leaving the hospital, respite care, other instances where a person may be temporarily at a disadvantage).

Table 1: Inclusion and	exclusion crit	eria for the review
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Inclusion criteria	Exclusion criteria
 Inclusion criteria Empirical-based observational quantitative studies such as cross- sectional, case-control, prospective and retrospective cohort, pre-post designs, and modeling studies Studies covering all geographical locations 	 Exclusion criteria Studies in Non-English language Qualitative studies, simulation modeling studies (without new empirical data), review studies, systematic review, review of the systematic review, meta-analysis, narrative reviews, conference abstracts, proceedings, thesis
 Studies in the English language only Studies covering people of all age groups Studies that include SDOH listed in PROGRESS-Plus & Healthy People 2020 Studies that include any COVID-19 positive population Studies that include populations tested positive for COVID-19, with underlying co-morbidities Studies that include a population that required hospitalization or resulted in mortality due to COVID-19 	 Pharmacological and biochemical studies, animal model studies, Opinion literature, including commentaries, editorials, brief reports, perspectives, and analyses Studies that include COVID-19 disease outcome among special populations (such as patients with HIV, prisoners, cancer patients, etc.) Studies that include laboratory measures and radiologic findings of COVID-19 diagnosis. Articles with missing descriptions of findings and/or results

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Search strategy

We undertook a comprehensive literature search to locate both published and unpublished literature. We searched articles published from January 1, 2019, to December 31, 2021, in three electronic bibliographic databases (MEDLINE via PubMed, Embase and Scopus), as well as the WHO COVID-19 Global Research on coronavirus disease database, to ensure results focused on the novel COVID-19 pandemic and retrieve pre-print articles. Our search strategy was based on the published Ovid Embase COVID-19 search strategy translated for use in the searched databases.[40] The full, detailed search strategy is available in **Supplement 1**. Following the search, all identified citations were imported into EndNote X9 (Clarivate Analytics, PA, USA), and duplicates were removed. Deduplicated results were exported to an Excel spreadsheet for screening. The reference lists of all included studies will be then further reviewed for eligible studies.

Study records

Selection process:

Based on the title and abstract (where available), ten (10) researchers initially reviewed and assessed potential articles for eligibility that meet inclusion criteria, while maintaining a low threshold for consideration for further review. The same researchers will screen the full text of the potential articles for inclusion. We will resolve the disagreement or uncertainty regarding the eligibility of particular studies through discussion by two independent researchers.

Data management and collection:

Ten (10) researchers will work on data extraction using a piloted data extraction tool, and the extracted data will be reviewed by a supervisor for errors.

Data to be collected:

- a. Study details (title, year of publication, author, abstract, study design, country, region)
- b. Study population characteristics (age, sex...)
- c. Sampling strategy and sample size

d. SODH including participant demographics (place of residence, occupation, race/ethnicity/culture/language, education, religion, social capital, socioeconomic status, economic stability, education, social and community contexts, health and health care access, neighborhood and built environment).[38, 39]

e. Outcome severity of COVID-19

OUTCOMES

This systematic review will focus on SDOH that impact the transmission and outcomes of COVID-19. We will also look for the geographical variations of these outcomes from the selected articles for this review. The following outcomes will be examined:

a. Positive COVID-19 cases

b. Hospitalization due to COVID-19 that includes regular bed patients admission, High Dependency Unit (HDU) patient admission, Intensive Care Unit (ICU) patient admission

c. Mortality due to COVID-19

RISK OF BIAS

To assess the quality of included observational studies, we will use a modified version of the Newcastle Ottawa Scale.[41] Two reviewers will independently assess each study, with discrepancies resolved by agreement or a third independent assessor if such agreement cannot be achieved.

DATA SYNTHESIS & ANALYSIS

This review is broad and exploratory in nature, and therefore, a meta-analysis of the effect estimate is not planned, but data will be evaluated for the possibility of conducting a metaanalysis. To avoid the shortcomings in the reporting of narrative synthesis, we will follow the Synthesis without Meta-Analysis (SWiM) reporting standards.[42] We will tabulate the results and narrate the summary of findings for each SDOH identified in this review. Additionally, we will prepare at least three tables consisting of the study characteristics, participant characteristics, and a summary of findings that describes study setting, size, methodology, primary outcomes,

secondary outcomes, summary statistics, and/or statistical results (risk ratios, odds ratios, risk differences, mean differences, standardized mean differences, the ratio of means), and relationship to SDOH.

DISCUSSION

Our systematic review will focus on the role that social determinants of health play in the transmission and outcomes of COVID-19. We hope that the concluded review will provide evidence to determine the impact and variability of social determinants of health associated with SARS-CoV-2 infection and the dynamics of transmission and outcomes. This protocol will guide the review homogeneously and methodologically. Our systematic review will address a gap in the COVID-19 literature, by exploring not only the impact social determinants of health have on the transmission and outcomes of the disease but also by exploring the global geographical differences of SDOH and its impact on the COVID-19 pandemic. Through this review, we hope to provide an empirical understanding of the diverse social determinants of COVID-19, which could appraise the global pandemic response efforts as well as provide comprehensive evidence for future public health policy implications.

PATIENT/PUBLIC INVOLVEMENT

There will be no patient or public involvement in this study.

ETHICS AND DISSEMINATION

As the data included in this review have been published or obtained from publicly available sources, ethical approval is not required. We will submit the full systematic review manuscript to a peer-reviewed journal and will present the study results at a national conference.

AUTHOR CONTRIBUTIONS

All authors have contributed equally to the design and conceptualization of this review. MA, AW, FNR, FRO, SS, SR, CAM, and LI drafted the manuscript and protocol with UKS, FF, SRM, and LF as editors. LF developed the search strategy with input from UKS, FF, and SRM concerning keywords

and databases. All review methods were planned and discussed with the authors, with LF acting as a methodological mentor.

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All authors declare that they have not received any grant/fund for this research from any source.

COMPETING INTERESTS

Authors declare that they have no competing interests.

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Figure 1: PRISMA 2009 Flow Diagram

Figure 1: PRISMA 2009 Flow Diagram

166x170mm (120 x 120 DPI)

SUPPLEMENT 1

Embase

13	'health care access'/de
14	((acces* OR avail*) NEXT/2 (healthcare OR 'health care' OR 'health service*')):ti,ab,kw
15	'socioeconomics'/exp
16	('socioeconomic factors' OR 'health services accessibility'):ti,ab,kw,de
17	(education* achieve* OR education* status):ti,ab,kw,de
18	'health insurance'/de
19	'unemployment'/de
20	'social isolation'/exp
21	'social determinant of health'/de
22	'social environment'/de
23	'social exclusion'/de
24	('health insurance' (standard* NEXT/1 living) OR 'social determinant*' OR
	unemployment OR 'social isolation' OR 'psychosocial deprivation' OR 'social
	environment' OR 'social exclusion' OR 'social marginali*ation'):ti,ab,kw
25	('social determinant? of health' OR SDOH OR SDH OR 'social deprivation' OR 'social
	disadvantage' OR 'financial difficult*' OR 'financial problem?' OR 'income difference*'
	OR indigent* OR 'insurance status' OR jobless OR 'job insecurity*' OR 'low income' OR
	marginali* OR 'occupation* status'):ti,ab,kw
26	(Poverty OR SES OR 'social disparit*' OR 'social environment' OR 'social exclusion' OR
	'social factor?' OR 'social gradient?' OR 'social position?' OR 'social variation?' OR
	'socioeconomic status' OR 'socioeconomic circumstances' OR 'socioeconomic
	gradient'):ti,ab,kw
27	('socioeconomic health differences' OR 'socioeconomic position' OR 'socioeconomic
	variable' OR underprivilege* OR unemployed OR unemployment OR uninsur* OR
	'vulnerable population' OR 'vulnerable group?' OR 'vulnerable communit*' OR
	'vulnerable people' OR 'vulnerable person?'):ti,ab,kw
28	((socio* OR social*) NEXT/10 (predict* OR prognos* OR risk*)):ti,ab,kw

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29	#13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR
	#24 OR #25 OR #26 OR #27 OR #28
30	#12 AND #29

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29	#13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR
	#24 OR #25 OR #26 OR #27 OR #28
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PubMe	ed
1	"Coronavirus"[Mesh]
2	"Coronavirus Infections"[Mesh]
3	(coronavirus*[tw] OR corona virus*[tw] OR OC43[tw] OR NL63[tw] OR 22pE[tw] OR
	HKU1[tw] OR HCoV*[tw] OR ncov*[tw] OR covid*[tw] OR sars-cov*[tw] OR
	sarscov*[tw] OR Sars-coronavirus*[tw] OR Severe Acute Respiratory Syndrome
	Coronavirus*[tw])
4	#1 OR #2 OR #3
5	(MERS[tw] OR MERS-CoV[tw] OR Middle East respiratory syndrome[tw] OR
	camel*[tw] OR dromedary*[tw] OR equine[tw] OR coronary[tw] OR coronal[tw] OR
	covidence*[tw] OR covidien[tw] OR influenza virus[tw] OR HIV[tw] OR bovine[tw] OR
	calves[tw] OR TGEV[tw] OR feline[tw] OR porcine[tw] OR BCoV[tw] OR PEDV[tw] OR
	PDCoV[tw] OR FIPV[tw] OR FCoV[tw] OR SADS-CoV[tw] OR canine[tw] or CCov[tw] OR
	zoonotic[tw] OR avian influenza[tw] OR H1N1[tw] OR H5N1[tw] OR H5N6[tw] OR
	IBV[tw] OR murine corona*[tw])
6	#4 NOT #5
7	(((pneumonia[tw] OR covid*[tw] OR coronavirus*[tw] OR corona virus*[tw] OR
	ncov*[tw] OR 2019ncov[tw] OR sars*[tw]) OR "Pneumonia"[Mesh]) AND Wuhan[tw])
8	(coronavirus disease 2019[tw] OR 2019-ncov[tw] OR 2019nCoV[tw] OR
	ncov2019[tw] OR ncov19[tw] OR ncov-19[tw] OR HCoV-19[tw] OR 2019-novel
	CoV[tw] OR severe acute respiratory syndrome coronavirus 2[tw] OR sars2[tw] OR
	sars 2[tw] OR sars-cov2[tw] OR sars-cov-2[tw] OR sarscov2[tw] OR sarscov-2[tw]
	OR Sars-coronavirus2[tw] OR Sars-coronavirus-2[tw] OR SARS-CoV-19[tw] OR SARS-
	like coronavirus*[tw] OR coronavirus-19[tw] OR covid19[tw] OR covid-19[tw] OR
	covid 2019[tw] OR ((novel[tw] OR new[tw] OR nouveau[tw]) AND (CoV OR nCoV OR

pandemic[tw] OR covid pandemic [tw] OR covid19 pandemic[tw] OR covid-19
pandemic[tw])
"COVID-19" [Supplementary Concept]
"severe acute respiratory syndrome coronavirus 2" [Supplementary Concept]
#7 OR #12 OR #9 OR #10
#6 OR #11
"Health Services Accessibility"[Mesh]
(acces* healthcare[tw] OR acces* heath care[tw] OR acces* health service*[tw] OR
avail* healthcare[tw] OR avail* health care[tw] OR avail* health service*[tw])
"socioeconomic factors"[MeSH]
(socioeconomic factors[tw] OR socioeconomic[tw] OR health services
accessibility[tw])
(education* achieve*[tw] OR education* status[tw])
"Insurance, Health"[MeSH:NoExp]
"Unemployment"[MeSH]
"Social Isolation"[Mesh]
"Social Determinants of Health"[MeSH]
"Social Environment"[Mesh:NoExp]
"Social Marginalization"[Mesh]
(health insurance[tw] OR "standard of living"[tw] OR social determinant*[tw] OR
unemployment[tw] OR social isolation[tw] OR psychosocial deprivation[tw] OR social
environment[tw] OR social exclusion[tw] OR social marginalization[tw] OR social
marginalisation[tw])
(social determinant of health[tw] OR social determinants of health[tw] OR SDOH[tw]
OR SDH[tw] OR social deprivation[tw] OR social disadvantage[tw] OR financial
difficult*[tw] OR financial problem[tw] OR financial problems[tw] OR income
differences[tw] OR indigent[tw] OR insurance status[tw] OR jobless[tw] OR job
insecurit*[tw] OR low income[tw] OR marginali*[tw] OR occupation* status[tw])

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26	(poverty[tw] OR SES[tw] OR social disparit*[tw] OR social factor[tw] OR social
	factors[tw] OR social gradient[tw] OR social gradients[tw] OR social position[tw] OR
	social positions[tw] OR social variation[tw] OR social variations[tw] OR socioeconomic
	status[tw] OR socioeconomic circumstance*[tw] OR socioeconomic gradient[tw])
27	(socioeconomic health differences[tw] OR socioeconomic position[tw] OR
	socioeconomic variable[tw] OR underprivilege*[tw] OR unemployed[tw] OR
	uninsur*[tw] OR vulnerable population[tw] OR vulnerable populations[tw] OR
	vulnerable group[tw] OR vulnerable groups[tw] OR vulnerable communit*[tw] OR
	vulnerable people[tw] OR vulnerable person[tw] OR vulnerable persons[tw])
28	(socio* predict*[tw] OR socio* prognos*[tw] OR socio* risk*[tw] OR
	social*predict*[tw] OR social* prognos*[tw] OR social* risk*[tw])
29	#13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR
	#24 OR #25 OR #26 OR #27 OR #28
30	#12 AND #29

Scopus

Scopus	
1	TITLE-ABS-KEY(coronavirus* OR "corona virus*" OR OC43 OR NL63 OR 22pE OR HKU1
	OR HCoV* OR ncov* OR covid* OR sars-cov* OR sarscov* OR Sars-coronavirus* OR
	"Severe Acute Respiratory Syndrome Coronavirus*" OR coronavirnae OR "coronavirus
	infection")
2	TITLE-ABS-KEY(SARS or SARS-CoV OR MERS OR MERS-CoV OR "Middle East respiratory
	syndrome" OR camel* OR dromedary* OR equine OR coronary OR coronal OR
	covidence* OR covidien OR influenza virus OR HIV or bovine OR calves OR TGEV OR
	feline OR porcine OR BCoV OR PEDV OR PDCoV OR FIPV OR FCoV OR SADS-CoV OR
	canine or CCov OR zoonotic OR avian influenza OR H1N1 OR H5N1 OR H5N6 OR IBV
	OR "murine corona*")
3	#1 NOT #2
4	TITLE-ABS-KEY((pneumonia OR covid* OR coronavirus* OR "corona virus*" OR ncov*
	OR 2019-ncov OR sars*) AND Wuhan)

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5	TITLE-ABS-KEY("coronavirus disease 2019" OR 2019-ncov OR 2019nCoV OR ncov2019
-	OR ncov19 OR ncov-19 OR HCoV-19 OR "2019-novel CoV" OR "severe acute
	respiratory syndrome coronavirus 2" OR sars2 OR "sars 2" OR sars-cov2 OR sars-cov-2
	OR sarscov2 OR sarscov-2 OR Sars-coronavirus2 OR Sars-coronavirus-2 OR SARS-CoV-
	19 OR "SARS-like coronavirus*" OR coronavirus-19 OR covid19 OR covid-19 OR "covid
	2019" OR ((novel OR new OR nouveau) W/2 (CoV OR nCoV OR covid OR coronavirus*
	OR "corona virus" OR Pandemi*2)) OR ((covid OR covid19 OR covid-19) AND
	pandemic*2) OR (coronavirus* AND pneumonia))
6	#3 OR #4 OR #5
7	TITLE-ABS-KEY((acces* OB avail*) W/2 (healthcare OB "health care" OB "health
,	service*"))
8	TITLE-ABS-KEV("socioeconomic factors" OB "health services accessibility")
0	TITLE ADS KEY ("aducation* achieve*" OD "aducation* status")
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10	TITLE-ABS-KEY("health insurance" (standard* W/1 living) OR "social determinant*" OR
	unemployment OR "social isolation" OR "psychosocial deprivation" OR "rural health"
	OR "social environment" OR "social exclusion" OR "social marginali?ation")
11	TITLE-ABS-KEY("social deprivation" OR "social disadvantage" OR "financial difficult*"
	OR "social determinant* of health" OR SDOH OR SDH OR "financial problem?" OR
	"income difference*" OR indigent* OR "insurance status" OR jobless OR "job
	insecurity*" OR "low income" OR marginali* OR "occupation* status")
12	TITLE-ABS-KEY(poverty OR SES OR "social disparit*" OR "social environment" OR
	"social exclusion" OR "social factor?" OR "social gradient?" OR "social position?" OR
	"social variation?" OR "socioeconomic status" OR "socioeconomic circumstances" OR
	"socioeconomic gradient")
13	TITLE-ABS-KEY("socioeconomic health differences" OR "socioeconomic position" OR
	"socioeconomic variable" OR underprivilege* OR unemployed OR unemployment OR
	uninsur* OR "vulnerable population" OR "vulnerable group?" OR "vulnerable
	communit*" OR "vulnerable people" OR "vulnerable person?")
14	TITLE-ABS-KEY((socio* OR social*) W/10 (predict* OR prognos* OR risk*))
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15	#7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14
16	#6 AND #15

WHO Database

1	(acces* healthcare OR acces* heath care OR acces* health service* OR avail*
	healthcare OR avail* health care OR avail* health service*)
2	("socioeconomic factors" OR "health services accessibility")
3	(education* achieve* OR education* status)
4	("health insurance" OR social determinant* OR unemployment OR "social isolation" OR
	"psychosocial deprivation" OR "social environment" OR "social exclusion" OR social
	marginali?ation)
5	("social deprivation" OR "social disadvantage" OR financial difficult* OR "social
	determinants of health" OR SDOH OR SDH OR "financial problem" OR "financial
	problems" OR "income difference" OR "income differences" OR indigent* OR
	"insurance status" OR jobless OR "job insecurity" OR "low income" OR marginali* OR
	occupation* status)
6	(poverty OR SES OR social disparit* OR "social environment" OR "social exclusion" OR
	"social factor" OR "social factors" OR "social gradient" OR "social position" OR "social
	positions" OR "social variation" OR "social variations" OR "socioeconomic status" OR
	"socioeconomic circumstances" OR "socioeconomic gradient")
7	("socioeconomic health differences" OR "socioeconomic position" OR "socioeconomic
	variable" OR underprivilege* OR unemployed OR unemployment OR uninsur* OR
	"vulnerable population" OR "vulnerable group" OR "vulnerable groups" OR "vulnerable
	community" OR "vulnerable communities" OR "vulnerable people" OR "vulnerable
	person")
8	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7

Section and topic	Item No	Checklist item
ADMINISTRATIVE INFORMA	ATION	
Title:		
Identification	1a	Identify the report as a protocol of a systematic review (page 1)
Update	1b	If the protocol is for an update of a previous systematic review, identify as such (N/A)
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number (page 3)
Authors:		
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author (page 1)
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review (page 12/13)
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments (N/A)
Support:		
Sources	5a	Indicate sources of financial or other support for the review (page 13)
Sponsor	5b	Provide name for the review funder and/or sponsor (page 13)
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol (N/A)
INTRODUCTION		
Rationale	6	Describe the rationale for the review in the context of what is already known (page 4/5/6)
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO) (page 6)
METHODS		
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review (page 8/9)
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage (page 10)
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated (page 10, Supplement 1)
Study records:		
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review (page 10/11)

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Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis) (page 10)
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators (page 10)
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications (page 11)
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale (page 11)
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis (page 11)
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised (page 11/12)
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I ² , Kendall's τ) (N/A)
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression) (N/A)
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned (page 11/12)
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies (at page 8)
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE) (page 6/7)

* It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the

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From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

BMJ Open

The impact and variability of social determinants of health on the transmission and outcomes of COVID-19 across the world: a systematic review protocol

Journal:	BMJ Open
Manuscript ID	bmjopen-2021-053481.R1
Article Type:	Protocol
Date Submitted by the Author:	05-Nov-2021
Complete List of Authors:	Abedin, Minhazul; Centre for Injury Prevention and Research Bangladesh, Public Health Sciences Wahab, Abrar; Centre for Injury Prevention and Research Bangladesh, Public Health Sciences Rahman, Farah Naz; Centre for Injury Prevention and Research Bangladesh, Public Health Sciences Omi, Fardina ; Bangladesh University of Health Sciences, Noncommunicable Diseases Shareen, Saadia ; Independent University, Department of Life Sciences, School of Environment and Life Sciences Rakhshanda, Shagoofa; Centre for Injury Prevention and Research Bangladesh, Public Health Sciences Islam, Labida; Centre for Injury Prevention and Research Bangladesh, Public Health Sciences Mayaboti, Cinderella ; Centre for Injury Prevention and Research Bangladesh, Public Health Sciences Saha, Uttam ; Centre for Injury Prevention and Research Bangladesh, Public Health Sciences Faruque, Fazlay; The University of Mississippi Medical Center, Department of Preventive Medicine, School of Population Health Fletcher, Lauren; The University of Mississippi Medical Center, Rowland Medical Library Mashreky, Saidur; Centre for Injury Prevention and Research Bangladesh, Public Health Sciences; Bangladesh University of Health Sciences, Noncommunicable Diseases
Primary Subject Heading :	Public health
Secondary Subject Heading:	Epidemiology, Infectious diseases, Sociology
Keywords:	Epidemiology < TROPICAL MEDICINE, Public health < INFECTIOUS DISEASES, PUBLIC HEALTH

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Review only

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5	2	of COVID-19 across the world: a systematic review protocol
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10 11	5	Minhazul Abedin ^a , Abrar Wahab ^a , Farah Naz Rahman ^a , Fardina Rahman Omi ^b , Saadia Shareen ^c ,
12 13	6	Shagoofa Rakhshanda ^a , Labida Islam ^a , Cinderella Akbar Mayaboti ^a , Uttam Kumar Saha ^a , Fazlay
14 15 16 17	7	Faruque ^d , Lauren M. Fletcher ^e , Saidur Mashreky ^{ab}
	8	
17 18 19 20	9 10	^a Department of Public Health Sciences, Centre for Injury Prevention and Research, Bangladesh, B-162, Road-23 New DOHS, Mohakhali, Dhaka-1206, Bangladesh
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40	11 12	^b Bangladesh University of Health Sciences, 125/1 Darus Salam Rd, Dhaka 1216, Bangladesh
	13	
	14 15	^c Department of Life Sciences, School of Environment and Life Sciences, Independent University, Bashundhara R/A, Dhaka-1229, Bangladesh
	16	
	17 18	^d Department of Preventive Medicine, School of Population Health, University of Mississippi Medical Center, 2500 North State Street, Jackson, MS, 39216, USA
	19 20 21 22	^e Rowland Medical Library, University of Mississippi Medical Center, 2500 North State Street, Jackson, MS, 39216, USA
	23	
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	25	*Correspondence to
41 42	26	Minhazul Abedin
42	27	Department of Public Health Sciences, Centre for Injury Prevention and Research, Bangladesh
44 45	28	Address: B-162, Road-23 New DOHS, Mohakhali, Dhaka-1206, Bangladesh
46 47	29	Email: abedin@ciprb.org
48 49	30	Phone: +8801756503780
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59 60		For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

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2 3 4	35	STRENGTHS AND LIMITATIONS OF THIS STUDY:
5	36	• This review will address the impact of a wide range of social determinants of health
6 7	37	(SODH) and the geographical variations that affect the transmission and outcomes of
8 9	38	COVID-19.
10 11	39	• A multidisciplinary team is involved in this review and the search strategy was undertaken
12 13	40	with the involvement of a library information scientist.
14 15	41	• A standard scientific reporting format will be used to summarize the review findings to
16 17	42	avoid the shortcoming and biases of narrative synthesis.
18 19	43	• The influx of journal articles that were published over the last year in response to the
20	44	current pandemic, without a scientific track record of previous studies, will bereviewed
21	45	in this manuscript
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58	46	

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Page 5 of 27

1		3
2 3 4 5	47	ABSTRACT
	48	Introduction:
6 7	49	The COVID-19 pandemic has exacerbated health inequalities across the globe, disproportionately
8 9	50	affecting those with poor social determinants of health (SDOH). It is imperative to understand
10 11	51	how SDOH influences the transmission and outcomes (positive case, hospitalization, and
12 13	52	mortality) of COVID-19. This systematic review will investigate the impact of a wide range of
14 15	53	SDOH across the globe on the transmission and outcomes of COVID-19.
16 17	54	Methods and analysis:
17	55	This review will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses
19 20	56	Protocol (PRISMA) guidelines. We searched articles published from January 1, 2019, to December
21 22	57	31, 2021, in three electronic bibliographic databases (MEDLINE via PubMed, Embase, and
23 24	58	Scopus), as well as the WHO COVID-19 Global Research on coronavirus disease database. We will
25 26	59	consider observational studies that report statistical relationships between the social
27 28	60	determinants of health (as listed in PROGRESS-Plus and Healthy People 2020) and COVID-19
29	61	transmission and outcomes. There will be no limitation on the geographical location of
30 31	62	publications. The quality of included observational studies will be assessed using a modified
32 33	63	version of the Newcastle Ottawa Scale (NOS). A narrative Synthesis without Meta-Analysis
34 35	64	(SWiM) reporting standards will be used to report the review findings.
36 37	65	Ethics and dissemination:
38 39	66	This review will be based on published studies obtained from publicly available sources, and
40 41	67	therefore, ethical approval is not required. We will publish the results of this review in a peer-
42	68	reviewed journal, as well as present the study findings at a national conference.
43 44	69	
45 46	70	PROSPERO registration number: CRD42021228818
47 48	71	Keywords:
49 50	72	Social determinants of health, COVID-19, transmission, outcomes, geographical variations
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76 INTRODUCTION

In December 2019, a pneumonia case associated with SARS-CoV-2 was first identified in Wuhan,
Hubei province, China. As of 24 April 2021, this emerging infection has caused 154,640,649
infections and 3,232,285 deaths globally.[1] The current experience of the COVID-19 pandemic

has taken the world by surprise, despite the modern advances in health sciences. Outcomes of the disease include not only an increased death toll but have put a spotlight on health inequalities.[2] According to the World Health Organization (WHO), social determinants of health (SDOH) are the non-medical factors that influence the health outcome of humans. They broadly define it by the conditions in which people are born, grow, work, live, and age and the wider set of forces and systems shaping the conditions of daily life.[3] All these conditions have a major impact on the health, wellbeing, and quality of life of an individual.[4] The transmission of any communicable disease is highly dependent on these SDOH. The vast dynamics of disease transmission may result in symptomatic or asymptomatic disease outcomes, which may lead to hospitalization and/or death. Generally, people residing in socioeconomically underdeveloped areas are at least three times more likely to die of preventable diseases compared to those in developed areas. [5] The socioeconomically disadvantaged population also has limited access to healthcare services. Studies show that even those who live above the poverty line are more prone to be affected by chronic health conditions.[6]

This pandemic has made it clear that social determinants of health differentially affect disease transmission and outcomes globally.[2] Reports and studies generated from countries with high infection rates suggest that geographic variations were signifying higher transmission rates, hospitalizations, and mortality in marginalized, densely populated, low-income, and crowded households.[7–12]. Populations living in crowded neighborhoods are at a higher risk of becoming ill and transmitting the virus at an increased rate, as social distancing may not be feasible.[13– 102 15]

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Access to health care services is described by the National Academies of Sciences, Engineering, and Medicine as the "timely use of personal health services to achieve the best possible health outcomes".[16] Access to healthcare is an influential SDOH that has gained attention during this COVID-19 pandemic.[17, 18] Accessibility to health care services may include geographic accessibility (within physical reach), economic accessibility (within financial reach), and cultural accessibility (acceptance and communication).[19–21] Health insurance is an important aspect of accessibility which is evident from several studies and reports. It has been demonstrated that there is unequal coverage of health insurance and access to services, leading to poorer health outcomes in marginalized groups. [22, 23] In a study by Gallup and West Health, it was found that 14% of adults in the U.S. do not seek healthcare when experiencing fever and dry cough due to the high cost of healthcare.[24] Given the fact that fever and dry cough are the most common symptoms of COVID-19, there is a high chance that many COVID-19 cases may go unnoticed or undiagnosed, which may result in unknowingly transmitting the disease.[25] Primary care visits may not be feasible, or people may hesitate to use health care resources without health insurance. This inability puts those without health insurance at risk of not being screened for chronic conditions, such as CVD (cardiovascular disease), hypertension, asthma, and diabetes. Therefore during this health emergency, access to health care may play a major role in whether an individual will test for COVID-19 and follow recommendations, such as social distancing and other preventive measures.[26]

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In terms of racial disparities, the United States has experienced disproportionate outcomes of infection, hospitalization, and mortality among historically marginalized groups, such as African American, Hispanic and Asian populations. [27, 28] studies show that mortality due to COVID-19 is associated with socioeconomic class.[29–31] Black, Asian, and minority ethnic (BAME) backgrounds represented one-third of the ICU admission in UK hospitals, while Somali immigrants living in Norway had a ten times higher rate of infection compared to the non-immigrants.[32, 33] Those who are minorities may not be aware of their underlying conditions due to barriers in accessing primary care and might be at high risk of developing more severe symptoms during this pandemic situation.[34, 35]

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4 5	133	
5 6	134	It is imperative to focus on SDOH during the COVID-19 pandemic to better understand
7 8	135	preventable health inequalities and to improve health outcomes. As such, there is an immediate
9	136	need to comprehend the social determinants of COVID-19 transmission and outcomes to
11	137	decrease human suffering and save lives.[36] In addition to known clinical risk factors, knowledge
12 13	138	of social risk factors will help policymakers and healthcare decision-makers to prioritize groups
14 15	139	who are most at-risk during the COVID-19 pandemic and formulate health messages accordingly.
16	140	
18	141	Objectives
19 20	142	1. To find the impact of social determinants of health (SDOH) on the transmission and outcomes
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59	143	of COVID-19.
	144	2. To explore the geographic variations of SDOH on transmission and outcomes of COVID-19.
	145	
	146	METHODS
	147	This protocol is registered with the International Prospective Register of Systematic Reviews
	148	(PROSPERO) under the registration number CRD42021228818 and follows the Preferred
	149	Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines,[37] as shown in
	150	Figure 1. The planned start dates of this review is 24 September 2020 and the anticipated end
	151	date will be 30 April 2022.
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60		For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

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4 5	154	Figure 1: PRISMA 2009 Flow Diagram
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/ 8	158	A summary of eligibility criteria is shown in Table 1 .
9 10	159	
11 12	160	Types of studies:
12	161	The types of studies that will be considered in this systematic review will include empirical
14 15	162	quantitative studies following prospective and retrospective cohort, case-control, cross-
16 17	163	sectional, pre-post designs, and modeling studies that report statistical relationships between
18	164	exposures of interest (i.e., social determinants of health) and COVID-19 transmission and
19 20 21 22 23 24 25 26 27 28 29 30 31 32 33	165	outcomes. The review will address the potential interaction effect or intersectional approach only
	166	if the analysis reports such findings, which is generally found in predictive modeling. Any
	167	hypothetical interaction or intersectional findings will be excluded from this review. This review
	168	will include studies with both self-reported and directly tested measures. We will only include
	169	studies published in the English language. Qualitative studies, reviews, narrative reviews,
	170	systematic reviews, meta-analyses, pharmacological and biochemical studies, animal model
	171	studies, conference abstracts, conference proceedings, and theses/dissertations will not be
	172	included in this systematic review. Simulation modeling, which does not report new empirical
34 35	173	data, opinion literature, including commentaries, editorials, and analyses that discuss COVID-19
36 37	174	regarding equity, social determinants, and/or vulnerable populations, will also be excluded from
38	175	the review.
39 40	176	
41 42	177	Types of study population:
43 44	178	Studies in this review will include populations of all ages, ethnicity, gender, and geographic
45 46	179	location. We will consider any population that has been tested for COVID-19.
47 48	180	
49	181	Types of outcome measures:
50 51	182	Studies will be included if they use a measure for SDOH that could be hypothesized to affect the
52 53	183	transmission and outcomes (confirmed positive case, hospitalization, and mortality) of COVID-
53 54 55 56 57 58	184	19. We will use Healthy People 2020 and PROGRESS-Plus to classify our definition of social

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determinants of health.[38, 39] Healthy People 2020 addresses five SDOH; economic stability, education, social and community context, health and health care, neighborhood, and built environment. PROGRESS-Plus refers to the place of residence, race/ethnicity/culture/language, occupation, gender, religion, education, socioeconomic status, and social capital. Plus refers to personal characteristics associated with discrimination (e.g., age, disability), features of relationships (e.g., smoking parents, excluded from school), and time-dependent relationships (e.g., leaving the hospital, respite care, other instances where a person may be temporarily at a disadvantage).

Table 1: Inclusion and exclusion criteria for the review

3 4 5 6 7 8		 Studies that include a population that required hospitalization or resulted in mortality due to COVID-19 Articles with missing descriptions of findings and/or results 				
9 10	194					
10 11 12	195	Search strategy				
13 14	196	We have developed a comprehensive literature search to locate both published and non-				
14 15	197	traditionally literature. We will search for articles published from January 1, 2019, to December				
16 17	198	31, 2021, in three electronic bibliographic databases (PubMed, Embase, and Scopus), as well as				
18 19 20 21 22	199	the WHO Global Research on Coronavirus Disease database, to ensure results focused on the				
	200	novel COVID-19 pandemic and retrieve pre-print articles and non-traditionally published				
22 23	201	literature. Our COVID_19 search strategy was developed using the published Ovid Embase				
24 25	202	COVID-19 search strategy translated for use in the searched databases.[40] The full, detailed				
25 26 27 28 29 30 31 32	203	search strategy is available in Supplement 1. Following the search, all identified citations will be				
	204	imported into EndNote X9 (Clarivate Analytics, PA, USA), and duplicates removed. Deduplicated				
	205	results will be exported to an Excel spreadsheet for screening. The reference lists of all included				
	206	studies will then be reviewed for eligible studies.				
33 34	207					
34 35 36 37 38 39	208	Study records				
	209	Selection process:				
	210	Based on the title and abstract (where available), ten (10) researchers will initially review and				
40 41	211	assess potential articles for eligibility that meet inclusion criteria, while maintaining a low				
42 43	212	threshold for consideration for further review. The same researchers will screen the full text of				
44 45	213	the potential articles for inclusion. We will resolve disagreement or uncertainty regarding the				
46	214	eligibility of particular studies through discussion by two independent researchers.				
47	215					
49 50	216	Data management and collection:				
51 52	217	Ten (10) researchers will work on data extraction using a piloted data extraction tool, and the				
53 54	218	extracted data will be reviewed by a supervisor for errors.				
55 56 57 58 59	219	Data to be collected:				
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2 3	220	a. Study details (title, year of publication, author, abstract, study design, country, region)
4 5	221	b. Study population characteristics (age. sex)
6 7	222	c. Sampling strategy and sample size
8 0	223	d. SODH including participant demographics (place of residence, occupation,
10	224	race/ethnicity/culture/language_education_religion_social_capital_socioeconomic_status
12	225	economic stability, education, social and community contexts, health and health care access.
13 14	226	neighborhood and built environment).[38, 39]
15 16	227	e. Outcome severity of COVID-19
17 18	228	
19 20	229	OUTCOMES
21	230	This systematic review will focus on SDOH that impacts the transmission and outcomes of COVID-
22 23 24 25 26 27 28 29 30 31 32 33	231	19. We will also look for the geographical variations of these outcomes from the selected articles
	232	for this review. The following outcomes will be examined:
	233	a. Positive COVID-19 cases
	234	b. Hospitalization due to COVID-19 that includes regular bed patients admission, High
	235	Dependency Unit (HDU) patient admission, Intensive Care Unit (ICU) patient admission
	236	c. Mortality due to COVID-19
34 25	237	
35 36	238	RISK OF BIAS
37 38	239	To assess the quality of included observational studies, we will use a modified version of the
39 40	240	Newcastle Ottawa Scale.[41] Two reviewers will independently assess each study, with
41 42	241	discrepancies resolved by agreement or a third independent assessor if such agreement cannot
43 44	242	be achieved.
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40	244	DATA SYNTHESIS & ANALYSIS
48 49	245	This review is broad and exploratory in nature, and therefore, a meta-analysis of the effect
50 51	246	estimate is not planned, but data will be evaluated for the possibility of conducting a meta-
52 53	247	analysis. To avoid the shortcomings in the reporting of narrative synthesis, we will follow the
54 55	248	Synthesis without Meta-Analysis (SWiM) reporting standards.[42] We will tabulate the results
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and narrate the summary of findings for each SDOH identified in this review. Additionally, we will prepare at least three tables consisting of the study characteristics, participant characteristics, and a summary of findings that describes study setting, size, methodology, primary outcomes, secondary outcomes, summary statistics, and/or statistical results (risk ratios, odds ratios, risk differences, mean differences, standardized mean differences, the ratio of means), and relationship to SDOH.

DISCUSSION

Our systematic review will focus on the role that social determinants of health play in the transmission and outcomes of COVID-19. We hope that the concluded review will provide evidence to determine the impact and variability of social determinants of health associated with SARS-CoV-2 infection and the dynamics of transmission and outcomes. This protocol will guide the review homogeneously and methodologically. Our systematic review will address a gap in the COVID-19 literature, by exploring not only the impact social determinants of health have on the transmission and outcomes of the disease but also by exploring the global geographical differences of SDOH and its impact on the COVID-19 pandemic. Through this review, we hope to provide an empirical understanding of the diverse social determinants of COVID-19, which could appraise the global pandemic response efforts as well as provide comprehensive evidence for future public health policy implications.

38 268

- 40 269 **PATIENT/PUBLIC INVOLVEMENT**
 - 270 There will be no patient or public involvement in this study.
- 44 271

272 ETHICS AND DISSEMINATION

As the data included in this review have been published or obtained from publicly available
sources, ethical approval is not required. We will submit the full systematic review manuscript to
a peer-reviewed journal and will present the study results at a national conference.

277 AUTHOR CONTRIBUTIONS

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1		13				
2						
3 4	278	All authors have contributed equally to the design and conceptualization of this review. MA, AW,				
5 6	279	FNR, FRO, SS, SR, CAM, and LI drafted the manuscript and protocol with UKS, FF, SRM, and LF as				
7	280	editors. LF developed the search strategy with input from UKS, FF, and SRM concerning keywords				
8 9	281	and databases. All review methods were planned and discussed with the authors, with LF acting				
10 11	282	as a methodological mentor.				
12 13 14 15	283					
	284	FUNDING				
15 16	285	All authors declare that they have not received any grant/fund for this research from any source.				
17 18	286					
19 20 21 22 23 24 25 26 27	287	COMPETING INTERESTS				
	288	Authors declare that they have no competing interests.				
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	290	PATIENT CONSENT FOR PUBLICATION				
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Figure 1: PRISMA 2009 Flow Diagram

Figure 1: PRISMA 2009 Flow Diagram

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SUPPLEMENT 1:

Embase

13	'health care access'/de
14	((acces* OR avail*) NEXT/2 (healthcare OR 'health care' OR 'health service*')):ti,ab,kw
15	'socioeconomics'/exp
16	('socioeconomic factors' OR 'health services accessibility'):ti,ab,kw,de
17	(education* achieve* OR education* status):ti,ab,kw,de
18	'health insurance'/de
19	'unemployment'/de
20	'social isolation'/exp
21	'social determinant of health'/de
22	'social environment'/de
23	'social exclusion'/de
24	('health insurance' (standard* NEXT/1 living) OR 'social determinant*' OR
	unemployment OR 'social isolation' OR 'psychosocial deprivation' OR 'social
	environment' OR 'social exclusion' OR 'social marginali*ation'):ti,ab,kw
25	('social determinant? of health' OR SDOH OR SDH OR 'social deprivation' OR 'social
	disadvantage' OR 'financial difficult*' OR 'financial problem?' OR 'income difference*'
	OR indigent* OR 'insurance status' OR jobless OR 'job insecurity*' OR 'low income' OR
	marginali* OR 'occupation* status'):ti,ab,kw
26	(Poverty OR SES OR 'social disparit*' OR 'social environment' OR 'social exclusion' OR
	'social factor?' OR 'social gradient?' OR 'social position?' OR 'social variation?' OR
	'socioeconomic status' OR 'socioeconomic circumstances' OR 'socioeconomic
	gradient'):ti,ab,kw
27	('socioeconomic health differences' OR 'socioeconomic position' OR 'socioeconomic
	variable' OR underprivilege* OR unemployed OR unemployment OR uninsur* OR
	'vulnerable population' OR 'vulnerable group?' OR 'vulnerable communit*' OR
	'vulnerable people' OR 'vulnerable person?'):ti,ab,kw
28	((socio* OR social*) NEXT/10 (predict* OR prognos* OR risk*)):ti,ab,kw

29	#13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR
	#24 OR #25 OR #26 OR #27 OR #28
30	#12 AND #29

PubMed

1	"Coronavirus"[Mesh]			
2	"Coronavirus Infections"[Mesh]			
3	(coronavirus*[tw] OR corona virus*[tw] OR OC43[tw] OR NL63[tw] OR 22pE[tw] OR			
	HKU1[tw] OR HCoV*[tw] OR ncov*[tw] OR covid*[tw] OR sars-cov*[tw] OR			
	sarscov*[tw] OR Sars-coronavirus*[tw] OR Severe Acute Respiratory Syndrome			
	Coronavirus*[tw])			
4	#1 OR #2 OR #3			
5	(MERS[tw] OR MERS-CoV[tw] OR Middle East respiratory syndrome[tw] OR			
	camel*[tw] OR dromedary*[tw] OR equine[tw] OR coronary[tw] OR coronal[tw] OR			
	covidence*[tw] OR covidien[tw] OR influenza virus[tw] OR HIV[tw] OR bovine[tw] OR			
	calves[tw] OR TGEV[tw] OR feline[tw] OR porcine[tw] OR BCoV[tw] OR PEDV[tw] OR			
	PDCoV[tw] OR FIPV[tw] OR FCoV[tw] OR SADS-CoV[tw] OR canine[tw] or CCov[tw] OR			
	zoonotic[tw] OR avian influenza[tw] OR H1N1[tw] OR H5N1[tw] OR H5N6[tw] OR			
	IBV[tw] OR murine corona*[tw])			
6	#4 NOT #5			
7	(((pneumonia[tw] OR covid*[tw] OR coronavirus*[tw] OR corona virus*[tw] OR			
	ncov*[tw] OR 2019ncov[tw] OR sars*[tw]) OR "Pneumonia"[Mesh]) AND Wuhan[tw])			
8	(coronavirus disease 2019[tw] OR 2019-ncov[tw] OR 2019nCoV[tw] OR			
	ncov2019[tw] OR ncov19[tw] OR ncov-19[tw] OR HCoV-19[tw] OR 2019-novel			
	CoV[tw] OR severe acute respiratory syndrome coronavirus 2[tw] OR sars2[tw] OR			
	sars 2[tw] OR sars-cov2[tw] OR sars-cov-2[tw] OR sarscov2[tw] OR sarscov-2[tw]			
	OR Sars-coronavirus2[tw] OR Sars-coronavirus-2[tw] OR SARS-CoV-19[tw] OR SARS-			
	like coronavirus*[tw] OR coronavirus-19[tw] OR covid19[tw] OR covid-19[tw] OR			
	covid 2019[tw] OR ((novel[tw] OR new[tw] OR nouveau[tw]) AND (CoV OR nCoV OR			

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	covid OR coronavirus*) OR ("corona virus" OR Pandemi*) OR coronavirus	
	pandemic[tw] OR covid pandemic [tw] OR covid19 pandemic[tw] OR covid-19	
	pandemic[tw])	
9	"COVID-19" [Supplementary Concept]	
10	"severe acute respiratory syndrome coronavirus 2" [Supplementary Concept]	
11	#7 OR #12 OR #9 OR #10	
12	#6 OR #11	
13	"Health Services Accessibility"[Mesh]	
14	(acces* healthcare[tw] OR acces* heath care[tw] OR acces* health service*[tw] OR	
	avail* healthcare[tw] OR avail* health care[tw] OR avail* health service*[tw])	
15	"socioeconomic factors"[MeSH]	
16	(socioeconomic factors[tw] OR socioeconomic[tw] OR health services	
	accessibility[tw])	
17	(education* achieve*[tw] OR education* status[tw])	
18	"Insurance, Health"[MeSH:NoExp]	
19	"Unemployment"[MeSH]	
20	"Social Isolation"[Mesh]	
21	"Social Determinants of Health"[MeSH]	
22	"Social Environment"[Mesh:NoExp]	
23	"Social Marginalization"[Mesh]	
24	(health insurance[tw] OR "standard of living"[tw] OR social determinant*[tw] OR	
	unemployment[tw] OR social isolation[tw] OR psychosocial deprivation[tw] OR social	
	environment[tw] OR social exclusion[tw] OR social marginalization[tw] OR social	
	marginalisation[tw])	
25	(social determinant of health[tw] OR social determinants of health[tw] OR SDOH[tw]	
	OR SDH[tw] OR social deprivation[tw] OR social disadvantage[tw] OR financial	
	difficult*[tw] OR financial problem[tw] OR financial problems[tw] OR income	
	differences[tw] OR indigent[tw] OR insurance status[tw] OR jobless[tw] OR job	
	insecurit*[tw] OR low income[tw] OR marginali*[tw] OR occupation* status[tw])	

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26	(poverty[tw] OR SES[tw] OR social disparit*[tw] OR social factor[tw] OR social
	factors[tw] OR social gradient[tw] OR social gradients[tw] OR social position[tw] OR
	social positions[tw] OR social variation[tw] OR social variations[tw] OR socioeconomic
	status[tw] OR socioeconomic circumstance*[tw] OR socioeconomic gradient[tw])
27	(socioeconomic health differences[tw] OR socioeconomic position[tw] OR
	socioeconomic variable[tw] OR underprivilege*[tw] OR unemployed[tw] OR
	uninsur*[tw] OR vulnerable population[tw] OR vulnerable populations[tw] OR
	vulnerable group[tw] OR vulnerable groups[tw] OR vulnerable communit*[tw] OR
	vulnerable people[tw] OR vulnerable person[tw] OR vulnerable persons[tw])
28	(socio* predict*[tw] OR socio* prognos*[tw] OR socio* risk*[tw] OR
	social*predict*[tw] OR social* prognos*[tw] OR social* risk*[tw])
29	#13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR
	#24 OR #25 OR #26 OR #27 OR #28
30	#12 AND #29

Scopus

Scopus				
1	TITLE-ABS-KEY(coronavirus* OR "corona virus*" OR OC43 OR NL63 OR 22pE OR HKU1			
	OR HCoV* OR ncov* OR covid* OR sars-cov* OR sarscov* OR Sars-coronavirus* OR			
	"Severe Acute Respiratory Syndrome Coronavirus*" OR coronavirnae OR "coronavirus			
	infection")			
2	TITLE-ABS-KEY(SARS or SARS-CoV OR MERS OR MERS-CoV OR "Middle East respiratory			
syndrome" OR camel* OR dromedary* OR equine OR coronary OR coronal (
	covidence* OR covidien OR influenza virus OR HIV or bovine OR calves OR TGEV OR			
	feline OR porcine OR BCoV OR PEDV OR PDCoV OR FIPV OR FCoV OR SADS-CoV OR			
	canine or CCov OR zoonotic OR avian influenza OR H1N1 OR H5N1 OR H5N6 OR IBV			
	OR "murine corona*")			
3	#1 NOT #2			
4	TITLE-ABS-KEY((pneumonia OR covid* OR coronavirus* OR "corona virus*" OR ncov*			
	OR 2019-ncov OR sars*) AND Wuhan)			

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5	TITLE-ABS-KEY("coronavirus disease 2019" OR 2019-ncov OR 2019nCoV OR ncov2019	
	OR ncov19 OR ncov-19 OR HCoV-19 OR "2019-novel CoV" OR "severe acute	
	respiratory syndrome coronavirus 2" OR sars2 OR "sars 2" OR sars-cov2 OR sars-cov-2	
	OR sarscov2 OR sarscov-2 OR Sars-coronavirus2 OR Sars-coronavirus-2 OR SARS-CoV-	
	19 OR "SARS-like coronavirus*" OR coronavirus-19 OR covid19 OR covid-19 OR "covid	
	2019" OR ((novel OR new OR nouveau) W/2 (CoV OR nCoV OR covid OR coronavirus*	
	OR "corona virus" OR Pandemi*2)) OR ((covid OR covid19 OR covid-19) AND	
	pandemic*2) OR (coronavirus* AND pneumonia))	
6	#3 OR #4 OR #5	
7	TITLE-ABS-KEY((acces* OR avail*) W/2 (healthcare OR "health care" OR "health	
	service*"))	
8	TITLE-ABS-KEY("socioeconomic factors" OR "health services accessibility")	
9	TITLE-ABS-KEY ("education* achieve*" OR "education* status")	
10	TITLE-ABS-KEY("health insurance" (standard* W/1 living) OR "social determinant*" OR	
	unemployment OR "social isolation" OR "psychosocial deprivation" OR "rural health"	
	OR "social environment" OR "social exclusion" OR "social marginali?ation")	
11	TITLE-ABS-KEY("social deprivation" OR "social disadvantage" OR "financial difficult*"	
	OR "social determinant* of health" OR SDOH OR SDH OR "financial problem?" OR	
	"income difference*" OR indigent* OR "insurance status" OR jobless OR "job	
	insecurity*" OR "low income" OR marginali* OR "occupation* status")	
12	TITLE-ABS-KEY(poverty OR SES OR "social disparit*" OR "social environment" OR	
	"social exclusion" OR "social factor?" OR "social gradient?" OR "social position?" OR	
	"social variation?" OR "socioeconomic status" OR "socioeconomic circumstances" OR	
	"socioeconomic gradient")	
13	TITLE-ABS-KEY("socioeconomic health differences" OR "socioeconomic position" OR	
	"socioeconomic variable" OR underprivilege* OR unemployed OR unemployment OR	
	uninsur* OR "vulnerable population" OR "vulnerable group?" OR "vulnerable	
	communit*" OR "vulnerable people" OR "vulnerable person?")	
14	TITLE-ABS-KEY((socio* OR social*) W/10 (predict* OR prognos* OR risk*))	
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 #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14

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 #6 AND #15

WHO Database

1	(acces* healthcare OR acces* heath care OR acces* health service* OR avail*			
	healthcare OR avail* health care OR avail* health service*)			
2	("socioeconomic factors" OR "health services accessibility")			
3	(education* achieve* OR education* status)			
4	("health insurance" OR social determinant* OR unemployment OR "social isolation" OI			
	"psychosocial deprivation" OR "social environment" OR "social exclusion" OR social			
	marginali?ation)			
5	("social deprivation" OR "social disadvantage" OR financial difficult* OR "social			
	determinants of health" OR SDOH OR SDH OR "financial problem" OR "financial			
	problems" OR "income difference" OR "income differences" OR indigent* OR			
	"insurance status" OR jobless OR "job insecurity" OR "low income" OR marginali* OR			
	occupation* status)			
6	(poverty OR SES OR social disparit* OR "social environment" OR "social exclusion" OR			
	"social factor" OR "social factors" OR "social gradient" OR "social position" OR "social			
	positions" OR "social variation" OR "social variations" OR "socioeconomic status" OR			
	"socioeconomic circumstances" OR "socioeconomic gradient")			
7	("socioeconomic health differences" OR "socioeconomic position" OR "socioeconomic			
	variable" OR underprivilege* OR unemployed OR unemployment OR uninsur* OR			
	"vulnerable population" OR "vulnerable group" OR "vulnerable groups" OR "vulnerable			
	community" OR "vulnerable communities" OR "vulnerable people" OR "vulnerable			
	person")			
8	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7			

Checklist item Section and topic Item No ADMINISTRATIVE INFORMATION Title[.] Identify the report as a protocol of a systematic review (page 1) Identification 1a If the protocol is for an update of a previous systematic review, identify as such (N/A) Update 1b 2 If registered, provide the name of the registry (such as PROSPERO) and registration number (page 3) Registration Authors: Contact 3a Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author (page 1) Describe contributions of protocol authors and identify the guarantor of the review (page 12/13) Contributions 3b If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; 4 Amendments otherwise, state plan for documenting important protocol amendments (N/A) Support: Indicate sources of financial or other support for the review (page 13) Sources 5a Provide name for the review funder and/or sponsor (page 13) 5b Sponsor 5c Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol (N/A) Role of sponsor or funder **INTRODUCTION** Describe the rationale for the review in the context of what is already known (page 4/5/6) Rationale 6 Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, 7 Objectives comparators, and outcomes (PICO) (page 6) **METHODS** Eligibility criteria Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years 8 considered, language, publication status) to be used as criteria for eligibility for the review (page 8/9) Information sources 9 Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage (page 10) Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be Search strategy 10 repeated (page 10, Supplement 1) Study records: Data management 11a Describe the mechanism(s) that will be used to manage records and data throughout the review (page 10/11)

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

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Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis) (page 10)
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators (page 10)
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications (page 11)
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale (page 11)
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis (page 11)
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised (page 11/12)
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I ² , Kendall's τ) (N/A)
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression) (N/A)
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned (page 11/12)
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies) (at page 8)
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE) (page 6/7)

* It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the

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From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.