PRISMA 2009 Checklist

Supplementary file 1, Table 1. PRISMA Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Page 4 & 5
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Page 6 & 7
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Page 7
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Page 8
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 8 & 9
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Page 10
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Supp 1 Table 3

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Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Page 10
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 10
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Page 10 Supp 1 Table 4 & 5

Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Page 11
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	Page 11
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Page 11

Section/topic	**#**	**Checklist item**	**Reported on page #**
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Page 11
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	Page 11
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Page 12

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Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Page 15
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Page 14
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Page 15 - 30
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Pages 15-30
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Page 14
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	Pages 15-19
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Page 31
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Page 3637
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Page 38
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Page 3

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097.
doi:10.1371/journal.pmed1000097

For more information, visit: **www.prisma-statement.org**.

Supplementary file 1, Table 2: PROSPERO

Systematic review

1. * Review title.

Give the title of the review in English

Effectiveness of the non-pharmacological interventions on the transmission of COVID-19: a systematic review

2. Original language title.

For reviews in languages other than English, give the title in the original language. This will be displayed with the English language title. 3. * Anticipated or actual start date.

Give the date the systematic review started or is expected to start.

01/05/2020 4. * Anticipated completion

date.

Give the date by which the review is expected to be completed.

31/10/2020 5. * Stage of review at time of this submission.

Tick the boxes to show which review tasks have been started and which have been completed. Update this field each time any amendments are made to a published record.

Reviews that have started data extraction (at the time of initial submission) are not eligible for inclusion in PROSPERO. If there is later evidence that incorrect status and/or completion date has been supplied, the published PROSPERO record will be marked as retracted.

This field uses answers to initial screening questions. It cannot be edited until after registration.

The review has not yet started: No

Review stage	**Started**	**Completed**
Preliminary searches	Yes	No
Piloting of the study selection process	No	No
Formal screening of search results against eligibility criteria	No	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No

No No

Data analysis
Provide any other relevant information about the stage of the review here.
We are in the process of updating our search and starting the data extraction.

We are in the process of updating our search and starting the data extraction. 6.

* Named contact.

The named contact is the guarantor for the accuracy of the information in the register record. This may be any member of the review team.

Dr Stella Talic Email salutation (e.g. "Dr Smith" or "Joanne") for correspondence:

Dr Stella Talic

7. * Named contact email.

Give the electronic email address of the named contact.

stella.talic@monash.edu

8. Named contact address

Give the full institutional/organisational postal address for the named contact.

553 St Kilda Rd, 3004, Melbourne 9.

Named contact phone number.

Give the telephone number for the named contact, including international dialling code.

03 9903 0021 10. * Organisational affiliation of the

review.

Full title of the organisational affiliations for this review and website address if available. This field may be completed as 'None' if the review is not affiliated to any organisation.

Monash University

Organisation web address:

https://www.monash.edu/medicine/sphpm/home

11. * Review team members and their organisational affiliations.

Give the personal details and the organisational affiliations of each member of the review team. Affiliation refers to groups or organisations to which review team members belong. **NOTE: email and country now MUST be entered for each person, unless you are amending a published record.**

Dr Stella Talic. Monash University
Dr Danijela Gasevic. Monash University
Miss Shivangi Shah. Monash University
Professor Evropi Theodoratou. Usher Institute – University of Edinburgh
Assistant/Associate Professor Zanfina Ademi. Monash University
Professor Danny Liew. Monash University

Professor Dragan Ilic. Monash University

12. * Funding sources/sponsors.

Details of the individuals, organizations, groups, companies or other legal entities who have funded or sponsored the review. Not applicable

Grant number(s)

State the funder, grant or award number and the date of award

13. * Conflicts of interest.

List actual or perceived conflicts of interest (financial or academic).

None

14. Collaborators.

Give the name and affiliation of any individuals or organisations who are working on the review but who are not listed as review team members. **NOTE: email and country must be completed for each person, unless you are amending a published record.**

15. * Review question.

State the review question(s) clearly and precisely. It may be appropriate to break very broad questions down into a series of related more specific questions. Questions may be framed or refined using PI(E)COS or similar where relevant.

The overarching aim of this review is to evaluate evidence on the effectiveness of non-pharmacological interventions forSpecifically, this review aims to: preventing spread and transmission of COVID-19.

1. Systematically evaluate existing evidence on the efficacy of NPIs and transmission of COVID-19
2. Assess the overall body of evidence on the effectiveness of each of the NPIs
3. Determine the strength of evidence and course of recommendations for each intervention With the proposed aims, this review will address the following question:

How effective are the non-pharmacological interventions in reducing the transmission of COVID-19? 16.

* Searches.

State the sources that will be searched (e.g. Medline). Give the search dates, and any restrictions (e.g. language or publication date). Do NOT enter the full search strategy (it may be provided as a link or attachment below.)

• MEDLINEThe proposed review will search the following databases from 2019 to current date • EMBASE (Elsevier)

• CINAHL (Cumulative Index to Nursing and Allied Health Literature, EBSCO)

• Global Health

• Joanna Briggs

• Cochrane Library17. URL to search strategy.

Upload a file with your search strategy, or an example of a search strategy for a specific database, (including the keywords) in pdf or word format. In doing so you are consenting to the file being made publicly accessible. Or provide a URL or link to the strategy. Do NOT provide links to your search **results**.

https://www.crd.york.ac.uk/PROSPEROFILES/178692_STRATEGY_20200910.pdf

Alternatively, upload your search strategy to CRD in pdf format. Please note that by doing so you are consenting to the file being made publicly accessible.

Do not make this file publicly available until the review is complete 18.

* Condition or domain being studied.

Give a short description of the disease, condition or healthcare domain being studied in your systematic review.

An acute respiratory disease, called coronavirus disease (COVID?19) is a new, rapidly emerging zoonotic infectious disease. The first case was reported from Wuhan (Hubei province, China) on 31 December 2019 (1), and since then it spread further on Asian continent (2), and other continents such as Europe, North America, and Oceania, leading World Health Organization (WHO) to declare a global health emergency, and on 12 March 2020, a pandemic. 19. * Participants/population.

Specify the participants or populations being studied in the review. The preferred format includes details of both inclusion and exclusion criteria.

• Population affected by COVID-19 20.

* Intervention(s), exposure(s).

Give full and clear descriptions or definitions of the interventions or the exposures to be reviewed. The preferred format includes details of both inclusion and exclusion criteria. o hand hygiene• Personal protective measures: o face masks (including respirators, surgical or self-made masks)

• Environmental measures: o surface and object cleaning

• Social distancing measures: o contact tracing o isolation of sick individuals o quarantine of exposed and/or susceptible individuals o school closures o workplace closures o social distance of a particular distance (e.g. 1.5m) o universal lockdown

• Travel-related measures o restricted inter-state travel o entry and exit screening (virus screening vs symptom screening) o international travel restrictions o full border closure 21. * Comparator(s)/control.

Where relevant, give details of the alternatives against which the intervention/exposure will be compared (e.g. another intervention or a non-exposed control group). The preferred format includes details of both inclusion and exclusion criteria.

• Comparison of different NPIsN NPIs

• Comparison of combination of different NPIs22. * Types of study to be included.

Give details of the study designs (e.g. RCT) that are eligible for inclusion in the review. The preferred format includes both inclusion and exclusion criteria. If there are no restrictions on the types of study, this should be stated.

• Observational – Prospective and retrospective cohort studies, case-control studies Interventional – Randomised Controlled Trials (RCTs)

• Systematic reviews23. Context.

Give summary details of the setting or other relevant characteristics, which help define the inclusion or exclusion criteria.

Population studies will be included. Studies in hospital settings will be excluded. 24.

* Main outcome(s).

Give the pre-specified main (most important) outcomes of the review, including details of how the outcome is defined and measured and when these measurement are made, if these are part of the review inclusion criteria.

• Daily effective reproduction number (Rt)Inc dence rat of COVID-19

* Measures of effect

Please specify the effect measure(s) for you main outcome(s) e.g. relative risks, odds ratios, risk difference, and/or 'number needed to treat. Odds ratiosRelative Risks

Risk difference mean difference (MD) and their respective 95% CI 25. * Additional

outcome(s).

List the pre-specified additional outcomes of the review, with a similar level of detail to that required for main outcomes. Where there are no additional outcomes please state 'None' or 'Not applicable' as appropriate to the review

Case fatality rateTotal number of confirmed COVID-19 cases

* Measures of effect

Please specify the effect measure(s) for you additional outcome(s) e.g. relative risks, odds ratios, risk difference, and/or 'number needed to treat. Risk rates and risk difference 26. * Data extraction (selection and coding).

Describe how studies will be selected for inclusion. State what data will be extracted or obtained. State how this will be done and recorded. This review will include:

• Articles involving individuals with confirmed or suspected case of COVID?19

• Articles testing for effectiveness and/or comparing one or multiple NPIs

• Articles reporting on incidence, total number of cases, or daily reproductive number of COVID-19

• Articles including RCTs, prospective cohort studies and systematic reviews will be given the priority, yetother study designs will also be considered for inclusion.

• Articles involving humans only and published in English language

This review will exclude:

• Articles involving individuals exposed to other pathogens that can cause respiratory infections such as SARS or MERS.

• Articles that do not report on the effectiveness of the intervention

• Articles including case series, case studies or cross-sectional studies

• Opinions, viewpoints and letters to the editor

Selection of studies

Firstly, two authors (SS and DG) will independently screen the titles and abstracts and exclude any studies that do not match the inclusion criteria. Secondly, the same authors will retrieve full text articles and carry out the selection independently using the specific inclusion criteria. Finally, they will extract data from the included studies into the data extraction table. This process will be documented, including the number of identified records, and included and excluded studies, in a PRISMA flow diagram.The data will be extracted into the extraction tables. Once data is extracted, another review author (DG) will check data for completeness and correctness. The process will be fully recorded.

Data extraction points

Study and Author, Country, Type of study, Setting, Sample size, NPI/s, Follow up/Dropouts, Confounders, Outcome/s, Results, Limitations, Strength of evidence

Summary of recommendations for each NPI will be extracted and summarised with quality of evidence provided for each NPI and each study that assessed it. 27. * Risk of bias (quality) assessment.

State which characteristics of the studies will be assessed and/or any formal risk of bias/quality assessment tools that will be used.

Two authors (SS, ST) will independently assess the risk of bias. Any disagreements will be discussed within the group and, if necessary, another review author (DG) will be consulted. The proposed review will use AMSTAR2 appraisal tool for the assessment of biases and quality of evidence provided in systematic reviews. For interventional and observational studies, SIGN checklists will be used. Given that no validated risk of bias checklist for mathematical transmission models exist, the modelling studies were assessed according to the beThe review will consider studies to be at high, low or unclear risk of bias in each of the domains. The studiest modelling practice recommendations of the ISPOR. will be considered as having low risk of bias if the methodologies employed in the study are of acceptable rigour to enable a confident interpretation of the results. On the contrary, the studies will be considered as high risk of bias if the methodologies employed raise concerns about their effects on the results. Finally, the studies will be considered as having an unclear risk of bias if there is insufficient information provided, or if the risk of bias of the methodologies employed is unknown. 28. * Strategy for data synthesis.

Describe the methods you plan to use to synthesise data. This **must not be generic text** but should be **specific to your review** and describe how the proposed approach will be applied to your data. If metaanalysis is planned, describe the models to be used, methods to explore statistical heterogeneity, and software package to be used.

Measures of treatments of effectThe review will express dichotomous data as risk ratio (RR) with 95% confidence interval (CI), whereas continuous data will be expressed as mean difference (MD) and their respective 95% CI.

Assessment of heterogeneity

It is proposed that data will be visually inspected using forest plot for any evidence of heterogeneity.

Heterogeneity in treatment effects will be assessed using the i^2 test whilst the degree of heterogeneity will be assessed using the I^2 statistic, with a value of 50% or higher indicating substantial heterogeneity. It is also anticipated that a subgroup analysis for at least one outcome will be performed, if sufficient data is available.

Subgroup analysis can be performed based on the following characteristics:

• Types of intervention

• Duration of the intervention received

• Type of study design

Assessment of reporting biases

It is anticipated that at least five studies with same outcome will be tested for publication bias by creating a funnel plot with a linear regression test to assess the degree of bias with a p value of 0.1 indicating significance.

Sensitivity analysis

The proposed review ought to perform sensitivity analysis to assess the impact of excluding studies with high or unclear risk of biases. 29. * Analysis of subgroups or subsets.

State any planned investigation of ‘subgroups’. Be clear and specific about which type of study or participant will be included in each group or covariate investigated. State the planned analytic approach.

Not applicable 30. * Type and method of review.

Select the type of review, review method and health area from the lists below.

Type of review

Cost effectiveness

No

Diagnostic

No

Epidemiologic

Yes

Individual patient data (IPD) meta-analysis

No

Intervention

No

Meta-analysis

No

Methodology

No

Narrative synthesis

Yes

Network meta-analysis

No

Pre-clinical

No

Prevention

Yes

Prognostic

No

Prospective meta-analysis (PMA)

No

Review of reviews

No

Service delivery

No

Synthesis of qualitative studies

No

Systematic review

Yes

Other

No

Health area of the review

Alcohol/substance misuse/abuse No

Blood and immune system

No

Cancer

No

Cardiovascular

No

Care of the elderly

No

Child health

No

Complementary therapies

No

COVID-19

Yes

For COVID-19 registrations please tick all categories that apply. Doing so will enable your record to appear in area-specific searches

Chinese medicine
Diagnosis
Epidemiological
Genetics
Health impacts
Mental health
PPE
Prognosis
Public health
Rehabilitation
Service delivery
Transmission
Treatments
Vaccines
Other

Crime and justice

No

Dental

No

Digestive system

No

Ear, nose and throat

No

Education

No

Endocrine and metabolic disorders

No

Eye disorders

No

General interest

No

Genetics

No

Health inequalities/health equity

No

Infections and infestations

Yes

International development

No

Mental health and behavioural conditions

No

Musculoskeletal

No

Neurological

No
Nursing

No

Obstetrics and gynaecology

No

Oral health

No
Palliative care

No

Perioperative care

No

Physiotherapy

No

Pregnancy and childbirth

No

Public health (including social determinants of health)

Yes

Rehabilitation

No

Respiratory disorders

No

Service delivery

No

Skin disorders

No

Social care

No

Surgery

No

Tropical Medicine

No

Urological

No

Wounds, injuries and accidents

No

Violence and abuse

No

31. Language.

Select each language individually to add it to the list below, use the bin icon to remove any added in error.

English

There is an English language summary.

32. * Country.

Select the country in which the review is being carried out. For multi-national collaborations select all the countries involved.

Australia

33. Other registration details.

Name any other organisation where the systematic review title or protocol is registered (e.g. Campbell, or The Joanna Briggs Institute) together with any unique identification number assigned by them. If extracted data will be stored and made available through a repository such as the Systematic Review Data Repository (SRDR), details and a link should be included here. If none, leave blank.

34. Reference and/or URL for published protocol.

If the protocol for this review is published provide details (authors, title and journal details, preferably in Vancouver format)

Add web link to the published protocol.

Or, upload your published protocol here in pdf format. Note that the upload will be publicly accessible.

No I do not make this file publicly available until the review is complete

Please note that the information required in the PROSPERO registration form must be completed in full even if access to a protocol is given.

35. Dissemination plans.

Do you intend to publish the review on completion?

Yes

Give brief details of plans for communicating review findings.?

The review will be published in a peer reviewed medical journal.

36. Keywords.

Give words or phrases that best describe the review. Separate keywords with a semicolon or new line. Keywords help PROSPERO users find your review (keywords do not appear in the public record but are included in searches). Be as specific and precise as possible. Avoid acronyms and abbreviations unless these are in wide use.

Covid-19Public health measures

Non-pharmacological interventions

SARS-COV-2

37. Details of any existing review of the same topic by the same authors.

If you are registering an update of an existing review give details of the earlier versions and include a full bibliographic reference, if available. 38. * Current review status.

Update review status when the review is completed and when it is published.New registrations must be ongoing.
Please provide anticipated publication date

Review_Ongoing

39. Any additional information.

Provide any other information relevant to the registration of this review.

40. Details of final report/publication(s) or preprints if available.

Leave empty until publication details are available OR you have a link to a preprint. List authors, title and journal details preferably in Vancouver format.

Give the link to the published review or preprint.

Supplementary file 1, Table 3: PICOS framework outlining specific inclusion criteria for the studies involved in the systematic review

PICOS FRAMEWORK	
Population	● Population at risk and affected by COVID-19
Intervention	● **Personal protective measures**: hand and personal hygiene face masks (including respirators, surgical or cloth masks) ● **Environmental measures**: surface and object cleaning, disinfection ● **Social measures**: contact tracing, isolation, quarantine, school closures, workplace closures, social distance of a particular distance (e.g., 1.5m), lockdown ● **Travel-related measures** restricted inter-state travel, symptom screening (e.g., fever screening), international travel restrictions, border closure
Comparison	● No NPIs or comparison of different NPIs
Outcome	**Primary** Incidence of COVID-19 **Secondary** Transmission (i.e., reproductive number, doubling time, growth rate) Mortality (i.e., case fatality rate, cumulative mortality and mortality rate)
Study design	• Interventional – Randomised Controlled Trials (RCTs) • Observational – Natural experiments, quasi experimental, prospective and retrospective cohort studies, case-control and cross-sectional or ecological comparative studies

Supplementary file 1. Section 4: Search Strategy

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions(R) <1946 to April 23, 2021> Search Strategy:

-- 1
(wuhan and (coronavirus or corona virus)).tw. (3840)
2 (coronavirus* and ("19" or "2019")).tw. (40774)
3 (COVID* or nCov or novel coronavirus* or novel corona virus* or SARS-COV-2 or Severe Acute Respiratory Syndrome Coronavirus 2 or Severe Acute Respiratory Syndrome Corona virus 2 or coronavirus disease 2019 or corona virus disease 2019 or new coronavirus* or new corona virus* or SARS Coronavirus 2 or SARS Corona virus 2).mp. (128665)
4 1 or 2 or 3 (129131)
5 limit 4 to yr="2019 -Current" (127889)
6 exp Betacoronavirus/ (62886)
7 exp Coronavirus Infections/ (83237) 8 exp Coronavirus/ (68600)
9 (2019nCoV or Betacoronavirus* or Corona Virus* or Coronavirus* or Coronovirus* or CoV or CoV2 or COVID or COVID19 or COVID-19 or HCoV-19 or nCoV or SARS CoV 2 or SARS2 or SARSCoV or SARS-CoV or SARS-CoV-2 or Severe Acute Respiratory Syndrome CoV*).mp. (143947)
10 6 or 7 or 8 or 9 (149039)
11 ("20200926" or "20200927" or "20200928" or "20200929" or "20200930" or 20201* or 2021*).ed. (619294)
12 ("20200926" or "20200927" or "20200928" or "20200929" or "20200930" or 20201* or 2021*).dt. (913084)
13 11 or 12 (1356522)
14 10 and 13 (86392)
15 Randomized Controlled Trials as Topic/ (142601)
16 randomized controlled trial/ (527694)
17 Random Allocation/ (105151)
18 Double Blind Method/ (163666)
19 Single Blind Method/ (30036)
20 clinical trial/ (528383)
21 controlled clinical trial.pt. (94129)
22 randomized controlled trial.pt. (527694)
23 multicenter study.pt. (292387)
24 clinical trial.pt. (528383)
25 exp Clinical Trials as topic/ (355663)
26 (clinical adj trial$).tw. (396105)
27 ((singl$ or doubl$ or treb$ or tripl$) adj (blind$3 or mask$3)).tw. (179506)
28 PLACEBOS/ (35449)
29 placebo$.tw. (224305)
30 randomly allocated.tw. (30821)
31 (allocated adj2 random$).tw. (34242)
32 (case report or case series).tw. (413393)
33 letter/ (1132093)
34 historical article/ (363148) 35 or/15-31 (1699090)
36 or/32-34 (1890618)
37 35 not 36 (1652921)

38 14 and 37 (4224)
39 Epidemiologic studies/ (8628)
40 exp case control studies/ (1161193)
41 exp cohort studies/ (2118019)
42 Case control.tw. (132894)
43 (cohort adj (study or studies)).tw. (232870)
44 Cohort analy$.tw. (8975)
45 (Follow up adj (study or studies)).tw. (50962)
46 (observational adj (study or studies)).tw. (120491)
47 Longitudinal.tw. (264134)
48 Retrospective.tw. (585447)
49 Cross sectional.tw. (391715)
50 Cross-sectional studies/ (360924)
51 or/39-50 (3213512)
52 14 and 51 (14931) 53 38 or 52 (17901)
54 (Trend of COVID-19 spreads and status of household handwashing practice and its determinants in Bangladesh-situation analysis using national representative data).m_titl. (1)
55 "The role of community-wide wearing of face mask for control of coronavirus disease 2019 (COVID-19) epidemic due to SARS-CoV-2".m_titl. (1)
56 (Understanding transmission and intervention for the COVID-19 pandemic in the United States).m_titl. (1)
57 "Efficacy of contact tracing for the containment of the 2019 novel coronavirus (COVID-19)".m_titl. (1)
58 A preliminary study on contact tracing & transmission chain in a cluster of 17 cases of severe acute respiratory syndrome coronavirus 2 infection in Basti, Uttar Pradesh, India.m_titl. (1)
59 (Epidemiological characteristics of and containment measures for COVID-19 in Busan, Korea).m_titl. (1)
60 "Incidence of novel coronavirus (2019-nCoV) infection among people under home quarantine in Shenzhen, China".m_titl. (1)
61 (Statewide Interventions and Covid-19 Mortality in the United States: An Observational Study).m_titl. (1)
62 Quantifying the impact of physical distance measures on the transmission of COVID-19 in the UK.m_titl.
(1)
63 "The basic reproduction number and prediction of the epidemic size of the novel coronavirus (COVID-19) in Shahroud, Iran".m_titl. (1)
64 (Physical distancing interventions and incidence of coronavirus disease 2019).m_titl. (1)
65 The effect of social distance measures on COVID-19 epidemics in Europe: an interrupted time series analysis.m_titl. (1)
66 The effect of state-level stay-at-home orders on COVID-19 infection rates.m_titl. (1)
67 Social distancing to slow the US COVID-19 epidemic: Longitudinal pretest-posttest comparison group study.m_titl. (2)
68 "Effect of the social distancing measures on the spread of COVID-19 in 10 highly infected countries.".m_titl. (1)
69 Social distancing in Sao Paulo State: demonstrating the reduction in cases using time series analysis of deaths due to COVID-19.m_titl. (1)
70 Strong Social Distancing Measures In The United States Reduced The COVID-19 Growth Rate.m_titl. (1)
71 Enacting national social distancing policies corresponds with dramatic reduction in COVID19 infection rates.m_titl. (1)
72 (Social Distancing and Outdoor Physical Activity During the COVID-19 Outbreak in South Korea: Implications for Physical Distancing Strategies).m_titl. (1)

73 (Coronavirus Disease 2019 Epidemic Doubling Time in the United States Before and During Stay-at-Home Restrictions).m_titl. (1)
74 (Excess Deaths and Hospital Admissions for COVID-19 Due to a Late Implementation of the Lockdown in Italy).m_titl. (1)
75 The Efficacy of Lockdown Against COVID-19: A Cross-Country Panel Analysis.m_titl. (1)
76 The positive impact of lockdown in Wuhan on containing the COVID-19 outbreak in China.m_titl. (1)
77 "Real-time estimation of the reproduction number of the novel coronavirus disease (COVID-19) in China in 2020 based on incidence data".m_titl. (1)
78 The effect of lockdown on the outcomes of COVID-19 in Spain: An ecological study.m_titl. (1)
79 Lockdown Contained the Spread of 2019 Novel Coronavirus Disease in Huangshi City, China: Early Epidemiological Findings.m_titl. (1)
80 COVID-19 effective reproduction number dropped during Spain's nationwide dropdown, then spiked at lower-incidence regions.m_titl. (1)
81 (Evaluation of the lockdowns for the SARS-CoV-2 epidemic in Italy and Spain after one month follow up).m_titl. (1)
82 Impact of population movement on the spread of 2019-nCoV in China.m_titl. (1)
83 (The effect of human mobility and control measures on the COVID-19 epidemic in China).m_titl. (2)
84 Temperature screening has negligible value for control of COVID-19.m_titl. (1)
85 (Impact of complete lockdown on total infection and death rates: A hierarchical cluster analysis).m_titl. (1)
86 Impact of nonpharmacological interventions on COVID-19 transmission dynamics in India.m_titl. (1)
87 "Reduction of secondary transmission of SAR-CoV-2 in households by face mask use, disinfection and social distancing: a cohort study in Beijing, China".m_titl. (0)
88 (Impact assessment of non-pharmaceutical interventions against coronavirus disease 2019 and influenza in Hong Kong: an observational study).m_titl. (1)
89 Serial interval of SARS-CoV-2 was shortened over time by nonpharmaceutical interventions.m_titl. (1)
90 (Rapid real-time tracking of non-pharmaceutical interventions and their association with SARS-CoV-2 positivity: The COVID-19 Pandemic Pulse Study).m_titl. (1)
91 (The COVID-19 pandemic in italy: Policy and technology impact on health and non-health outcomes).m_titl. (1)
92 Association of Public Health Interventions with the Epidemiology of the COVID-19 Outbreak in Wuhan, China.m_titl. (1)
93 Epidemiology of 2019 novel coronavirus in Jiangsu Province, China after wartime control measures: a population-level retrospective study.m_titl. (1)
94 (Covid-19 epidemic in Italy: evolution, projections and impact of government measures).m_titl. (1) 95 New Measures for the Coronavirus Disease 2019 Response: A Lesson From the Wenzhou Experience.m_titl. (1)
96 (Timing of community mitigation and changes in reported COVID-19 and community mobility).m_titl. (1)
97 (Evaluation of the Effectiveness of Surveillance and Containment Measures for the First 100 Patients with COVID-19 in Singapore - January 2-February 29, 2020).m_titl. (1) 98 or/54-97 (45)
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153 51 or 152 (7076132)

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46 44 or 45 4671914
47 43 or 46 5568267
48 7 and 27 and 47 10878
49 limit 48 to (human and english language and yr="2021") 4651

Supplementary file 1, Table 5 Public health measures definitions

Public health interventions	Definition
• Shelter in Place Orders • Stay at home	Work and study from home arrangements.
• Travel Bans • Travel Restrictions • Border closures • Restrictions on internal movement	Closure of international borders, restricted movement across international and state borders.
• Contact tracing	Active surveillance of the movements and personal contacts of diagnosed cases.
• Universal symptom screening • Expanded testing • Fever screening	Increased testing capacity and symptom screening within the community.
• Home quarantine • Isolation of cases	Quarantine of diagnosed cases and their close contacts for infectious period.
• Quarantine	Quarantine of returned travellers.
• Lockdown	Universal closure of business and workplaces. Includes stay at home orders.
• Social Distance	Measures that reduce the movement/congregation of people within the community.
• Face masks	Use of face masks within the community, indoors and outdoors or when physical distancing is not possible.

• School/Childcare closure	The closure of early learning centres, primary schools, and secondary schools.
• Physical distancing	Maintaining physical distance of particular distance measured in metres.
• Business Closure • Workplace closure	Closure of all non-essential business, working from home arrangements.
• Ban on social gatherings/mass gatherings	Restrictions on congregations of people.

Supplementary file 1, Table 6 Study Design Definitions

Study Design	Definition
Natural Experiment	A study that assesses risk or outcome between countries or geographical regions in which the exposure is occurring naturally.
Quasi Experimental	A study in which investigators have control over how and exposure is allocated. People/regions/countries are organised into exposure/intervention and non-exposed/control groups.
Cross Sectional Comparative	A study that compares outcome or risk between different regions, or pre and post intervention but only once.
Ecological Study	A study that assesses the correlation or linearity of two variables, with no comparator provided and no measures of association provided.

Supplementary file 2: Table 1. ROBINS-1 Risk of Bias for Observational Studies: Individual intervention studies

Study	Bias in confounding	Bias in selection of participants into the study at intervention	Bias in classification of interventions	Bias in deviation from intended interventions	Bias in missing data	Bias in measurement of outcomes	Bias in selection of reported results	Overall score	Overall RoB
Siedner et al(1)	4	1	2	2	1	2	3	15	Moderate
Lio et al(2)	3	2	2	1	1	1	2	12	Moderate
Van den Berg et al(3)	3	1	2	2	2	2	0	12	Moderate
Tobias et al(4)	3	1	2	2	2	3	1	14	Moderate
Guzzetta et al(5)	3	1	2	3	2	2	0	13	Moderate
Al-Tawfiq et al(6)	2	1	1	1	1	1	2	9	Low
Guo et al(7)	3	2	3	3	1	1	2	15	Moderate
Dreher et al(8)	3	2	3	2	2	2	1	15	Moderate
Vaman et al(9)	4	2	3	2	2	2	1	16	Serious
Xu et al(10)	3	2	3	2	2	2	2	16	Serious
Silva et al(11)	4	2	2	2	1	3	1	15	Moderate
Vlachos et al(12)	3	1	1	2	2	1	1	11	Low
Quaife et al(13)	3	2	3	3	2	2	2	17	Serious

Krishnamachari et al[14]	2	3	3	3	1	2	1	15	Moderate
Iwata et al[15]	3	1	2	2	2	2	2	14	Moderate
Rader et al[16]	3	2	2	2	1	2	2	14	Moderate
Emeto et al[17]	4	2	3	3	2	2	2	18	Serious
Pillai et al[18]	3	2	1	2	1	2	1	12	Moderate
Alimohamadi et al[19]	3	2	2	2	2	2	1	14	Moderate
Auger et al[20]	3	2	2	2	2	2	1	14	Moderate
Leffler et al[21]	3	1	2	2	2	2	1	13	Moderate
Doung-Ngern et al[22]	4	2	3	2	3	3	3	20	Serious
Lyu et al[23]	3	2	2	3	2	2	1	15	Moderate
Basu et al[24]	3	2	3	3	2	3	2	18	Serious
Cheng et al[25]	3	2	3	1	1	2	2	14	Moderate
Alfano et al[26]	3	2	3	4	1	4	1	18	Serious
Wang K. et al[27]	2	1	2	1	1	1	1	9	Low
Voko et al[28]	3	1	2	1	2	3	1	13	Moderate
Mitra et al[29]	3	2	2	1	1	2	1	12	Moderate

Khosravi et al (30)	3	2	2	2	2	3	2	16	Moderate
Thayer et al(31)	3	2	2	2	2	3	1	15	Moderate
Jarvis et al(32)	3	3	2	2	3	1	2	16	Serious
Wang Y et al(33)	3	1	3	0	0	3	2	12	Moderate
Liu et al(34)	4	1	2	1	1	2	2	13	Moderate

Supplementary file 2, Table 2. ROBINS-2 Risk of Bias Randomised Control Study

Study	Risk of bias arising from randomisation process	Risk of bias due to deviations from intended interventions	Missing outcome data	Risk of bias in measurement of outcome	Risk of bias in selection of reported result	Overall RoB
Bundgaard et al(35)	0	1	0.5	0.5	0	Moderate

Supplementary file 2, Table 3. ROBINS-1 Risk of Bias for Observational Studies - Multiple interventions studies

Study	Bias in confounding	Bias in selection of participants into the study at intervention	Bias in classification of interventions	Bias in deviation from intended interventions	Bias in missing data	Bias in measurement of outcomes	Bias in selection of reported results	Overall score	Overall RoB
Wahaibi et al(36)	3	1	2	1	1	2	2	12	Moderate
Tsai et al(37)	4	2	2	2	1	1	0	12	Moderate
Dasgupta et al(38)	3	1	3	3	1	1	0	12	Moderate
Timelli et al(39)	3	1	2	2	1	1	2	12	Moderate
Bo et al(40)	3	1	2	2	1	2	0	11	Low
Koh et al(41)	3	2	2	2	2	1	0	12	Moderate
Juni et al(42)	3	2	3	2	2	3	1	16	Serious
Liu et al(43)	3	2	3	2	2	2	1	15	Moderate
Tariq et al(44)	3	2	2	2	2	3	2	16	Serious
Malheiro et al(45)	3	3	2	2	2	2	1	15	Moderate
Tchole et al(46)	4	1	2	2	2	4	1	16	Serious
Singh et al(47)	3	2	2	2	2	2	1	14	Moderate

McCreesh et al(48)	3	2	3	2	2	3	1	16	Moderate
Haapanen et al(49)	3	2	2	2	2	3	1	15	Moderate
Bendavid et al(50)	3	2	2	2	2	3	1	15	Moderate
Yeoh et al(51)	3	2	2	2	2	2	1	14	Moderate
Erim et al(52)	4	3	2	2	3	3	2	19	Serious
Islam et al(53)	3	1	2	2	1	3	1	13	Moderate
Ghoshal et al(54)	2	3	1	1	1	2	3	13	Moderate
Patel et al(55)	3	2	2	1	1	3	1	13	Moderate
Thu et al(56)	3	2	2	1	1	3	2	14	Moderate
Son et al(57)	3	3	2	2	1	1	3	15	Moderate
Yehya et al(58)	3	1	2	2	2	3	1	14	Moderate
Courtemanche et al(59)	3	3	1	1	1	2	3	14	Moderate
Piovani et al(60)	4	1	2	2	2	2	0	13	Moderate
Ruan 2020 et al(61)	3	2	2	1	2	2	0	12	Moderate

Rubin et al(62)	4	2	2	1	2	3	0	14	Moderate
Clipman et al(63)	2	3	1	1	0	2	3	12	Moderate
Zhang et al(64)	3	2	1	0	2	2	1	11	low
Pan et al(65)	4	1	3	2	1	2	0	13	Moderate
McGrail et al(66)	4	2	2	1	1	2	0	12	Moderate
Wang J et al(67)	3	1	3	2	1	2	0	12	Moderate
Wang K et al(68)	3	2	3	1	2	3	1	15	Moderate
Qureshi et al(69)	4	1	1	1	1	2	3	13	Moderate
Lau et al(70)	3	1	1	1	2	3	1	12	Moderate
Castillo et al(71)	3	2	1	2	1	3	1	13	Moderate
Ryu et al(72)	3	2	2	2	2	3	0	14	Moderate

Table 1: Supplementary file 3, Table 1. Study Characteristics and results of studies assessing individual interventions

Study	Country	Objectives	Setting	Intervention	Study / Statistical Method	Outcome/s	Results (stats)	Results/Conclusion	Limitations
Bundgard et al(1)	Denmark	To assess whether recommending surgical mask use outside the home reduces wearers' risk for SARS-CoV-2 infection in a setting where masks were uncommon and not among recommended public health measures.	Nationwide	Face mask	Randomised Controlled Trial (RCT) Investigator-initiated, nationwide, unblinded, randomized controlled trial	Incidence	N= 2392 cases N= 2470 control OR mask group: 0.82 (0.54-1.23), *P*= 0.330 No statistically significant difference in SARS-CoV-2 incidence was observed, the 95% CIs are compatible with a possible 46% reduction to 23% increase in infection among mask wearers.	The recommendation to wear surgical masks to supplement other public health measures did not reduce the SARS-CoV-2 infection rate among wearers by more than 50% in a community with modest infection rates, some degree of social distancing, and uncommon general mask use. The data were compatible with lesser degrees of self-protection.	Inconclusive results Missing data Variable adherence Patient-reported findings on home tests No blinding, and no assessment of whether masks could decrease disease transmission from mask wearers to others.
Voko et al(2)	Multi-national.	To characterise the change point in the transmission of the epidemic in each country; to evaluate the association of the level of social distancing with the observed decline in the national epidemics	Natural experiment Europe Countries (n=28)	Social distancing	Natural experiment Poisson regression model	Incidence Rate Ratio (IRR)	IRR Pre-intervention Overall: 1.23 (1.19–1.28). Post intervention Q1: 1.01(0.98-1.02) p<0.12 Q2: 1.00(0.98-1.03) p<0.82 Q3: 0.99(0.99-1.00) p<0.054 Q4: 0.98(0.97-0.99) p<0.00	Countries in the highest SDI quartile = statistically significant decline of the epidemic. Before the change point, incidence of new SARS-CoV-2 cases grew by 26% per day on average. From the change point, the growth rate was reduced to 0.9%, 0.3% increase, and to 0.7% and 1.7% decrease by increasing social distancing quartiles.	Assumptions on identical effects of interventions across countries and over time. Possible over-representation of countries with more advanced epidemics.

Wang Y et al[3]	China	To study the importance of using NPIs, such as face masks, social distancing, and disinfection in the household setting	Retrospective cohort study	Face mask, Disinfection, Social distance.	Retrospective cohort study Study of 335 people in 124 families who have at least one confirmed SARS-Co-V2 case. Characteristics and practices of primary cases, of well family contacts and house-hold hygiene practices were analysed.	Attack Rate (AR)	Secondary AR= 23.0% (77/335) *Face mask* Face mask use prior to symptoms: 79% effective in reducing transmission OR = 0.21 (0.06-0.79). Face mask use after illness onset of the primary case: not significantly protective. *Social distance* Frequent daily close contact with the primary case: 18 times higher transmission risk OR= 18.26 (3.93-84.79). If the primary case had diarrhoea, four times higher risk OR = 4.10 (1.08-15.60). *Disinfection* Daily use of chlorine or ethanol-based disinfectant: 77% effective	Face mask use prior to symptoms: 79% effective in reducing transmission Frequent daily close contact with the primary case: 18 times higher transmission risk Daily use of chlorine or ethanol-based disinfectant: 77% effective	Social distancing, disinfection and HH hygiene within the home is effective. Wearing a mask after illness onset of the primary case was not significantly protective. Having close contact (within 1 m or 3 feet, such as eating around a table or sitting together watching TV) is a risk factor for transmission.

Cheng et al[4]	North America, Europe, and Asia (n=16)	The incidence of COVID-19 per million population in HKSAR with community-wide masking was compared to that of non-mask-wearing countries which are comparable with HKSAR in terms of population density, healthcare system, BCG vaccination and social distancing measures but not community-wide masking.	Hong Kong Special Administrative Region (HKSAR) compared to multiple countries worldwide	Face-masks (universal masking)	Cross sectional comparative study Incidence rates were compared using the exact Poisson test Proportions were compared using the chi-squared test	Incidence	Incidence (per million population) Mandated mask wearing HKSAR= 129.0 No Mandated mask wearing Spain= 2983.2 Italy= 2250.8 Germany= 1241.5 France= 1151.6 USA= 1102.8 UK= 831.5 Singapore= 259.8 South Korea= 200.5 Mask compliance in HKSAR: 96.6% (95.7-97.2)	Incidence of SARS-CoV-2 in HKSAR was significantly less than that of the selected countries Community-wide mask wearing may contribute to the control of SARS-CoV-2 by reducing the amount of emission of infected saliva and respiratory droplets from individuals with subclinical or mild SARS-CoV-2.	Mask-off in family settings not analysed Type of mask in the community was not determined Unable to count the mask compliance directly for every community setting
Mitra et al[5]	Australia	To report the incidence of fever among patients who tested positive for SARS-CoV-2.	Single centre retrospective cohort study	Temperature Screening	Retrospective cohort study Temperature at time of testing and on repeat testing within 24 h were collected.	Sensitivity of fever for a positive SARS-CoV-2 test result	Positive SARS-CoV-2 (n=86) Sensitivity of fever test Initial=19% (11-28) =16/86 Repeat=24% (15-35) 18/75	Screening for fever lacked sensitivity for detection of patients with SARS-CoV-2. Generic public health measures, such as self-isolation when sick, physical distancing and contact tracing, are more likely to be effective than widespread temperature screening	NS

Siedner et al(6)	USA	To estimate the public health impact of government mandated NPIs before and after their recent staged relaxation	45 States State-wide	Lockdown	Quasi experimental Longitudinal pre-test–post-test comparison group study analysed the implementation of state-wide SD measures	Growth Rate (GR) Mortality Growth Rate (MGR)	GR 4 days post intervention: decrease of 0.9% (−1.4 - −0.4) P< 0.001 per day MGR 7 days post intervention: decreased by 2.0% (−3.0 - −0.9) P < 0.001.	Mean daily SARS-CoV-2 case GR and MGR decreased beginning 4 days and 7 days respectively, after implementation of the first state-wide SD measures.	Challenge disentangling the unique associations with state-wide restrictions on internal movement from the unique associations with the first SD measures Bias resulting from the aggregate nature of the ecological data, potential confounding by contemporaneous changes (e.g., increases in testing) Underestimation of social distancing due to spill over effects from neighbouring states
Khosravi et al(7)	Iran	To estimate the reproduction number (R0) in the early stage of the epidemic and predict the trajectory of the epidemic and new cases	Shahroud	Self-isolation/stay at home	Cross Sectional comparative study Ro estimated using serial interval distribution and the no. of incidence cases. Poisson distribution determined by daily infectiousness	Ro	Ro Pre-intervention (early 14 days) Ro= 2.7(2.10–3.40) Post intervention (end of 42 days) Ro= 1.13 (1.03–1.25)	With preventive measures and public education, transmission was reduced within 42 days.	Testing in the first period was only for those admitted to hospital Ro is the average of R0i in population subgroups; its value may be higher in some high-risk subgroups

Alfano et al[8]	Global	To assess the effect of lockdown measures and having the lockdown implemented over a given number of days (from 7 to 20 days).	n=202 countries or regions	Lockdown.	Natural experiment Johns Hopkins University & ACAPs data used for building a longitudinal dataset estimating the impact of lockdown via feasible generalized least squares fixed effect, random effects, generalised equation, and hierarchical linear models.	Incidence	β3 coefficient Pre-intervention β3= 89.82 (-4.92), P< 0.01 Post-intervention β3= 235.8 (-11.04) P< 0.01 True effect = 10 days post implementation and efficacy continue to grow up to 20 days after	Lockdown has a negative and statistically significant coefficient, suggesting that countries that implemented the lockdown have fewer new cases than countries that did not. Benefits of lockdown increase exponentially with the passing of time.	Serious limitations in deriving precise estimates since standard errors can of course increase. Caution is thus suggested in reading these results Timing of the measures taken in Europe and the rest of the world, as well as by the spread of the pandemic.
Wang K et al l[9]	China	To quantify the transmissibility on real-time basis for designing public health responses	China, Hubei and Wuhan	Lockdown	Retrospective cohort study Data of the confirmed SARS-CoV-2 cases collected from the National Health Commission of the People's Republic of China. Timeline of the outbreak was divided into three stages.	Rt	Rt Pre-intervention: China= 4.95 (4.26-5.67) Hubei = 4.29 (3.66-4.93) Wuhan= 3.88 (3.30, 4.49) Post intervention: China: 0.98 (0.96 - 1.03) Hubei: 1.14 (1.10 - 1.19) Wuhan: 1.41 (1.35-1.48)	The reproduction number largely dropped after the city lockdown. Control of SARS-CoV-2 epidemic was effective in substantially reducing the Rt to 0.98.	Severe under-reporting phenomena caused by the imbalanced regional detection level existed before the appearance of the new coronavirus nucleic acid detection kit. In stage II and stage III, the rate of under-reporting had little effect on their reproduction numbers.

Tobias et al[10]	Italy Spain	To describe, quantify, and compare the lockdown effects within and between countries using incident data.	Multinational	Universal lockdown	Analysed trends of incidence, deaths, and ICU admissions in both countries before and after their respective lockdowns using an interrupted time-series. Data was analysed with quasi-Poisson regression, using an interaction model to estimate the change in trends	Incidence Mortality	Pre-intervention: Spain Cases= 38.5% (27.0-50.0) Deaths= 59.3% (23.0-95.2) Italy Cases= 21.6% (16.2-27.1) Deaths= 32.8% (21.0-44.6) Post-intervention (1): Spain Cases= 11.9% (9.5-14.3) Deaths= 17.6% (14.4-20.7) Italy Cases= 12.5% (9.6-15.5) Deaths= 13.7% (10.1-17.4) Post-intervention (2): Spain Cases= -2.7% (-7.3-1.9) Deaths = -1.8% (-5-3.1) Italy Cases= -2% (-3.1- -0.9) Deaths = -0.29% (-1.5-1)	Lockdown, including restricted social contact and keeping open only those businesses essential to the country's supply chains, has had a beneficial effect in both countries.	Real-time detection of pattern changes is essential to evaluate the current measures of control and design future ones.

Thayer et al[11]	India	To evaluate the effect of lockdown policy on the SARS-CoV-2 incidence rate at the national level to inform policy response	Nationwide	Lockdown	Quasi experimental Interrupted time series analysis using segmented regression.	Incidence (% Median)	Median IRR (IQR) Pre-intervention (23 days): 15.8(7.00-20.20) Lockdown 1: (21 days) 15.9 (10.40-19.70) Lockdown 2: (19 days) 7.30 (6.30-8.0) Lockdown 3: (14 days) 5.8 (5.2-6.4) Lockdown 4: (14 days) 5.0 (4.7-5.4)	The findings indicate a significant reduction in the rate of increase in new SARS-CoV-2 cases during Lockdown 1.0 and then Lockdown 4.0, with no significant rebound increase in this rate during the subsequent easing of the lockdown policy. Additionally, other than Lockdown 1.0, there was no significant increase in the level of SARS-CoV-2 incidence.	Quasi-experimental design and reliance on reported incident SARS-CoV-2 cases. No comparison group or estimate of a counterfactual number of cases that would have occurred without the policy. Difficult to fully account for all national and subnational policy changes implemented. Possible biases related to efforts at scale-up of testing, increasing awareness of the disease by health professionals and the public, and changes to the diagnostic criteria.

Auger et al[12]	United States	To determine if school closure and its timing were associated with decreased SARS-CoV-2 incidence and mortality	Nationwide and by state	School closure	Comparative study Interrupted time series analysis with lag and negative binomial regression	Incidence Mortality (Adjusted relative change per week, %) Incidence & mortality (Relative change per week, %)	Incidence Pre-intervention: 265% (231-303) Post intervention: 10% (1-18) Relative change per week: -62% (-71- -49) Mortality Pre-Intervention: 186% (175-197) Post intervention: 2% (-8 – 14) Relative change per week -58% (-68 - -46)	School closure in the US was temporally associated with decreased SARS-CoV-2 incidence and mortality; states that closed schools earlier, when cumulative incidence of SARS-CoV-2 was low, had the largest relative reduction in incidence and mortality	Additional NPIs during the same study = difficult to isolate the effect of school closure on incidence and mortality Analysis is at the state level and different states had different policies. Measurement of incidence rate, testing availability differences... Completeness and accuracy of the data
Leffler et al[13]	200 countries	Compare per capita SARS-CoV-2 mortality, between countries where mask use was either an accepted cultural norm or favoured by government policies on a national level, and countries which did not advocate masks	Nationwide (multiple countries)	Face Masks	Natural experiment Multivariable linear regression	Mortality (weekly increase, %)	No intervention: 61.9% (37 - 91) Post intervention: 16.2% (-14.40 - 57.40) Weekly per capita increase in mortality with masks 8.1% P=<0.000 compared to 55.70% in weeks when masks were not recommended.	Mortality was lower in countries that implemented early use of masks.	Bias and heterogeneity between countries in measurement of mortality Confounding Limitation of statistical models.

Basu et al[14]	India	To evaluate the effect of four-phase national lockdown from March 25 to May 31 in response to the pandemic in India and assess the state-wise variations in terms of multiple public health metrics.	Nationwide	Lockdown	Retrospective cohort study Bayesian sequential method Log-linear models	Rt Doubling time (DT)	Pre-lockdown Rt= 3.36 (3.03-3.71) DT = 3.56 Post Lockdown Rt = 1.27 (1.26-1.28) DT =14.37	Rt declined and DT increased after lockdown. Patterns of change over lockdown periods indicate the lockdown has been partly effective in slowing the spread of the virus nationally.	Influence of confounding cannot be excluded No predictions of future incidence or CFR so does not inform healthcare needs. Does not account for age-sex structure and mobility patterns in India Reported case counts used are underestimated

Van den Berg et al[15]	United states	To compare incident cases of SARS-CoV-2 in students and staff in Massachusetts public schools among districts with different physical distancing requirements.	Massachusetts public schools	Physical distancing Mask mandates	Retrospective cohort study Log-binomial regression	Incidence rate ratios (IRRs)	Students IRR: 0.89 (0.59-1.34) Staff IRR: 0.98 (0.73 -1.334)	No significant difference in K-12 student and staff SARS-CoV-2 case rates in Massachusetts public school districts that implemented ≥3 feet versus ≥6 feet of physical distancing between students, provided other mitigation measures, such as universal masking, are implemented.	Lack of complete data on potential cases only cases reported to the state could be included in our analysis. Unable to measure the impact of physical distance stratified by school type (elementary, middle, or high) or age group. Unable to examine how lower distancing policies may have affected school closures. Unable to fully evaluate the impact of other types of infection control interventions owing to a lack of variation across the state.
Guzzetta et al[16]	Italy	To measure SARS-CoV-2 transmissibility around national lockdown	Nationwide	National lockdown	Longitudinal study Measured SARS-CoV-2 transmissibility in terms of the basic (R0) and net (Rt) reproduction numbers.	Rt	Rt Pre-intervention: 1 day before =2.03(1.94–2.13) Post intervention 1 week after=1.28 (1.23-1.33) 2 weeks after =0.88 (0.84-0.91) 3 weeks after=0.76 (0.67-0.85)	Results suggest that the national lockdown put in place as of March 11 to limit the spread of SARS-CoV-2 in Italy brought R_t below 1 in most regions and provinces within 2 weeks.	Asymptomatic cases were not considered in the analysis

Al-Tawfiq et al[17]	The Kingdom of Saudi Arabia	To test the association between arriving travellers to quarantine facilities and the prevalence or incidence of positive SARS-CoV-2.	Nationwide	Mandatory quarantine of returning travellers	Longitudinal cohort study Descriptive statistics	Incidence of detected SARS-CoV-2 Cases among arriving travellers	Weeks since intervention Introduced / Incidence (%) 4= 5.9% 5=2.8% 6=3.2% 7=0.28% 8=1% 9=0% 10=0% 11=0% 12=0% 13=0%	This study showed the efforts put for facility quarantine and that such activity yielded a lower incidence of positive cases.	The prevalence is very low of confirmed cases and not many were quarantined
Vaman et al[18]	India	To assess the effectiveness of home quarantine practises and its role in determining SARS CoV2 transmission.	State-wide (Kerala)	Home Quarantine	Retrospective cohort study Descriptive statistics; binary & multiple logistic regression analysis	Risk of Transmission (OR)	No intervention: Increased chance of transmission [RR:11.85 (2.91--48.23), P < 0.001 No quarantine vs strict room quarantine [OR:14.44 (2.42–86.17) P = 0.003 Post intervention Home quarantine without room vs strict room quarantine OR: 24.14(4.87--119.75), P < 0.001	Low-resource settings successful in the initial phases of SARS-CoV-2 pandemic should make periodic revisions in the quarantine guidelines while continually promoting physical distancing strategies	Testing and case detection variation in low-income environments Recall bias self-reported quarantine measures

Silva et al[19]	Brazil	We used interrupted time series analysis to estimate the impact of lockdowns on reducing the number of cases and deaths due to SARS-CoV-2 in Brazil.	Nationwide	Lockdown	Quasi experimental Interrupted time series analysis (modelling); segmented linear regression	Incidence (β3) Mortality (%)	<u>Incidence</u> <u>Pre-intervention</u> São Luís: β3= -0.09; p < 0.001), Recife: β3 = -0.12; p < 0.001) Belem: β3 = -0.13; p < 0.001), Fortaleza β3= -0.07; p < 0.001) <u>Post intervention:</u> São Luís: β3 = -0.13; p< 0.001 Recife: β3 =-0.06; p < 0.001 Belem: β3 = -0.10; p < 0.001 Fortaleza β3= -0.09; p < 0.001 <u>Mortality reduced by</u> São Luís, 37.85% Fortaleza 33.4%, Recife by 21.76% Belem had 16.77%	After lockdown, a statistically significant decrease in new confirmed cases and mortality was found in all state capitals.	Data inconsistencies Testing intensified during the post-intervention period, resulting in a higher number of diagnosed cases There is significant delay between testing cases and actual report them in official datasets,
Pillai et al[20]	South Africa	To measure the effects of lockdown measures introduced in SA on SARS-CoV-2 attack rates (ARs, the percentage of individuals who tested positive in a specified time period) in Gauteng Province during a 4-month period (March - June 2020).	Nationwide	Lockdown	Retrospective Cohort Study logistic regression model	Attack Rate (AR)	<u>Pre-intervention:</u> AR= 4.1% <u>Post intervention</u> Level 5 lockdown: AR= 2.2% Level 4 lockdown: AR= 3.4% <u>Restrictions eased</u> Level 3 Lockdown: AR = 18.5%	The findings of this study testify to the rapid increase in ARs resulting from easing of the lockdown regulations, especially to level 3 in June.	Retrospective analysis of secondary data from a private pathology laboratory-findings may therefore not be generalisable It is not clear to what extent the change to a more selective testing policy influenced requests made to private laboratories (and the high AR)

Vlachos et al(21)	Sweden	To study the impact of school closure on the incidence of SARS-CoV-2 in parents and teachers.	National	School closures	Cross-sectional comparative study OLS and logistic regression model	Incidence (OR)	Parents exposed to open schools saw a small increase in infections: OR 1.17 (1.03-1.32 p<0.05 Infection rate in lower-secondary teachers doubled compared to upper secondary schools OR 2.01 (1.52-2.67) p<0.01 Higher infection rate of partners of lower secondary school teachers OR 1.29; (1.00 -1.67) *P* < 0.1	While the overall impact on overall virus transmission was limited according to this study, keeping lower-secondary schools open had a quite substantial impact on teachers, and the results suggest that the risk to teachers can be increasing in student age. This should be considered, and precautionary measures could be considered.	Heterogeneity in the school environment, protective measures within school and in local communities.

Iwata et al[22]	Japan	A time series analysis with Bayesian statistics to infer the effectiveness of school closure for decreasing the incidence of coronavirus infection in Japan.	Nationwide	School Closures	Natural experiment Pre and post intervention Bayesian method	Incidence	α= 0.08 (0.36-0.65)	School closure carried out in Japan did not show any mitigating effect on the transmission of novel coronavirus infection.	Outcome data provided started from one-week post intervention. Local linear trend model might not be an appropriate model for the current epidemic of SARS-CoV-2 in Japan. The estimated α value using data by the time of intervention effectiveness might not be accurately predicting the α value afterward, i.e., the α value after March 18. Estimations resulted in rather wide confidence intervals, and the results should be interpreted cautiously. School closures in other forms might be useful in mitigating the epidemic, such as ones including infants and small children, or university students. School closures combined with other measures such as traffic limitations or even city

									lockdown might be useful.
Rader et al[23]	United States	We investigate the association between self-reported mask-wearing, physical distancing, and SARS-CoV-2 transmission in the USA, along with the effect of state-wide mandates on mask uptake.	Nationwide	Mask wearing controlled for physical distancing	Cross sectional comparative study Multivariate logistic regression models	Ro	10% increase in self-reported mask-wearing was associated with an increased odds of transmission control: aOR =3·53 (2·03–6·43).	This study shows that the community adoption of face masks might be an important non-pharmaceutical intervention for the reduction of SARS-CoV-2. Beyond mask mandates, innovative strategies to increase the use of face masks should be explored.	Mask-wearing was assessed via anonymous internet surveys, increasing risk of responder bias. Used a four-point Likert scale, which might not fully capture the nuances of an individual's behaviour, or community variation.

Emeto et al[24]	9 African Countries: Egypt, Tunisia, Democratic Republic of the Congo (DRC), Ethiopia, Kenya, Ghana, Nigeria, Senegal and South Africa	We evaluated the effect of border closure on the incidence rate of SARS-CoV-2 across nine African countries.	Nationwide	Border Closure	Natural experiment Interrupted time series analysis	Incidence rate (Beta-coefficients)	Difference between pre-closure and post closure, treatment vs control Egypt β3= 0.012 SE=0.006 (0.001-0.023) P=0.033 Tunisia β3=−0.035 SE=0.004 (0.027-0.043) P=<0.001 DRC β3= −0.007 S= 0.003 (0.002-0.008) P=<0.001 Ethiopia β3= 0.013 SE=0.002 (0.009-0.017) P=<0.001 Kenya β3=0.004 SE=0.002 (0.000 -0.007) P=0.049 Ghana β3=0.013 SE=0.002 (0.009-0.017) P=<0.001 Nigeria β3= 0.003 S=0.002 (−0.000-0.006) P=<0.054 Senegal β3=0.003 SE=0.006 (−0.008-0.014) P=0.615 South Africa	Overall, the countries recorded an increase in the incidence rate of SARS-CoV-2 after border closure. However, when compared with matched control groups, SA, Nigeria, Ghana, Egypt and Kenya showed a higher incidence rate trend. In contrast, Ethiopia, DRC and Tunisia showed a lower trend compared with their controls The implementation of border closures within African countries had minimal effect on the incidence of SARS-CoV-2.	Does not consider data at the subject level = cannot predict the likelihood of the effectiveness of the intervention at the individual level. The estimates of the overall effect of the intervention involved extrapolation, which is inevitably associated with uncertainty. The regression method assumes linear trends overtime that may not be the case for infectious disease dynamics.

							β3=0.022 SE=0.006 (0.011-0.034) P=<0.001		
Lio et al[25]	China	To clarify the efficacy of personal protective health behaviour measures, and the results may provide valuable guidance to policymakers to educate the general public about how to reduce the individual-level risk of SARS-Co-V2 infection.	Hospital confirmed cases; control participants who completed a 14-day mandatory quarantine	Personal protective measures, Physical distance, Handwashing Face masks	Case-control study Univariate and multivariate logistic regression with forward-selection stepwise method	Growth rate (aOR)	Physical contact with confirmed case: aOR =12.108 (3.380–43.376], P < 0.005 High-risk gathering (interacting with people within 2 m without mask: aOR= 12.129 (1.048-1.216) p >0.005 Handwashing after outdoor activity: aOR: 0.021 (0.003–0.134] P < 0.005 Hand Washing after touching mouth and nose: aOR: 0.303 (0.114–0.808) P < 0.05 Wearing a mask outdoors: (aOR): 0.307 (0.109–0.867), P < 0.05).	Participating in high-risk gatherings, wearing a mask whenever outdoors, and practising hand hygiene at key times should be advocated to the public to mitigate SARS-Co-V2 infection	Recall bias was inevitable. Sample size of the infected group was relatively small compared to the non-infected group- due to the unavailability of confirmed cases. Low response rate in the control group = reason for implementing an internet- based questionnaire. Lack of objective evaluation of behaviour and practice= reflect on consistency between attitude and actual behaviour. Limited to the Asian population = generalization should be thoughtfully considered.

Dreher et al[26]	United States	To assess the impact of social distancing policies on SARS-Co-V2 transmission in US states during the early outbreak phase to assess which policies were most effective	Nationwide	Stay-at-home orders aimed to encourage social distancing	Retrospective Cohort Descriptive statistics; logistic regression (univariable, multivariable); cox proportional hazards regression	Rt (OR) Case Fatality Rate (CFR)	Average Rt, −13.3% (absolute change = −0.1673, SD=0.070) HR 0.35 (0.17–0.72, p = 0.004) Week following 500th case: Rt>1 Doubling time (500 to 1000) Stay at Home Orders: OR 0.07 (0.01, 0.37 P= 0.0032) Non-essential business: OR 0.09 (0.01, 0.43 P 0.0050) Day 8-14 following 500th case: Stay at Home Orders: OR 0.16 (0.04- 0.58) P= 0.0011 Non-essential business: OR 0.21 (0.05- 0.72 P=0.023)	States with stay-at-home orders in place at the time of their 500th case were associated with lower average Rt the following week compared to states without them ($p<0.001$) ; no association between distancing efforts and case fatality rate or doubling time from 50 to 100 deaths	State-level analysis may miss variation at the county level Mobility results may be limited by potential flaws in Google's publicly available phone data Different NPIs were sometimes enacted simultaneously or soon after one another.

Xu et al[27]	China	To understand the relationships between SARS-Co-V2 infection; four personal NPIs; and public risk perception, knowledge, attitude, and other social demographic variables.	Nationwide	Handwashing, Proper coughing habits, Social distancing, Mask wearing	Cross Sectional Survey Descriptive statistics; bivariate associations between categorical variables examined using Fisher exact test; logistic regression	Incidence (RR & OR)	Increased risk of infection those who did not: Hand wash 2.28% vs 0.65% RR= 3.53 (1.53-8.15) P=0.009 Practice proper coughing 1.79% vs 0.73 RR= 2.44 (1.15-5.15) P=0.03 Social distancing 1.52% vs 0.58% RR = 2.63 (1.48-4.67) P=0.002 Mask wearing 7.41% vs 0.6% RR = 12.38 (5.81-26.36) P<0.00 Wearing a mask was the only significant predictor of SARS-Co-V2 infection among the four NPIs OR = 7.20 (2.41-23.11) p=<0.001	Mask wearing, among the four personal NPIs, was the most effective protective measure against SARS-Co-V2 infection, with added preventive effect among those who practiced all or part of the other three NPIs.	Study sample had disproportionately more female, well-educated, and less smoker respondents, reflecting a typically young and healthy cohort The generalization of the results to other settings and countries may be limited. Association between the predictors and outcomes should be interpreted with caution.
Jarvis et al[28]	UK	To evaluate whether physical distancing is sufficient to control the epidemic by estimating their impact on the reproduction number (R0, the average number of secondary cases generated per case)	Nationwide	Stay a home/isolation .	Cross Sectional A questionnaire was conducted online via email recruitment and documents the age and location of contacts and a measure of their intimacy (whether physical contact was made or not).	Ro	N= 1356 cases Pre-intervention: Ro= 2.7 (2.10-3.40) Post intervention Ro= 0.62 (0.37– 0.89)	74% reduction in the average daily number of contacts observed per participant.	Recall bias Selection bias (individuals who are adhering to physical distancing measures may have been more likely to respond to this survey) Child-child contacts not explored

Doung-Ngern et al[29]	Thailand	To evaluate the effectiveness of mask-wearing, handwashing, social distancing, and other personal protective measures against SARS-CoV-2 infection in public in Thailand.	We included contact investigations of 3 large SARS-CoV-2 clusters in nightclubs, boxing stadiums, and a state enterprise office in Thailand.	Physical distance, Handwashing Mask	Community based Case control Multilevel mixed-effects logistic regression	Incidence (aOR)	211 cases 839 controls Physical contact ≤1m: aOR =1.09 (0.58-2.07) p=0.02 >1m aOR= 0.15 (0.04-0.63) p=0.02 Duration (min) of contact in 1m >15-60: 0.67 (0.29-1.55) p=0.09 ≤ 15: 0.24 (0.07-0.90) p=0.09 Handwashing Often:0.33 (0.13-0.87) p= 0.045 Sometimes: 0.34(0.14-0.81) p= 0.045 Facemask Always: =0.23 (0.09-1.60) p=0.006 Sometimes:0.87 (0.41-1.84) p=0.006	Our findings provide evidence that mask-wearing, handwashing, and social distancing are independently associated with lower risk for SARS-CoV-2 infection in the public in community settings in Thailand.	Findings based on contacts of cases, not generalizable to all settings. Studies do not evaluate the probability of contact with a different case from the index case. only 90% of controls were tested so some of them might have been cases. Not all contacts were identified. Findings subject to common biases of retrospective case-control studies (memory bias, observer bias, and information bias).

Krishnamachari et al[30]	United States	To examine the impact of government mandated school closures, stay at home orders and mask requirements	50 states and the District of Columbia.	Face masks	Natural experiment negative binomial regression	Incidence (Cumulative rate)	Intervention at 3-6 month aOR=1.61 (1.23-2.10) *P* =0.001 Intervention after >6 months aOR=2.16 (1.64-2.88) *P*< 0 .0001	States with mask mandates made after 6 months or with no mandate had a 2.16 times higher rate than those who implemented within 1 month.	Potential weakness as the use of aggregate data from a variety of external sources is not ideal. In terms of physical distancing laws, it is unclear how each state reported their data, which may lead to a great deal of heterogeneity. The results of our study are representative only of the US.
Lyu et al[31]	United States	To identify the effects of state mandates for the use of face masks in public on the daily SARS-CoV-2 growth rate, using an event study that examined the effects over different periods.	15 States plus Washington DC	Face masks	Cross-sectional comparative Regression models using least squared weighted methods.	Case Growth Rate (CGR)	Pre-intervention 16 days or more:0 11-15 days: - 0.2 6-10 days: 0.1 Reference 1-5 days before mandate: 0 Post intervention 1-5 days: -0.9 p<0.05 6-10 days: -1.1 p<0.05 11-15 days: -1.4 p<0.05 16-20: -1.7 p<0.05 21 days or more: -2.0 p<0.05	There was a significant decline in daily SARS-CoV-2 growth rate after the mandating of face covers in public, with the effect increasing over time after the orders were signed	Unable to measure face cover use in the community or enforcement of the mandates. No data on county-level mandates for wearing face masks. Some counties might have had mandates, although the state did not. Underestimation of cases- only confirmed (by testing) cases.

Liu X. et al[32]	United States	To measure the effectiveness of nine different NPIs by assessing risk ratios (RRs) between Rt and NPIs through a generalized linear model	50 states	Interstate travel restrictions	Natural experiment Generalized linear regression	Rt (Risk Ratios)	RR Stay-at-home 51% (46–57) Face masks 29% (15–42) Gathering ban 19% (14–24), Business closure 16% (10–21) Emergency declaration 13% (8–17), Interstate travel restriction 11% (5–16) School closure 10% (7–14) Initial business closure 10% (6–14) Gathering ban 7% (2–11).	This retrospective assessment of NPIs on Rt has shown that NPIs played critical roles on epidemic control in the US in the past several months. The quantitative results could guide individualized decision making for future adjustment of NPIs in the US and other countries for SARS-CoV-2 and other similar infectious diseases.	Three parameters for estimating Rt, i.e., incubation time, reporting delay, and generation time, were not estimated using US data due to limited data availability. This may cause some bias for the estimation of Rt There are other confounders that have not been considered in evaluating the association between Rt and NPIs, such as climate factors and medical resources. Variations in the enforcement of NPIs in different states have not been considered, as more detailed data are required to quantify their impact.

Guo et al[33]	50 states and 1 territory (Virgin Islands	To investigate the associations of the Rt of SARS-CoV-2 with ambient temperature and the implementation of physical distancing interventions in the United States (US)	state level	Physical distance, school closure, workplace closure, gatherings restrictions, lockdown and public transport closing	Natural experiment Interrupted time-series model	Rt	Overall Rt reduction Physical distancing: 0.88 (0.86-0.89) School closing: 0.87 (0.86-0.89) Workplace closing: 0.88 (0.86-0.89) p<0.001 Gathering's restriction: 0.88 (0.87-0.90) p<0.001 Lockdown: 0.89 (0.88-0.91) p<0.001 Public transport closing: 0.98 (0.97-0.99) p<0.003	Increased temperature did not offset the risk of SARS-CoV-2 Rt posed by the relaxation of physical distancing implementation.	Generalising the findings to other countries Potential confounders These state-level data were relatively crude and cannot capture the within-state variations.
Alimohamadi et al[34]	Iran	To examine the effectiveness of social distance mandates on SARS-CoV-2 incidence and mortality	Nationwide	Social distancing	Quasi-experimental study Interrupted time series	Incidence & Mortality (ß)	Decrease in daily new cases and mortality post intervention New cases: $\beta 3 = -1.70(-2.30 - -1.1)$ $P<0.001$ Deaths $\beta 3 = -0.07$ (-0.1 - -0.5) $P<0.001$	The results of the present study showed that social distancing significantly reduced the incidence and mortality of SARS-CoV-2 in Iran.	The case and accuracy of diagnostic tests may have changed during the study period, which might affect the effectiveness of intervention. Population knowledge, access to healthcare and compliance might influence effectiveness of social distancing, but data about this was unavailable.

Quaife et al l[35]	Kenya	To assess if control measures have changed contact patterns and estimate the impact of changes on the basic reproduction number (R0).	five informal settlements around Nairobi	Social distancing/physical distance	Cross-sectional comparative study Examined contact patterns by demographic factors, including socioeconomic status and described the impact of SARS-CoV-2 and control measures on income and food security	Ro	Ro (IQR) Pre-intervention 2.64 Post intervention 0.60 (0.50-0.68)	Control measures reduced physical contacts by 62% and non-physical contacts by either 63% or 67%, depending on the pre-SARS-CoV-2 comparison matrix used.	Absence of baseline contact data. Adjusted datasets by the age structure of the Kenyan population, other factors such as household size were not reported and may influence the number of contacts and therefore pathogen transmission. The true reduction in contacts may be more than we estimate here The impact of different types of face masks, and real-world adherence of mask users, R0 calculations do not assume any protective effect from mask use.

Supplementary file 3, Table 2. Study Characteristics and results of studies assessing multiple interventions

Study	Country	Objectives	Setting	Intervention	Study / Statistical Method	Timeframe	Outcome/s	Results (stats)	Results/Conclusion	Limitations
Patel et al (36)	India	Impact of NPI on transmission dynamics; and to estimate the minimum level of herd immunity needed	Nationwide	Contact tracing, Expanded testing, Isolation of cases, Social distancing, Lockdown, Travel restrictions.	Natural experiment Time distribution estimated basic (Ro) and time-dependent effective (Rt) reproduction numbers using software R, and calculated doubling time, growth rate for confirmed cases.	30th January - 4th May 2020.	Rt Epidemic Doubling time (EDT) Epidemic Growth Rate (EGR)	Rt Pre-interventions = 2.51 (2.05–3.14) During = 1.23 (1.22–1.32) Post intervention 1.83 (1.71–1.93) EDT* Pre-intervention= 4.3 days, SD = 1.86 During = 5.4 days SD= 1.03 Post intervention= 10.9 days, SD = 2.19 EGR Pre-intervention= 21% Post intervention= 6%	India' s early response slowed the SARS COV-2 epidemic.	Unavailability of symptom onset data for all cases to achieve a serial interval distribution overtime. Assumed that measures issued by the government were executed timely, uniformly, and successfully throughout the country, which could not be verified independently.
Clipman et al(37)	USA	Monitoring of NPI adoption and their association with SARS-CoV-2 infection history	Maryland State	Social distance Face masks	Cross Sectional Survey to capture socio-demographically and geographically data on NPI	17th June – 28th June 2020	Incidence (aOR)	1030 individuals (100%) 68% reported strict SD indoors 53% reported strict masking indoors	Results support that strict social distancing during most activities can reduce SARS-CoV-2 transmission	Generalisability to State Internet connectivity required to participate

					adoption, access to SARS-CoV-2 testing, and examine associations with self-reported SARS-CoV-2. Logistic regression analysis.			*Association with testing positive and NPI's* -ve association with outdoor SD: Always SD = aOR =0.10 (0.03 – 0.33) Sometimes SD= aOR =0.34 (0.10-1.19) -ve association with indoor SD: Always SD = aOR 0.26 (0.08-0.90) Sometimes SD =aOR 0.32 (0.10-0.99) +ve association with public transport use: 1-2 times (weekly) = aOR 6.00 (2.13-16.9) 3-7 times (weekly) = aOR 3.80 (1.8-12.3) >7 times (weekly)= aOR 4.29 (1.12 - 16.50) +ve association with worship place visit: 1-2 times (weekly) = aOR 1.41 (0.38-5.31)		Homeless population and very low-income groups missed in survey

								>3 times (weekly)= aOR 16.0 (5.97 -42.7)		
Thu et al(38)	Multi-national (n=10)	To present the effect of the promulgation of SD measures on the spread of SARS-Co-V2 in the cases of 10 highly infected countries	USA, Spain, Italy, UK, France, Germany, Russia, Turkey, Iran and China	Travel restrictions, Facilities shutdown, Social distancing.	Natural Experiment Levels of the SD measures and the growth or decline rate of the SARS-Co-V2 daily confirmed-cases were analysed by time-series.	11th January - 2nd May, 2020	Case Growth Rate (CGR) Mortality	Weeks of intervention until a decline in cases was observed (%) Iran: 1 week =51.8% Turkey: 1 week= 50.8% Germany: 1.5 weeks =39.2% France: 2 weeks = 48% Spain: 2.5 weeks =47.7% China: 2.5 weeks = 71% Italy: 3.5 weeks= 35.8% USA: 4 Weeks =14.8% UK: 4 weeks= 25.9% Russia: no decrease in recorded period Weeks of intervention until a decrease in mortality was observed	The results showed it took 1–4 weeks from the highest level of social distancing measures promulgation until the daily confirmed-cases and deaths showed signs of decreasing. Results varied between countries, because of differences in promulgation and rates of infection at the time of promulgation.	Influence of public gatherings not considered. Small and regional measures in localities in each country not considered Significant differences between the strictness and combination of measures between countries

								Iran & Turkey = 1 week Germany = 3.5 weeks France = 4 weeks Spain =2.5 weeks China= 4.5 weeks Italy = 5.5 weeks USA = 4.5 weeks UK & Russia= no decrease in recorded period		
Zhang et al(39)	China	To investigate the impact of population movement on the spread of 2019-nCoV, and estimate the effect of travel bans	Regions in China-Nationwide	Travel Restrictions Limited population movement	Cross Sectional comparative study Assumed Poisson distribution and built a simple linear regression model	23rd January-14th February 2020	Incidence (%)	No travel restrictions: Overall case increase = 118% (91–172) Travel ban implemented: 3 days earlier = 47% (26–58) reduction (cases) 1 week earlier= 83% (78–89) reduction (cases)	Population movement makes substantial contribution to the disease spread in the early stage of the outbreak and travel bans were effective but would have been more helpful if implemented earlier	Very early-stage pandemic may influence the reliability of the incidence data utilised.
Son et al(40)	South Korea	Describe and evaluate epidemiologic al investigation results and containment measures	Busan	Contact tracing, Quarantine.	Cross Sectional Serial intervals were estimated and the effective R0 was computed	21st February-March 24, 2020.	Attack Rate (AR), Rt	N=108 cases 3,223 contacts identified and quarantined. AR AR = 8.2% (4.7 to 12.9).	Early containment strategy implemented in Busan shows control is possible if outbreaks are of limited scope.	Local data-selection bias Results may not be generalisable

								Rt Rt values, initially high and decreased to < 1		
Yehya et al(41)	USA	To assess association between timing of emergency declaration and school closures and subsequent mortality	Nationwide (n=50 states)	State of emergency declarations School closure	Cross sectional comparative study Multivariable negative binomial regression	21st January - 29th April 2020	Mortality (aMRR)	Measurement was 28 days after a state reported ≥ 10 deaths Later emergency declaration = higher mortality. aMRR Every day of delay declaring a state of emergency increased 28-day mortality by 5% aMRR =1.05 (1.00–1.09). Every day of delay implementing a school closure final mortality increased by 6% aMRR= 1.06 (1.03–1.09).	Later declarations of emergency and later school closure orders by a state were associated with higher state-level SARS-Co-V2 mortality in the United States.	Significant population based confounding factors between states Both exposures were measured at the state level, while local school districts also closed schools of their own accord prior to state orders. Death rates were based on publicly available data derived from inconsistent testing using assays with imperfect test characteristics and uneven state-level reporting.

Lau et al(42)	China	To assess the total effect travel restrictions and lockdown on the spread of SARS-Co-V2	Four economic regions of China: East, Northeast, Central and West.	Travel Restrictions Lockdown Home quarantine Cancelling events and gatherings Closing of schools, universities a nd public spaces	Cross Sectional Evaluated the correlation of domestic air traffic to the incidence and determined the growth curves within China before and after lockdown as well as after changes in SARS-Co-V2 diagnostic criteria.	23rd January - 27th of February 2020	Doubling Time (DT) Ro Correlation coefficient (R^2)	DT Pre-intervention: 2 days (1.9–2.6) Post intervention: 4 days (3.5–4.3) Pre-Intervention Central China & Hubei 5.5 ± 1.5 and 375 Eastern 9 ± 2.6 Western 4.2 ± 1 North-eastern 2 ± 0.3 Post Intervention Central China & Hubei 594 ± 252 and 22112 Eastern 380.10 ± 90 Western 136 ± 41 North-eastern 121 ± 53 Correlation of confirmed cases to domestic passengers Ro Pre-intervention: Ro = 0.98 Post intervention: Ro =0.91	A significantly decreased growth rate and increased doubling time of cases was observed, which is most likely due to Chinese lockdown measures. A more stringent confinement of people in high-risk areas seems to have a potential to slow down the spread of SARS-Co-V2	Data unable to differentiate which of the stringent measures were most successful, analyses only assessed the efficacy of the totality of these measures Available data on air traffic was limited.

								<u>R^2</u> Pre-intervention: R^2= 0.97, (P <0.05) Post intervention R^2 = 0.83 (P =NS).		
Pan et al(43)	China	To assess the association of public health interventions with improved control of the SARS-Co-V2 outbreak in Wuhan, China	Wuhan	Cordons sanitaire, Traffic restriction, Social distancing, Home quarantine, Centralized quarantine, Universal symptom screening.	Cohort study n = 32,583 patients with laboratory-confirmed cases, classification of 5 time periods to reflect the evolving dynamics of COVID	8th December 2019 - 8th March 2020	Rt	<u>Rt</u> No intervention: Rt= 3.82 Post Intervention- (without *symptom survey):* Rt below 1.0 (Feb 6) Post Intervention (*with symptom survey)*: Rt below 0.3 (Mar 1)	A series of multifaceted public health interventions was temporally associated with improved control of the SARS-Co-V2 outbreak in Wuhan, China.	Individual strategies could not be evaluated due to multiple interventions implemented Data did not have further information on other epidemiological variables and clinical characteristics. (e.g., incubation period, time to hospitalization, time to discharge, medical treatment strategies, and vital status, diagnostic testing pattern, ascertainment rate, and proportion of asymptomatic cases.

Courtemanche et al(44)	USA	To evaluate the impact of SD measures on the growth rate of confirmed SARS-Co-V2 cases across US counties	2,477 counties in the South and Midwest	School closures, Closures of entertainment venues, gyms, bars, and restaurant dining areas Shelter-in-place orders (SIPO)	Cross Sectional Comparative study Estimated the relationship between SD policies and the exponential growth rate, using an event study regression with multiple policies.	5th March - 25th April 2020	Daily growth rate (DGR)	*SIPO Measure* 1- 5 days: 2.4 percentage points 6-10 days: 3.9 percentage points 11-15 days: 5.3 percentage points 16-20 days: 8 percentage points *Business Closure:* 1-5 days: 5 percentage points <16 days: 6.2 percentage points *Combined effect of all SD measures:* 1- 5 days: 5.4 percentage point (P=0.16) 6-10 days: 6.8 percentage points (P=0.005) 11-15 days: 8.2 percentage points (P=0.12) 16-20 days: 9.1 percentage points (P=0.005)	There would have been ten times greater spread of SARS-Co-V2 by April 27 without shelter-in-place orders (ten million cases). More than thirty-five times greater spread without any of the four measures (thirty-five million cases)	Official case counts are unknown The number of tests performed was controlled for state, rather than county level.

								Percentage point = growth rate multiplied by 100, read as percentage point changes.		
Wang K et al(45)	China	To compare the epidemiological characteristics in Jiangsu Province and assess whether so-called wartime control measures changed the trend of coronavirus disease 2019	Jiangsu Province	Lockdown, Limit population mobility, Restricted crowded activities, School closures.	Cross Sectional Comparator Time series of observations from January 22 to February 18, 2020 obtained from the government websites. The dates of illness onset and the geographical locations of cases were plotted	22nd January - 27th February 2020	Incidence	Incidence (cumulative) = 631 cases Daily incidence declined 30th Jan - 39 5th Feb - 45 Feb 17th - 3 Feb 18th - 2 Feb 19th - 0 Feb 19-27th -No new cases were confirmed after	Wartime control measures, such as putting cities on lockdown to limit population mobility in Jiangsu Province, resulted in dramatic reductions in SARS-Co-V2 cases	The influence of confounding factors cannot be excluded Websites where data sourced, lacked detailed case information. Based on the time of diagnosis instead of the time of onset, the time distribution of cases resulted in the effect of time lag on the epidemic and error of the incubation calculation
Ruan et al(46) (	China	Effectiveness of different responses in 4 affected Chinese cities in preventing the SARS-Co-V2 spread.	4 cities Wenzhou in Zhejiang Province and Jingzhou, Xiaogan and Huanggang) in Hubei Province	Universal lockdown, Social and physical distance, Contact tracing,	Natural Experiment Epidemic growth rate was estimated by analysing the number of the confirmed cases. Transmission model in	17th January - 17th March 2020	Case Fatality Rate (CFR)	*Wenzhou:* Stringent measures: 31st January Incidence peak 31st Jan, declined, no second peak. CRF: Wenzhou= 0.2% Recovery Rate: 99.6%; (502/504)	Stringent control measures in Wenzhou controlled outbreak lowering incidence and mortality, when other areas mirrored these measures declines in incidence were demonstrated	The influence of confounding factors cannot be excluded Data from early in the pandemic may be incomplete or unreliable

				Quarantine.	Wenzhou was established using the data-driven network modelling analysis methods			*<u>Huanggang, Xiaogan and Jingzhou:</u>* Stringent measures: 10-15 Feb Experienced 2nd and 3rd incidence peaks after 31st January. <u>Recovery Rate:</u> Huanggang: 93.5%; 2720/2907) Jingzhou: 92.6%; 1464/1580), Xiaogan: 91.1%; 3204/3518) <u>CFR:</u> Huanggang=4.2% Jingzhou=3.1% Xiaogan= 3.5% <u>National, Hubei Province, Wuhan, Regions outside of Hubei.</u> <u>Recovery rate:</u> Nationwide: 79.3%; 64111/80813),		

								Wuhan: 70.4%; 35197/49991), CFR: China= 3.9% Hubei=4.5% Wuhan=4.9% Regions outside of Hubei= 0.87%		
Rubin et al (47)	USA	To examine the association between instantaneous reproduction number (SARS-CoV-2) with social distancing, wet-bulb temperature, and population density in counties across the United States	Statewide 211 counties across 46 states	Social distancing, measured by percentage change in visits to nonessential businesses;	Cross Sectional Comparator Hierarchical linear mixed-effects model with random intercepts	25th February - 23rd April 2020	Rt	Rt ratios associated with % decrease in visits to non-essential businesses 25% - 0.73 (0.71-0.75) 50% - 0.54 (0.51-0.57) 75% - 0.40 (0.36-0.43) p<0.001	Social distancing, lower population density, and temperate weather were associated with a decreased Rt for SARS-CoV-2 in counties across the United States.	Very local data, results may not be generalisable Temperature associations observed might have been confounded by the time period in the analysis. Increases in testing capacity might have biased the models by inflating the total cases reported within each county The influence of additional confounding

										factors cannot be excluded
Juni et al(48)	Global	To determine whether epidemic growth is globally associated with climate or public health interventions intended to reduce transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).	Global 144 geopolitical areas worldwide (Excluding China, South Korea, Iran and Italy)	Social distance, Restriction on mass gatherings, School closures.	Prospective cohort study Weighted random-effects regression	7th March - 27th March 2020	Incidence (Cumulative)[RRR]	*Composite of any public health intervention* RRR =0.62, (0.53–0.73) *Restrictions of mass gatherings* RRR =0.65, (0.53–0.79) *School closures* RRR =0.63 (0.52–0.78) *Measures of social distancing* RRR= 0.62 (0.45–0.85) P = < 0.001 The negative association was more pronounced in geopolitical areas that had 2 or 3 public health interventions compared with regions	These findings suggest that seasonality is likely to play only a minor role in the epidemiology of SARS-Co-V2, while public health interventions (school closures, restricting mass gatherings, social distancing) appear to have a major impact	Heterogeneity in testing practices between different geopolitical areas - actual rates of SARS-Co-V2 could not be reliably estimated.

								that had implemented 1 intervention.		
Bendavid et al(49)	England,France, Germany, Iran, Italy, Netherlands, Spain, South Korea, Sweden, The United States	To evaluate the effects on epidemic case growth of more restrictive NPIs (mrNPIs), above and beyond those of less-restrictive NPIs (lrNPIs)	Subnational administrative regions of each country	*mrNPI's* stay-at-home, business & school closures, social distancing, local domestic and international travel bans restriction on mass gatherings *lrNPIs* social distancing, discourage international and domestic travel and a ban on large gatherings. testing, contact tracing and isolation of infected and close contacts.	Quasi Experimental First difference models with fixed effects that isolate the effect of mrNPIs (in England, France, Germany, Iran, Italy, Netherlands, Spain and the United States) by subtracting the effect of lrNPIs and epidemic dynamics.	March - May 2020	Daily growth Rate (DGR)	DGR* in all 10 countries prior to intervention: DGR= 0.32 This ranged between: Spain 0.23 (0.13 - 0.34) Netherlands 0.47 (0.39 - 0.55) The combined effects of all NPIs was a significant reduction in the DGR in 9 out of 10 countries ranging from: −0.10 (-0.06 - −0.13) in England to −0.33 (−0.09 to −0.57) in South Korea. With the exclusion of Spain 0 (−0.02: −0.12 - 0.07).	NPIs were associated with statistically significant reduction in case growth for 9 of the 10 countries. However, mrNPIs alone did not reach a significant beneficial effect on case growth in any country. The study failed to find strong evidence supporting more restrictive NPIs.	Limitations associated with cross-country comparisons such as; Measurement bias, Cultural differences in the view and adherence to NPIs, Differences in NPI policies that could introduce bias in the estimated effects.

								Results did not support the use of mrNPI's over lrNPI's		
Yeoh et al(50)	Hong Kong, Japan, Malaysia, Shanghai, Singapore, South Korea, and Taiwan	To compare the impact of NPIs in seven western pacific region countries by quantifying the transmissibility and severity of SARS-Co-V2 infections in different phases of the pandemic during the first five months	Nationwide	Travel restrictions Social distancing.	Natural Experiment Bayesian regression model sampling the posterior means of the piecewise reproduction numbers. CRF estimated by dividing the cumulative number of deaths by the cumulative number of cases on their date of confirmation.	January - May 2020	Rt Case-fatality rate adjusted (aCFR)	*Rt Pre-intervention; Intervention First Wave; Intervention Second Wave:* Hong Kong 2.35 (2.35–2.65) 0.42 (0.29–0.55) 0.42 (0.29–0.55) Japan 1.91 (1.61–2.21) NS Malaysia 2.93 (2.54–3.30) >1 5.73 (4.10–7.26) Shanghai 3.36 (3.12–3.59) 0.28 (0.10–0.46) 0.09 (0.00–0.24)	NPIs were able to reduce the transmissibility of SARS-Co-V2 in seven jurisdictions of the WPR. Comparatively lower CFR was seen in WPR, maybe be representative of health system capacity Implementing NPIs was associated with an apparent reduction of the piecewise *Rt* in two epidemic waves in general. However, large cluster outbreaks and relaxing the NPIs could result in an increase of *Rt*.	Bias due to underestimation of cases and deaths Not pooled estimate of the effect of NPIs in Rt or case fatality rate Variation in measures via country CFR can vary as a result of population composition, ascertainment bias and climatic conditions.

								Singapore 3.70 (3.14–4.25) 0.75(0.38–1.14) 3.02 (2.39–3.65) South Korea 0.15 (1.85–2.50) >1; 0.61 (0.43–0.80) Taiwan 1.83 (1.54–2.12) 0.41 (0.17–0.65 0.12 (0.01–0.28) *Estimated dFCR* Hong Kong 0.47% (0.01-0.93) Japan 5.31% (4.97-6.65) Malaysia 0.33% (0.20–0.47) Shanghai 1.05% (0.27–1.82)		

								Singapore,0.09% (0.05- .12) South Korea 0.20% (0.11–0.28) Taiwan 1.59% (0.43–2.75)		
Erim et al(51)	Nigeria	To measure the association of closures and restrictions with aggregate mobility and the association of mobility with SARS-CoV-2 infections and to characterize community spread	Nationwide	Business and leisure facilities closure	Cross-sectional Interrupted time series and negative binomial regression	Data 27th February - 21st July 2020 Measures 30th March - 4th May, 2020	Incidence	Incidence Each percentage point increase in aggregate daily mobility saw the corresponding increase in incidence Retail and Recreation: IRR= 0.99 (0.97- 1.02 P 0.56) Grocery and pharmacy: IRR= 1.00 (0.99 - 1.02 p 0.96) Parks: IRR= 0.99 (0.97 - 1.01 p 0.19) Transit stations: IRR= 1.02 (1- 1.03) p 0.008)	Government-mandated closures and restrictions in Nigeria owing to SARS-Co-V2 had significant associations with aggregate mobility and may have been associated with averting up to 5.8 million SARS-CoV-2 infections	Unmeasured confounders Limited information on the accuracy of mobility categories No suitable controls for comparison No assessment of travel bans on visits, international or domestic flights. Heterogeneity between states in closures and restrictions

								Workplaces: IRR= 1.01 (1- 1.02) p 0.04) Residential areas: IRR= 1.03 (1- 1.07 p 0.04)		
Wahaibi et al(52)	Oman	To investigate the different responses to NPIs, across different populations a nd assess the use of the time-varying reproduction number (Rt) to monitor them.	Nationwide	closures of schools and workplaces, service industry establishment, outdoor recreational facilities, Cancellations of public events, Closures of state borders, Travel restriction, Quarantine	Natural Experiment Time-varying reproduction number was calculated using Epicontacts and EpiEstim. The comparison of Rt values for the different groups was performed using a simple line plot.	March - April 2020	Rt	*Pre-Intervention in mid-March:* Rt 3.7 (2.8-4.6) *Post Intervention:* Late March: Rt 1.4 (1.2-1.7) Late April: Rt 1.2 (1.1 1.3) *Response to NPI's between migrant and non-migrant groups* Non-Migrant - response evident earlier: *R*t to 1.09 (0.84–1.3) by the end of March Migrant response delayed: *R*t for the non-Omani group, reaching	There was a marked reduction in the reproduction number for SARS-Co-V2 infections in Oman in response to the major public health control (NPIs) introduced by the government. This response differed between population groups.	Daily time series of SARS-Co-V2 incidence, epidemic curves of reported cases may not always reflect the true epidemic growth rate Limited diagnostic testing capacity during the early epidemic phase. Increasing number of sporadic cases by the end of the study period indicates a lag in the identification and hence classification of the source of infection.

								0.9 (0.8–1.1) by mid-April (post closure of key market retail)		
Tsai et al(53)	United States	To estimate the extent to which relaxation of social distancing affected epidemic control, as indicated by the time-varying, state-specific effective reproduction number (Rt).	Nationwide	Closures of schools and workplaces, Closures of service industry establishment, outdoor recreational facilities, Cancellations of public events, restrictions on internal movement, Closures of state borders	Cross-sectional study Comparator Segmented linear regression	10 March - 15 July 2020	Rt	During the 8 weeks prior to the first date in each state that social distancing measures relaxed, estimated R_t declined by an average of 0.012 per day (−0.013 - −0.012) Relaxation of SD measures increase Rt*: 0.019 per day (0 .018-0.020) 56 days post relaxation mean: Rt 1.16 (1.13–1.18) *Estimated Rt*	The study found an immediate and significant reversal in SARS-CoV-2 epidemic suppression after relaxation of social distancing measures across the United States. Premature relaxation of social distancing measures undermined the country's ability to control the disease burden associated with SARS-Co-V2.	The influence of confounding factors cannot be excluded Variation in measures across jurisdictions

								Day prior to relaxation: 0.761 (0.728-0.793) p= <0.001) Pre relaxation period: : -0.012 (-0.013 - -0.012) p= <0.001) Post relaxation period intercept: 0.032 (0.01 – 0.054) p= 0.005 Time × post relaxation period: 0.019 (0.018 - 0.02) p= <0.001) Post relaxation period: 0.007 (0.006 – 0.007) p= <0.001)		
Dasgupta et al(54)	United States	To examine differences in the probability of rapid riser identification by implementation of mitigation policies: state-wide closures	State Level	State-wide Lockdown Mask mandates	Cross Sectional Comparative Poisson regression	1st June - 30th September 2020	Prevalence ratios adjusted (aPR)	Counties in states that closed for 0–59 days were more likely to become a rapid riser county than those that closed for >59 days.	Results underscore the potential value of community mitigation strategies in limiting the SARS-Co-V2 spread, especially in	Heterogeneity in type and implementation of measures were not incorporated in this study.

		and state-wide mask mandates						0 days: aPR= 1.45 (1.17–1.79); 1–29 days: aPR = 2.19 (1.94–2.48) 30–50 days: aPR = 1.79 (1.58–2.04) 51–59 days: aPR = 1.61 (1.42–1.83) The probability of becoming a rapid riser county was 43% lower among counties that had state-wide mask mandates at reopening: aPR 0.57; (0.51–0.63)	nonmetropolitan areas.	Variation in incidence between regions Universal compliance with mandatory state-wide mitigation measures was not likely.
Qureshi et al(55)	119 geographic regions, derived from 41 states within the United States and 78 other countries.	To estimate the effect of timing of mandated social distancing on the rate of SARS-Co-V2 cases in 119 geographic regions, derived from 41 states within the United States and 78 other countries.	Nationwide	closure of educational institutes, Public transport, restaurants, and other shops	Cross Sectional Comparative study Linear regression	9th March - 15th April 2020	Growth Rate (per million persons) (β)	Highest number of new cases per day/million persons significantly associated with the total number of cases per million persons on the day before mandated social distancing $\beta = 0.66$ ($P < 0.0001$) Subgroup analysis on those regions where the highest number of new cases per day has peaked showed increase: $\beta = 0.85$ ($P < 0.0001$)	Initiating mandated social distancing when the numbers of SARS-CoV-2 cases are low within a region significantly reduces the number of new daily SARS-Co-V2 cases and perhaps also reduces the total number of cases in the region.	Variability in policies pertaining to mandated social distancing and compliance to the policies in various geographic regions. Confounding effect of case identification and isolation, and robustness of testing for asymptomatic individuals, between regions

								This was also demonstrated for outbreaks: β= 0.97 (*P* < 0.0001)		There were certain analyses that could not be performed for all the regions included in the present study as the pandemic is ongoing.
Piovani et al(56)	37 countries	To estimate the effect of early application of social distancing interventions on SARS-Co-V2 cumulative mortality during the first pandemic wave.	37 countries SARS-Co-V2 surveillance	Social distancing interventions: closure of schools and workplaces, restrictions on mass gatherings (a combination of ban of public events and restriction on the number of people gathering in the same place)	Cross sectional comparator Multivariable negative binomial regression	1st January - 30th June 202 0	Mortality	Mortality (cumulative): Mass gatherings ban (one-day delay) increased 6.97% (0.34-10.50 P= <0.001) School closures (one-day delay) increased: 4.37% (1.58 - 7.17) p= 0.002 Interventions implemented one week earlier, SARS-Co-V2 cumulative mortality could have been reduced: 44.1% (20.2 - 67.9)	Early application of mass gatherings bans and school closures in outbreak epicentres was associated with an important reduction in SARS-Co-V2 cumulative mortality during the first pandemic wave.	Multiple social distancing interventions enacted- cannot exclude that a portion of the predicted effect may have been related to other, concurrent, policies applied. SARS-Co-V2 deaths could be underreported especially in countries with a very high SARS-Co-V2 mortality.
Timelli et al(57)	Italy	To evaluate if incidence in different regions at the time of implementatio	Nationwide	Closures of schools,	Natural Experiment	11th March - 11th May 2020	Mortality (Correlation coefficients)	low cumulative Incidence at time of beginning of measures <265 cases/100,000	Level of cumulative incidence at the moment of lockdown is important to	Study did not consider confounding factors

		n of NPIs affected CI and had an impact on the healthcare system in terms of ICU bed occupancy and mortality rates.		Cancellations of public event, Social distancing, Quarantine, Nationwide lockdown	The temporal daily trend, on a logarithmic scale of cumulative incidence (CI). Mortality rate at the end of period. Scatterplot was visualized pairing the delay and CI at the end of the period for each Region and a correlation coefficient was calculated.			hospitalised in ICU did not exceed 79.4% mortality <0.27/1000 high cumulative Incidence at time of beginning of measures 382-921 cases/100,000 hospitalised in ICU = 270% mortality= 1.5/1000	control the subsequent spread of infection so NPIs should be adopted very early during the course of the epidemic, in order to mitigate the impact on the healthcare system and to reduce related mortality.	Measures implemented and course of the pandemic varied between regions The data used to aggregate the regional reported daily new cases does not permit a more in-depth analysis.
Bo et al(58)	190 countries	To evaluate and compare the effectiveness of four types of non-pharmaceutical interventions (NPIs) to contain the time-varying effective reproduction number (Rt) of coronavirus disease-2019 (SARS-Co-V2)	190 countries SARS-Co-V2 surveillance	Face mask in public, Isolation or quarantine, Social distancing Traffic restriction	Natural Experiment Generalised linear mixed model (GLMM)	23th January and 13th April 2020	Rt (%)	Single measure Mandatory mask −15.14% (-21.79 - -7.93) p<0.001) Quarantine: −11.40% (-13.66 - -9.07 p=<0.001) Distancing: −42.94% (-44.24 - -41.60) P=<0.001) Traffic: −9.26% (-11.46 - -7.0) P=<0.001) *Any 2 measures* Traffic + mandatory mask:	Distancing and the simultaneous implementation of two or more NPIs should be the strategic priorities for containing SARS-Co-V2.	Unable to account for the intensity and people's compliance of measures. The contents of each NPI at different sites are different. A few NPIs, such as knowledge promotion, voluntary isolation and voluntarily wearing a mask were not considered.

								-66.58 % (-92.67- 52.41) Traffic + distancing: -44.11% (-46.37 -- 41.76) P<0.001 *Any 3 measures* Distancing + quarantine + mandatory mask: -69.73% (-82.48 to - 47.69) P<0.001 Distancing + traffic + mandatory mask: -54.12% (-55.63- - 52.56) P<0.001 All four NPI's : -62.81 (-66.27- - 58.98) P<0.001		Cultural factors such as personal hygiene, social habits and family size may influence. Information of testing capacities in each site was not available. The effects of not separating infected persons remain unknown. The effects of different NPIs may be highly correlated- contradict the assumption of independent covariates in GLMM model.

Koh et al(59)	170 countries	Evaluates the effectiveness of different physical distancing measures in controlling viral transmission	Nationwide	School and workplace closures; public transport Cancellation of public events; Restrictions on size of gatherings, Stay-at-home orders, Restrictions on internal movements, Restrictions on international travel.	Cross Sectional Comparative study Regression	1 January - 28th May 2020	Rt	<u>No measures being taken, a total border closure</u> Rt reduces by 0.24 (-0.50- 0.01) <u>*Early Implementation*</u>- work from home and stay at home recommendations Rt reduces by 0.45 (-0.82- -0.07) <u>Partial lockdown</u> Rt reduces by 0.38 (-0.72- -0.04); <u>Complete lockdown</u> Rt reduces by 0.32 (-0.55- -0.09).	A combination of physical distancing measures, if implemented early, can be effective in containing SARS-Co-V2—tight border controls to limit importation of cases, encouraging physical distancing, moderately stringent measures such as working from home, and a full lockdown in the case of a probable uncontrolled outbreak	The influence of confounding factors cannot be excluded Potential reporting errors or data quality issue of the OxCGRT database The country-level analysis may miss the variation of policies implemented at the city/county/province level.
Tariq et al(60)	Chile	The effectiveness of 23 interventions, especially the effectiveness of lockdowns by conducting short-term forecasts based on the 24 early transmission	Nationwide	Border closures, School closures Ban on social gatherings,	Cross-sectional study Phenomenological growth models	March - October 2020	Growth rate	<u>Pre-intervention:</u> R= 1.8 (1.6-1.9) <u>Post intervention</u>: R= 0.87 (0.84-0.89)	Implementation of lockdowns and social distancing interventions slowed the spread of the virus. However, the number of new SARS-Co-V2 cases continue to accumulate, underscoring the	Study analyses cases by the dates of reporting while it is ideal to analyse the cases by the dates of onset or after adjusting for reporting delays.

		dynamics of SARS-Co-V2.		Lockdown, Business closures, Facemasks					need for persistent social distancing and active contact tracing efforts to maintain the epidemic under control.	Substantial fraction of the infections exhibits very mild/no symptoms = not be reflected by data. Data are not stratified by local and imported cases- assumed that all cases contribute equally to the transmission dynamics. Selective under reporting, and its impact on these results is difficult to assess.
Malheiro et al(61)	Portugal	This study aimed to assess the effectiveness of contact tracing and quarantine measures (in combination with case isolation) on reducing transmission of SARS-CoV-2 in Eastern Porto, Portugal, from March 1st,	Porto City	Contact tracing, Quarantine, Close contact isolation.	Retrospective cohort study Chi-squared and Mann-Whitney U tests	1st March - 30th April 2020.	Attack rate (AR)	N= 551 N (intervention) =98 N (Control) = 453 No differences were observed between groups when comparing the median number of secondary cases by index case and the proportion of cases with secondary cases.	Local public health measures were effective in reducing the time between symptom onset and laboratory diagnosis and the number of close contacts per case.	Some contacts = not identified with all downstream implications. Travelers from affected countries are often unknown to local authorities thus, limiting the ability to block the transmission chain in this population. Some cases may have been under

		2020 to May 15th, 2020.						AR Intervention group= 12.1 (7.1- 18.9) control group = 9.2 (7.8- 10.8) Secondary cases Intervention= 16 Control = 138		surveillance by another local public health authority- misclassified as control, which may contribute to the underestimation of the true effects Residual confounding.
Tchole et al(62)	Niger	This study aimed to investigate the epidemiological characteristics and transmission dynamics of SARS-Co-V2 in Niger, evaluate the effects of control measures, estimate the burden of SARS-Co-V2,	Nationwide	Prohibition of public gatherings, Travelling ban, Contact tracing, Isolation and quarantine at home	Cross-sectional study Kulldorff 's purely spatial scan statistics	19th March - 4th July 2020	Rt	*Rt* Pre-Intervention 6.7 Post intervention >1	Classic public health control measures are proved to be effective to contain the outbreak in Niger	Lack of laboratory tests might have created delays in identifying cases, and the number of reported cases might be underestimated. The health care resources were disproportionately distributed across Niger Public awareness of SARS-Co-V2 in distant areas was relatively low. CFR and DALYs in Niger might have been underestimated.

Singh et al(63)	United States	To assess the impact of introducing and lifting NPIs on daily growth rate of SARS-CoV 2 cases and mobility.	Nationwide	Lockdown, Business closure, Limited gatherings, School closures, Physical distancing	Quasi experimental We exploit the spatial and temporal variation in the introduction and lifting of NPIs across counties using a staggered difference-in-differences (DID) approach. For implementation of NPIs, we compare counties with NPIs in place (treated) with counties that do not have NPIs in place (control) before and after implementation.	1st January - 3rd June 2020	Daily growth rate [DGR] (Per 100,000)	DGR* Implementing NPIs = -2.019 SE= 0.298 p < 0.01. Lifting NPIs = 1.002 SE = 0.243 p < 0.01.	NPIs are effective in reducing cases but only up to 12 weeks. Implementing one NPI leads to a reduction of the daily SARS-Co-V2 growth rate by 176 cases per 100,000. However, lifting one NPI leads to a significant increase in the daily growth rate of 354cases per 100,000.	Analysis does not allow the assessment of each NPI individually Control for testing at the state level rather than county level. Some businesses may have shut or reopened without a county-wide mandate leading to an underestimation of estimated effects
McCreesh et al(64)	South Africa	To estimate the impact of physical distancing measures on interpersonal contact on the spread of SARS-Co-V2	Rural and lower income settings	Mandatory stay at home, Business closures, Restrictions on public gatherings,	Cross sectional comparative Compared population-representative social contact surveys, Built a mixing matrix, estimated reproduction number, bootstrapped	March-May 2020	Ro	N= 1704 Mean (95% PR) p-value Survey 1 (Mar-Dec 2019) - 41.7% (13.60 - 59.1) P=0.004 Survey 2 (Jun-Jul) - 45.1% (24.2-60.8) P<0.001)	National physical distancing rules decreased the rates of inter-household contact, resulting in a fall in the R number	Limitations of observational studies. Recall bias.

				Banning of inter-household contact	samples, logistic or linear bivariate regression and indicator variables, several sensitivity analyses			Survey 3 (Jul-Aug)- 2.3% (-53.0 - 43.5) =0.4		
Haapanen et al(65)	Finland	To describe the effect of closures and reopening of day-care facilities and school on respiratory pathogen epidemiology	Schools & day-cares	School closures, Day-care closure Lockdown	Retrospective study Poisson's exact regression, Incidence rate ratios	16th March - 1st August 2020	Incidence (IRR)	*Incidence during lockdown (Week 1-9): 5.13/100,000 (3.95-6.59) *Incidence after schools & day-cares re-opened (Week 10-11): 2.65/100,000 (1.85-3.7) *Incidence during vacations (Week 12-20): 0.95/100,000 (0.5-1.83) *Incidence after schools & day-cares continued - 2.8/100,000 (2.00-3.88)	Incidence of SARS-Cov-2, started to decline eight weeks after the lockdown began. Lockdown and social distancing can reduce infections and have effects lasting several weeks	Hospital based data Absence of nationwide numbers of primary care and hospital visits due to infectious disease. Missing number of tests performed for other pathogens, since the testing numbers are not recorded to the register

Islam et al(66)	Global (n=149)	To assess the association between physical distancing and incidence of SARS-Co-V2	n=149 countries or regions	Social distancing, School closures, Workplace closures, Restrictions on mass gatherings, Lockdown.	Natural experiment. Interrupted time series analysis with meta-analysis.	1st January - 30th May 2020	Incidence rate ratios (IRR)	Any social distancing measures was seen to reduce incidence by 13% - IRR 0.87, (0.85-0.89 n=149) 5 measures: IRR 0.87 (0.85-0.90) n=118 countries 4 measures: IRR 0.85 (0.82- 0.89) n=25 countries 3 measures: IRR 0.88 (0.77-1.00) n= 4 countries Early implementation lockdown IRR 0.86, (0.84 to 0.89) n=105 countries Later implementation IRR 0.90, (0.87 to 0.94) n=41 countries	Physical distancing intervention associated with an overall reduction in SARS-Co-V2 incidence of 13%. No evidence was found of additional benefits from closure of public transport when four other physical distancing measures	Reliance solely on Oxford response tracker Local and cultural factors affecting implementation of interventions Difficult to interpret combination and sequence of interventions Optimum time for lifting restrictions undefined
Ghosal et al(67)	Multi-national (n=14)	To assess the impact of lockdown on the rate of change in infection and	Worldwide	Lockdown	Natural Experiment Total infection and death rates	March-May 2020	Incidence Mortality	*__Incidence__* *__1-week post lockdown:__*	Very strong exponential decay in both the rates of infection and death overtime after lockdown was	Non-exclusion of other countries in lockdown- steered results in a different direction

		death rates over a period			at baseline and weeks prior to lockdown vs rates of total infection and death change at the end of 4 weeks lockdown			61% incidence reduction overall 43% reduction in overall India cohorts <u>Mortality</u> *<u>4 weeks post lockdown:</u>* Rates of Infection R^2 0.995 Mortality R^2: 0.979	declared in the overall cohort.	Absence of a comparative arm. Other variables both objective as well as subjective, which could have influenced the outcomes
McGrail et al(68)	Global (n=134) USA	To assess the efficacy of social distancing	n=134 countries or regions	Workplace's closure Schools closure, Physical spacing	Natural experiment Generalised linear mixed-effects model taking each country as a random effect.	2-week period - March - June, 2020	Spread rate (Rt)	Reduction in Rt was proportional to reduction in Mobility. <u>Net change in Rt in states that did and did not implement SD policies.</u> No policy = -0.07 SD policy = -0.26 47 US states: R= 0.32, P = 0.02 Global: R = 0.57, P =1.8x10-8	Social distancing policies globally significantly reduced the SARS-Co-V2 spread rate, resulting in an estimated 65% reduction (39–80) in new SARS-Co-V2 cases over a two-week time period.	Reliance on direct SARS-Co-V-2 testing- underestimate prevalence when compared to antibody-based serology testing approaches.
Castillo et al(69)	USA	To examine the effect of the stay-at-home policies on the rate of increase in	42 states and the District of Columbia	Stay at home Social Isolation	Quasi Experimental Cases were tracked before and after state-	19th March -7th April 2020	Incidence	<u>Average rate of increase per day</u> pre-intervention: 0.11 (0.11-0.12) post intervention: 0.05 (0.05- 0.05)	Reduction from ~12% more cases per day (and thus a 5 to 6-day doubling rate) to 5% more cases per day (and thus a 14-	Impossible to isolate the effect of these orders against the background of numerous other local, state, and federal

		SARS-Co-V2 diagnoses			level stay-at-home orders; Linear regression determined slopes for log case count data, and meta-analyses combined data across states			Number of days (standardized mean difference): Pre-pooled = 3.8 (3.65-4.04) P <.0001 Post = 4.22 (4.01-4.44) P < .0001 *Number of cases (standardized mean difference):* Pre-pooled= 6.84 (6.83- 6.86) P< .0001) Post = 6.81 (6.79-6.82) P < .0001)	day doubling rate).	interventions occurring at the same time. States implemented stay-at-home orders in response to the pandemic thus, observations are profoundly threatened by selection and indication biases. Threat of regression to the mean if stay-at-home orders were consistently placed at the peak of epidemic growth. Endogenous relationship between case counts and both the availability and use of testing
Wang J et al(70)	China	To estimate the incidence of 2019-nCoV infection among people under home quarantine in Shenzhen, China	Shenzhen	Lockdown, Social distance,	Cross Sectional Comparative study A stratified multistage random sampling method used to	22nd January - 20th February 2020	Incidence	N=2004 in home quarantine N=1637 completed the survey. Incidence= 1.5% (0.31 –4.37)	Home quarantine has been effective in preventing the early transmission of SARS-Co-V2, but more needs to be done to improve early	Nasopharyngeal swab sample collected once. Laboratory results may show false negatives.

				Business closures, Quarantine and isolation of close contacts Airport screening.	recruit participants and collected demographic information and laboratory results of people under home quarantine				detection of SARS-Co-V2 infection	This is a sampling survey not a census Incidence calculated in this study may not be representative for all the people under home quarantine
Ryu et al(71)	South Korea	To evaluate the effect of NPI's implemented in South Korea during the SARS-Co-V-2 outbreak on the virus transmissibilit y and suppressed local spread	Nationwide	Travel related measures Screening Social distancing measures	Cross sectional comparator Time-varying reproduction number was calculated	20th January - 21st April 2020	Rt	N = 2066 cases <u>Pre-intervention:</u> Mean Rt 2.23 (2.05-2.4) <u>Post intervention:</u> Mean Rt: 1.48 (1.36-1.60) 33.6% (23.46–43.44) reduction in transmissibility.	The findings suggest that the nonpharmaceutic al interventions implemented in South Korea during the SARS-Co-V2 outbreak effectively reduced virus transmissibility and suppressed local spread.	Study did not include the large, clustered cases reported as superspreading events because they would overestimate Rt. Uncertain on how many cases were still undetected. Time delay on self-reported data, and at risk of reporting (recall) bias. Inaccuracies in the information used for analysis as there was huge reliance on government-

										generated data, including dates of symptom onset, were not available.
Liu H, et al(72)	United States	We quantified the association between public compliance with social distancing measures and the spread of SARS-CoV-2 during the first wave of the epidemic (March–May 2020) in 5 states that accounted for half of the total number of COVID-19 cases in the United States.	5 States (California, Illinois, Massachusetts, New Jersey, and New York)	Stay-at-home Bans on large events, Closures of schools, entertainment venues, and non-essential businesses	Cross sectional comparative daily growth rate, yt = y(t - 1)(1 + r); descriptive stats; Kruskal–Wallis test; auto-regressive model	March-May 2020	Rt Daily growth (DG)	Rt Pre-intervention New York: 5.21 (5.10-5.31) New Jersey: 4.14 (3.86-4.42) Illinois: 4.21 (3.86-4.57) Massachusetts: 2.41 (2.21-2.61) California: 2.41(2.24-2.60) Post intervention New York: 0.85(0.83-0.86) New Jersey: 0.92(0.90-0.94) Illinois: 0.72 (0.71-0.73) Massachusetts: 0.76 (0.74-0.78) California: 1.19 (1.18-1.21) DG	Social distancing is an effective strategy to reduce the incidence of SARS-CoV-2 and illustrates the role of public compliance with social distancing measures to achieve public health benefits.	Estimated the daily reproduction number and daily growth rate based on reported cases. Case ascertainment improved during the study period and may have introduced bias 2 quantitative measures of human mobility were measured in aggregate and might not represent mobility at the individual level, possibly leading to ecological fallacy.

								Pre-intervention New York: 0.77(0.69-0.85) New Jersey: 0.47(0.33-0.61) Illinois: 0.44(0.38-0.50) Massachusetts:0.40(0.32-0.47) California: 0.22(0.20-0.24) Post intervention New York: 0.01(-0.04-0.06) New Jersey: - 0.01(-0.06-0.04) Illinois: -0.04 (-0.09-0.01) Massachusetts:0.02(-0.02-0.06) California: 0.05(0.01-0.08)		

Supplementary file 3, Table 3. Effectiveness of measures assessing “package of interventions”

Study Country	Personal protective measures	Social measures	Travel measures	Outcome	Time frame	Effectiveness	RoB
						0-25%	
						26-50%	
						51-75%	
						>75%	
Patel et al(36) India		🏢🏢+👤👤↔👤👤+🏠🏠	✈	*Rt*	30 Jan – 4 May 2020		
				EDT			
				GR			
Clipman et al(37) USA	😷😷	👤👤↔👤👤		Incidence	17 Jun – 28 June 2020		
Thu et al(38) Japan		🏫🏫+👤👤↔👤👤	✈	CGR	11 Jan – 2 May 2020		
Zhang et al(39) China		🏠🏠	✈	Incidence	23 Jan – 14 Feb 2020		
Son et al(40) South Korea		🏢🏢 +📝📝		*Rt*	21 Feb –24 Mar 2020		
Yehya et al(41) USA		🏫🏫		Mortality	21 Jan – 29 Apr 2020		

Lau et al[42] China		🏥🏥 + 🏡🏡 + 🏫🏫	🛫	EDT *R*0	23 Jan – 27 Feb 2020		
Pan et al(43)		🏥🏥 + 🧑🧑 ↔ 🧑🧑 + 🏡🏡	🤒🤒	*Rt*	8 Dec 19 – 8 Mar 2020		
China							
Courtemanche[44] USA		🏡🏡 + 🏫🏫		DGR	5 Mar – 25 April 2020		
Wang K et al[45] China		🏫🏫 + 🏡🏡 🧑🧑 ↔ 🧑🧑		Incidence	22 Jan – 27 Feb 2020		
Ruan et al(46) China		📝📝 + 🧑🧑 ↔ 🧑🧑 + 🏡🏡 + 🏥🏥		CFR	17 Jan –17 Mar 2020		
Rubin et al[47] USA		🧑🧑 ↔ 🧑🧑		*Rt* **	25 Feb – 23 April 2020		
Juni et al(48) Switzerland		🏫🏫 + 🧑🧑 ↔ 🧑🧑		Incidence**	7 – 27 March 2020		
Bendavid et al[49] USA		🏡🏡 + 🏫🏫 + 🧑🧑 ↔ 🧑🧑 + 📝📝 + 🏥🏥	🌍🌍🛫	DGR	1 March – May 2020		
Yeoh et al[50] Singapore		🧑🧑 ↔ 🧑🧑	🛫	*Rt*	1 Jan – May 2020		

Erim et al(51) Nigeria		🏘🏘		Incidence	30 Mar – 4 May 2020		
Wahaibi et al[(52)] Oman		🏘🏘+🏢🏢	🌍🌍✈	*Rt*	March – April 2020		
Tsai et al[(53)] USA		🏘🏘	✈	*Rt* **	10 Mar – 15 July 2020		
Dasgupta et al[(54)] USA	😷😷	🏫🏫			1 Jun – 30 Sept 2020		
Qureshi et al[(55)] USA		🏘🏘		DGR ***	9 Mar –15 Apr 2020		
Piovani et al[(56)] Italy		🏘🏘		Mortality**	1 Jan – 30th June 2020		
Timelli et al[(57)] Italy		🏘🏘+👤👤↔👤👤+🏢🏢+🏫🏫		Mortality	11 Mar– 11 May 2020		
Bo et al[(58)] China	😷😷	🏢🏢+👤👤↔👤👤	✈	*Rt* **	23 Jan – 13 April 2020		
Koh et al[(59)] China		🏘🏘+🏫🏫	🌍🌍✈	*Rt*	1 Jan – 28 May 2020		
Tariq et al[(60)] Chile	😷😷	🏘🏘+🏫🏫	✈	DGR	March – October 2020		

Malheiro et al[61] Portugal		📝📝+🏫🏫		AR	1 Mar – 30 April 2020		
Tchole et al(62) Niger		📝📝+🏫🏫	✈	*Rt*	19 Mar – 4 July 2020		
Singh et al[63] USA		🏡🏡+🏫🏫+🧑🧑↔🧑🧑		DGR*	1 Jan – 3 June 2020		
McCreesh et al(64)		🏡🏡+🏫🏫		*R0***	March – May 2020		
South Africa							
Haapanen et al[65] Finland		🏫🏫+🏡🏡		Incidence	16 Mar – 1 Aug 2020		
Islam et al[66] UK		🧑🧑↔🧑🧑+🏡🏡+🏫🏫		Incidence	1 Jan – 30 May 2020		
Ghosal et al(67) India		🏡🏡		Incidence	March – May 2020		
McGrail et al[68] USA		🏫🏫+🧑🧑↔🧑🧑		*Rt*	March – June 2020		
Castillo et al(69) USA		🏡🏡+🏨🏨		Incidence ***	19 Mar – 7 April 2020		
Wang J et al[70] China		🏡🏡+🧑🧑↔🧑🧑+🏫🏫+🏨🏨	🤒🤒	Incidence	22 Jan – 20 Feb 2020		

Ryu et al[71] South Korea		🧑🧑↔🧑🧑	✈️+ 🤒🤒	*Rt*	20 Jan – 21 April 2020		
Liu H et al[72] USA		🏠🏠+🏫🏫 +🧑🧑↔🧑🧑		*Rt*	March – May 2020		
				DGR			

Effectiveness was established via calculating the percentage difference between outcomes including estimates from pre and post intervention, or between countries/regions; OR= odds ratio; RRR= relative risk reduction; DGR=Daily growth rate; AR=Attack Rate; EDT=Epidemic doubling time; Rt & Ro=Reproductive number; CFR=Case Fatality Rate; = Hand and personal hygiene; 😷😷 = Face masks; 📝📝= Contact tracing; 🏢🏢= Isolation and quarantine of sick/exposed/ susceptible; 🏫🏫 =School & workplace closure ; 🧑🧑↔🧑🧑 = Social distance; 🏠🏠 = Lockdown; ✈️=Interstate & border closure; 🤒🤒= Symptom screening; 🌍🌍 = Travel restrictions; *p=<0.01;**p=<0.001; *** p=<0.0001; Low risk: Moderate risk: Serious/Critical risk: not assessable

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