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The rate of asymptomatic COVID-19 among ascertained infections: A systematic review and meta-analysis including 12,713 infections from 136 studies

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The rate of asymptomatic COVID-19 among ascertained infections: A systematic review and meta-analysis including 12,713 infections from 136 studies

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Abstract

Introduction: Asymptomatic infection of SARS-CoV-2 may lead to silent community transmission and compromise pandemic control measures of COVID-19. We aimed to estimate the rate of asymptomatic COVID-19 infection from published studies, and compare this rate among different patient groups.

Methods: The electronic databases including Medline, Embase, PubMed, and three Chinese electronic databases (The Chinese National Knowledge Infrastructure (CNKI), WanFang Data, and VIP) were searched. Studies with sample size (or number of subjects) not less than 5 were included. The STATA command '*Metaprop*' was implemented to conduct meta-analysis for the pooled rate estimates of asymptomatic infections with exact binomial and score test-based 95% confidence intervals (CIs).

Results: A total of 12,713 ascertained COVID-19 infections in 136 studies were included in the meta-analysis, including 2,785 asymptomatic infections. The overall rate of asymptomatic infection was 15.1% (12.0%-18.4%). Subgroup analysis showed that the rate was significantly higher in pregnant women (36.3%, 15.7%-59.6%), children (29.4%, 17.4%-42.9%), and studies for screening settings (25.3%, 15.4%-36.5%) conducted on or after 01 March 2020 (27.8%, 15.7%-41.7%). In terms of geographical regions, the rate was the highest in Asia (excluding China) (27.4%, 14.3%-42.6%), followed by Europe (22.7%, 6.3%-44.9%), the US (15.9%, 8.9%-24.3%), and China (13.1%, 10.2%-16.3%).

Conclusion: High proportion of asymptomatic infection were observed in pregnant women, children, European residents, screening programmes, and in studies conducted in and after March 2020. Our findings help inform the true burden of COVID-19 among different groups of cases, and provide information on cost-effective strategies of identifying and tracing asymptomatic infections.

(247 words)

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Keywords: COVID-19; SARS-CoV-2; asymptomatic infection; asymptomatic ratio; meta-analysis.

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Article Summary

Strengths and limitations of this study

1. Reviewed a large number of studies, and conducted subgroup analysis from several angles.

2. The pooled asymptomatic infection rate had a high level of heterogeneity.

3. Majority of the selected studies are from China and the US.

4. Pre-symptomatic infection might be wrongly classified as 'asymptomatic' when reported.

5. The study findings bear significance on public health policies that aim to achieve early identification and more stringent containment of the pandemic.

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Introduction

In 2019, a cluster of severe pneumonia cases of unknown type were reported in Wuhan, China (1). Later coined as the coronavirus disease 2019 (COVID-19), it rapidly resulted in large-scale outbreaks across many regions. On 30 January 2020, the World Health Organization (WHO) declared the COVID-19 as a public health emergency of international concern (2), and further defined it as a pandemic on 11 March 2020. As of 2 September 2020, a cumulative total of 25,937,361 COVID-19 cases have been confirmed globally, with 861,910 associated deaths.

The pathogen of COVID-19, i.e., severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is highly contagious, and could be transmitted from human to human (1, 3). The viral load in an asymptomatic patient has been found to be similar to that in symptomatic patients in a study of nine patients (4), and this observation was later confirmed in a study involving large samples (5). The early peaking of SARS-CoV-2 viral load during the pre-symptomatic phase may cause silent community outbreaks (6). Further investigations also found that the asymptomatic infections may carry SARS-CoV-2 for more than 1 month, indicating the long lasting risk of secondary infection (7-11). Several similar definitions of 'asymptomatic case' were noted in previous studies (12). We followed the official definition from the State Council of China and the World Health Organization (WHO) (13, 14), and defined 'asymptomatic case' as individuals who 1) have no clinical manifestations of COVID-19, such as fever, cough, sore throat, and other self-perceived or clinically identifiable symptoms and signs; 2) have positive result of SARS-CoV-2 pathogen test; and 3) does not develop symptoms until the end of hospital admission or follow-up observations. Asymptomatic COVID-19 infection rate, or asymptomatic ratio, is calculated as the proportion of asymptomatic cases among all COVID-19 infections.

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Determining the rate of asymptomatic infection is important as it may deepen the understanding of the real reproductive number (R_0), as well as the true incidence and mortality rate of COVID-19. The rate may also function as an essential epidemiological parameter to inform disease combating policies, including the density and range of screening, patient isolation as well as early intervention (15). Nevertheless, the significance of the invisibly infected person as the source of infection depends on its distribution in the population, and the amount and duration of the virus excreted (16). The reported proportions of asymptomatic individuals in existing literature varied a lot (15), depending on their research settings (e.g. geographical region, screening vs. non-screening studies), demographic characteristics (e.g. age groups, pregnant women, children), and other latent factors. The present study performed a systematic review and meta-analysis to estimate the asymptomatic infection rate based on published studies, and compare the rate among different patient groups as well as study settings.

Methods

Searching strategy

The Medline, Embase, PubMed, and three Chinese electronic databases (the Chinese National Knowledge Infrastructure [CNKI], WanFang Data, and VIP) were searched from 1 November 2019 to 10 July 2020 for studies reporting the rate of asymptomatic COVID-19 infection. This systematic review and meta-analysis was conducted according to the standards strictly following the '*Preferred Reporting Items for Systematic reviews and Meta-Analyses*' (PRISMA) guideline (17). The searching details were presented in the **Supplementary Table 1**. Meanwhile, highly relevant references were also searched by reviewing the reference list of the included articles All manuscripts were imported into the Endnote software (version X8, Thomson Reuters, Carlsbad, California) and duplicate studies were removed.

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Literature screening and selection criteria

Two reviewers (XC and ZH) determined the eligible studies independently. Consensus was reached by referral to a third reviewer (JW) when there was disagreement. All studies were screened by title and abstract first, followed by full texts if the study meets the inclusion criteria, which consist of:

- inclusion criterion #1: the studying subjects were diagnosed with SARS-CoV-2 infection;
- inclusion criterion #2: the study was designed as an observational study; and
- inclusion criterion #3: the numbers of asymptomatic and symptomatic COVID-19 infections were explicitly and exactly reported.

The literature screening was conducted without language or region restriction. The exclusion criteria are as follows. They included

- exclusion criterion #1: study that included patients without virological evidence of SARS-CoV-2 infection;
- exclusion criterion #2: study which did not investigate the distribution of asymptomatic COVID-19 infections among all subjects;
- exclusion criterion #3: study that is not classified as original research, such as reviews, comments, case report; and
- exclusion criterion #4: study has an overall sample size of less than 5.

For studies that analyzed the same group of subjects more than once, only those with the most updated and detailed information were included for further analysis.

Data extraction and subgrouping schemes

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For eligible articles, two types of the information were extracted by the two reviewers (XC and ZH) independently. For each study, we include

- information type #1: the basic information of the individual studies that contains the name of the first author, investigation period, geographical region, and the study setting (screening and non-screening); and
- information type #2: the characteristics of subjects including age statistics, sex distribution, sample size, the number of COVID-19 infections, the number of asymptomatic COVID-19 infections, and the number of subsequent clinically detectable symptoms among symptomatic COVID-19 cases.

To ensure the accuracy of data, cross-checking was conducted after extraction of the preliminary information. Disagreements were resolved through consensus or by referral to the third reviewer (JW).

To explore the source of heterogeneity among the included studies, several subgroup analyses were performed according to the study design and characteristics of subjects in each study. First, we identified three groups based on the subjects' demographical features. They included 'children' groups consisting of subjects less than 18 years old; 'pregnant women' groups involving expectant mothers as subjects; and the 'general population' group. Second, three age groups were identified according to the subjects' mean or median age: ≤ 18, from 19 to 45, and > 45 years, respectively. The selection of mean or median age followed the statistics reported in each study. Third, studies were categorized into 'screening' or 'non-screening' types, identified by examining whether all subjects in each study were previously diagnosed with COVID-19. Forth, we separated studies based on subjects from different geographical regions including China, Asia (excluding China), the US and Europe. Last, subgroup analysis was performed by study period, during which the subjects were tested for COVID-19, including 'before 01 March 2020' or '01 March 2020 and afterwards'.

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Quality assessment

The quality of each included study was assessed by two researchers (XC and ZH) independently using the quality of cross-sectional studies (AXIS) scale (18). There are five components including 20 questions in the AXIS scale. Seven questions measure the quality of reporting; another seven questions measure the quality of study design, and six questions measure the possible introduction of biases in each study.

Statistical analysis

Accounting for all included studies, the pooled estimates of the asymptomatic rates were generated with exact binomial-distributed likelihood framework and score test-based 95% confidence intervals (CIs) (1). The STATA command "*metaprop*" was adopted to conduct meta-analysis. Heterogeneity across the studies was examined by the I^2 statistic, measuring the proportion of total variation contributed by between-study variation. The I^2 values < 25%, ranging from 25% to 75%, and > 75% correspond to the thresholds for three ordinal levels of heterogeneity including low, moderate, and high, respectively (19).

Univariate and multivariate meta-regression analysis was performed to identify any potential effects of modifiers or confounders on the estimated rate. We examined the effects of the covariates including study population, age-specific proportion, screening/non-screening study, geographical region, and time trend in multivariate analysis. Sensitivity analysis was conducted by omitting one study at a time, generating the pooled estimates and comparing with the original estimates. Potential publication bias was examined by Egger's test and visualized using

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a funnel plot. If the tests indicated potential publication bias, the Trim and Fill's method, which is based on a modified funnel plot, would be adopted to adjust the small-study effect (20).

All analyses were performed using STATA statistical software (version 14.0, Stata, College Station, Texas, USA). The figures were generated using R software (version 3.6.3) with the '*forestplot*' package.

Results

Characteristics of studies and subjects

4,243 citations were identified by the literature search, of which 362 were from MEDLINE, 573 were from PubMed, 955 were from Embase, 1,106 were from CNKI (Chinese), 1,010 were from WanFang (Chinese), and 237 were from VIP (Chinese) (**Figure 1**). There were 3,268 citations after removal of duplicates. We retrieved 382 full-text articles assessed for eligibility after 686 citations were excluded during title or abstract screening with pre-determined criteria. We excluded 245 articles that fulfilled our exclusion criteria, or that consisted of duplicate data source. Finally, there were 136 articles included in the meta-analysis.

The basic characteristics of the included studies are shown in **Supplementary Table 2** including cities, countries and study periods in which the ascertained COVID-19 infections were recruited; the number of test-positive and asymptomatic infections; the number of presymptomatic infection in patients if available; and the travel history and demographics of each patient. Approximately 80.1% (109 out of 136) of all included studies were conducted in China, 4.4% in the US, 2.9% in Japan, and 2.2% in Korea. Among 136 studies, 89.0% were

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performed among the general population, 7.4% in children and 3.7% in pregnant women, respectively.

Quality scores of AXIS for the included studies ranged between 11 and 19 points, with 69 studies meeting the criteria of having high quality (≥ 16 points). Overall, 97.1% (132 out of 136) of all studies met the criteria for both reporting and quality design, and the risk factors and outcome variables were appropriate for the studies. In all studies, the methods were clearly defined so that those studies could be repeated, and the presentation of results met the analysis descriptions in the methods with internal consistency (**Supplementary Table 3**).

Asymptomatic ratio estimates

A total of 12,713 ascertained COVID-19 infections from 136 studies were finally included in the meta-analysis (**Figure 2)**, including 2,889 asymptomatic infections at the time of diagnosis. The overall rate of asymptomatic infections was estimated at 16.8% (13.7%-20.1%). The I^2 equaled to 96.0%, indicating a high heterogeneity among the studies. Of the 2,889 asymptomatic infections, 104 (3.6%) developed symptoms after admission. After excluding these pre-symptomatic observations, the pooled rate was 15.1% (12.0%-18.4%) at a I^2 of 96.2%.

In subgroup analysis, we found that pregnant women (36.3%, 15.7%-59.7%; I^2 = 79.6%) had a significantly higher asymptomatic infection rate than children (29.4%,17.4%-42.9%; I^2 = 87.2%), whereas the general population had the lowest asymptomatic rate (13.5%, 10.4%-16.7%; I^2 = 96.4%). Regarding age-specific proportion, patients aged ≤ 18 years (22.9%, 14.6%-32.1%; I^2 = 66.2%) had a significantly higher prevalence of asymptomatic cases than

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adults aged 19-45 years (16.5%, 10.8%-22.9%; I^2 = 94.0%) or > 45 years (9.3%, 5.8%-13.4%; I^2 = 93.5%).

The asymptomatic infection rate was 25.3% (15.4%-36.5%; I^2 = 97.3%) among studies for screening settings, which is almost twice of that among studies for non-screening settings (12.9%, 10.3%-15.8%; I^2 = 94.0%). Significantly different asymptomatic rates were observed in different geographical regions (p-value <0.001) - the rate was highest in Asia (excluding China) (27.4%, 14.3%-42.6%; I^2 = 92.6%), followed by Europe (22.7%, 6.3%-44.9%; I^2 = 98.1%), and the US (15.9%, 8.9%-24.3%; I^2 = 94.9%). China was estimated to have the lowest rate of asymptomatic infection (13.1%, 10.2%-16.3%; I^2 = 93.7%). For subgroup analysis by time period, we noted that studies conducted before 01 March 2020 reported a pooled asymptomatic infection rate of 11.2% (7.5%-15.3%; I^2 = 95.0%), while the rate increased sharply to 27.8% (15.7%-41.7%; I^2 = 98.4%) among studies conducted after 01 March 2020.

All subgroup analysis results were shown in **Figure 3**.

We performed both univariate and multivariate meta-regression analysis to investigate study-level factors that may contribute to the heterogeneity among studies and might have influenced our estimations of the asymptomatic infection rate. The results (**Table 1**) presented that the estimation on rate of asymptomatic infection was not significantly altered by population groups (p-values range from 0.227 to 0.457) or age groups (p-values range from 0.478 to 0.992). Being 'non-screening' studies where all subjects were diagnosed with COVID-19 would marginally alter the estimation (p-value = 0.113). Geographical location (studies in Asia excluding China)

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(*p*-value = 0.019) and study period (01 March 2020 afterwards; *p*-value = 0.005) were significant sources of heterogeneity.

We found no evidence of publication bias among studies by Egger's test with *p*-value = 0.415. Sensitivity analysis showed that it was unlikely that any individual study significantly influenced the pooled estimates, demonstrating the robustness and reliability of our estimates (**Supplementary Table 4)**.

Discussion

Our meta-analysis of 12,713 infections in 136 studies performed in 15 countries provides an up-to-date as well as comprehensive overview of asymptomatic infection rate of COVID-19. We also estimated the statistics by different study settings and patients' demographic factors. We found a higher asymptomatic ratio in European countries, in studies on screening settings, and among pregnant women as well as younger populations. The estimated rate in our study (15.1%) is half the size of a previous estimate (33.0%) using binomial distribution (21), yet is consistent with the estimation using Hamiltonian Monte Carlo (HMC) algorithm (22). Regarding real-world evidence, our estimation is consistent with a meta-analysis of 41 studies in May 2020, which also noted an asymptomatic infection rate of approximately 15%, with a higher rate among pregnant women and children (23). The findings are very similar with that of the present study. However, our study included 100 more articles, resulting in a more precise estimation with significantly narrower confidence interval. With a larger dataset, we conducted more subgroup analysis which resulted in more implications. First, while China and the US were having a similar asymptomatic infection rates, the rate is two times higher in European countries as well as Asian countries (excluding China). Second, the proportion of asymptomatic carriers was nearly doubled in screening studies than that in non-screening

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studies. Third, asymptomatic infection rate was significantly higher in studies conducted in or after 01 March 2020 than those conducted beforehand.

In the subgroup analysis, we noted a large variety of asymptomatic rates among different populations. For instance, younger people tended to have a significantly higher rate. These findings are consistent with that from previous publications (24). Infection control measures may be targeted on the early detection and isolation of asymptomatic youth, as the young asymptomatic carriers are of higher probability to bring in community transmission due to their more socially active lifestyle habits with more frequent travelling than people in other age groups (25).

We also noted that the asymptomatic infection rate for pregnant women (36.3%) is almost three times that for the general population (13.5%). Previous publication on pregnant women and COVID-19 is very limited. Case reports from the New York hospital reported a similarly high rate (14 women, 32.6%) at presentation, yet 71.4% (10 women) of the asymptomatic mothers developed symptoms during their hospitalization and postpartum course (26). Therefore, the high proportion of asymptomatic infections estimated by our study may include both pre-symptomatic and asymptomatic cases, due to a high proportion of pregnant women undergoing COVID-19 screening at inpatient admission. More follow-up studies among the pregnant women are needed before drawing further conclusions. Nevertheless, undetected asymptomatic pregnant women may lead to more severe consequences. Without early detection and proper preventive measures, the delivery of asymptomatic patients brings extra risks to nosocomial infection, and may also result in droplet transmission among the women, kids, as well as other family members (26). Importantly, the data suggest that the severity and mortality risk of hospital transmission may be greater than that of community-acquired COVID-19 (27).

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We compared the asymptomatic infection rate in China, in Asia (excluding China), in the US, and in Europe. Previous meta-analysis indicated no significant difference in the proportion of asymptomatic infection between studies conducted in China or other countries (28). On the contrary, our results showed that the rates in Europe (22.7%) and Asia (excluding China) (27.4%) were almost twice than that in China (13.1%) and the US (15.9%). For China, the rate is consistent with a previous meta-analysis (15.6%) (29), as well as the latest government release on Wuhan population nucleic acid testing (14.7%) (30). The changing rate of asymptomatic infection in Hong Kong also confirmed our findings - in the first phase of the pandemic, the infected cases were dominated by imported ones from mainland China, and the asymptomatic infection rate was around 16% (23); whereas in the second and third waves, the infections were mainly imported from Europe and South-East Asian countries, giving a significantly higher rate (23%) (31). However, the smaller sample size for Europe and Asia (excluding China) led to wider confidence intervals for the two regions.

We noted that the asymptomatic infection rate was nearly doubled in screening studies than that in non-screening studies. If we consider the ate as a constant, the higher asymptomatic infection rate estimates were likely due to higher probabilities of ascertaining asymptomatic COVID-19 infections in the community with screening implemented. This implies the importance of mass screening in detecting the infections, which is of importance in community infection control. Increasing the accessibility and affordability of community testing could be an important surveillance strategy for early containment of diagnosed cases (32).

We also found that the pooled asymptomatic infection rate increased from 11.2% (95% CI: 7.5%-15.3%) for studies conducted before 01 March 2020, to 27.8% (15.7%-41.7%) for studies

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conducted in 01 March 2020 or afterwards, although the 95% CI is larger in the latter time period. This timeline is highly consistent with a previous study using the publicly released from the Centre for Health Protection in Hong Kong (33). The increased rate may be due to overlooking of asymptomatic, especially pre-symptomatic cases at the early stage of the pandemic, when medical resources were targeted to patients with severe symptoms. Later, with increased public awareness and test accessibility, more COVID-19 infected individuals without symptoms were detected, while more and more studies reported the proportion of asymptomatic patients. In this context, future studies may explore whether the proportion of COVID-19 infections with mild or no symptoms is increasing, especially when considering the SARS-CoV-2 variant with D replaced by G at the 614-th codon in the Spike protein which dominated the pandemic since late February 2020 (34-37).

This study has limitations. First, our pooled asymptomatic infection rates were found to have a high level of heterogeneity (I^2 = 96.2%). This could be attributed to the difficulties in generating the exact number of infections and asymptomatic cases during an outbreak. Different studies reported at different time periods, regions and populations may result in diverse prevalence (38). We conducted subgroup analysis and meta-regression to figure out the source of heterogeneity. This high level may be due to some unobserved factors which have not be included in the original studies, such as changing pandemic control measures in some countries; the diverse definition of asymptomatic infection, varying practices of surveillance and ascertainment of asymptomatic infection; as well as meteorological disparities across time and regions. Nevertheless, previous studies indicated that any amount of heterogeneity is acceptable if both accurate data and predefined eligibility criteria were provided (39, 40). Second, although we applied a comprehensive searching strategy for the literature, 80% of the selected articles and (50,973/55,951 = 91.1%) of the sampled individuals in our analysis are from China (35,003 individuals) and the US (15,970 individuals). Subgroup analysis was

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conducted to compare the ratio in different geographical regions, yet there are very few studies performed in Australia and Africa by the end of July 2020. Third, a symptomatic COVID-19 case might be mis-classified as 'asymptomatic' during the incubation period. Although we excluded 104 (3.6%) subjects who developed symptoms in the follow-up period, most studies are cross-sectional without follow-up data, while other individuals may not have completed observations for the whole incubation period. This may result in a certain degree of overestimation on the asymptomatic infection rate, yet we consider the impact from this phenomenon as minor owing to our relatively long study period. With additional information of the exposure and reporting dates of each case, we remark our estimation can be extended to a right censoring version to further address some potential bias in the existing frameworks (15).

Conclusions

We estimated the asymptomatic infection rate of 15.1% among COVID-19 infections. We reported that pregnant women, children, European residents, screening programmes, and studies conducted after 01 March 2020 had higher asymptomatic infection rates. Our findings provide further insights on the distribution of asymptomatic COVID-19 infections in different groups of individuals, which bear significance on public health policies that aim to achieve early identification and more stringent containment of the pandemic.

Declarations

Patient and Public Involvement

Not applicable.

Ethics approval and consent to participate

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Not applicable.

Availability of materials

Not applicable.

Consent for publication

Not applicable.

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Disclaimer

The funding agencies had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

Conflict of interests

DH received a grant from Alibaba (China) Co. Ltd., Collaborative Research grant. Other authors declared no conflict of interest.

Author's contributions

XC and ZH designed the study and searched the literature. XC, ZH, and JW extracted the data and evaluated the quality. XC conducted the statistical analysis. XC, ZH, and JW wrote the full

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manuscript. SZ, MSCW, MKCC, DH, and JL provided critical revision of the manuscript for important intellectual content. All authors discussed the results, and approved the final version of the manuscript for publication.

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Supplementary Table 1 Search strategy for systematic review

Supplementary Table 2 Characteristics of the studies included for meta-analysis

Supplementary Table 3 Quality assessment of selected articles

Supplementary Table 4 Results of sensitivity analysis

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Table 1 Results of Univariate and Multivariate Meta-regression Analysis

Variable	Univariate Regression Analysis				Multivariate Regression Analysis		
	No. of Studies (%)	Crude Meta-RR	95% CI	p	Adjusted Meta-RR	95% CI	p
Patient Group							
Children	10 (7.35%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
Pregnant	5 (3.68%)	1.13	(0.85-1.48)	0.398	1.12	(0.82-1.53)	0.457
General population	121 (89.97%)	0.88	(0.76-1.01)	0.075	0.89	(0.73-1.08)	0.227
Age							
≤18y	9 (6.61%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
19-45y	49 (36.03%)	0.95	(0.79-1.13)	0.565	1.05	(0.82-1.34)	0.712
>45y	49 (36.03%)	0.88	(0.74-1.05)	0.165	1.00	(0.78-1.27)	0.992
NM	29 (21.32%)	0.98	(0.81-1.17)	0.798	1.09	(0.86-1.37)	0.478
Screening							

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Non-screening studies	112 (82.35%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
Screening studies	24 (17.65%)	1.14	(1.05 -1.25)	0.003	1.08	(0.98-1.20)	0.113
Region							
US	6 (4.51%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
China	109 (81.95%)	0.96	(0.83-1.11)	0.569	1.12	(0.96-1.31)	0.159
Europe	9 (6.77%)	1.07	(0.89-1.29)	0.468	1.04	(0.87-1.24)	0.645
Asia (exclude China)	9 (6.77%)	1.12	(0.92-1.36)	0.274	1.26	(1.04-1.53)	0.019
Time Trend							
Before March 2020	85 (62.50%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
March 2020 afterwards	10 (7.35%)	1.23	(1.09-1.39)	0.001	1.27	(1.08-1.50)_	0.005
NM	41 (30.15%)	1.07	(1.00-1.16)	0.039	1.07	(1.00-1.15)	0.061

NM, not mentioned.

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Figure 1

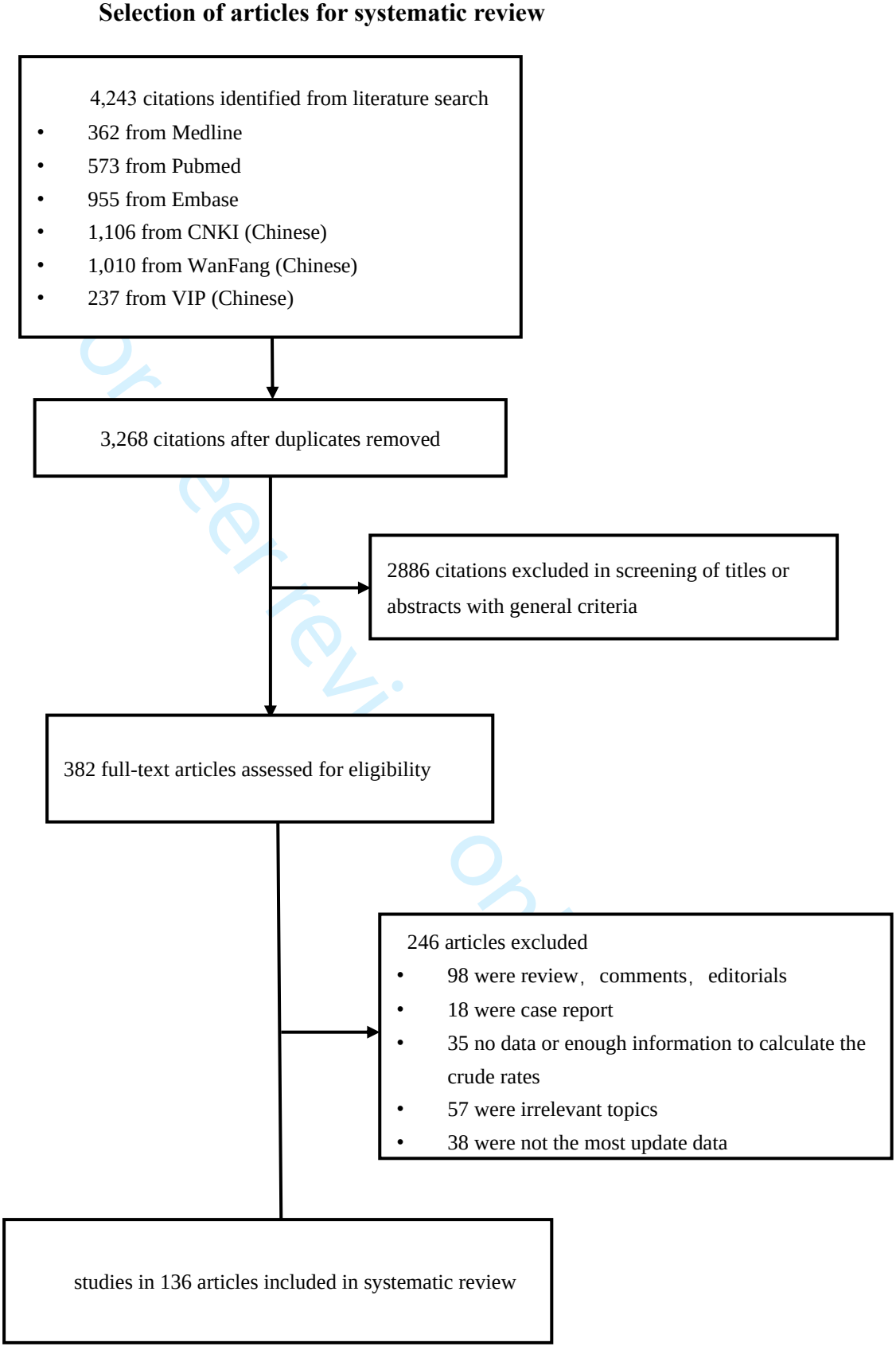
Selection of articles for systematic review
4,243 citations identified from literature search
362 from Medline
573 from Pubmed
955 from Embase
1,106 from CNKI (Chinese)
1,010 from WanFang (Chinese)
237 from VIP (Chinese)
3,268 citations after duplicates removed
2886 citations excluded in screening of titles or abstracts with general criteria
382 full-text articles assessed for eligibility
246 articles excluded
98 were review, comments, editorials
18 were case report
35 no data or enough information to calculate the crude rates
57 were irrelevant topics
38 were not the most update data
studies in 136 articles included in systematic review

Figure 2 Meta-analysis of the asymptomatic ratio among COVID-19 patients (including and excluding pre-symptomatic infections)

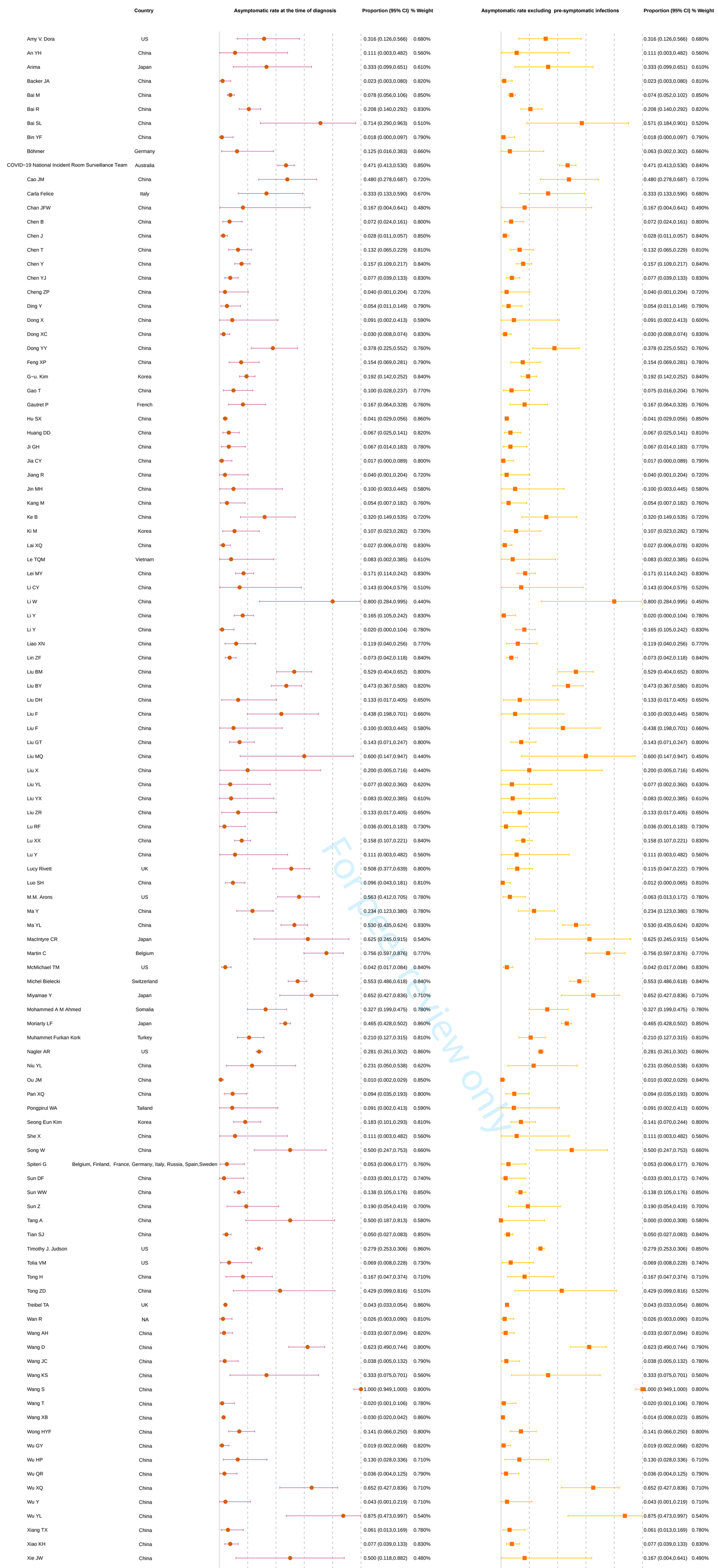

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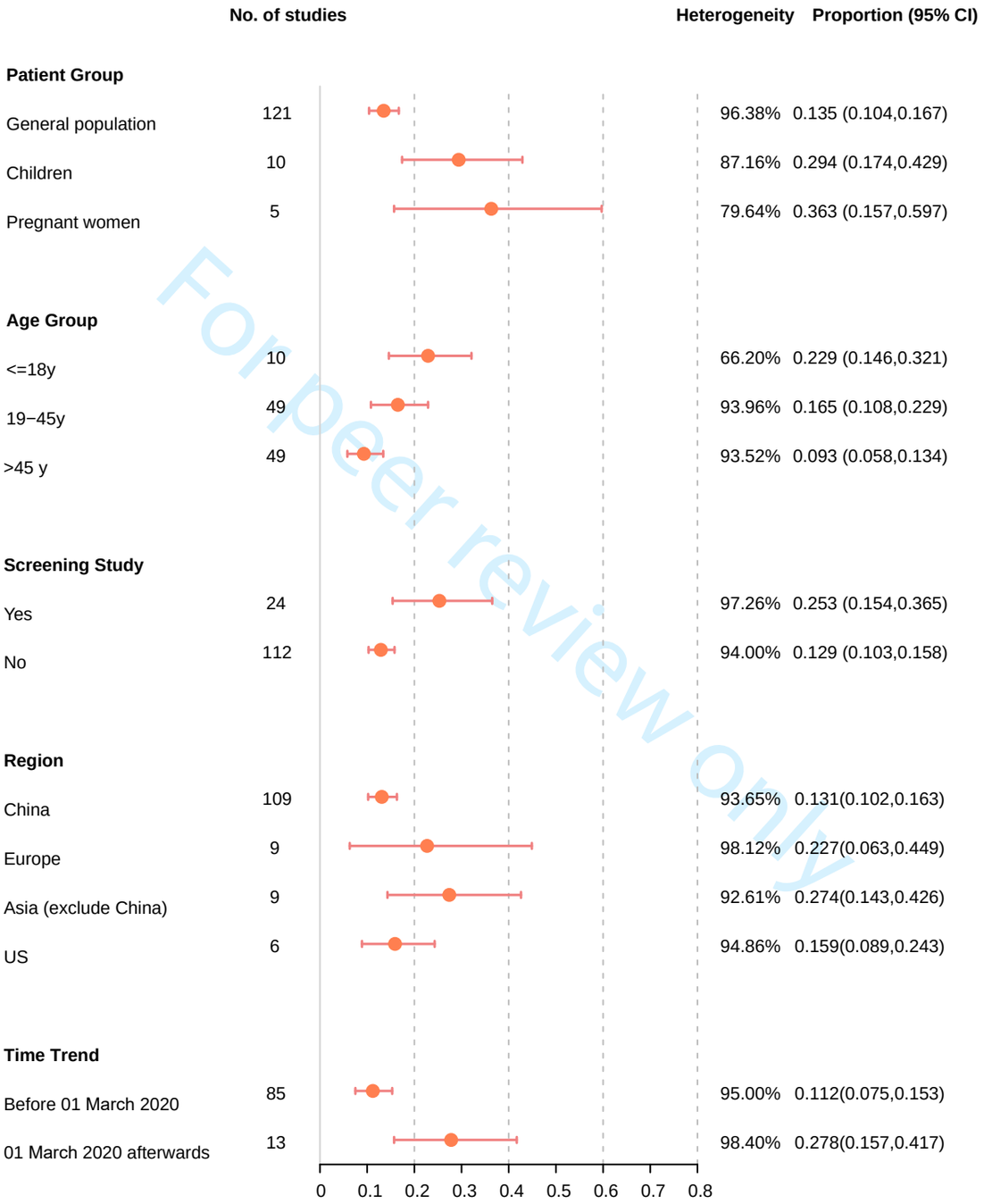
Figure 3 Asymptomatic ratio among COVID-19 patients by patient group, age group, screening study, region, and time trend



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Supplementary Tables and Figure Legends

Supplementary Table 1 Search strategy for systematic review

Supplementary Table 2 Characteristics of the studies included for meta-analysis

Supplementary Table 3 Quality assessment of selected articles

Supplementary Table 4 Results of sensitivity analysis

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Supplementary Table 1 Search strategy for systematic review

Medline (n=362)

# ▲	Searches	Results
1	SARS-CoV-2.mp.	2844
2	COVID-19.mp.	10022
3	2019-nCoV.mp.	509
4	novel coronavirus.mp.	1585
5	coronavirus 2019.mp.	296
6	2019 coronavirus.mp.	81
7	Wuhan coronavirus.mp.	11
8	Wuhan pneumonia.mp.	9
9	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8	10428
10	Asymptomatic.tw.	132670
11	Asymptomatic Carrier*.tw.	3086
12	Asymptomatic positive*.tw.	38
13	Asymptomatic Carrier Transmission.tw.	2
14	No symptom*.tw.	7724
15	No sign*.tw.	622825
16	Asymptomatic individual*.tw.	3403
17	Asymptomatic person*.tw.	706
18	Asymptomatic patient*.tw.	13664
19	Asymptomatic case*.tw.	1185
20	Asymptomatic carriage.tw.	520
21	Asymptomatic proportion.tw.	6
22	Asymptomatic transmission.tw.	43
23	Symptomless.tw.	1920

24	Asymptomatic contact.tw.	57
25	No reported symptom*.tw.	22
26	No clinical symptom*.tw.	1113
27	No onset symptom*.tw.	1
28	Before symptom onset.tw.	251
29	Before onset of symptom*.tw.	135
30	No respiratory symptom*.tw.	234
31	No typical symptom*.tw.	56
32	Reported no symptom*.tw.	177
33	10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32	759427
34	9 and 33	362

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PubMed (n=573)

# ▲	Searches	Results
1	SARS-CoV-2.mp.	1106
2	COVID-19.mp.	2922
3	2019-nCoV.mp.	899
4	novel coronavirus.mp.	2656
5	coronavirus 2019.mp.	1878
6	2019 coronavirus.mp.	1878
7	Wuhan coronavirus.mp.	640
8	Wuhan pneumonia.mp.	630
9	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8	5630
10	Asymptomatic.tw.	153267
11	Asymptomatic Carrier*.tw.	3641
12	Asymptomatic positive*.tw.	21404
13	Asymptomatic Carrier Transmission.tw.	705
14	No symptom*.tw.	9230
15	No sign*.tw.	676976
16	Asymptomatic individual*.tw.	3830
17	Asymptomatic person*.tw.	753
18	Asymptomatic patient*.tw.	14964
19	Asymptomatic case*.tw.	1329
20	Asymptomatic carriage.tw.	1315
21	Asymptomatic proportion.tw.	3907
22	Asymptomatic transmission.tw.	6822
23	Symptomless.tw.	2687
24	Asymptomatic contact.tw.	2321

25	No reported symptom*.tw.	8056
26	No clinical symptom*.tw.	60765
27	No onset symptom*.tw.	544
28	Before symptom onset.tw.	22459
29	Before onset of symptom*.tw.	14445
30	No respiratory symptom*.tw.	257
31	No typical symptom*.tw.	4180
32	Reported no symptom*.tw.	2307
33	10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32	951361
34	9 and 33	573

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Embase (n=955)

# ▲	Searches	Results
1	SARS-CoV-2.mp.	24274
2	COVID-19.mp.	829
3	2019-nCoV.mp.	3251
4	novel coronavirus.mp.	557
5	coronavirus 2019.mp.	159
6	2019 coronavirus.mp.	17
7	Wuhan coronavirus.mp.	10
8	Wuhan pneumonia.mp.	26912
9	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8	220827
10	Asymptomatic.tw.	4583
11	Asymptomatic Carrier*.tw.	67
12	Asymptomatic positive*.tw.	3
13	Asymptomatic Carrier Transmission.tw.	14021
14	No symptom*.tw.	1031507
15	No sign*.tw.	5594
16	Asymptomatic individual*.tw.	972
17	Asymptomatic person*.tw.	23180
18	Asymptomatic patient*.tw.	2113
19	Asymptomatic case*.tw.	735
20	Asymptomatic carriage.tw.	8
21	Asymptomatic proportion.tw.	69
22	Asymptomatic transmission.tw.	2332
23	Symptomless.tw.	79

24	Asymptomatic contact.tw.	55
25	No reported symptom*.tw.	1770
26	No clinical symptom*.tw.	1
27	No onset symptom*.tw.	448
28	Before symptom onset.tw.	222
29	Before onset of symptom*.tw.	479
30	No respiratory symptom*.tw.	98
31	No typical symptom*.tw.	341
32	Reported no symptom*.tw.	1257281
33	10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32	963
34	9 and 33	955

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CNKI (n=1,106)

FT=("新型冠状病毒"+"新冠肺炎"+"新型冠状病毒肺炎"+"严重急性呼吸综合征冠状病毒2"+"2019-nCov"+"2019 新型冠状病毒 "+"2019 冠状病毒 "+"corona virus disease-19"+"COVID-19"+"SARS-COV-2"+"novel coronavirus pneumonia"+"NCP")and FT=("无症状"+"无症状携带者"+"无症状患者"+"无症状阳性"+"无症状的阳检测病例"+"检测患者"+"没有症状"+"无症状感染"+"无症状感染者"+"无临床症状"+"无感染症状"+"无相关感染症状"+"无临床特征"+"没有临床特征"+"无明显症状"+"没有明显症状"+"隐性感染"+"隐性感染者")

WanFang (n=1,010)

(全部:(新型冠状病毒+新冠肺炎+新型冠状病毒肺炎+严重急性呼吸综合征冠状病毒2+2019-nCov+2019 新型冠状病毒 +2019 冠状病毒 +corona virus disease-19+COVID-19+SARS-COV-2+novel coronavirus pneumonia+NCP)*全部:(无症状+无症状携带者+无症状患者+无症状阳性+无症状的阳检测病例+检测患者+没有症状+无症状感染+无症状感染者+无临床症状+无感染症状+无相关感染症状+无临床特征+没有临床特征+无明显症状+没有明显症状+隐性感染+隐性感染者)) *Date:2019-

VIP (n=237)

(U=(新型冠状病毒 OR 新冠肺炎 OR 新型冠状病毒肺炎 OR 严重急性呼吸综合征冠状病毒2 OR 2019-nCov OR 2019新型冠状病毒 OR 2019冠状病毒 OR corona virus disease-19 OR COVID-19 OR SARS-COV-2 OR novel coronavirus pneumonia OR NCP)) AND (U=(无症状 OR 无症状携带者 OR 无症状患者 OR 无症状阳性 OR 无症状的阳检测病例 OR 检测患者 OR 没有症状 OR 无症状感染 OR 无症状感染者 OR 无临床症状 OR 无感染症状 OR 无相关感染症状 OR 无临床特征 OR 没有临床特征 OR 无明显症状 OR 没有明显症状 OR 隐性感染 OR 隐性感染者))

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Supplementary Table 2 Characteristics of the studies included for meta-analysis

Author	City/Province	Country	Sample size	Age (mean or median [± SD or IQR]; range)	Study population	Male (%)	Positive patient (n)	The number of test-positive and asymptomatic patients (n)	The number of presymptomatic infections (n)	Confirmed date
Amy V. Dora(1)	Los Angeles, California	US	19	Median: 75y (66–85)	General	1.00	19	6	0	2020/3/29-2020/3/21
An YH(2)	Beijing	China	54	Median: 48y (37-87)	General	0.44	9	1	0	2020/01/21-2020/03/04
Arima(3)	Japan	Japan	566	NA	General	NA	12	4	0	2020/1-2020/2
Backer JA(4)	Wuhan	China	88	Range: 2y-72y	General	0.65	88	2	0	2020/01/22-2020/01/29
Bai M(5)	Wuhan	China	472	Mean: 50.7y (±11.6)	General	0.46	472	37	2	2020/02/12-2020/03/08
Bai R(6)	Xian	China	120	Mean: 43y (1.5-93)	General	0.48	120	25	0	2020/01/01-2020/03/06
Bai SL(7)	Gansu	China	8	Median: 50.5y (2-82)	General	0.50	7	5	1	2020/01/22-2020/01/31
Bin YF(8)	Wuhan	China	55	Mean: 53.9y (±17. 1)	General	0.56	55	1	0	2020/01/29-2020/02/16
Böhmer(9)	Bavaria	Germany	16	Median: 35y (2-58)	General	0.75	16	2	1	2020/1/1-2020/2/19
Cao JM(10)	Nanchong	China	25	Range: 10y-77y	General	0.48	25	12	0	2020/01/21-2020/02/18
Carla Felice(11)	NA	Italy	98	NA	General	0.39	18	6	0	NA
Chan JFW(12)	Wuhan	China	7	Mean: 46.17y(10-66)	General	0.50	6	1	0	2020/01/10-2020/01/15
Chen B(13)	Hainan	China	69	Median: 51y (28-83)	General	0.59	69	5	0	2020/01/18-2020/02/29
Chen J(14)	Shanghai	China	249	Median: 51y(36-64)	General	0.51	249	7	0	2020/01/20-2020/02/06
Chen T(15)	Wuhan	China	76	Mean: 59.5y (28-86)	General	0.57	76	10	0	2020/01-2020/02
Chen Y(16)	Ningbo	China	187	Median: 12y(30-70)	General	NA	191	30	0	2020/01/21-2020/03/06
Chen YJ(17)	Chongqing	China	143	Mean: 45.13y (15-79)	General	0.51	143	11	0	2020/01/23-2020/02/08
Cheng ZP(18)	Yantai	China	25	Median: 42y (±12)	General	0.56	25	1	0	2020/01-2020/02
COVID-19 National	NA	Australia	295	Median: 47y (0-94)	General	0.50	295	139	0	2020/01/21-2020/03/14

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Incident Room Surveillance Team(19)										
Ding Y(20)	Wuhan	China	56	Mean: 54.6y (24-86)	General	0.54	56	3	0	2020/01/01-2020/02/03
Dong X(21)	Wuhan	China	11	Median: 43y (2-69)	General	0.45	11	1	0	2020/01/20-2020/02/29
Dong XC(22)	Tianjin	China	135	Mean: 48.62y (8-90)	General	0.53	135	4	0	2020/01/13-2020/02/20
Dong YY(23)	Yangzhou	China	37	Mean: 38.64y (1-74)	General	0.59	37	14	0	2020/01-2020/02
Feng XP(24)	Jingzhou	China	52	Median: 46y (30-63)	General	0.64	52	8	0	2020/01/23-2020/03/08
Gao T(25)	Liaocheng, Xianyang	China	40	Mean: 41y	General	0.48	40	4	1	2020/1/21-2020/2/16
Gautret P(26)	NA	French	36	Mean: 45.1y	General	0.42	36	6	0	2020/3/1-2020/3/16
Gu. Kim(27)	Daegu	Korea	213	NA	General		213	41	0	
Hu SX(28)	Hunan	China	888	Median: 35y (2-88)	General	0.444	888	36	0	2020/01/01-2020/02/08
Huang DD(29)	Chongqing	China	89	Median: 48.2y (±17.9)	General	0.58	89	6	0	2020/01/22-2020/02/17
Ji GH(30)	jingzhou	China	45	Mean: 45.4y(21-67)	General	0.60	45	3	0	2020/1/19-2020/2/1
Jia CY(31)	Beijing	China	60	Median: 59.5y (28-91)	General	0.40	60	1	0	2020/01/20-2020/02/20
Jiang R(32)	Guangzhou	China	25	Mean: 44.2y (12-86)	General	0.44	25	1	0	2020/01/25-2020/03/25
Jin MH(33)	Huzhou	China	10	Median: 32y (0.58-56)	General	0.50	10	1	0	2020/01/25-2020/02/07
Kang M(34)	Shenzhen, Guangzhou, Foshan, Yangjiang, Shaoguan	China	37	Median: 58y (10-78)	General	0.49	37	2	0	2020/01/12-2020/01/23
Ke B(35)	Chongqing	China	25	Median: 11.0y (0.6-17)	Children	0.56	25	8	0	2020/1/19-2020/3/12
Ki M(36)	Seoul, Goyang, Siheung, Bucheon, Gwangju, Suwon, Incheon, Pyeongtaek, Gunsan, Guri, Naju, Evacuated	Korea	28	Median: 42y (20-73)	General	0.54	28	3	0	2020/01/20-2020/02/10

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	from Wuhan									
Lai XQ(37)	Wuhan	China	110	Median: 36.5y (30.0-47.0)	General	0.28	110	3	0	2020/1/1-2020/2/9
Le TQM(38)	Vinh Phuc Province, Thanh Hoa Province	Vietnam	12	Median: 30y (0.25-55)	General	0.33	12	1	0	2020/01/21-2020/01/27
Lei MY(39)	Guizhou	China	146	NA	General	NA	146	25	0	2020/01/21-2020/03/10
Li CY(40)	Xuzhou	China	7	Median: 42y (21-62)	General	0.57	7	1	0	2020/01/25-2020/01/31
Li W(41)	Zhuhai	China	5	Median: 3y (1.4-6)	Children	0.80	5	4	0	2020/01/28-2020/02/08
Li Y(42)	Wuhan	China	53	Mean: 58y (26-83）)	General	0.55	51	1	0	2020/01/23-2020/01-29
Li Y(43)	Wuhan	China	127	Median: 6y （(0.17-15)	Children	0.57	127	21	0	2020/1/28-2020/3/12
Liao XN(44)	wuhan	China	42	Median:51.6y (22-69)	General	0.69	42	5	0	2020/01/16-2020/02/18
Lin ZF(45)	Yichang	China	205	Median: 56.0y (1.25-88)	General	0.55	205	15	0	2020/01/24-2020/03/09
Liu BM(46)	Wuhan	China	68	Mean: 44.3y (±16.4)	General	0.37	68	36	0	2020/2/7-2020/3/26
Liu BY(47)	Zhejiang	China	91	Mean: 33.66y (7-73)	General	0.53	91	43	0	2020/03/01-2020/04/07
Liu DH(48)	Wuhan	China	15	Mean: 32y (23-40)	Pregnant	0.00	15	2	0	2020/01/20-2020/02/10
Liu F(49)	Hangzhou	China	10	Median: 42y (34–50)	General	0.40	10	1	0	2020/01/22-2020/02/22
Liu F(50)	Wuhan	China	44	Mean: 30y (22-43)	Pregnant	0.00	16	7	0	2020/01/11-2020/02/13
Liu GT(51)	Ningxia	China	70	Mean: 40y (3-77)	General	0.53	70	10	0	2020/01/22-2020/02/17
Liu MQ(52)	Chongqing	China	5	Median: 5.2y (0.58-13)	Children	0.60	5	3	0	NA
Liu X(53)	Chenzhou	China	5	Mean: 30y (2.5-56)	General	0.40	5	1	0	2020/01/31-2020/02/06
Liu YL(54)	Hubei, Fujian, Shanxi, Beijing, Guangdong, Jiangxi, Heilongjiang, Anhui	China	12	Median: 30y (22-36)	Pregnant	0.00	13	1	0	2019/12/08-2020/02/25

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Liu YX(55)	Shenzhen	China	12	Median: 62.5y (10-72)	General	0.67	12	1	0	2020/01/11-2020/01/20
Liu ZR(56)	Anhui	China	15	Median: 42y (14-84)	General	0.47	15	2	0	2020/02/04-2020/02/12
Lu RF(57)	Nantong	China	28	Median: 50y (26-73）)	General	0.61	28	1	0	2020/1/23-2020/2/26
Lu XX(58)	Wuhan	China	1391	Median: 6.7y (0-15)	Children	0.61	171	27	0	2020/01/28-2020/02/26
Lu Y(59)	Guangzhou	China	9	Mean: 7.8y (0.17- 15)	Children	0.56	9	1	0	2020/1/22-2020/2/9
Lucy Rivett(60)	UK	UK	1270	NA	General	0.00	61	31	24	2020/04/06-2020/04/24
Luo SH(61)	Anqing	China	83	NA	General	NA	83	8	7	till 2020/02/21
M.M. Arons(62)	King County	US	76	Mean: 78.6y (±9.5)	General		48	27	24	2020/3/3-2020/3/26
Ma Y(63)	Jinan	China	47	Median: 34y (1-72)	General	0.43	47	11	0	2020/1/23-2020/3/10
Ma YL(64)	Wuhan	China	115	Range: 1.67y-5y	Children	0.64	115	61	0	
MacIntyre CR(65)	NA	Japan	565	NA	General	NA	8	5	0	2020/01/29-2020/01/31
Martin C(66)	Brussels	Belgium	326	Mean: 36y (21-59.)	General	0.24	41	31	0	2020/04/15-2020/05/18
McMichael TM(67)	King County	US	167	Median: 72y (21-100)	General	0.33	167	7	0	2020/02/28-2020/03/18
Michel Bielecki(68)	Swiss Army Base in Airolo	Switzerland	508	Median: 21y (18-28)	General	0.92	228	126	0	2020/3/11-2020/5/3
Miyamae Y(69)	Tokyo	Japan	23	Median: 67y (29-79)	General	0.43	23	15	0	2020/02/18-2020/02/25
Mohammed A M Ahmed(70)	Somalia	Somalia	182	Mean: 22y (±4)	General	0.66	49	16	0	2020/4/23-2020/5/7
Moriarty LF(71)	Yokohama	Japan	3711	Range: 29y-73y	General	0.55	712	331	0	2020/02/05-2020/02/20
Muhammet Furkan Korkmaz(72)	NA	Turkey	81	Median: 9.50y (0–17.75)	Children	0.59	81	17	0	2020/3/5-2020/5/5
Nagler AR(73)	Long Island, Brooklyn, Long Island	US	14746	NA	General	NA	1905	536	0	2020/03/25-2020/05/18
Niu YL(74)	Suqian	China	13	Mean: 32.3y (12-48)	General	0.46	13	3	0	2020/01/25-2020/03/03

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Ou JM(75)	Fujian	China	298	Median: 42y (0.42-93)	General	0.55	298	3	0	till 2020/02/21
Pan XQ(76)	Wenzhou	China	64	Mean: 48.8y (±12.9))	General	0.61	64	6	0	2020/02/05-2020/02/20
Pongpirul WA(77)	Bangkok	Tailand	11	Median: 61y (28-74)	General	0.55	11	1	0	2020/01/08-2020/01/31
Seong Eun Kim(78)	NA	Korea	71	Median: 31y (17.8-55.8)	General	0.46	71	13	3	NA
She X(79)	Suining	China	9	Mean: 29y (24-35)	General	0.33	9	1	0	2020/01/20-2020/02/12
Song W(80)	Xiangyang	China	16	Median: 8.5y (0.96-14y)	Children	0.63	16	8	0	2020/01/01-2020/03/17
Spiteri G(81)	NA	Belgium, Finland, France, Germany, Italy, Russia, Spain,Sweden	38	Median: 42y (2-81)	General	0.66	38	2	0	2020/01/17-2020/02/21
Sun DF(82)	Jiaxing	China	30	Mean: 49y (30-71)	General	0.50	30	1	0	2020/01/24-2020/02/06
Sun WW(83)	Zhejiang	China	391	NA	General	0.41	391	54	0	2020/01/08-2020/02/06
Sun Z(84)	Anhui	China	21	Mean: 40.52y (±17.14)	General	0.52	21	4	0	2020/01/23-2020/03/08
Tang A(85)	Zhoushan	China	10	Mean: 50.9y (28-67)	General	0.70	10	5	5	till 2020/02/17
Tian SJ(86)	Beijing	China	262	Median: 47.5y (1-94)	General	0.49	262	13	0	till 2020/02/10
Timothy J. Judson(87)	San Francisco	US	1129	NA	General		1129	315	0	
Tolia VM(88)	San Diego	US	283	NA	General	0.53	29	2	0	20020/03/10-2020/03-19
Tong H(89)	Bengbu	China	24	Mean: 53y (17-74)	General	0.63	24	4	0	2020/01/10-2020/02/15
Tong ZD(90)	Zhoushan	China	7	Median: 28.5y (12-45).	General	0.43	7	3	0	2020/1/1
Treibel TA(91)	London	UK	1523	NA	General	NA	1523	65	0	since2020/3/23
Wan R(92)	NA	NA	78	NA	General	NA	78	2	0	
Wang AH(93)	Chongqing	China	29	Mean: 48.19y (3-89)	General	0.64	90	3	0	till 2020/03/01
Wang D(94)	Chongqing	China	576	Mean: 54.79y	General	0.41	61	38	0	2020/1/24-2020/3/10
Wang JC(95)	Nanjing	China	52	Mean: 44y (13-73)	General	0.56	52	2	0	2020/01/19-2020/02/03
Wang KS(96)	Pingyang	China	138	Median: 48y (33-68)	General	0.22	9	3	0	2020/01/19-2020/02/03

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Wang S(97)	Yichang	China	738	Range: 0.58y-91y	General	0.51	70	70	0	2020/02/11-2020/02/23
Wang T(98)	Jilin	China	50	Mean: 44.52y (16-87)	General	0.60	50	1	0	2020/01/28-2020/02/21
Wang XB(99)	Wuhan	China	1012	Median: 50y (16-89)	General	0.52	1012	30	16	2020/02/07-2020/02/12
Wong HYF(100)	Hongkong	China	64	Mean: 56y (16-96)	General	0.41	64	9	0	2020/1/1-2020/3/31
Wu GY(101)	Wenzhou	China	104	Mean: 45y (±13)	General	0.57	104	2	0	2020/01/17-2020/02/04
Wu HP(102)	Jiangxi	China	23	Range: 0.25y-17.67y	Children	0.39	23	3	0	2020/01/21-2020/02/29
Wu QR(103)	Ganzhou	China	55	Mean: 45.22y (0.25-79)	General	0.51	55	2	0	2020/1/23-2020/3/2
Wu XQ(104)	Wuhan	China	23	Median: 29y (21-37)	Pregnant	0.00	23	15	0	2019/12/31-2020/03/07
Wu Y(105)	Nantong	China	23	Median: 48y (26-68)	General	0.65	23	1	0	NA
Wu YL(106)	Chengde	China	8	Range: 22y-56y	General	0.50	8	7	0	2020/1/24-2020/3/31
Xiang TX(107)	Jiangxi	China	49	Mean: 42.9y (18-78)	General		49	3	0	2020/1/21-2020/1/27
Xiao KH(108)	Chongqing	China	143	Mean: 45.13y (±1.04)	General	0.49	143	11	0	2020/01/23-2020/02/08
Xie JW(109)	Chongqing	China	6	Median: 46y (40-67)	General	0.67	6	3	2	2020/01/29-2020/02/03
Xie YB(110)	Yongjia	China	39	Median: 52y (22-87)	General	0.56	39	5	0	2020/01/20-2020/02/10
Xu TM(111)	Changzhou	China	51	NA	General	0.33	51	6	0	2020/1/23-2020/2/18
Yang K(112)	Nanjing	China	57	Median: 37y (5-97)	General	0.51	57	13	0	
Yang RR(113)	Wuhan	China	78	Median: 37y (26-45)	General	0.33	78	33	0	2019/12/24-2020/02/24
Yang YL(114)	Chongqing	China	8	Median: 53y (9-67)	General	0.63	8	1	0	2020/02/01-2020/02/16
Yang YX(115)	Chibi	China	88	Range: 10y-89y	General	0.60	88	1	0	2020/01-2020/02
Yao QD(116)	Wuhan	China	45	Mean: 47.7y (25-88)	General	0.36	45	1	0	2020/01/25-2020/02/22
Yao XY(117)	Baotou	China	7	Median: 51y (36-68)	General	0.43	7	1	1	2020/02/01-2020/02/08
Ye XX (118)	Yongjia	China	17	Median: 48.8y (31-87)	General	0.65	14	2	0	2020/01/24-2020/02/09
Ye Y(119)	Henan	China	1272	NA	General	NA	1272	113	0	till 2020/03/09
Yu FT(120)	Beijing	China	127	Median: 40y (0.5-92y)	General	0.50	77	2	0	2020/02/05-2020/02/19
Yu JX(121)	Hangzhou	China	87	Mean: 42.89y (±17.02; range:4-88)	General	0.46	87	2	0	2020/1/21-2020/2/12

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Yu X(122)	Guangxi	China	108	Median: 41y (0.25-85)	General	0.40	108	3	0	2020/02/06-2020/04/16
Yuan L(123)	Wuhan	China	28	Mean: 29.75 (±3.5))	Pregnant	0.00	28	15	0	2020/01/30-2020/03/14
Zeng J(124)	Sichuan	China	24184	NA	General	NA	226	1	0	NA
Zeng WZ(125)	Yongzhou	China	44	Mean: 39.1y (±14.5))	General	0.64	44	6	0	2020/01/21-2020/03/05
Zhai HL(126)	Fuyang	China	11	Mean: 11.76y (0.33-17)	General	0.64	11	1	0	2020/01/22-2020/02/24
Zhan H(127)	Shiyan	China	6	Median: 8.5y (0.5-11))	General	0.50	6	1	0	2020/2/1
Zhang JJ(128)	Beijing	China	5	NA	General	NA	5	1	0	2020/01/24-2020/02/29
Zhang KY(129)	Kunming	China	11	Mean: 42y (8-67)	General	0.45	11	3	0	2020/01/26-2020/02/20
Zhang R(130)	Liaoning	China	2784	NA	General	0.49	67	9	0	2020/01/22-2020/02/29
Zhang YC(131)	Nanjing, Xuzhou	China	21	Median:25y (10-61)	General	0.60	21	5	0	2020/01/25-2020/03/18
Zhang YD(132)	Qinghai	China	18	Range: 7y-47y	General	0.67	18	7	6	2020/01/24-2020/02/05
Zhao L(133)	Shijiazhuang	China	30	NA	General	0.63	30	9	0	2020/01/21-2020/02-25
Zhong ZM(134)	Wuhan, Nanning, Liuzhou	China	193	Mean: 48.1y (3-95)	General	0.58	193	46	0	2020/01/03-2020/03/04
Zhou H(135)	Qujing	China	13	Mean: 28y (11.83)	General	0.46	13	2	0	2020/01/23-2020/02/27
Zhu SQ(136)	Shenzhen	China	417	Mean: 45.3y (1-86)	General	0.47	417	11	11	2020/01/01-2020/02/14

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Supplementary Table 3 Quality assessment of selected articles

	Introduction	Methods											Results				Discussion		Other	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Amy V. Dora	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
An YH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Arima	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Backer JA	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Bai M	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Bai R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Bai SL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Bin YF	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Böhmer MM	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM
Cao JM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Carla Felice	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Chan JFW	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Chen B	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Chen J	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Chen T	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Chen Y	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Chen YJ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Cheng ZP	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NM	Y	Y	Y	N	Y
COVID-19 National Incident Room Surveillance Team	NM	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	N	N	NM	NM
Ding Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Dong X	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM

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Dong XC	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Dong YY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM
Feng XP	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Gao T	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Gautret P	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
G-u. Kim	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Hu SX	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Huang DD	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Ji GH	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Jia CY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Jiang R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Jin MH	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Kang M	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	Y
Ke B	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Ki M	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Lai XQ	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Le TQM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Lei MY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Li CY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	N	N	NM	NM
Li W	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Li Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Li Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Liao XN	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Lin ZF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Liu BM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y

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Liu BY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Liu DH	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Liu F	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Liu F	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Liu GT	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Liu MQ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	NM
Liu X	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Liu YL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Liu YX	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Liu ZR	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Lu RF	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Lu XX	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	N	N	NM	NM
Lu Y	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Lucy Rivett	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Luo SH	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	Y
M.M. Arons	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Ma Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Ma YL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
MacIntyre CR	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	NM	Y	N	N	N	NM
Martin C(Charlotte Martin)	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
McMichael TM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Michel Bielecki	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Miyamae Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Mohammed A M Ahmed	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM	NM	Y	Y	Y	N	Y
Moriarty LF	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	NM	N	NM

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Muhammet Furkan Korkmaz	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Nagler AR	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Niu YL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Ou JM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Pan XQ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Pongpirul WA	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Seong Eun Kim	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
She X	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Song W	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Spiteri G	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Sun DF	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Sun WW	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	NM	NM	NM
Sun Z	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tang A	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tian SJ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Timothy J. Judson	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Tolia VM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Tong H	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tong ZD	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Treibel TA	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Wan R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang AH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	Y
Wang D	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang JC	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Wang KS	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM	NM

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Wang S	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Wang T	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Wang XB	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wong HYF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Wu GY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	Y
Wu HP	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Wu QR	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Wu XQ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Wu Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Wu YL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Xiang TX	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Xiao KH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Xie JW	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Xie YB	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Xu TM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Yang K	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yang RR	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Yang YL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yang YX	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yao QD	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM
Yao XY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Ye XX	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Ye Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Yu FT	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM
Yu JX	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y

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Yu X	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Yuan L	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zeng J	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zeng WZ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Zhai HL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhan H	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhang JJ	Y	Y	N	Y	Y	Y	Y	N	NM	N	Y	Y	Y	Y	NM	Y	N	N	N	Y
Zhang KY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Zhang R	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhang YC	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Zhang YD	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhao L	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Zhong ZM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	NM
Zhou H	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhu SQ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM

Y, Yes; N, Not; NM, not mentioned.

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According to quality of cross-sectional studies (AXIS) scale (Downes MJ, Brennan ML, Williams HC, Dean RS. Development of a critical appraisal tool to assess the quality of cross-sectional studies (AXIS). *BMJ open* 2016; **6**(12): e011458.):

Introduction

1. Were the aims/objectives of the study clear?

Methods

2. Was the study design appropriate for the stated aim(s)?
3. Was the sample size justified?
4. Was the target/reference population clearly defined? (Is it clear who the research was about?)
5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?
6. Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?
7. Were measures undertaken to address and categorise non-responders?
8. Were the risk factor and outcome variables measured appropriate to the aims of the study?
9. Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialled, piloted or published previously?
10. Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)
11. Were the methods (including statistical methods) sufficiently described to enable them to be repeated?

Results

12. Were the basic data adequately described?
13. Does the response rate raise concerns about non-response bias?
14. If appropriate, was information about non-responders described?
15. Were the results internally consistent?
16. Were the results for the analyses described in the methods, presented?

Discussion

17. Were the authors' discussions and conclusions justified by the results?
18. Were the limitations of the study discussed?

Other

19. Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?
20. Was ethical approval or consent of participants attained?

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Supplementary Table 4 Results of sensitivity analysis

Study omitted	Estimate	[95% Conf. Interval]	
Amy V. Dora	0.159917	0.145099	0.174734
An YH	0.160117	0.145304	0.17493
Arima	0.159967	0.145152	0.174781
Backer JA	0.160788	0.145941	0.175635
Bai M	0.162473	0.14746	0.177486
Bai R	0.159756	0.144896	0.174617
Bai SL	0.159914	0.145102	0.174726
Bin YF	0.160541	0.145709	0.175374
Böhmer	0.160182	0.145366	0.174998
COVID-19 National Incident Room Surveillance Team	0.154752	0.139816	0.169688
Cao JM	0.159624	0.144804	0.174444
Carla Felice	0.159907	0.14509	0.174724
Chan JFW	0.160088	0.145276	0.1749
Chen B	0.160439	0.145601	0.175278
Chen J	0.161997	0.147082	0.176913
Chen T	0.160215	0.145374	0.175057
Chen Y	0.160124	0.145233	0.175015
Chen YJ	0.160777	0.145907	0.175648
Cheng ZP	0.160265	0.145445	0.175085
Ding Y	0.160435	0.145602	0.175268
Dong X	0.160136	0.145322	0.17495
Dong XC	0.161107	0.146241	0.175974
Dong YY	0.159622	0.144797	0.174447
Feng XP	0.160109	0.145278	0.174941
G-u. Kim	0.159691	0.14479	0.174591
Gao T	0.160288	0.145461	0.175114
Gautret P	0.160077	0.145252	0.174901
Hu SX	0.166479	0.151279	0.181678
Huang DD	0.160566	0.145719	0.175413
Ji GH	0.160334	0.145505	0.175162
Jia CY	0.160587	0.145753	0.175422
Jiang R	0.160265	0.145445	0.175085
Jin MH	0.160126	0.145313	0.17494
Kang M	0.160318	0.145493	0.175143
Ke B	0.159857	0.145037	0.174677
Ki M	0.160177	0.145355	0.174998
Lai XQ	0.160934	0.146077	0.17579
Le TQM	0.160145	0.145331	0.17496
Lei MY	0.159996	0.145125	0.174868
Li CY	0.160098	0.145285	0.17491

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Li W	0.159889	0.145078	0.174701
Li Y	0.160505	0.145674	0.175336
Li Y	0.160052	0.145188	0.174915
Liao XN	0.16019	0.145363	0.175017
Lin ZF	0.161122	0.146225	0.176019
Liu BM	0.15864	0.143802	0.173479
Liu BY	0.15845	0.143602	0.173298
Liu DH	0.160114	0.145298	0.17493
Liu F	0.160126	0.145313	0.17494
Liu F	0.159829	0.145013	0.174645
Liu GT	0.16016	0.145321	0.174999
Liu MQ	0.159952	0.145141	0.174764
Liu X	0.160078	0.145266	0.174889
Liu YL	0.160154	0.14534	0.174969
Liu YX	0.160145	0.145331	0.17496
Liu ZR	0.160114	0.145298	0.17493
Lu RF	0.160293	0.145472	0.175114
Lu XX	0.160112	0.14523	0.174994
Lu Y	0.160117	0.145304	0.17493
Lucy Rivett	0.16025	0.145415	0.175085
Luo SH	0.160799	0.145955	0.175644
M.M. Arons	0.160361	0.145532	0.175191
Ma Y	0.159889	0.14506	0.174719
Ma YL	0.157632	0.142774	0.17249
MacIntyre CR	0.159865	0.145052	0.174677
Martin C	0.158675	0.143848	0.173502
McMichael TM	0.161231	0.146351	0.176112
Michel Bielecki	0.154902	0.139995	0.169809
Miyamae Y	0.159429	0.14461	0.174248
Mohammed A M Ahmed	0.159619	0.144789	0.174449
Moriarty LF	0.147166	0.132046	0.162286
Muhammet Furkan Korkmaz	0.159858	0.145014	0.174701
Nagler AR	0.145287	0.1296	0.160974
Niu YL	0.160036	0.145221	0.174851
Ou JM	0.162691	0.147754	0.177628
Pan XQ	0.160336	0.145499	0.175172
Pongpirul	0.160136	0.145322	0.17495
Seong Eun	0.160169	0.14533	0.175009
She X	0.160117	0.145304	0.17493
Song W	0.15977	0.144954	0.174586
Spiteri G	0.160327	0.145502	0.175153
Sun DF	0.160311	0.145489	0.175134
Sun WW	0.160593	0.145615	0.17557

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Sun Z	0.160053	0.145235	0.174871
Tang A	0.160186	0.145373	0.175
Tian SJ	0.161771	0.14685	0.176692
Timothy J. Judson	0.151894	0.136582	0.167205
Tolia VM	0.160244	0.145422	0.175066
Tong H	0.160081	0.145262	0.174901
Tong ZD	0.159975	0.145163	0.174788
Treibel TA	0.171275	0.155777	0.186774
Wan R	0.160696	0.145853	0.175538
Wang AH	0.160749	0.145901	0.175596
Wang D	0.158459	0.143624	0.173295
Wang JC	0.160456	0.145625	0.175287
Wang KS	0.159996	0.145183	0.17481
Wang S	0.156696	0.141857	0.171535
Wang T	0.160495	0.145665	0.175326
Wang XB	0.169063	0.153807	0.18432
Wong HYF	0.160162	0.145326	0.174999
Wu GY	0.160936	0.146082	0.175789
Wu HP	0.16013	0.145311	0.174949
Wu QR	0.160484	0.145651	0.175316
Wu XQ	0.159429	0.14461	0.174248
Wu Y	0.160247	0.145428	0.175066
Wu YL	0.159743	0.14493	0.174556
Xiang TX	0.160371	0.14554	0.175201
Xiang TX	0.160371	0.14554	0.175201
Xiao KH	0.160777	0.145907	0.175648
Xie JW	0.160088	0.145276	0.1749
Xie YB	0.160162	0.145337	0.174988
Xu TM	0.160215	0.145385	0.175046
Yang K	0.159866	0.145033	0.1747
Yang RR	0.158906	0.144064	0.173749
Yang YL	0.160107	0.145295	0.17492
Yang YX	0.160846	0.145999	0.175692
Yao QD	0.160449	0.145621	0.175278
Yao XY	0.160159	0.145347	0.174971
Ye XX	0.160105	0.145289	0.17492
Ye Y	0.165672	0.150294	0.181051
Yu FT	0.160686	0.145844	0.175528
Yu JX	0.160779	0.145932	0.175625
Yu X	0.160915	0.14606	0.17577
Yuan L	0.159478	0.144657	0.174299
Zeng J	0.16213	0.147224	0.177035
Zeng WZ	0.160151	0.145323	0.174979
Zhai HL	0.160136	0.145322	0.17495

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Zhan H	0.160088	0.145276	0.1749
Zhang JJ	0.160078	0.145266	0.174889
Zhang KY	0.160016	0.145202	0.17483
Zhang R	0.16019	0.145352	0.175028
Zhang YC	0.159994	0.145176	0.174813
Zhang YD	0.160201	0.145384	0.175018
Zhao L	0.159846	0.145024	0.174668
Zhong ZM	0.159216	0.144325	0.174108
Zhou H	0.160095	0.14528	0.17491
Zhu SQ	0.163999	0.14901	0.178988
Combined	0.16009	0.145281	0.174899

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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	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.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5
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.	5
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.	5-6
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.	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5
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).	6
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.	7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	7
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.	8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	8
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.	8

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PRISMA 2009 Checklist

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).	8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	8
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.	9
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.	9
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).	11
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.	9
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	9-11
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	11
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	10-11
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).	11-13
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).	14-15
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	15
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.	15

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

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BMJ Open

Rate of asymptomatic COVID-19 among ascertained infections in different region and population groups: A systematic review and meta-analysis including 130,123 infections from 241 studies

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-049752.R1
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Date Submitted by the Author:	21-Jun-2021
Complete List of Authors:	Chen, Xiao; Zhejiang University Huang, Ziyue; Mianyang Maternal and Child Health Care Hospital Wang, Jingxuan; The Chinese University of Hong Kong Zhao, Shi; The Chinese University of Hong Kong; The Chinese University of Hong Kong Wong, Martin Chi-Sang; The Chinese University of Hong Kong Chong, Ka; The Chinese University of Hong Kong; The Chinese University of Hong Kong He, Daihai; Hong Kong Polytechnic University, Department of Applied Mathematics Li, Jinhui; The Chinese University of Hong Kong, ;
Primary Subject Heading:	Public health
Secondary Subject Heading:	Infectious diseases, Epidemiology
Keywords:	COVID-19, INFECTIOUS DISEASES, EPIDEMIOLOGY, PUBLIC HEALTH

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Rate of asymptomatic COVID-19 among ascertained infections in different region and population groups: A systematic review and meta-analysis including 130,123 infections from 241 studies

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Abstract

Introduction: Asymptomatic infection of SARS-CoV-2 may lead to silent community transmission and compromise pandemic control measures of COVID-19. We aimed to estimate the rate of asymptomatic COVID-19 infection from published studies, and compare this rate among different region and patient groups.

Methods: This systematic review and meta-analysis was conducted according to the standards strictly following the '*Preferred Reporting Items for Systematic reviews and Meta-Analyses*' (PRISMA) guideline. The electronic databases including Medline, Embase, PubMed, and three Chinese electronic databases (The Chinese National Knowledge Infrastructure (CNKI), WanFang Data, and VIP) from 1 November 2019 to 31 December 2020 were searched. Original studies with sample size (or number of subjects) not less than 5 were included. Subgroup analyses were conducted according to different study types, study periods, geographical regions, and patients' demographics. The STATA command '*Metaprop*' was implemented to conduct meta-analysis for the pooled rate estimates of asymptomatic infections with exact binomial and score test-based 95% confidence intervals (CIs).

Results: A total of 130,123 ascertained COVID-19 infections in 241 studies were included in the meta-analysis, including 31,411 asymptomatic infections. The overall rate of asymptomatic infection was 23.6% (18.5%-29.1%) and 21.7% (16.8%-27.0%), before and after excluding pre-symptomatic cases, respectively. Subgroup analysis showed that the rate was significantly higher in pregnant women (48.8%, 28.9%-68.9%), children (32.1%, 24.4%-40.5%), and studies reporting screening programmes (36.0%, 24.6%-48.1%) conducted on or after 01 March 2020 (42.5%, 33.4%-51.9%). In terms of geographical regions, the rate was the highest in Africa (64.3%, 56.7%-71.6%), followed by America (40.0%, 27.4%-53.3%), Europe (28.1%, 19.0%-38.1%), and Asia (18.1%, 13.2%-23.5%).

Conclusion: One-fifth of the COVID-19 infection is asymptomatic throughout the infection course. High proportion of asymptomatic infection were observed in some patient groups and regions. Public health policies targeting these high-risk groups may be recommended to achieve early identification and more stringent containment of the pandemic.

(300 words)

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Keywords: COVID-19; SARS-CoV-2; asymptomatic infection; asymptomatic ratio; meta-analysis.

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Article Summary

Strengths and limitations of this study

1. The comprehensive systematic literature search included a greater number of studies which reported varied asymptomatic infection rate.
2. Several subgroup analyses were conducted by considering different aspects of the study design.
3. Heterogeneity in the asymptomatic infection rate shall be noted.
4. Cross-sectional design of most reviewed studies may misclassify 'pre-symptomatic' as 'symptomatic' infections.

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Introduction

In 2019, a cluster of severe pneumonia cases of unknown type were reported in Wuhan, China (1). Later coined as the coronavirus disease 2019 (COVID-19), it rapidly resulted in large-scale outbreaks across many regions. On 30 January 2020, the World Health Organization (WHO) declared the COVID-19 as a public health emergency of international concern (2), and further defined it as a pandemic on 11 March 2020. As of 2 September 2020, a cumulative total of 25,937,361 COVID-19 cases have been confirmed globally, with 861,910 associated deaths.

The pathogen of COVID-19, i.e., severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is highly contagious, and could be transmitted from human to human (1, 3). The viral load in an asymptomatic patient has been found to be similar to that in symptomatic patients in a study of nine patients (4), and this observation was later confirmed in a study involving large samples (5). The early peaking of SARS-CoV-2 viral load during the pre-symptomatic phase may cause silent community outbreaks (6). Further investigations also found that the asymptomatic infections may carry SARS-CoV-2 for more than 1 month, indicating the long-lasting risk of secondary infection (7-11).

Determining the rate of asymptomatic infection is important as it may deepen the understanding of the real reproductive number (R_0), as well as the true incidence and mortality rate of COVID-19. The rate may also function as an essential epidemiological parameter to inform disease combating policies, including the density and range of screening, patient isolation as well as early intervention (12). Nevertheless, the significance of the invisibly infected person as the source of infection depends on its distribution in the population, and the amount and duration of the virus excreted (13). The reported proportions of asymptomatic individuals in existing literature varied a lot (12), depending on their research settings (e.g. geographical region, screening vs. non-screening studies), demographic characteristics (e.g. age groups, pregnant women,

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children), and other latent factors. The present study performed a systematic review and meta-analysis to estimate the asymptomatic infection rate based on published studies, and compare the rate among different patient groups as well as study settings.

Methods

Searching strategy

This systematic review and meta-analysis was conducted according to the standards strictly following the '*Preferred Reporting Items for Systematic reviews and Meta-Analyses*' (PRISMA) guideline (14). XC and ZH searched the Medline, Embase, PubMed, and three Chinese electronic databases (the Chinese National Knowledge Infrastructure [CNKI], WanFang Data, and VIP) from 1 November 2019 to 31 December 2020. The search string related to "COVID-19" AND "asymptomatic" was systematically developed in PubMed with the help of its MeSH terms, and was applied to all databases after discussing with an experienced Libationary (Maggie Choi). The search fields of "Text Word" was applied to ensure the best possible search evidence (**Supplementary Table 1**). No filters or limitations were applied to retrieve the best possible result and to avoid excluding pre-indexed materials. Meanwhile, highly relevant references were also searched (by XC and ZH) by reviewing the reference list of the included articles. Two reviewers (XC and ZH) determined the eligible studies independently. Consensus was reached by referral to a third reviewer (JW) when there was disagreement. All manuscripts were imported into the Endnote software (version X8, Thomson Reuters, Carlsbad, California) to store and manage the retrieved citations. Duplicate studies were removed.

Asymptomatic case and asymptomatic ratio

Several similar definitions of 'asymptomatic case' were noted in previous studies (15). We followed the official definition from the State Council of China and the World Health Organization (WHO) (16, 17), and defined 'asymptomatic case' as individuals

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who 1) have no clinical manifestations of COVID-19, such as fever, cough, sore throat, and other self-perceived or clinically identifiable symptoms and signs; 2) have positive result of SARS-CoV-2 pathogen test; and 3) does not develop symptoms until the end of hospital admission or follow-up observations. Asymptomatic COVID-19 infection rate, or asymptomatic ratio, is calculated as the proportion of asymptomatic cases among all COVID-19 infections.

Literature screening and selection criteria

All studies were screened by title and abstract first, followed by full texts if the study meets the inclusion criteria, which consist of: (1) the studying subjects were diagnosed with SARS-CoV-2 infection; (2) the study was designed as an observational study; and (3) the numbers of asymptomatic and symptomatic COVID-19 infections were explicitly and exactly reported.

The literature screening was conducted without language or region restriction. The exclusion criteria are as follows. They included (1) study that included patients without virological evidence of SARS-CoV-2 infection; exclusion criterion (2) study which did not investigate the distribution of asymptomatic COVID-19 infections among all subjects; (3) study that is not classified as original research, such as reviews, comments, case report; and (4) study has an overall sample size of less than 5.

For the same group of subjects been reported by different articles, only articles with the most updated and detailed information were included for further analysis.

Data extraction and subgrouping schemes

For eligible articles, two types of the information were extracted by the two reviewers (XC and ZH) independently. For each study, we include two types of information: (1) the basic information of the individual studies that contains the name of the first author, investigation period, geographical region, and the study setting (screening and non-

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screening); and (2) the study settings, characteristics of subjects, sample size, and the number of COVID-19 infections (total infections, pre-symptomatic infections, and asymptomatic infections).

To ensure the accuracy of data, cross-checking was conducted after extraction of the preliminary information. Disagreements were resolved through consensus or by referral to the third reviewer (JW).

To explore the source of heterogeneity among the included studies, several subgroup analyses were performed according to the study design and characteristics of subjects in each study. First, we identified three groups based on the subjects' demographical features. They included 'children' groups consisting of subjects less than 18 years old; 'pregnant women' groups involving expectant mothers as subjects; and the 'general population' group. Second, three age groups were identified according to the subjects' mean or median age: ≤ 18, from 19 to 45, and > 45 years, respectively. The selection of mean or median age followed the statistics reported in each study. Third, studies were categorized into 'screening' or 'non-screening' types by referring to the positive rate of SARS-CoV-2 pathogen test among included subjects. In the screening studies, the positive rate is less than 100%; while for non-screening studies, all subjects were tested positive. Forth, we separated studies based on subjects from different geographical regions including China, Asia (excluding China), the US and Europe. Last, subgroup analysis was performed by study period, during which the subjects were tested for COVID-19, including 'before 01 March 2020' or '01 March 2020 and afterwards'.

Quality assessment

The quality of each included study was assessed by two researchers (XC and ZH) independently using the quality of cross-sectional studies (AXIS) scale (18). There are five components including 20 questions in the AXIS scale. Seven questions measure

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the quality of reporting; another seven questions measure the quality of study design, and six questions measure the possible introduction of biases in each study.

Statistical analysis

Accounting for all included studies, the pooled estimates of the asymptomatic rates were generated with exact binomial-distributed likelihood framework and score test-based 95% confidence intervals (CIs) (1). The STATA command "*metaprop*" was adopted to conduct meta-analysis. Heterogeneity across the studies was examined by the I^2 statistic, measuring the proportion of total variation contributed by between-study variation. The I^2 values < 25%, ranging from 25% to 75%, and > 75% correspond to the thresholds for three ordinal levels of heterogeneity including low, moderate, and high, respectively (19).

Univariate and multivariate meta-regression analysis was performed to identify any potential effects of modifiers or confounders on the estimated rate. We examined the effects of the covariates including study population, age-specific proportion, screening/non-screening study, geographical region, and time trend in multivariate analysis. Sensitivity analysis was conducted by omitting one study at a time, generating the pooled estimates and comparing with the original estimates. Potential publication bias was examined by Egger's test and visualized using a funnel plot. If the tests indicated potential publication bias, the Trim and Fill's method, which is based on a modified funnel plot, would be adopted to adjust the small-study effect (20).

All analyses were performed using STATA statistical software (version 14.0, Stata, College Station, Texas, USA). The figures were generated using R software (version 3.6.3) with the '*forestplot*' package.

Results

Characteristics of studies and subjects

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In total, 9,798 unique citations were identified in different databases by the literature search **(Figure 1)**. We retrieved 661 full-text articles assessed for eligibility after 9,247 citations were excluded during title or abstract screening with pre-determined criteria. Finally, there were 241 studies in 240 articles included in the meta-analysis, among which 3 studies were additional records identified through reference lists.

The basic characteristics of the included studies are shown in **Supplementary Table 2**. These characteristics include: cities, countries and study periods in which the ascertained COVID-19 infections were recruited; the number of test-positive and asymptomatic infections; the number of pre-symptomatic infection in patients if available; and demographics of each patient. Approximately 72.9% (175 out of 241) of all included studies were conducted in Asia, 11.7% in the Europe, and 10.42% in America. In terms of study populations, 80.5% were performed in the general adults, 12.4% in children and 7.1% in pregnant women, respectively.

Quality scores of AXIS for the included studies ranged between 11 and 19 points, with 153 studies meeting the criteria of having high quality (≥ 16 points). Overall, 97.9% (235 out of 240) of all studies met the criteria for both reporting aims/objectives and quality design, and the risk factors and outcome variables were appropriate for the studies. In all studies, the methods were clearly defined so that those studies could be repeated, and the presentation of results met the analysis descriptions in the methods with internal consistency (**Supplementary Table 3**).

Asymptomatic ratio estimates

A total of 130,123 ascertained COVID-19 infections from 241 studies were finally included in the meta-analysis **(Figure 2)**, including 31,411 asymptomatic infections at the time of diagnosis. The rate of asymptomatic infections varied from 0.1% in the general adults in Wuhan, China (21), to 95.6% in the pregnant women in Peru (22). The overall rate of asymptomatic infections was estimated at 23.6% (18.5%-29.1%). The

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I^2 equaled to 99.7%, indicating a high heterogeneity among the studies. Of the 31,411 asymptomatic infections, 448 (1.4%) developed symptoms after admission. After excluding these pre-symptomatic observations, the pooled rate was 21.7% (16.8%-27.0%) at an I^2 of 99.7%.

In subgroup analysis, we found that pregnant women (48.8%, 28.9%-68.9%; I^2 = 96.9%) had a significantly higher asymptomatic infection rate than children (32.1%,24.2%-40.5%; I^2 = 94.4%), whereas the general non-pregnant adults had the lowest asymptomatic rate (20.4%, 15.0%-26.3%; I^2 = 99.8%). Regarding age-specific proportion, patients aged ≤ 18 years (31.1%, 23.5%-39.2%; I^2 = 94.4%) had a significantly higher prevalence of asymptomatic cases than adults aged 19-45 years (26.7%, 19.1%-34.9%; I^2 = 99.7%) or > 45 years (15.3%, 10.7%-20.6%; I^2 = 97.1%).

The asymptomatic infection rate was 36.0% (24.6%-48.1%; I^2 = 99.8%) among studies for screening settings, which is almost twice of that among studies for non-screening settings (19.4%, 14.3%-24.9%; I^2 = 99.6%). Significantly different asymptomatic rates were observed in different geographical regions (p-value <0.001) - the rate was highest in Africa (64.3%, 56.7%-71.6%; I^2 = 96.8%), followed by America (40.0%, 27.4%-53.3%; I^2 = 99.6%), and Europe (28.1%, 19.0%-38.1%; I^2 = 98.5%). Asia was estimated to have the lowest rate of asymptomatic infection (18.1%, 13.2%-23.5%; I^2 = 99.5%). For subgroup analysis by time period, we noted that studies conducted before 01 March 2020 reported a pooled asymptomatic infection rate of 13.3% (9.8%-17.1%; I^2 = 94.2%), while the rate increased sharply to 42.5% (33.4%-51.9%; I^2 = 99.6%) among studies conducted after 01 March 2020.

All subgroup analysis results were shown in **Figure 3**.

We performed both univariate and multivariate meta-regression analysis to investigate study-level factors that may contribute to the heterogeneity among studies and might

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have influenced our estimations of the asymptomatic infection rate. The results of univariate regression analysis (**Table 1**) demonstrated several significant sources of heterogeneity in the estimated asymptomatic infection rate - studies focused on subjects aging >45 years old (*p*-value = 0.015) and were conducted out of Africa (*p*-value ≤ 0.001) are significantly associated with a lower ratio of asymptomatic infection; whereas those using a non-screening study design (*p*-value < 0.001), and conducted on or after 01 March 2020 (*p*-value < 0.001) tend to report a higher ratio of asymptomatic infection. A screening study design (*p*-value = 0.031), geographical region (*p*-value < 0.001) and time trend (*p*-value < 0.001) remained the significant sources of heterogeneity in the multivariate regression analysis.

We found no evidence of publication bias among studies by Egger's test with *p*-value = 0.414. Sensitivity analysis showed that it was unlikely that any individual study significantly influenced the pooled estimates, demonstrating the robustness and reliability of our estimates (**Supplementary Table 4).**

Discussion

Our meta-analysis of 130,123 infections in 241 studies performed in 36 countries provides an up-to-date as well as comprehensive overview of asymptomatic infection rate of COVID-19. The estimated rate in our study is 23.6% and 21.7%, before and after excluding pre-symptomatic cases, respectively. There are three key findings in the subgroup analysis (23). First, African studies reported the highest asymptomatic infection rate, while Asian studies reported the lowest. Second, the proportion of asymptomatic carriers was nearly doubled in screening studies than that in non-screening studies. Third, asymptomatic infection rate was more than two times higher in studies conducted in or after 01 March 2020 than those conducted beforehand.

Our estimation is higher than some existing meta-analysis which reported a ratio between 15.6% to 20% (24, 25). One possible explanation is that the included studies

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in previous meta-analysis were dominated by that conducted during the early course of the pandemic and in China or the US, where the asymptomatic ratio is lower than other regions. However, our study included more than 200 articles, resulting in a more precise estimation with significantly narrower confidence interval. With a much larger dataset, we conducted more subgroup analysis which resulted in more implications.

In the subgroup analysis, we noted a large variety of asymptomatic rates among different populations. For instance, children and adults aged ≤ 45 years old tended to have a significantly higher rate. The inverse correlation between age and symptom severity has also been reported and discussed by a few studies, and the prevalence of chronic diseases was considered as the risk factors of symptomatic infection (23, 26, 27). Nevertheless, a multi-center study in China noted that more than half of the asymptomatic children had lung injuries, although the injuries were usually less severe than that among the adults. Infection control measures may be targeted on the early detection and isolation of asymptomatic youth, as the young asymptomatic carriers are of higher probability to bring in community transmission due to their more socially active lifestyle habits with more frequent travelling than people in other age groups (26).

We also noted that the asymptomatic infection rate for pregnant women (48.8%) is more than two times that for the general adults (20.4%). Previous study suggested cytotoxic cells may be poised to control virus load, and hence affect the disease severity during pregnancy (28). Case reports from the New York hospital reported a similarly high rate (14 women, 32.6%) at presentation, yet 71.4% (10 women) of the asymptomatic mothers developed symptoms during their hospitalization and postpartum course (29). Nevertheless, we noted that 15 out of our 17 included studies on pregnant women are cross-sectional studies that in which the high proportion of asymptomatic infections may include both pre-symptomatic and asymptomatic cases. More follow-up studies among the pregnant women are needed before drawing further conclusions. Undetected asymptomatic pregnant women may lead to more severe

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consequences. Without early detection and proper preventive measures, the delivery of asymptomatic patients brings extra risks to nosocomial infection, and may also result in droplet transmission among the women, kids, as well as other family members (30). Importantly, the data suggest that the severity and mortality risk of hospital transmission may be greater than that of community-acquired COVID-19 (31).

To our knowledge, this is the first meta-analysis that compared the asymptomatic infection rate in different continents. Previous meta-analysis only concluded that population in Asia may have a lower asymptomatic ratio, while did not explored the differences among other continents (32). Our results also showed that estimated ratio in Asia is the lowest among all continents. Possible explanations were summarized in a published meta-analysis, from the perspectives of infection control policies and host characteristics (32). Meanwhile, the rates in Africa (64.3%) were the highest among all continents, although the limited number of subjects (20,271 COVID-19 infections) in African studies reminded us to think twice before generalizing the results. The phenomenon may be partly explained by a few factors in African patients, including the generally younger age, the lower proportion of chronic disease patients and elderlies living in nursing homes, and the higher serum Vitamin D levels due to rich sun exposure (33). Despite the higher asymptomatic ratio, it is noted that Africa is the continent with the lowest RT-PCR testing rate as well as the lowest vaccination rate. The high proportion of asymptomatic rate may further hinder the timely detection and control of COVID-19 infections.

We noted that the asymptomatic infection rate was nearly doubled in screening studies than that in non-screening studies. One possible explanation is that people may get tested for varied reasons associated with the social, cultural, and political factors in each region. For instance, frontline health workers and people with a history of exposure were in general more likely to be reported in screening programmes, while the samples in non-screening studies were likely to be dominated by subjects having severe

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symptoms requiring hospitalization (34). If we consider the rate as a constant, the higher asymptomatic infection rate estimates were likely due to higher probabilities of ascertaining asymptomatic COVID-19 infections in the community with screening implemented. This implies the importance of mass screening in detecting the infections, which is of importance in community infection control. Increasing the accessibility and affordability of community testing could be an important surveillance strategy for early containment of diagnosed cases (35).

We also found that the pooled asymptomatic infection rate increased from 13.3% (95% CI: 9.8%-17.1%) for studies conducted before 01 March 2020, to 42.5% (33.4%-51.9%) for studies conducted on 01 March 2020 or afterwards, although the 95% CI is larger in the latter time period. This timeline is highly consistent with a previous study using the publicly released from the Centre for Health Protection in Hong Kong (36). The increased rate may be due to overlooking of asymptomatic, especially pre-symptomatic cases at the early stage of the pandemic, when medical resources were targeted to patients with severe symptoms. Later, with increased public awareness and test accessibility, more COVID-19 infected individuals without symptoms were detected, while more and more studies reported the proportion of asymptomatic patients. In this context, future studies may explore whether the proportion of COVID-19 infections with mild or no symptoms is increasing, especially when considering the SARS-CoV-2 variant with D replaced by G at the 614-th codon in the Spike protein which dominated the pandemic since late February 2020 (6, 37, 38).

This study has limitations. First, our pooled asymptomatic infection rates were found to have a high level of heterogeneity (I^2 = 96.2%). This could be attributed to the difficulties in generating the exact number of infections and asymptomatic cases during an outbreak. Although we conducted subgroup analysis and meta-regression to figure out the source of heterogeneity, some unobserved factors which have not be included in the original studies may lead to the high heterogeneity, such as changing pandemic

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control measures in some countries; the diverse definition of asymptomatic infection, varying practices of surveillance and ascertainment of asymptomatic infection; as well as meteorological disparities across time and regions. Nevertheless, previous studies indicated that any amount of heterogeneity is acceptable if both accurate data and predefined eligibility criteria were provided (39, 40). Second, we followed the WHO definition of COVID-19 infection and only included infections detected by RT-PCR, while the availability of RT-PCR is restricted in many countries (41). Increasing number of studies reported the results of antibody-based rapid diagnostic tests, yet they were not included in our meta-analysis. Third, our meta-analysis focused on real-world evidence and observational studies, in which subjects with more severe and easily recognized symptoms are more likely to be selected. The collider bias caused by non-representative sampling strategies (such as sampling conditional on testing and prognosis conditional on hospitalization) in existing observational studies on COVID-19 has been deeply discussed in (34). Forth, cross-sectional studies included in this review might mis-classified pre-symptomatic cases as 'asymptomatic', hence result in a certain degree of overestimation on the asymptomatic infection rate. With additional information of the exposure and reporting dates of each case, we remark our estimation can be extended to a right censoring version to further address some potential bias in the existing frameworks (12).

Conclusions

We estimated the asymptomatic infection rate of 23.6%, which decreased to 21.7% after excluding pre-symptomatic cases. Subgroup analysis indicates that pregnant women, children, African residents, screening programmes, and studies conducted after 01 March 2020 had higher asymptomatic infection rates. Our findings provide further insights on the distribution of asymptomatic COVID-19 infections in different groups of individuals, which bear significance on public health policies that aim to achieve early identification and more stringent containment of the pandemic.

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Declarations

Patient and Public Involvement

Not applicable.

Ethics approval and consent to participate

Not applicable.

Availability of materials

All data relevant to the study are included in the article or uploaded as supplementary information.

Consent for publication

Not applicable.

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Disclaimer

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Conflict of interests

DH received a grant from Alibaba (China) Co. Ltd., Collaborative Research grant. Other authors declared no conflict of interest.

Author's contributions

XC and ZH designed the study and searched the literature. XC, ZH, and JW extracted the data and evaluated the quality. XC conducted the statistical analysis. XC, ZH, and JW wrote the full manuscript. SZ, MSCW, MKCC, DH, and JL provided critical

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revision of the manuscript for important intellectual content. All authors discussed the results, and approved the final version of the manuscript for publication.

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Tables and Figures Legends

Table 1 Results of univariate and multivariate meta-regression analysis

Figure 1 The process of study selection for the meta-analysis

Figure 2 Meta-analysis of the asymptomatic ratio among ascertained COVID-19 infections (including and excluding pre-symptomatic infections)

Figure 3 Asymptomatic ratio among ascertained COVID-19 infections by patient group, age group, screening study, region, and time trend

Supplementary Table 1 Search strategy for systematic review

Supplementary Table 2 Characteristics of the studies included for meta-analysis

Supplementary Table 3 Quality assessment of selected articles

Supplementary Table 4 Results of sensitivity analysis

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Table 1 Results of Univariate and Multivariate Meta-regression Analysis

Variable	Univariate Regression Analysis				Multivariate Regression Analysis		
	No. of Studies (%)	Crude Meta-RR	95% CI	*p*-value	Adjusted Meta-RR	95% CI	*p*-value
Patient Group							
Children	30 (12.45%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
Pregnant	17 (7.05%)	1.16	(0.99-1.37)	0.074	1.02	(0.75-1.10)	0.901
Adults	194 (80.50%)	0.91	(0.82-1.00)	0.057	0.83	(0.63-1.11)	0.209
Age							
⩽18y	30 (12.45%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
19-45y	102 (42.32%)	0.98	(0.88-1.09)	0.682	1.12	(0.84-1.48)	0.446
>45y	68 (27.39%)	0.87	(0.77-0.97)	0.015	1.09	(0.82-1.45)	0.539
NM	43 (17.84%)	0.93	(0.83-1.05)	0.252	1.13	(0.85-1.49)	0.393
Screening							
Non-screening studies	176 (73.03%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
Screening studies	65 (26.97%)	1.16	(1.08 -1.25)	<0.001	1.08	(1.01-1.17)	0.031
Region							
Africa	12 (5.00%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
America	25 (10.42%)	0.78	(0.67-0.90)	0.001	0.71	(0.62-0.82)	<0.001
Asia	175 (72.92%)	0.64	(0.56-0.72)	<0.001	0.78	(0.68-0.89)	<0.001
Europe	28 (11.67%)	0.71	(0.62-0.82)	<0.001	0.69	(0.60-0.78)	<0.001
Time Trend							
Before March 2020	95 (39.42%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
March 2020 afterwards	68 (28.22%)	1.33	(1.24-1.43)	<0.001	1.29	(1.17-1.43)	<0.001
NM	78 (32.37%)	1.07	(1.00-1.14)	0.092	1.05	(0.98-1.12)	0.158

NM, not mentioned.

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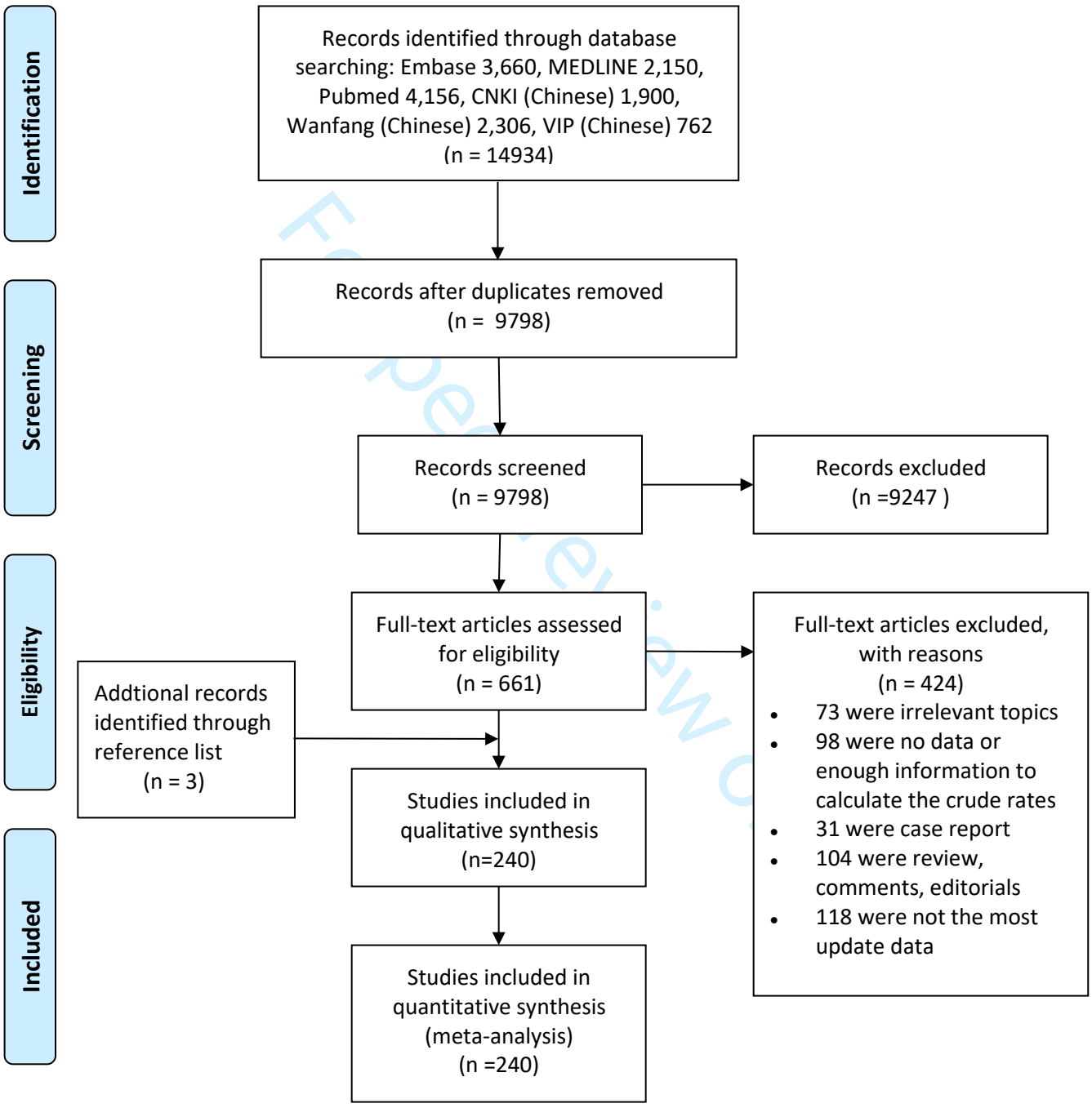
PRISMA 2009 Flow Diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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

Figure 2 Meta-analysis of the asymptomatic ratio among COVID-19 patients (including and excluding pre-symptomatic infections)

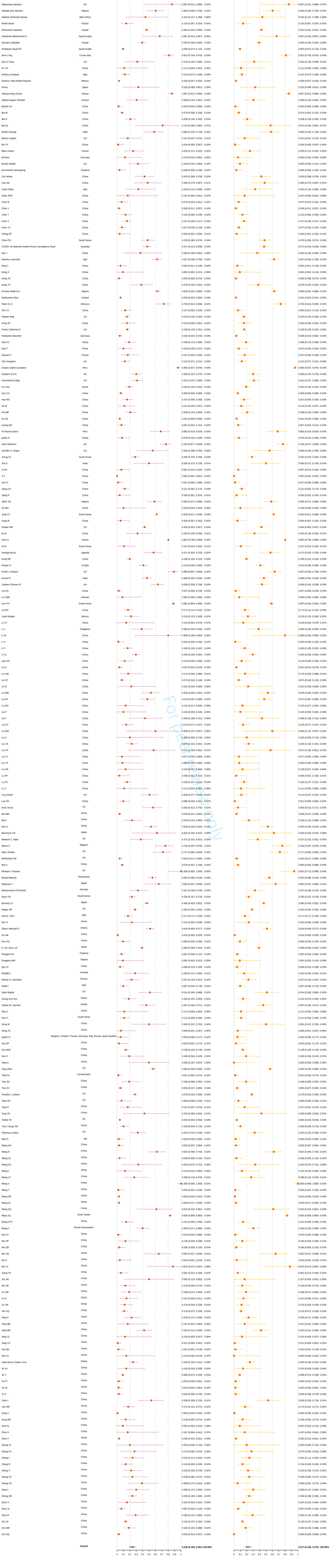


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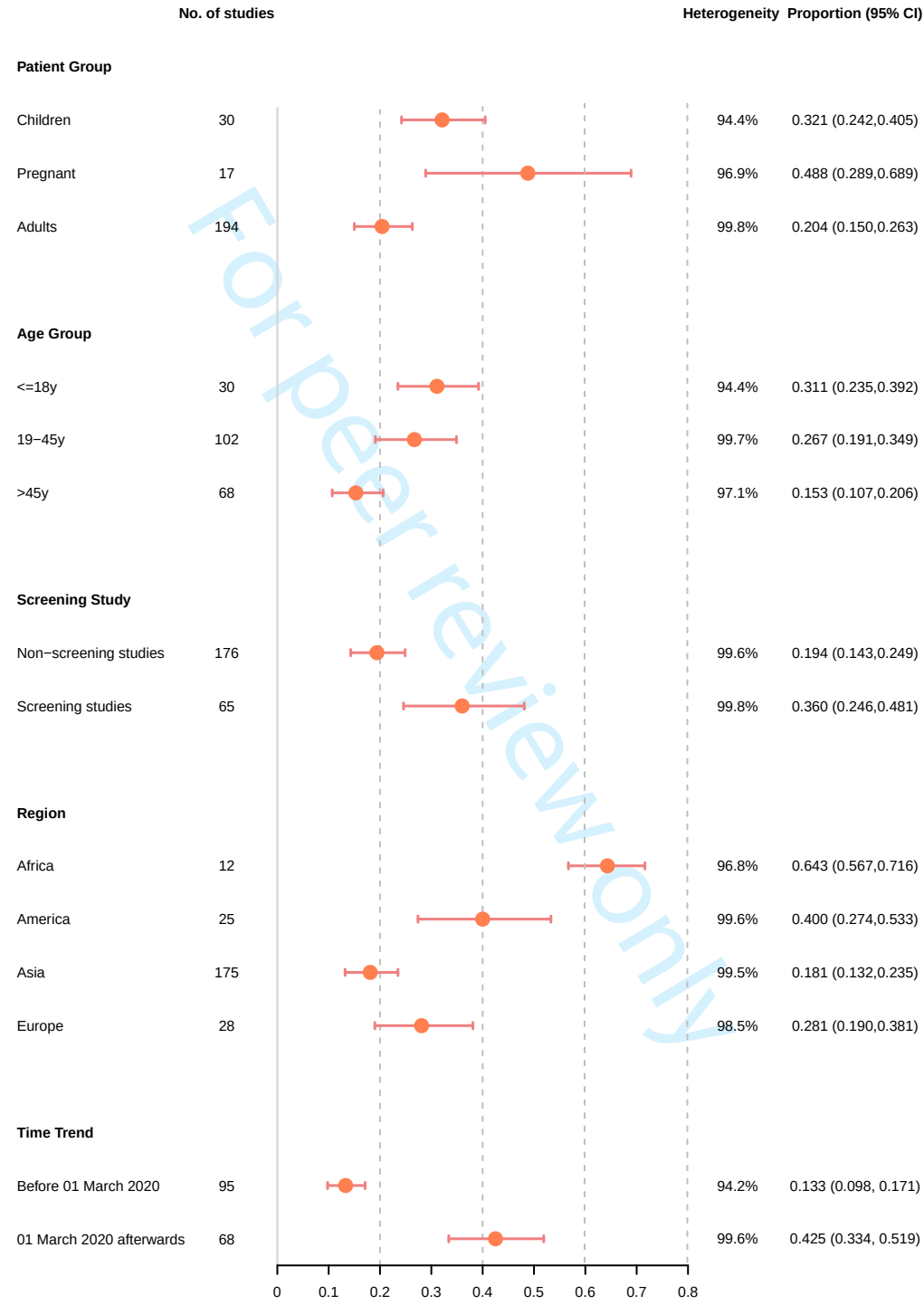
Figure 3 Asymptomatic ratio among COVID-19 patients by patient group, age group, screening study, region, and time trend



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Supplementary Tables and Figure Legends

Supplementary Table 1 Search strategy for systematic review

Supplementary Table 2 Characteristics of the studies included for meta-analysis

Supplementary Table 3 Quality assessment of selected articles

Supplementary Table 4 Results of sensitivity analysis

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Supplementary Table 1 Search strategy for systematic review

Medline (n=2,150)

# ▲	Searches	Results
1	SARS-CoV-2.tw.	22572
2	COVID-19.tw.	68487
3	2019-nCoV.tw.	811
4	novel coronavirus.tw.	4999
5	coronavirus 2019.tw.	928
6	2019 coronavirus.tw.	368
7	Wuhan coronavirus.tw.	15
8	Wuhan pneumonia.tw.	8
9	COVID 19.tw.	68487
10	Coronavirus Disease-19.tw.	716
11	SARS Coronavirus 2 Infection.tw.	4
12	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11	75773
13	Asymptomatic.tw.	140452
14	Asymptomatic Carrier*.tw.	3332
15	Asymptomatic positive*.tw.	45
16	No symptom*.tw.	8151
17	No sign*.tw.	655183
18	Asymptomatic individual*.tw.	3748
19	Asymptomatic person*.tw.	742
20	Asymptomatic patient*.tw.	14504
21	Asymptomatic case*.tw.	1406
22	Asymptomatic carriage.tw.	560
23	Asymptomatic proportion.tw.	9

24	Asymptomatic transmission.tw.	92
25	Symptomless.tw.	1961
26	Asymptomatic contact.tw.	62
27	No respiratory symptom*.tw.	263
28	Inapparent Infection*.tw.	365
29	Subclinical Infection*.tw.	1807
30	Presymptomatic*.tw.	3821
31	Asymptomatic State*.tw.	222
32	Pre-Symptomatic Disease*.tw.	31
33	13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32	805657
34	12 and 33 to yr="2019 - 2020"	2150

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PubMed (n=4,156)

# ▲	Searches	Results
1	Search: SARS-CoV-2 [Text Word]	83767
2	Search: COVID-19 [Text Word]	129668
3	Search: 2019-nCoV [Text Word]	1629
4	Search: novel coronavirus [Text Word]	8709
5	Search: coronavirus 2019[Text Word]	1522
6	Search: 2019 coronavirus [Text Word]	525
7	Search: Wuhan coronavirus [Text Word]	15
8	Search: Wuhan pneumonia [Text Word]	8
9	Search: COVID 19 [Text Word]	129668
10	Search: Coronavirus Disease-19 [Text Word]	1402
11	Search: SARS Coronavirus 2 Infection [Text Word]	8
12	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11	134001
13	Search: Asymptomatic [Text Word]	168176
14	Search: Asymptomatic Carrier*[Text Word]	4055
15	Search: Asymptomatic positive*[Text Word]	56
16	Search: No symptom*[Text Word]	10181
17	Search: No sign*[Text Word]	753877
18	Search: Asymptomatic individual*[Text Word]	4437
19	Search: Asymptomatic person*[Text Word]	831
20	Search: Asymptomatic patient*[Text Word]	16575
21	Search: Asymptomatic case*[Text Word]	1792
22	Search: Asymptomatic carriage [Text Word]	655
23	Search: Asymptomatic proportion [Text Word]	12
24	Search: Asymptomatic transmission [Text Word]	145

25	Search: Symptomless [Text Word]	2890
26	Search: Asymptomatic contact [Text Word]	73
27	Search: No respiratory symptom*[Text Word]	306
28	Search: Inapparent Infection*[Text Word]	396
29	Search: Subclinical Infection*[Text Word]	2030
30	Search: Presymptomatic*[Text Word]	5647
31	Search: Asymptomatic State*[Text Word]	264
32	Search: Pre-Symptomatic Disease*[Text Word]	36
33	13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32	1029910
34	12 and 33 yr="2019/11/01 - 2020/12/31"	4156

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Embase (n=3,660)

# ▲	Searches	Results
1	SARS-CoV-2.tw.	35873
2	COVID-19.tw.	112478
3	2019-nCoV.tw.	1252
4	novel coronavirus.tw.	7926
5	coronavirus 2019.tw.	1403
6	2019 coronavirus.tw.	494
7	Wuhan coronavirus.tw.	24
8	Wuhan pneumonia.tw.	11
9	COVID 19.tw.	112478
10	Coronavirus Disease-19.tw.	1309
11	SARS Coronavirus 2 Infection.tw.	7
12	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11	123709
13	Asymptomatic.tw.	236862
14	Asymptomatic Carrier*.tw.	4966
15	Asymptomatic positive*.tw.	88
16	No symptom*.tw.	15110
17	No sign*.tw.	1097376
18	Asymptomatic individual*.tw.	6175
19	Asymptomatic person*.tw.	1038
20	Asymptomatic patient*.tw.	24930
21	Asymptomatic case*.tw.	2480
22	Asymptomatic carriage.tw.	794
23	Asymptomatic proportion.tw.	17
24	Asymptomatic transmission.tw.	119

25	Symptomless.tw.	2478
26	Asymptomatic contact.tw.	85
27	No respiratory symptom*.tw.	536
28	Inapparent Infection*.tw.	374
29	Subclinical Infection*.tw.	2235
30	Presymptomatic*.tw.	5955
31	Asymptomatic State*.tw.	363
32	Pre-Symptomatic Disease*.tw.	69
33	13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32	1346922
34	13 and 42 yr="2019 - 2020"	3660

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CNKI (n=1,900)

FT=("新型冠状病毒"+"新冠肺炎"+"新型冠状病毒肺炎"+"严重急性呼吸综合征冠状病毒2"+"2019-nCov"+"2019 新型冠状病毒 "+"2019 冠状病毒 "+"corona virus disease-19"+"COVID-19"+"SARS-COV-2"+"novel coronavirus pneumonia"+"NCP")and FT=("无症状"+"无症状携带者"+"无症状患者"+"无症状阳性"+"无症状的阳检测病例"+"检测患者"+"没有症状"+"无症状感染"+"无症状感染者"+"无临床症状"+"无感染症状"+"无相关感染症状"+"无临床特征"+"没有临床特征"+"无明显症状"+"没有明显症状"+"隐性感染"+"隐性感染者")

WanFang (n=2,306)

(全部:(新型冠状病毒+新冠肺炎+新型冠状病毒肺炎+严重急性呼吸综合征冠状病毒2+2019-nCov+2019 新型冠状病毒 +2019 冠状病毒 +corona virus disease-19+COVID-19+SARS-COV-2+novel coronavirus pneumonia+NCP)*全部:(无症状+无症状携带者+无症状患者+无症状阳性+无症状的阳检测病例+检测患者+没有症状+无症状感染+无症状感染者+无临床症状+无感染症状+无相关感染症状+无临床特征+没有临床特征+无明显症状+没有明显症状+隐性感染+隐性感染者)) *Date:2019-

VIP (n=762)

(U=(新型冠状病毒 OR 新冠肺炎 OR 新型冠状病毒肺炎 OR 严重急性呼吸综合征冠状病毒2 OR 2019-nCov OR 2019新型冠状病毒 OR 2019冠状病毒 OR corona virus disease-19 OR COVID-19 OR SARS-COV-2 OR novel coronavirus pneumonia OR NCP)) AND (U=(无症状 OR 无症状携带者 OR 无症状患者 OR 无症状阳性 OR 无症状的阳检测病例 OR 检测患者 OR 没有症状 OR 无症状感染 OR 无症状感染者 OR 无临床症状 OR 无感染症状 OR 无相关感染症状 OR 无临床特征 OR 没有临床特征 OR 无明显症状 OR 没有明显症状 OR 隐性感染 OR 隐性感染者))

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Supplementary Table 2 Characteristics of the studies included for meta-analysis

Author	City/Province	Country	Sample size	Age (mean or median [± SD or IQR]; range)	Study population	Male (%)	Positive patient (n)	The number of test-positive and asymptomatic patients (n)	The number of presymptomatic infections (n)	Confirmed date
Abeysuriya Sanduni(1)	London	UK	180	Mean:29.9y (±7.4）	Pregnant	0.0	7	6	0	2020/04/22-2020/05/05
Adedeji Idris Abiodun(2)	Bauchi State	Nigeria	53	Mean:12.63y (±4.31）	Children	52.8	53	32	0	2020/03/-2020/06
Adetola Hammed Hassan(3)	northern Sierra Leone	West Africa	30	Mean: 69.0 months (±51.7)	Children	55.6	9	4	0	2020/04/24-2020/09
Aherfi Sarah(4)	Marseille	France	63	Mean: 45y	Adult	NA	63	9	0	2020/03/15-2020/03/30
Almazeedi Sulaiman(5)	South Surra	Kuwait	1096	Median: 41y	Adult	81.0	1096	507	35	2020/02/24-2020/04/20
Alshahrani Mohammed S(6)	Alkhobar	Saudi Arabia	301	Mean: 32.9y (±8.7)	Adult	38.9	18	12	0	2020/05/01-2020/06/15
Alshukry Abdullah(7)	South Surra	Kuwait	417	Median: 47y（IQR:32-60y）	Adult	62.8	417	164	0	2020/02/24-2020/05/24
Alsofayan Yousef M(8)	NA	Saudi Arabia	825	Median: 36y	Adult	54.3	825	77	0	2020/03/01-2020/03/31
Alvin J Ing(9)	Cruise ship	Cruise ship	217	NA	Adult	NA	128	104	0	2020/04/03
Amy V. Dora(10)	Los Angeles, California	US	19	Median: 75y (66–85y)	Adult	100.0	19	6	0	2020/3/29-2020/3/21
An YH(11)	Beijing	China	54	Median: 48y (37-87y)	Adult	44.0	9	1	0	2020/01/21-2020/03/04
Andrea Lombardi(12)	Lombardy	Italy	1573	Mean: 44.5y	Adult	35.8	139	17	0	2020/02/24-2020/03/31
Antonio-Villa Neftali Eduardo(13)	NA	Mexico	35095	Mean:40.2y (±10.7）	Adult	37.0	11226	341	0	till 2020/07/05
Arima(14)	Japan	Japan	566	NA	Adult	NA	12	4	0	2020/1-2020/2

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Ashinyo Mary Eyram(15)	Greater Accra	Ghana	307	Mean: 37.9y (±16.3）	Adult	56.7	307	263	0	2020/03/23-2020/06/29
Atakla Hugues Ghislain(16)	Conakry	Guinea	36	Mean:9.66y (±1.32）	Children	55.6	36	11	0	2020/01/01-2020/09/30
Backer JA(17)	Wuhan	China	88	Range: 2-72y	Adult	65.0	88	2	0	2020/01/22-2020/01/29
Bai M(18)	Wuhan	China	472	Mean: 50.7y (±11.6)	Adult	46.0	472	37	2	2020/02/12-2020/03/08
Bai R(19)	Xian	China	120	Mean: 43y (range: 1.5-93y)	Adult	48.0	120	25	0	2020/01/01-2020/03/06
Bai SL(20)	Gansu	China	8	Median: 50.5y (range: 2-82y)	Adult	50.0	7	5	1	2020/01/22-2020/01/31
Bhakti Sarangi(21)	Maharashtra	India	50	Median:6y(IQR:2-12y）	Children	56.0	50	29	0	2020/04/01-2020/05/20
Bianco Angela(22)	New York	US	155	Mean: 32.7y (±6.4)	Pregnant	0.0	24	4	0	2020/04/04-2020/04/15
Bin YF(23)	Wuhan	China	55	Mean: 53.9y (±17. 1)	Adult	56.0	55	1	0	2020/01/29-2020/02/16
Blain Hubert(24)	Montpellier	France	113	Mean: 86y (±15.5)	Adult	NA	36	9	0	2020/03/03-2020/03/06
Böhmer(25)	Bavaria	Germany	16	Median: 35y (range: 2-58y)	Adult	75.0	16	2	1	2020/1/1-2020/2/19
Breslin Noelle(26)	New York	US	43	Mean: 29.7y (±6.0)	Pregnant	0.0	43	14	10	2020/03/12-2020/03/27
Bruminhent Jackrapong(27)	Bangkok	Thailand	405	Mean: 36y (±10)	Adult	34.0	53	2	0	2020/03/23-2020/04/07
Cai Jiehao(28)	Shanghai	China	49	Mean: 11.5y (±5.12)	Children	57.1	49	21	0	2020/01/19-2020/04/30
Cao JM(29)	Nanchong	China	25	Range: 10-77y	Adult	48.0	25	12	0	2020/01/21-2020/02/18
Carla Felice(30)	NA	Italy	98	NA	Adult	39.0	18	6	0	NA
Chan JFW(31)	Wuhan	China	7	Mean: 46.17y(range: 10-66y)	Adult	50.0	6	1	0	2020/01/10-2020/01/15

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Chen B(32)	Hainan	China	69	Median: 51y (range: 28-83y)	Adult	59.0	69	5	0	2020/01/18-2020/02/29
Chen J(33)	Shanghai	China	249	Median: 51y (36-64y)	Adult	51.0	249	7	0	2020/01/20-2020/02/06
Chen T(34)	Wuhan	China	76	Mean: 59.5y (range: 28-86y)	Adult	57.0	76	10	0	2020/01-2020/02
Chen Y(35)	Ningbo	China	187	Median: 12y(range: 30-70y)	Adult	NA	191	30	0	2020/01/21-2020/03/06
Chen YJ(36)	Chongqing	China	143	Mean: 45.13y (range: 15-79y)	Adult	51.0	143	11	0	2020/01/23-2020/02/08
Cheng ZP(37)	Yantai	China	25	Median: 42y (±12)	Adult	56.0	25	1	0	2020/01-2020/02
Choe PG(38)	Seoul	South Korea	113	Median:25y (IQR: 21.5-39.5y)	Adult	47.8	113	54	0	2020/03/05-2020/04/09
COVID-19 National Incident Room Surveillance Team(39)	NA	Australia	295	Median: 47y (range: 0-94y)	Adult	50.0	295	139	0	2020/01/21-2020/03/14
Dai Y(40)	Guangxi	China	11	Median:6.1y(range: 0.25-15y）	Children	36.3	11	4	0	2020/01/19-2020/03/11
Daniela Loconsole(41)	Apulia	Italy	166	Median:11y(range: 0-17y)	Children	48.8	166	104	0	2020/03/01-2020/06/01
Ding Y(42)	Wuhan	China	56	Mean: 54.6y (range: 24-86y)	Adult	54.0	56	3	0	2020/01/01-2020/02/03
Dong X(43)	Wuhan	China	11	Median: 43y (range: 2-69y)	Adult	45.0	11	1	0	2020/01/20-2020/02/29
Dong XC(44)	Tianjin	China	135	Mean: 48.62y (range:8-90y)	Adult	53.0	135	4	0	2020/01/13-2020/02/20
Dong YY(45)	Yangzhou	China	37	Mean: 38.64y (range: 1-74y)	Adult	59.0	37	14	0	2020/01-2020/02
Erinoso Olufemi A.(46)	Lagos State	Nigeria	632	Median:40y（IQR:30.5-49y）	Adult	60.1	632	398	0	2020/04/01-2020/05/31
Eythorsson Elias(47)	NA	Iceland	1564	Median:40y(IQR:26-53y, range: 0-103y）	Adult	51.0	1564	83	34	2020/03/17-2020/04/30
Fakiri EL K(48)	Marrakesh	Morocco	74	Mean: 7y (±1.5)	Children	54.1	74	54	0	2020/03/02-2020/04/01

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Fan YZ(49)	Luan	China	79	NA	Adult	NA	79	10	5	2020/01/20-2020/02/20
Feaster Matt(50)	California	US	1093	NA	Adult	35.5	631	97	0	2020/04-2020/05
Feng XP(51)	Jingzhou	China	52	Median: 46y (30-63y)	Adult	64.0	52	8	0	2020/01/23-2020/03/08
Foster Catherine E.(52)	Texas	US	16544	Median:7.1y(IQR:1.7-13.8y）	Children	51.4	1215	193	0	2020/03/10-2020/06/28
Friederike Maechler(53)	Berlin	Germany	5179	Median:34y(24-67y)	Adult	49.1	333	14	2	2020/03/03-2020/04/13
Gao HJ(54)	Ganzizhou	China	54	Mean:42.69y (±17.94）	Adult	55.1	96	18	0	till 2020/02/28
Gao T(55)	Liaocheng, Xianyang	China	40	Mean: 41y	Adult	48.0	40	4	1	2020/1/21-2020/2/16
Gautret P(56)	NA	France	36	Mean: 45.1y	Adult	42.0	36	6	0	2020/3/1-2020/3/16
Gill Livingston(57)	UK	UK	344	Mean:75.3y (±8.2）	Adult	48.0	131	16	0	2020/03/01-2020/04/30
Grados Isabel Zumalave(58)	Callao	Peru	671	Mean:27.2y（range:14-45y）	Pregnant	0.0	317	303	0	2020/05/01-2020/0731
Graham N.S.N.(59)	London	UK	313	NA	Adult	NA	180	54	0	2020/03-2020/04/09
Grechukhina Olga(60)	New Haven	US	1567	Median:30y（IQR:25-34y）	Pregnant	0.0	141	44	0	2020/03/03-2020/05/11
Gu. Kim(61)	Daegu	Korea	213	NA	Adult	NA	213	41	0	NA
Guo CX(62)	mainland China	China	341	Median:7y（4 days to 14 years）	Children	53.7	341	20	0	2020/1/15-2020/3/15
Han RD(63)	Haozhou	China	108	Median:42y (range: 5-86y)	Adult	48.2	108	17	0	2020/01/21-2020/03/05
He M(64)	Beijing	China	35	Mean: 7.1y (±4.2; range:0.5-15y)	Children	51.4	35	4	0	2020/01-2020/06
He WB(65)	Zhuzhou	China	101	Range: 3-88y	Adult	47.5	101	21	0	2020/01/01-2020/05/15

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Hu SX(66)	Hunan	China	888	Median: 35y (2-88y)	Adult	44.4	888	36	0	2020/01/01-2020/02/08
Huang DD(67)	Chongqing	China	89	Median: 48.2y (±17.9)	Adult	58.0	89	6	0	2020/01/22-2020/02/17
IH Huerta Saenz(68)	Lima	Peru	41	Mean:32.3y	Pregnant	0.0	41	28	0	2020/03/24-2020/05/07
Ipekci A(69)	Istanbul	Turkey	87	Mean: 51.27y(±6.45)	Adult	72.5	51	4	0	2020/03/20-2020/04/01
Irene Petersen(70)	UK	UK	36061	NA	Adult	NA	115	88	0	2020/04/26-2020/06/27
Jennifer S. Singer(71)	LA	US	4751	Median:58y	Adult	50.0	18	10	0	2020/04/07-2020/05/21
Jeong SJ(72)	Seoul	South Korea	234	Mean: 37.78y (±15.57)	Adult	39.7	234	66	0	2020/03/15-2020/04/10
Jha S(73)	NA	India	3667	IQR: 18-40y	Adult	52.1	20	10	0	2020/03/23-2020/04/30
Ji GH(74)	Jingzhou	China	45	Mean: 45.4y(range: 21-67y)	Adult	60.0	45	3	0	2020/1/19-2020/2/1
Ji T(75)	Huangshi,Wuhan	China	51021	NA	Adult	NA	51021	50	0	2020/01/10-2020/03/27
Jia CY(76)	Beijing	China	60	Median: 59.5y (28-91y)	Adult	40.0	60	1	0	2020/01/20-2020/02/20
Jiang CH(77)	Wuhan	China	214	Median:51y(range: 11-82y)	Adult	40.0	214	26	0	2020/02/05-2020/03/10
Jiang R(78)	Guangzhou	China	25	Mean: 44.2y (range:12-86y)	Adult	44.0	25	1	0	2020/01/25-2020/03/25
Jibrin YB(79)	Bauchi	Nigeria	84	Mean: 41.0y(±10.5)	Adult	72.0	84	49	0	2020/03/01-2020/06/30
Jin MH(80)	Huzhou	China	10	Median: 32y (range: 0.58-56y)	Adult	50.0	10	1	0	2020/01/25-2020/02/07
Jung CY(81)	South Korea	South Korea	10237	Mean: 45y (±19.8）	Adult	39.9	10237	6350	0	2020/01/24-2020/04/09
Kang M(82)	Shenzhen, Guangzhou, Foshan, Yangjiang, Shaoguan	China	37	Median: 58y (range:10-78y)	Adult	49.0	37	2	0	2020/01/12-2020/01/23

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Kasper MR(83)	Theodore Roosevelt aircraft carrier	US	4779	Mean: 27y	Adult	78.3	1331	572	0	2020/03/23-2020/05/18
Ke B(84)	Chongqing	China	25	Median: 11.0y (range: 0.6-17y)	Children	56.0	25	8	0	2020/1/19-2020/3/12
Kenu E(85)	NA	Ghana	17736	Median:33y (IQR: 0.1-85y)	Adult	57.8	17763	14242	0	2020/03/12-2020/06/30
Ki M(86)	Seoul, Goyang, Siheung, Bucheon, Gwangju, Suwon, Incheon, Pyeongtaek, Gunsan, Guri, Naju, Evacuated from Wuhan	South Korea	28	Median: 42y (range: 20-73y)	Adult	54.0	28	3	0	2020/01/20-2020/02/10
Kirenga Bruce(87)	Entebbe	Uganda	56	Mean:34.2y（±15.5; range:25-43y）	Adult	67.9	56	32	0	till 16 May 2020
Kong WF(88)	Sichuan	China	511	Range:1 month to 87 years	Adult	55.0	511	100	0	2020/01/25-2020/02/20
Krajcar N(89)	NA	Croatia	289	Median:10y (IQR: 4.6-15.7y)	Children	43.1	230	95	0	2020/03/12-2020/07/19
Kristin J. Meyers(90)	Indianapolis Metropolitan	US	2953	Mean:48.1y (±16.3）	Adult	36.3	91	81	23	2020/04/07-2020/05/16
Kumar R(91)	New Delhi	India	231	Mean: 39.8y(±13.6)	Adult	78.3	231	108	0	2020/03/20-2020/04/30
Ladhani Shamez N(92)	London	UK	264	Median:47y(IQR:35-56y)	Adult	21.9	105	67	21	2020/04/10-2020/04/13
Lai XQ(93)	Wuhan	China	110	Median: 36.5y (30.0-47.0y)	Adult	28.0	110	3	0	2020/1/1-2020/2/9
Le TQM(94)	Vinh Phuc Province, Thanh Hoa Province	Vietnam	12	Median: 30y (range: 0.25-55y)	Adult	33.0	12	1	0	2020/01/21-2020/01/27
Lee YH(95)	Daegu	South Korea	632	Mean: 40.6y (±17.3）	Adult	32.0	632	557	186	2020/03/02-2020/04/30
Lei MY(96)	Guizhou	China	146	NA	Adult	NA	146	25	0	2020/01/21-2020/03/10
Lewis Megan(97)	Texas	Mexico	231	Median:22y（range:19-62y）	Adult	55.0	64	14	0	2020/03/26-2020/04/05

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Li CY(98)	Xuzhou	China	7	Median: 42y (range: 21-62y)	Adult	57.0	7	1	0	2020/01/25-2020/01/31
Li J(99)	NA	Singapore	39	NA	Children	60.0	39	15	0	2020/01-2020/05
Li W(100)	Zhuhai	China	5	Median: 3y (1.4-6y)	Children	80.0	5	4	0	2020/01/28-2020/02/08
Li Y(101)	Wuhan	China	53	Mean: 58y (range: 26-83)	Adult	55.0	51	1	0	2020/01/23-2020/01-29
Li Y(102)	Wuhan	China	127	Median: 6y(range:0.17-15y)	Children	57.0	127	21	0	2020/1/28-2020/3/12
Li YL(103)	Hubei	China	252	Median:46y(range: 8-65y)	Adult	49.6	252	74	0	2020/02/22-2020/03/08
Liao XN(104)	wuhan	China	42	Median:51.6y (22-69y)	Adult	69.0	42	5	0	2020/01/16-2020/02/18
Lin S(105)	Shanghai	China	161	Median:45y(range:1-84y)	Adult	49.7	161	6	0	till 2020/02/17
Lin XM(106)	Zhaoqing	China	23	Range: 3-65y	Adult	56.5	23	4	0	2020/01/23-2020/05/06
Lin ZF(107)	Yichang	China	205	Median: 56.0y (range: 1.25-88y)	Adult	55.0	205	15	0	2020/01/24-2020/03/09
Liu B(108)	Shunde	China	9	Range: 21-61y	Adult	44.4	9	2	0	2020/01/22-2020/02/20
Liu BM(109)	Wuhan	China	68	Mean: 44.3y (±16.4)	Adult	37.0	68	36	0	2020/2/7-2020/3/26
Liu BY(110)	Zhejiang	China	91	Mean: 33.66y (range: 7-73y)	Adult	53.0	91	43	0	2020/03/01-2020/04/07
Liu DH(111)	Wuhan	China	15	Mean: 32y (range:23-40y)	Pregnant	0.0	15	2	0	2020/01/20-2020/02/10
Liu F(112)	Hangzhou	China	10	Median: 42y (34–50y)	Adult	40.0	10	1	0	2020/01/22-2020/02/22
Liu F(113)	Wuhan	China	44	Mean: 30y (range:22-43y)	Pregnant	0.0	16	7	0	2020/01/11-2020/02/13
Liu GT(114)	Ningxia	China	70	Mean: 40y (range: 3-77y)	Adult	53.0	70	10	0	2020/01/22-2020/02/17

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Liu MQ(115)	Chongqing	China	5	Median: 5.2y (range: 0.58-13y)	Children	60.0	5	3	0	NA
Liu X(116)	Chenzhou	China	5	Mean: 30y (range:2.5-56y)	Adult	40.0	5	1	0	2020/01/31-2020/02/06
Liu XX(117)	Hefei	China	105	Median: 45y (range: 21-87 years)	Adult	0.0	105	24	0	till 2020/03/06
	Hefei	China	7	Median: 10y (range: 5-10y)	Children	NA	7	4	0	till 2020/03/06
Liu YL(118)	Hubei, Fujian, Shanxi, Beijing, Guangdong, Jiangxi, Heilongjiang, Anhui	China	12	Median: 30y (22-36)	Pregnant	0.0	13	1	0	2019/12/08-2020/02/25
Liu YX(119)	Shenzhen	China	12	Median: 62.5y (range: 10-72y)	Adult	67.0	12	1	0	2020/01/11-2020/01/20
Liu ZR(120)	Anhui	China	15	Median: 42y (range:14-84y)	Adult	47.0	15	2	0	2020/02/04-2020/02/12
Lu RF(121)	Nantong	China	28	Median: 50y (range: 26-73y)	Adult	61.0	28	1	0	2020/1/23-2020/2/26
Lu XX(122)	Wuhan	China	1391	Median: 6.7y (range: 0-15y)	Children	61.0	171	27	0	2020/01/28-2020/02/26
Lu Y(123)	Guangzhou	China	9	Mean: 7.8y (range: 0.17-15y)	Children	56.0	9	1	0	2020/1/22-2020/2/9
Lucy Rivett(124)	UK	UK	1270	NA	Adult	0.0	61	31	24	2020/04/06-2020/04/24
Luo SH(125)	Anqing	China	83	NA	Adult	NA	83	8	7	till 2020/02/21
M.M. Arons(126)	King County	US	76	Mean: 78.6y (±9.5)	Adult	NA	48	27	24	2020/3/3-2020/3/26
Ma MM(127)	Guangzhou	China	347	Median: 48y	Adult	49.8	361	14	0	till 2020/03/11
Ma Y(128)	Jinan	China	47	Median: 34y (range: 1-72y)	Adult	43.0	47	11	0	2020/1/23-2020/3/10
Ma YL(129)	Wuhan	China	115	Range: 1.67-5y	Children	64.0	115	61	0	NA

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MacIntyre CR(130)	NA	Japan	565	NA	Adult	NA	8	5	0	2020/01/29-2020/01/31
Mahesh C. Patel(131)	DuPage, Illinois	US	126	Median:82y(IQR:75-92y）	Adult	31.0	35	13	0	2020/03/11-2020/03/15
Martin C(132)	Brussels	Belgium	326	Mean: 36y (range: 21-59y)	Adult	24.0	41	31	0	2020/04/15-2020/05/18
Maru Sheela(133)	New York	US	124	Mean: 30.2y	Pregnant	0.0	46	33	0	2020/03/29-2020/04/22
McMichael TM(134)	King County	US	167	Median: 72y (range: 21-100y)	Adult	33.0	167	7	0	2020/02/28-2020/03/18
Mei X(135)	Shanghai	China	494	Median:40y(6-88y）	Adult	53.8	494	39	8	2020/01/20-2020/03/31
Michael J. Fassett(136)	Southern California	US	3923	Mean: 31.2y (±5.29）	Pregnant	0.0	17	17	1	2020/04/06-2020/05/11
Michel Bielecki(137)	Swiss Army Base in Airolo	Switzerland	508	Median: 21y (18-28y)	Adult	92.0	228	126	0	2020/3/11-2020/5/3
Miyamae Y(138)	Tokyo	Japan	23	Median: 67y (29-79y)	Adult	43.0	23	15	0	2020/02/18-2020/02/25
Mohammed A M Ahmed(139)	Somalia	Somalia	182	Mean: 22y (±4)	Adult	66.0	49	16	0	2020/4/23-2020/5/7
Moon SS(140)	Gyeongsangbuk-do	South Korea	352	Mean: 56 y (range: 14–95y)	Adult	40.9	352	81	0	2020/02/18-2020/06/30
Moriarty LF(141)	Yokohama	Japan	3711	Range: 29-73y	Adult	55.0	712	331	0	2020/02/05-2020/02/20
Nagler AR(142)	Long Island, Brooklyn, Long Island	US	14746	NA	Adult	NA	1905	536	0	2020/03/25-2020/05/18
Niccolò Parri(143)	Italy	Italy	170	Median:3.75y（IQR:4 months-10.7y）	Children	56.0	170	29	0	2020/03/02-2020/05/02
Niu YL(144)	Suqian	China	13	Mean: 32.3y (range: 12-48y)	Adult	46.0	13	3	0	2020/01/25-2020/03/03
Oduro-Mensah E(145)	NA	Ghana	275	Mean: 40.7y±16.4	Adult	54.5	275	142	0	2020/03-2020/05
Ou JM(146)	Fujian	China	298	Median: 42y (range: 0.42-93y)	Adult	55.0	298	3	0	till 2020/02/21

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Pan XQ(147)	Wenzhou	China	64	Mean: 48.8y (±12.9)	Adult	61.0	64	6	0	2020/02/05-2020/02/20
Pérez-GarcíaF(148)	Madrid	Spain	2963	NA	Adult	24.7	884	345	0	2020/03-2020/05
Pongpirul W(149)	NA	Thailand	193	Median: 37y (IQR: 29–53y)	Adult	58.5	193	13	3	2020/01/08-2020/04/16
Pongpirul WA(150)	Bangkok	Tailand	11	Median: 61y (range: 28-74y)	Adult	55.0	11	1	0	2020/01/08-2020/01/31
Qiu CF(151)	Hunan	China	104	Mean:43y (±7.54）	Adult	47.1	104	5	0	2020/01/22-2020/02/12
Redditt V(152)	Toronto	Canada	60	Mean: 36.0y(±10.0)	Adult	80.0	25	7	3	2020/4/20
Roman G. Shmakov(153)	Moscow	Russia	66	Mean:30.3y (±6.25）	Pregnant	0.0	66	15	0	NA
Rubbi I(154)	Ravenna	Italy	93	Mean: 45.96y ± 10.71	Adult	29.0	93	9	0	2020/03/25-2020/05/05
Salim Mattar(155)	Colombia	US	686	Mean:43y（range:1-95y）	Adult	NA	35	18	0	2020/04/09-2020/05/16
Seong Eun Kim(156)	NA	Korea	71	Median: 31y (17.8-55.8y)	Adult	46.0	71	13	3	NA
Shaher M. Samrah(157)	Jordan	Jordan	81	Mean:39.95y (±16.59; range:18-80y）	Adult	45.7	81	37	0	2020/03/17-2020/04/02
She X(158)	Suining	China	9	Mean: 29y (range: 24-35y)	Adult	33.0	9	1	0	2020/01/20-2020/02/12
Son H(159)	Busan	South Korea	18303	NA	Adult	45.4	108	12	0	2020/02/21-2020/03/24
Song W(160)	Xiangyang	China	16	Median: 8.5y range:0.96-14y)	Children	63.0	16	8	0	2020/01/01-2020/03/17
Song YS(161)	Zhengzhou	China	17	Mean:47y (range: 12-83y)	Adult	58.8	17	1	0	2020/02-2020/03
Spiteri G(162)	NA	Belgium, Finland, France, Germany, Italy, Russia, Spain,Sweden	38	Median: 42y (2-81y)	Adult	66.0	38	2	0	2020/01/17-2020/02/21

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Sun DF(163)	Jiaxing	China	30	Mean: 49y (range: 30-71y)	Adult	50.0	30	1	0	2020/01/24-2020/02/06
Sun WW(164)	Zhejiang	China	391	NA	Adult	41.0	391	54	0	2020/01/08-2020/02/06
Sun Z(165)	Anhui	China	21	Mean: 40.52y (±17.14)	Adult	52.0	21	4	0	2020/01/23-2020/03/08
Tang A(166)	Zhoushan	China	10	Mean: 50.9y (range: 28-67y)	Adult	70.0	10	5	5	till 2020/02/17
Tang Olive(167)	Baltimore	US	1970	Median:73.9y（IQR:21.9-105.4y）	Adult	57.0	752	424	0	2020/03/01-2020/06/12
Thiel SL(168)	NA	Liechtenstein	95	Median: 39y (IQR: 28-56y)	Adult	51.6	95	2	0	2020/03/02-2020/04/23
Tian SC(169)	Liaocheng	China	37	Mean:44.3y (±1.67）	Adult	45.9	37	7	0	NA
Tian SJ(170)	Beijing	China	262	Median: 47.5y (range: 1-94y)	Adult	49.0	262	13	0	till 2020/02/10
Timothy J. Judson(171)	San Francisco	US	1129	NA	Adult	NA	1129	315	0	NA
Tolia VM(172)	San Diego	US	283	NA	Adult	53.0	29	2	0	20020/03/10-2020/03-19
Tong H(173)	Bengbu	China	24	Mean: 53y (range: 17-74y)	Adult	63.0	24	4	0	2020/01/10-2020/02/15
Tong ZD(174)	Zhoushan	China	7	Median: 28.5y (12-45y).	Adult	43.0	7	3	0	2020/1/1
Treibel TA(175)	London	UK	1523	NA	Adult	NA	1523	65	0	since2020/3/23
Tsou Tsung-Pei(176)	Taiwan	China	100	Median:44y(range:11-88y)	Adult	44.0	100	10	0	2020/01/11-2020/03/16
Viktoriya London(177)	New York	US	156	Range:24.5-34.8y	Pregnant	0.0	68	22	0	2020/03/15-2020/04/15
Wan R(178)	Hunan	China	78	NA	Adult	NA	78	2	0	NA
Wang AH(179)	Chongqing	China	29	Mean: 48.19y (range: 3-89y)	Adult	64.0	90	3	0	till 2020/03/01

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Wang D(180)	Chongqing	China	576	Mean: 54.79y	Adult	41.0	61	38	0	2020/1/24-2020/3/10
Wang JC(181)	Nanjing	China	52	Mean: 44y (range: 13-73y)	Adult	56.0	52	2	0	2020/01/19-2020/02/03
Wang KS(182)	Pingyang	China	138	Median: 48y (33-68y)	Adult	22.0	9	3	0	2020/01/19-2020/02/03
Wang L(183)	Zibo	China	244	Range: 23-84y	Adult	68.8	16	2	0	2020/01/10-2020/02/14
Wang LZ(184)	Liaocheng	China	26	Median:42y(IQR:34-53y)	Adult	42.3	26	7	0	2020/01/31-2020/02/12
Wang S(185)	Yichang	China	738	Range: 0.58-91y	Adult	51.0	70	70	0	2020/02/11-2020/02/23
Wang T(186)	Jilin	China	50	Mean: 44.52y (range: 16-87y)	Adult	60.0	50	1	0	2020/01/28-2020/02/21
Wang XB(187)	Wuhan	China	1012	Median:50y(IQR:39-58y;range:16-89y）	Adult	52.0	1012	30	16	2020/02/07-2020/02/12
Wang XL(188)	Beijing	China	7432	Median:39y(IQR:27-56y)	Adult	45.8	602	17	0	2020/01/19-2020/04/02
Wang ZQ(189)	Wuhan	China	30	Median:29.9y (26.8–33.3y)	Pregnant	0.0	13	8	0	2019/12/08-2020/04/01
Waya JLL(190)	NA	South Sudan	1330	Mean: 37.1y	Adult	77.0	1330	1104	0	2020/04/05-2020/06/03
Wong HYF(191)	Hongkong	China	64	Mean: 56y (range: 16-96y)	Adult	41.0	64	9	0	2020/1/1-2020/3/31
Wong J(192)	NA	Brunei Darussalam	135	Median: 36y (range:0.5–72y)	Adult	60.7	135	54	13	2020/03/09-2020/04/05
Wu GY(193)	Wenzhou	China	104	Mean: 45y (±13)	Adult	57.0	104	2	0	2020/01/17-2020/02/04
Wu HP(194)	Jiangxi	China	23	Range: 0.25-17.67y	Children	39.0	23	3	0	2020/01/21-2020/02/29
Wu QR(195)	Ganzhou	China	55	Mean: 45.22y (range: 0.25-79y)	Adult	51.0	55	2	0	2020/1/23-2020/3/2
Wu XQ(196)	Wuhan	China	23	Median: 29y (21-37)	Pregnant	0.0	23	15	0	2019/12/31-2020/03/07

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Wu Y(197)	Nantong	China	23	Median: 48y (26-68y)	Adult	65.0	23	1	0	NA
Wu YL(198)	Chengde	China	8	Range: 22-56y	Adult	50.0	8	7	0	2020/1/24-2020/3/31
Xiang TX(199)	Jiangxi	China	49	Mean: 42.9y (18-78y)	Adult	NA	49	3	0	2020/1/21-2020/1/27
Xie JW(200)	Chongqing	China	6	Median: 46y (40-67y)	Adult	67.0	6	3	2	2020/01/29-2020/02/03
Xie YB(201)	Yongjia	China	39	Median: 52y (22-87y)	Adult	56.0	39	5	0	2020/01/20-2020/02/10
Xu HM(202)	Chongqing,Shanxi,Guizhou,Sichuan	China	32	Mean:8.7y (±4.7）	Children	53.0	32	6	0	2020/01/24-2020/02/12
Xu S(203)	Wuhan	China	34	Range: 20-40y	Pregnant	0.0	34	5	0	2020/01/15-2020/03/15
Xu TM(204)	Changzhou	China	51	NA	Adult	33.0	51	6	0	2020/1/23-2020/2/18
Yan XQ(205)	Hunan	China	218	Median:43y(IQR:32-52y）	Adult	NA	218	24	0	2020/01/21-2020/06/27
Yang K(206)	Nanjing	China	57	Median: 37y (range: 5-97y)	Adult	51.0	57	13	0	NA
Yang NB(207)	Ningbo	China	12	Median:33y	Adult	30.0	12	2	0	2020/01/25-2020/02/28
Yang RR(208)	Wuhan	China	78	Median: 37y (26-45y)	Adult	33.0	78	33	0	2019/12/24-2020/02/24
Yang YL(209)	Chongqing	China	8	Median: 53y (range: 9-67y)	Adult	63.0	8	1	0	2020/02/01-2020/02/16
Yang YX(210)	Chibi	China	88	Range: 10-89y	Adult	60.0	88	1	0	2020/01-2020/02
Yao QD(211)	Wuhan	China	45	Mean: 47.7y (range: 25-88y)	Adult	36.0	45	1	0	2020/01/25-2020/02/22
Yao XY(212)	Baotou	China	7	Median: 51y (36-68y)	Adult	43.0	7	1	1	2020/02/01-2020/02/08
Yayla Burcu Ceylan Cura(213)	NA	Turkey	220	Median:10y(range: 0-17y)	Children	48.2	220	55	0	2020/03/11-2020/06/23

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Ye XX(214)	Yongjia	China	17	Median: 48.8y (31-87y)	Adult	65.0	14	2	0	2020/01/24-2020/02/09
Ye Y(215)	Henan	China	1272	NA	Adult	NA	1272	113	0	till 2020/03/09
Yu FT(216)	Beijing	China	127	Median: 40y (range: 0.5-92y)	Adult	50.0	77	2	0	2020/02/05-2020/02/19
Yu JX(217)	Hangzhou	China	87	Mean: 42.89y (±17.02; range:4-88y)	Adult	46.0	87	2	0	2020/1/21-2020/2/12
Yu X(218)	Guangxi	China	108	Median: 41y (range: 0.25-85y)	Adult	40.0	108	3	0	2020/02/06-2020/04/16
Yuan L(219)	Wuhan	China	28	Mean: 29.75y (±3.5)	Pregnant	0.0	28	15	0	2020/01/30-2020/03/14
Yue HM(220)	Gansu	China	86	Median:41y(IQR:31-54.3y)	Adult	44.2	86	15	0	2020/01/21-2020/02/11
Zeng J(221)	Sichuan	China	24184	NA	Adult	NA	226	1	0	NA
Zeng WZ(222)	Yongzhou	China	44	Mean: 39.1y (±14.5)	Adult	64.0	44	6	0	2020/01/21-2020/03/05
Zhai HL(223)	Fuyang	China	11	Mean: 11.76y (range: 0.33-17y)	Children	64.0	11	1	0	2020/01/22-2020/02/24
Zhan H(224)	Shiyan	China	6	Median: 8.5y (range: 0.5-11y)	Children	50.0	6	1	0	2020/2/1
Zhan T(225)	Wuhan	China	405	Median:56y(17-95y)	Adult	45.9	405	12	0	2020/01/12-2020/03/08
Zhang JJ(226)	Beijing	China	5	NA	Adult	NA	5	1	0	2020/01/24-2020/02/29
Zhang KY(227)	Kunming	China	11	Mean: 42y (range: 8-67y)	Adult	45.0	11	3	0	2020/01/26-2020/02/20
Zhang L(228)	Anhui	China	33	Mean:9.59y (±5.12)	Children	48.5	33	8	0	till 2020/02/16
Zhang R(229)	Liaoning	China	2784	NA	Adult	49.0	67	9	0	2020/01/22-2020/02/29
Zhang Y(230)	NA	China	41	Mean:5.93y(range:0.5-14y)	Children	73.2	41	9	0	2020/01-2020/02

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Zhang YC(231)	Nanjing, Xuzhou	China	21	Median:25y (range: 10-61y)	Adult	60.0	21	5	0	2020/01/25-2020/03/18
Zhang YD(232)	Qinghai	China	18	Range: 7-47y	Adult	67.0	18	7	6	2020/01/24-2020/02/05
Zhao L(233)	Shijiazhuang	China	30	NA	Adult	63.0	30	9	0	2020/01/21-2020/02-25
Zhong ZM(234)	Wuhan, Nanning, Liuzhou	China	193	Mean: 48.1y (range: 3-95y)	Adult	58.0	193	46	0	2020/01/03-2020/03/04
Zhou H(235)	Qujing	China	13	Mean: 28y (±11.83)	Adult	46.0	13	2	0	2020/01/23-2020/02/27
Zhou JL(236)	Xinyang	China	149	Mean: 52y (±15.48)	Adult	57.1	149	10	0	2020/01/13-2020/03/02
Zhou R(237)	Guangzhou	China	31	NA	Adult	NA	31	9	0	2020/01/23-2020/03/03
Zhu JF(238)	Shanxi, Qinghai, Tibet, Xinjiang, Ningxia, Gansu, Inner Mongolia, Hubei	China	617	Median:42y(1 to 94 years）	Adult	52.0	617	82	0	2020/01/21-2020/03/11
Zhu MR(239)	Shanghai	China	77	Range: 14-62y	Adult	70.1	77	14	0	2020/03/14-2020/07/03
Zhu SQ(240)	Shenzhen	China	417	Mean: 45.3y (range:1-86y)	Adult	47.0	417	11	11	2020/01/01-2020/02/14

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Supplementary Table 3 Quality assessment of selected articles

	Introduction			Methods										Results			Discussion		Other	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Abeysuriya Sanduni	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	N
Adedeji Idris Abiodun	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Adetola Hammed Hassan	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Aherfi Sarah	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Almazeedi Sulaiman	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Alshahrani Mohammed S	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Alshukry Abdullah	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Alsofayan Yousef M	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Alvin J Ing	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Amy V. Dora	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
An YH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Andrea Lombardi	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Antonio-Villa Neftali Eduardo	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Arima	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Ashinyo Mary Eyram	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Atakla Hugues Ghislain	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	N
Backer JA	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Bai M	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Bai R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Bai SL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
BHAKTI SARANGI	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y

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Bianco Angela	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Bin YF	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Blain Hubert	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
Böhmer MM	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM
Breslin Noelle	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Bruminhent Jackrapong	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	NM	Y	Y	Y	N	Y
Cai Jiehao	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Cao JM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Carla Felice	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Chan JFW	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Chen B	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Chen J	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Chen T	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Chen Y	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Chen YJ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Cheng ZP	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NM	Y	Y	Y	N	Y
Choe PG	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y
COVID-19 National Incident Room Surveillance Team	NM	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	N	N	NM	NM
Dai Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Daniela Loconsole	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Ding Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Dong X	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Dong XC	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Dong YY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM

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Erinoso Olufemi A.	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Eythorsson Elias	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Fakiri EL K	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Fan YZ	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Feaster Matt	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Feng XP	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Foster Catherine E.	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Friederike Maechler	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Gao HJ	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	NM
Gao T	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Gautret P	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Gill Livingston	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Grados Isabel Zumalave	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Graham N.S.N.	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Grechukhina Olga	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM
Gu. Kim	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Guo CX	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Han RD	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
He M	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
He WB	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Hu SX	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Huang DD	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
IH Huerta Saenz	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Ipekci A	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Irene Petersen	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y

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Jennifer S. Singer	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Jeong SJ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM
Jha S	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Ji GH	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Ji T	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Jia CY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Jiang CH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Jiang R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Jibrin YB	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Jin MH	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Jung CY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Kang M	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	Y
Kasper MR	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Ke B	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Kenu E	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Ki M	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Kirenga Bruce	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Kong WF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Krajcar N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Kristin J. Meyers	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Kumar R	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Ladhani Shamez N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Lai XQ	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Le TQM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Lee YH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM

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Lei MY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Lewis Megan	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	NM
Li CY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	N	N	NM	NM
Li JH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Li W	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Li Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Li Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Li YL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Liao XN	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Lin S	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Lin XM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Lin ZF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Liu B	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Liu BM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Liu BY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Liu DH	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Liu F	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Liu F	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Liu GT	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Liu MQ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	NM
Liu X	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Liu XX	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Liu YL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Liu YX	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Liu ZR	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM

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Lu RF	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Lu XX	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	N	N	NM	NM
Lu Y	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Lucy Rivett	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Luo SH	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	Y
M.M. Arons	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Ma MM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM
Ma Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Ma YL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
MacIntyre CR	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	NM	Y	N	N	N	NM
Mahesh C. Patel	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Martin C	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Maru Sheela	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
McMichael TM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Mei X	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Michael J. Fassett	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Michel Bielecki	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Miyamae Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Mohammed A M Ahmed	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM	NM	Y	Y	Y	N	Y
Moon SS	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Moriarty LF	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	NM	N	NM
Nagler AR	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Niccolò Parri	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Niu YL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Oduro-Mensah E	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y

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Ou JM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Pan XQ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Pérez-GarcíaF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Pongpirul W	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Pongpirul WA	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Qiu CF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Redditt V	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Roman G. Shmakov	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Rubbi I	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Salim Mattar	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Seong Eun Kim	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Shaher M. Samrah	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
She X	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Son H	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Song W	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Song YS	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Spiteri G	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Sun DF	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Sun WW	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NM	Y	Y	NM	NM	NM
Sun Z	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tang A	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tang Olive	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM
Thiel SL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Tian SC	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Tian SJ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y

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Timothy J. Judson	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Tolia VM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Tong H	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tong ZD	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Treibel TA	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tsou Tsung-Pei	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Viktoriya London	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Wan R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang AH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	Y
Wang D	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang JC	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Wang KS	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM	NM
Wang L	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Wang LZ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang S	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Wang T	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Wang XB	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang XL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang ZQ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Waya JLL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wong HYF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Wong J	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Wu GY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	Y
Wu HP	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Wu QR	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM

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Wu XQ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Wu Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Wu YL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Xiang TX	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Xie JW	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Xie YB	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Xu HM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Xu S	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Xu TM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Yan XQ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Yang K	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yang NB	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Yang RR	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Yang YL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yang YX	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yao QD	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM
Yao XY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Yayla Burcu Ceylan Cura	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Ye XX	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Ye Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Yu FT	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM
Yu JX	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Yu X	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Yuan L	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yue HM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y

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Zeng J	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zeng WZ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Zhai HL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhan H	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhan T	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Zhang JJ	Y	Y	N	Y	Y	Y	Y	N	NM	N	Y	Y	Y	Y	NM	Y	N	N	N	Y
Zhang KY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Zhang L	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Zhang R	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhang Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Zhang YC	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Zhang YD	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhao L	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Zhong ZM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	NM
Zhou H	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhou JL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhou R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Zhu JF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Zhu MR	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhu SQ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM

Y, Yes; N, Not; NM, not mentioned.

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According to quality of cross-sectional studies (AXIS) scale (Downes MJ, Brennan ML, Williams HC, Dean RS. Development of a critical appraisal tool to assess the quality of cross-sectional studies (AXIS). *BMJ open* 2016; **6**(12): e011458.):

Introduction

1. Were the aims/objectives of the study clear?

Methods

2. Was the study design appropriate for the stated aim(s)?
3. Was the sample size justified?
4. Was the target/reference population clearly defined? (Is it clear who the research was about?)
5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?
6. Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?
7. Were measures undertaken to address and categorise non-responders?
8. Were the risk factor and outcome variables measured appropriate to the aims of the study?
9. Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialled, piloted or published previously?
10. Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)
11. Were the methods (including statistical methods) sufficiently described to enable them to be repeated?

Results

12. Were the basic data adequately described?
13. Does the response rate raise concerns about non-response bias?
14. If appropriate, was information about non-responders described?
15. Were the results internally consistent?
16. Were the results for the analyses described in the methods, presented?

Discussion

17. Were the authors' discussions and conclusions justified by the results?
18. Were the limitations of the study discussed?

Other

19. Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?
20. Was ethical approval or consent of participants attained?

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Supplementary Table 4 Results of sensitivity analysis

Study omitted	Estimate	[95% Conf.	Interval]
Abeysuriya Sanduni	0.24138328	0.2359522	0.2468143
Adedeji Idris Abiodun	0.24126983	0.2358378	0.2467018
Adetola Hammed Hassan	0.24140392	0.2359729	0.246835
Aherfi Sarah	0.24146682	0.2360346	0.246899
Almazeedi Sulaiman	0.2395409	0.234087	0.2449948
Alshahrani Mohammed S	0.24135832	0.2359271	0.2467896
Alshukry Abdullah	0.24093036	0.235491	0.24637
Alsofayan Yousef M	0.2423633	0.236915	0.247811
Alvin J Ing	0.24085474	0.235421	0.246288
Amy V. Dora	0.2414076	0.235976	0.246839
An YH	0.24142824	0.235997	0.246859
Andrea Lombardi	0.24154645	0.236113	0.24698
Antonio-Villa Neftali Eduardo	0.26132575	0.2556445	0.267007
Arima	0.24140991	0.2359788	0.2468411
Ashinyo Mary Eyram	0.2399627	0.2345254	0.2454
Atakla Hugues Ghislain	0.24140076	0.2359691	0.2468324
Backer JA	0.24156743	0.236135	0.247
Bai M	0.24201234	0.236572	0.247453
Bai R	0.24144937	0.236016	0.246883
Bai SL	0.24139151	0.23596	0.246823
Bhakti Sarangi	0.24128741	0.235855	0.246719
Bianco Angela	0.2414328	0.236001	0.246864
Bin YF	0.24151391	0.236082	0.246946
Blain Hubert	0.24141634	0.235985	0.246848
Böhmer	0.24143349	0.236002	0.246865
Breslin Noelle	0.24139062	0.235959	0.246822
Bruminhent Jackrapong	0.24150243	0.2360704	0.2469344
Cai Jiehao	0.24134758	0.235916	0.246779
Cao JM	0.24137202	0.235941	0.246803
Carla Felice	0.24140568	0.235974	0.246837
Chan JFW	0.24142247	0.235991	0.246853
Chen B	0.24150895	0.236077	0.246941
Chen J	0.24182814	0.236392	0.247264
Chen T	0.24148329	0.236051	0.246916
Chen Y	0.24154295	0.236108	0.246978
Chen YJ	0.24160017	0.236166	0.247034
Cheng ZP	0.24145818	0.236027	0.24689
Choe PG	0.2412125	0.235779	0.246646
COVID-19 National Incident Room Surveillance Team	0.24089625	0.2354592	0.2463333

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Dai Y	0.24140795	0.235977	0.246839
Daniela Loconsole	0.24092582	0.235491	0.24636
Ding Y	0.24150026	0.236068	0.246932
Dong X	0.24143203	0.236001	0.246863
Dong XC	0.2416393	0.236206	0.247073
Dong YY	0.24137929	0.235948	0.246811
Erinoso Olufemi A.	0.23952371	0.23408	0.244968
Eythorsson Elias	0.24370873	0.238245	0.249173
Fakiri EL K	0.24113926	0.235707	0.246572
Fan YZ	0.24148887	0.236056	0.246921
Feaster Matt	0.24184601	0.236402	0.24729
Feng XP	0.24145405	0.236022	0.246886
Foster Catherine E.	0.24219659	0.2367402	0.247653
Friederike Maechler	0.24145871	0.236026	0.246892
Gao HJ	0.24146272	0.236031	0.246894
Gao T	0.24143969	0.236008	0.246871
Gautret P	0.24153928	0.236106	0.246973
Gill Livingston	0.23967291	0.2342354	0.2451104
Grados Isabel Zumalave	0.24133743	0.235903	0.246772
Graham N.S.N.	0.2413419	0.235908	0.246776
Grechukhina Olga	0.24149908	0.236064	0.246934
Gu. Kim	0.24189922	0.236461	0.247337
Guo CX	0.24148878	0.236056	0.246922
Han RD	0.24145339	0.236022	0.246885
He M	0.24144486	0.236012	0.246878
He WB	0.24279851	0.237349	0.248248
Hu SX	0.24153839	0.236106	0.246971
Huang DD	0.24127801	0.235846	0.24671
IH Huerta Saenz	0.24148321	0.236051	0.246915
Ipekci A	0.24095382	0.235521	0.246387
Irene Petersen	0.24137411	0.235943	0.246805
Jennifer S. Singer	0.24134545	0.23591	0.246781
Jeong SJ	0.24137802	0.235947	0.246809
Jha S	0.24147981	0.236048	0.246912
Ji GH	0.39626896	0.389306	0.403232
Ji T	0.24152319	0.236091	0.246955
Jia CY	0.24161656	0.236181	0.247052
Jiang CH	0.23967837	0.234267	0.24509
Jiang R	0.24145818	0.236027	0.24689
Jibrin YB	0.24119677	0.235764	0.246629
Jin MH	0.24143013	0.235999	0.246861
Jung CY	0.20909713	0.203439	0.214755
Kang M	0.24147271	0.236041	0.246904

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Kasper MR	0.23947349	0.234015	0.244932
Ke B	0.24140336	0.235972	0.246835
Kenu E	0.15292338	0.147079	0.158767
Ki M	0.24144812	0.236017	0.24688
Kirenga Bruce	0.24127552	0.235843	0.246708
Kong WF	0.24159901	0.236157	0.247041
Krajcar N	0.24111447	0.235679	0.24655
Kristin J. Meyers	0.2409627	0.23553	0.246395
Kumar R	0.24101612	0.23558	0.246452
Ladhani Shamez N	0.24109717	0.235664	0.24653
Lai XQ	0.24160057	0.236167	0.247034
Le TQM	0.24143392	0.236003	0.246865
Lee YH	0.23829599	0.232852	0.24374
Lei MY	0.24149777	0.236064	0.246932
Lewis Megan	0.24142997	0.235998	0.246862
Li CY	0.24142441	0.235993	0.246855
Li J	0.2413753	0.235944	0.246807
Li W	0.24139515	0.235964	0.246826
Li Y	0.24150647	0.236075	0.246938
Li Y	0.24149327	0.23606	0.246927
Li YL	0.24131729	0.235881	0.246753
Liao XN	0.24145868	0.236027	0.24689
Lin S	0.2416722	0.236238	0.247106
Lin XM	0.24143092	0.236	0.246862
Lin ZF	0.24168462	0.236249	0.24712
Liu B	0.24142013	0.235989	0.246851
Liu BM	0.24126719	0.235835	0.2467
Liu BY	0.24125627	0.235823	0.246689
Liu DH	0.24143161	0.236	0.246863
Liu F	0.24143013	0.235999	0.246861
Liu F	0.24139389	0.235963	0.246825
Liu GT	0.24147211	0.23604	0.246904
Liu MQ	0.24140359	0.235973	0.246835
Liu X	0.24142049	0.23599	0.246851
Liu XX	0.24142915	0.235996	0.246862
Liu XX	0.24139974	0.235969	0.246831
Liu YL	0.2414358	0.236005	0.246867
Liu YX	0.24143392	0.236003	0.246865
Liu ZR	0.24143161	0.236	0.246863
Lu RF	0.24146377	0.236032	0.246895
Lu XX	0.24152887	0.236094	0.246963
Lu Y	0.24142824	0.235997	0.246859
Lucy Rivett	0.2412927	0.235861	0.246725

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Luo SH	0.24151178	0.236079	0.246944
M.M. Arons	0.24129912	0.235867	0.246731
Ma MM	0.24198274	0.236544	0.247421
Ma Y	0.24142143	0.23599	0.246853
Ma YL	0.24116221	0.235729	0.246596
MacIntyre CR	0.2413937	0.235963	0.246825
Mahesh C. Patel	0.24138328	0.235952	0.246815
Martin C	0.24125469	0.235823	0.246686
Maru Sheela	0.24124874	0.235817	0.246681
McMichael TM	0.24167565	0.236241	0.24711
Mei X	0.24203795	0.236597	0.247479
Michael J. Fassett	0.2413168	0.235886	0.246748
Michel Bielecki	0.24087179	0.235436	0.246307
Miyamae Y	0.24134462	0.235913	0.246776
Mohammed A M Ahmed	0.24144942	0.236011	0.246888
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Tang Olive	0.24158044	0.236148	0.247013

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Combined	0.24141874	0.235988	0.24685

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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	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.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5-6
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.	/
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.	7
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.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	6
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).	7
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.	7-8
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	7-8
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.	9
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	9
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.	9

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PRISMA 2009 Checklist

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).	9
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	9
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.	9-10
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.	10
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).	12
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.	10-11
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	10-12
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	12
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	11-12
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).	12
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).	15-16
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	16
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.	17

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

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BMJ Open

Rate of asymptomatic COVID-19 among ascertained infections in different region and population groups in 2020: A systematic review and meta-analysis including 130,123 infections from 241 studies

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Rate of asymptomatic COVID-19 among ascertained infections in different region and population groups in 2020: A systematic review and meta-analysis including 130,123 infections from 241 studies

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Abstract

Introduction: Asymptomatic infection of SARS-CoV-2 may lead to silent community transmission and compromise pandemic control measures of COVID-19. We aimed to estimate the rate of asymptomatic COVID-19 infection from published studies, and compare this rate among different region and patient groups.

Methods: This systematic review and meta-analysis was conducted according to the standards strictly following the '*Preferred Reporting Items for Systematic reviews and Meta-Analyses*' (PRISMA) guideline. The electronic databases including Medline, Embase, PubMed, and three Chinese electronic databases (The Chinese National Knowledge Infrastructure (CNKI), WanFang Data, and VIP) from 1 November 2019 to 31 December 2020 were searched. Original studies with sample size (or number of subjects) not less than 5 were included. Subgroup analyses were conducted according to different study types, study periods, geographical regions, and patients' demographics. The STATA command '*Metaprop*' was implemented to conduct meta-analysis for the pooled rate estimates of asymptomatic infections with exact binomial and score test-based 95% confidence intervals (CIs).

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Results: A total of 130,123 ascertained COVID-19 infections in 241 studies were included in the meta-analysis, including 31,411 asymptomatic infections. The overall rate of asymptomatic infection was 23.6% (18.5%-29.1%) and 21.7% (16.8%-27.0%), before and after excluding pre-symptomatic cases, respectively. Subgroup analysis showed that the rate was significantly higher in pregnant women (48.8%, 28.9%-68.9%), children (32.1%, 24.4%-40.5%), and studies reporting screening programmes (36.0%, 24.6%-48.1%) conducted on or after 01 March 2020 (42.5%, 33.4%-51.9%). In terms of geographical regions, the rate was the highest in Africa (64.3%, 56.7%-71.6%), followed by America (40.0%, 27.4%-53.3%), Europe (28.1%, 19.0%-38.1%), and Asia (18.1%, 13.2%-23.5%).

Conclusion: One-fifth of the COVID-19 infection is asymptomatic throughout the infection course. High proportion of asymptomatic infection were observed in some patient groups and regions. Public health policies targeting these high-risk groups may be recommended to achieve early identification and more stringent containment of the pandemic.

(300 words)

Keywords: COVID-19; SARS-CoV-2; asymptomatic infection; asymptomatic ratio; meta-analysis.

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Article Summary

Strengths and limitations of this study

1. The comprehensive systematic literature search included a greater number of studies which reported varied asymptomatic infection rate.
2. Several subgroup analyses were conducted by considering different aspects of the study design.
3. Heterogeneity in the asymptomatic infection rate shall be noted.
4. Cross-sectional design of most reviewed studies may misclassify 'pre-symptomatic' as 'symptomatic' infections.

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Introduction

In 2019, a cluster of severe pneumonia cases of unknown type were reported in Wuhan, China (1). Later coined as the coronavirus disease 2019 (COVID-19), it rapidly resulted in large-scale outbreaks across many regions. On 30 January 2020, the World Health Organization (WHO) declared the COVID-19 as a public health emergency of international concern (2), and further defined it as a pandemic on 11 March 2020. As of 2 September 2020, a cumulative total of 25,937,361 COVID-19 cases have been confirmed globally, with 861,910 associated deaths.

The pathogen of COVID-19, i.e., severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is highly contagious, and could be transmitted from human to human (1, 3). The viral load in an asymptomatic patient has been found to be similar to that in symptomatic patients in a study of nine patients (4), and this observation was later confirmed in a study involving large samples (5). The early peaking of SARS-CoV-2 viral load during the pre-symptomatic phase may cause silent community outbreaks (6). Further investigations also found that the asymptomatic infections may carry SARS-CoV-2 for more than 1 month, indicating the long-lasting risk of secondary infection (7-11).

Determining the rate of asymptomatic infection is important as it may deepen the understanding of the real reproductive number (R_0), as well as the true incidence and mortality rate of COVID-19. The rate may also function as an essential epidemiological parameter to inform disease combating policies, including the density and range of screening, patient isolation as well as early intervention (12). Nevertheless, the significance of the invisibly infected person as the source of infection depends on its distribution in the population, and the amount and duration of the virus excreted (13).

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The reported proportions of asymptomatic individuals in existing literature varied a lot (12), depending on their research settings (e.g. geographical region, screening vs. non-screening studies), demographic characteristics (e.g. age groups, pregnant women, children), and other latent factors. The present study performed a systematic review and meta-analysis to estimate the asymptomatic infection rate based on published studies, and compare the rate among different patient groups as well as study settings.

Methods

Searching strategy

This systematic review and meta-analysis was conducted according to the standards strictly following the '*Preferred Reporting Items for Systematic reviews and Meta-Analyses*' (PRISMA) guideline (14). XC and ZH searched the Medline, Embase, PubMed, and three most commonly-used Chinese electronic databases (the Chinese National Knowledge Infrastructure [CNKI], WanFang Data, and VIP) from 1 November 2019 to 31 December 2020. CNKI, WanFang Data, and VIP are affiliates of the Chinese Ministry of Science & Technology that providing access to peer reviewed, continuously updated research journal articles in Chinese. The search string related to "COVID-19" AND "asymptomatic" was systematically developed in PubMed with the help of its MeSH terms, and was applied to all databases after discussing with an experienced Libationary (Maggie Choi). The search fields of "Text Word" was applied to ensure the best possible search evidence (**Supplementary Table 1**). No filters or limitations were applied to retrieve the best possible result and to avoid excluding pre-indexed materials. Meanwhile, highly relevant references were also searched (by XC and ZH) by reviewing the reference list of the included articles. Two reviewers (XC and ZH) determined the eligible studies independently. Consensus was reached by referral to a third reviewer (JW) when there was disagreement. All manuscripts were

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imported into the Endnote software (version X8, Thomson Reuters, Carlsbad, California) to store and manage the retrieved citations. Duplicate studies were removed.

Asymptomatic case and asymptomatic ratio

Several similar definitions of 'asymptomatic case' were noted in previous studies (15). We followed the official definition from the State Council of China and the World Health Organization (WHO) (16, 17), and defined 'asymptomatic case' as individuals who 1) have no clinical manifestations of COVID-19, such as fever, cough, sore throat, and other self-perceived or clinically identifiable symptoms and signs; 2) have positive result of SARS-CoV-2 pathogen test; and 3) does not develop symptoms until the end of hospital admission or follow-up observations. Asymptomatic COVID-19 infection rate, or asymptomatic ratio, is calculated as the proportion of asymptomatic cases among all COVID-19 infections.

Literature screening and selection criteria

All studies were screened by title and abstract first, followed by full texts if the study meets the inclusion criteria, which consist of: (1) the studying subjects were diagnosed with SARS-CoV-2 infection; (2) the study was designed as an observational study; and (3) the numbers of asymptomatic and symptomatic COVID-19 infections were explicitly and exactly reported.

The literature screening was conducted without language or region restriction. The exclusion criteria are as follows. They included (1) study that included patients without virological evidence of SARS-CoV-2 infection; exclusion criterion (2) study which did not investigate the distribution of asymptomatic COVID-19 infections among all

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subjects; (3) study that is not classified as original research, such as reviews, comments, case report; and (4) study has an overall sample size of less than 5.

For the same group of subjects been reported by different articles, only articles with the most updated and detailed information were included for further analysis.

Data extraction and subgrouping schemes

For eligible articles, two types of the information were extracted by the two reviewers (XC and ZH) independently. For each study, we include two types of information: (1) the basic information of the individual studies that contains the name of the first author, investigation period, geographical region, and the study setting (screening and non-screening); and (2) the study settings, characteristics of subjects, sample size, and the number of COVID-19 infections (total infections, pre-symptomatic infections, and asymptomatic infections).

To ensure the accuracy of data, cross-checking was conducted after extraction of the preliminary information. Disagreements were resolved through consensus or by referral to the third reviewer (JW).

To explore the source of heterogeneity among the included studies, several subgroup analyses were performed according to the study design and characteristics of subjects in each study. First, we identified three groups based on the subjects' demographical features. They included 'children' groups consisting of subjects less than 18 years old; 'pregnant women' groups involving expectant mothers as subjects; and the 'general population' group. Second, three age groups were identified according to the subjects' mean or median age: ≤ 18, from 19 to 45, and > 45 years, respectively. The selection

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of mean or median age followed the statistics reported in each study. Third, studies were categorized into 'screening' or 'non-screening' types by referring to the positive rate of SARS-CoV-2 pathogen test among included subjects. In the screening studies, the positive rate is less than 100%; while for non-screening studies, all subjects were tested positive. Forth, we separated studies based on subjects from different geographical regions including China, Asia (excluding China), the US and Europe. Last, subgroup analysis was performed by study period, during which the subjects were tested for COVID-19, including 'before 01 March 2020' or '01 March 2020 and afterwards'.

Quality assessment

The quality of each included study was assessed by two researchers (XC and ZH) independently using the quality of cross-sectional studies (AXIS) scale (18). There are five components including 20 questions in the AXIS scale. Seven questions measure the quality of reporting; another seven questions measure the quality of study design, and six questions measure the possible introduction of biases in each study.

Statistical analysis

Accounting for all included studies, the pooled estimates of the asymptomatic rates were generated with exact binomial-distributed likelihood framework and score test-based 95% confidence intervals (CIs) (1). The STATA command "*metaprop*" was adopted to conduct meta-analysis. Heterogeneity across the studies was examined by the I^2 statistic, measuring the proportion of total variation contributed by between-study variation. The I^2 values < 25%, ranging from 25% to 75%, and > 75% correspond to the thresholds for three ordinal levels of heterogeneity including low, moderate, and high, respectively (19).

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Univariate and multivariate meta-regression analysis was performed to identify any potential effects of modifiers or confounders on the estimated rate. We examined the effects of the covariates including study population, age-specific proportion, screening/non-screening study, geographical region, and time trend in multivariate analysis. Sensitivity analysis was conducted by omitting one study at a time, generating the pooled estimates and comparing with the original estimates. Potential publication bias was examined by Egger's test and visualized using a funnel plot. If the tests indicated potential publication bias, the Trim and Fill's method, which is based on a modified funnel plot, would be adopted to adjust the small-study effect (20).

All analyses were performed using STATA statistical software (version 14.0, Stata, College Station, Texas, USA). The figures were generated using R software (version 3.6.3) with the '*forestplot*' package.

Results

Characteristics of studies and subjects

In total, 9,798 unique citations were identified in different databases by the literature search **(Figure 1)**. We retrieved 661 full-text articles assessed for eligibility after 9,247 citations were excluded during title or abstract screening with pre-determined criteria. Finally, there were 241 studies in 240 articles included in the meta-analysis, among which 3 studies were additional records identified through reference lists.

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The basic characteristics of the included studies are shown in **Supplementary Table 2**. These characteristics include: cities, countries and study periods in which the ascertained COVID-19 infections were recruited; the number of test-positive and asymptomatic infections; the number of pre-symptomatic infection in patients if available; and demographics of each patient. Approximately 72.9% (175 out of 241) of all included studies were conducted in Asia, 11.7% in the Europe, and 10.42% in America. In terms of study populations, 80.5% were performed in the general adults, 12.4% in children and 7.1% in pregnant women, respectively.

Quality scores of AXIS for the included studies ranged between 11 and 19 points, with 153 studies meeting the criteria of having high quality (≥ 16 points). Overall, 97.9% (235 out of 240) of all studies met the criteria for both reporting aims/objectives and quality design, and the risk factors and outcome variables were appropriate for the studies. In all studies, the methods were clearly defined so that those studies could be repeated, and the presentation of results met the analysis descriptions in the methods with internal consistency (**Supplementary Table 3**).

Asymptomatic ratio estimates

A total of 130,123 ascertained COVID-19 infections from 241 studies were finally included in the meta-analysis **(Figure 2)**, including 31,411 asymptomatic infections at the time of diagnosis. The rate of asymptomatic infections varied from 0.1% in the general adults in Wuhan, China (21), to 95.6% in the pregnant women in Peru (22). The overall rate of asymptomatic infections was estimated at 23.6% (18.5%-29.1%). The I^2 equaled to 99.7%, indicating a high heterogeneity among the studies. Of the 31,411 asymptomatic infections, 448 (1.4%) developed symptoms after admission.

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After excluding these pre-symptomatic observations, the pooled rate was 21.7% (16.8%-27.0%) at an I^2 of 99.7%.

In subgroup analysis, we found that pregnant women (48.8%, 28.9%-68.9%; I^2 = 96.9%) had a significantly higher asymptomatic infection rate than children (32.1%,24.2%-40.5%; I^2 = 94.4%), whereas the general non-pregnant adults had the lowest asymptomatic rate (20.4%, 15.0%-26.3%; I^2 = 99.8%). Regarding age-specific proportion, patients aged ≤ 18 years (31.1%, 23.5%-39.2%; I^2 = 94.4%) had a significantly higher prevalence of asymptomatic cases than adults aged 19-45 years (26.7%, 19.1%-34.9%; I^2 = 99.7%) or > 45 years (15.3%, 10.7%-20.6%; I^2 = 97.1%).

The asymptomatic infection rate was 36.0% (24.6%-48.1%; I^2 = 99.8%) among studies for screening settings, which is almost twice of that among studies for non-screening settings (19.4%, 14.3%-24.9%; I^2 = 99.6%). Significantly different asymptomatic rates were observed in different geographical regions (p-value <0.001) - the rate was highest in Africa (64.3%, 56.7%-71.6%; I^2 = 96.8%), followed by America (40.0%, 27.4%-53.3%; I^2 = 99.6%), and Europe (28.1%, 19.0%-38.1%; I^2 = 98.5%). Asia was estimated to have the lowest rate of asymptomatic infection (18.1%, 13.2%-23.5%; I^2 = 99.5%). For subgroup analysis by time period, we noted that studies conducted before 01 March 2020 reported a pooled asymptomatic infection rate of 13.3% (9.8%-17.1%; I^2 = 94.2%), while the rate increased sharply to 42.5% (33.4%-51.9%; I^2 = 99.6%) among studies conducted after 01 March 2020.

All subgroup analysis results were shown in **Figure 3**.

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We performed both univariate and multivariate meta-regression analysis to investigate study-level factors that may contribute to the heterogeneity among studies and might have influenced our estimations of the asymptomatic infection rate. The results of univariate regression analysis (**Table 1**) demonstrated several significant sources of heterogeneity in the estimated asymptomatic infection rate - studies focused on subjects aging >45 years old (p-value = 0.015) and were conducted out of Africa (p-value ≤ 0.001) are significantly associated with a lower ratio of asymptomatic infection; whereas those using a non-screening study design (p-value < 0.001), and conducted on or after 01 March 2020 (p-value < 0.001) tend to report a higher ratio of asymptomatic infection. A screening study design (p-value = 0.031), geographical region (p-value < 0.001) and time trend (p-value < 0.001) remained the significant sources of heterogeneity in the multivariate regression analysis.

We found no evidence of publication bias among studies by Egger's test with p-value = 0.414. Sensitivity analysis showed that it was unlikely that any individual study significantly influenced the pooled estimates, demonstrating the robustness and reliability of our estimates (**Supplementary Table 4).**

Discussion

Our meta-analysis of 130,123 infections in 241 studies performed in 36 countries provides an up-to-date as well as comprehensive overview of asymptomatic infection rate of COVID-19. The estimated rate in our study is 23.6% and 21.7%, before and after excluding pre-symptomatic cases, respectively. There are three key findings in the subgroup analysis (23). First, African studies reported the highest asymptomatic infection rate, while Asian studies reported the lowest. Second, the proportion of asymptomatic carriers was nearly doubled in screening studies than that in non-

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screening studies. Third, asymptomatic infection rate was more than two times higher in studies conducted in or after 01 March 2020 than those conducted beforehand.

Our estimation is higher than some existing meta-analysis which reported a ratio between 15.6% to 20% (24, 25). One possible explanation is that the included studies in previous meta-analysis were dominated by that conducted during the early course of the pandemic and in China or the US, where the asymptomatic ratio is lower than other regions. However, our study included more than 200 articles, resulting in a more precise estimation with significantly narrower confidence interval. With a much larger dataset, we conducted more subgroup analysis which resulted in more implications.

In the subgroup analysis, we noted a large variety of asymptomatic rates among different populations. For instance, children and adults aged ≤ 45 years old tended to have a significantly higher rate. The inverse correlation between age and symptom severity has also been reported and discussed by a few studies, and the prevalence of chronic diseases was considered as the risk factors of symptomatic infection (23, 26, 27). Nevertheless, a multi-center study in China noted that more than half of the asymptomatic children had lung injuries, although the injuries were usually less severe than that among the adults. Infection control measures may be targeted on the early detection and isolation of asymptomatic youth, as the young asymptomatic carriers are of higher probability to bring in community transmission due to their more socially active lifestyle habits with more frequent travelling than people in other age groups (26).

We also noted that the asymptomatic infection rate for pregnant women (48.8%) is more than two times that for the general adults (20.4%). Previous study suggested cytotoxic cells may be poised to control virus load, and hence affect the disease severity

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during pregnancy (28). Case reports from the New York hospital reported a similarly high rate (14 women, 32.6%) at presentation, yet 71.4% (10 women) of the asymptomatic mothers developed symptoms during their hospitalization and postpartum course (29). Nevertheless, we noted that 15 out of our 17 included studies on pregnant women are cross-sectional studies that in which the high proportion of asymptomatic infections may include both pre-symptomatic and asymptomatic cases. More follow-up studies among the pregnant women are needed before drawing further conclusions. Undetected asymptomatic pregnant women may lead to more severe consequences. Without early detection and proper preventive measures, the delivery of asymptomatic patients brings extra risks to nosocomial infection, and may also result in droplet transmission among the women, kids, as well as other family members (30). Importantly, the data suggest that the severity and mortality risk of hospital transmission may be greater than that of community-acquired COVID-19 (31).

To our knowledge, this is the first meta-analysis that compared the asymptomatic infection rate in different continents. Previous meta-analysis only concluded that population in Asia may have a lower asymptomatic ratio, while did not explored the differences among other continents (32). Our results also showed that estimated ratio in Asia is the lowest among all continents. Possible explanations were summarized in a published meta-analysis, from the perspectives of infection control policies and host characteristics (32). Meanwhile, the rates in Africa (64.3%) were the highest among all continents, although the limited number of subjects (20,271 COVID-19 infections) in African studies reminded us to think twice before generalizing the results. The phenomenon may be partly explained by a few factors in African patients, including the generally younger age, the lower proportion of chronic disease patients and elderlies living in nursing homes, and the higher serum Vitamin D levels due to rich sun exposure (33). Despite the higher asymptomatic ratio, it is noted that Africa is the continent with

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the lowest RT-PCR testing rate as well as the lowest vaccination rate. The high proportion of asymptomatic rate may further hinder the timely detection and control of COVID-19 infections.

We noted that the asymptomatic infection rate was nearly doubled in screening studies than that in non-screening studies. One possible explanation is that people may get tested for varied reasons associated with the social, cultural, and political factors in each region. For instance, frontline health workers and people with a history of exposure were in general more likely to be reported in screening programmes, while the samples in non-screening studies were likely to be dominated by subjects having severe symptoms requiring hospitalization (34). If we consider the rate as a constant, the higher asymptomatic infection rate estimates were likely due to higher probabilities of ascertaining asymptomatic COVID-19 infections in the community with screening implemented. This implies the importance of mass screening in detecting the infections, which is of importance in community infection control. Increasing the accessibility and affordability of community testing could be an important surveillance strategy for early containment of diagnosed cases (35).

We also found that the pooled asymptomatic infection rate increased from 13.3% (95% CI: 9.8%-17.1%) for studies conducted before 01 March 2020, to 42.5% (33.4%-51.9%) for studies conducted on 01 March 2020 or afterwards, although the 95% CI is larger in the latter time period. This timeline is highly consistent with a previous study using the publicly released from the Centre for Health Protection in Hong Kong (36). The increased rate may be due to overlooking of asymptomatic, especially pre-symptomatic cases at the early stage of the pandemic, when medical resources were targeted to patients with severe symptoms. Later, with increased public awareness and test

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accessibility, more COVID-19 infected individuals without symptoms were detected, while more and more studies reported the proportion of asymptomatic patients. In this context, future studies may explore whether the proportion of COVID-19 infections with mild or no symptoms is increasing, especially when considering the SARS-CoV-2 variant with D replaced by G at the 614-th codon in the Spike protein which dominated the pandemic since late February 2020 (6, 37, 38).

This study has limitations. First, our pooled asymptomatic infection rates were found to have a high level of heterogeneity (I^2 = 96.2%). This could be attributed to the difficulties in generating the exact number of infections and asymptomatic cases during an outbreak. Although we conducted subgroup analysis and meta-regression to figure out the source of heterogeneity, some unobserved factors which have not be included in the original studies may lead to the high heterogeneity, such as changing pandemic control measures in some countries; the diverse definition of asymptomatic infection, varying practices of surveillance and ascertainment of asymptomatic infection; as well as meteorological disparities across time and regions. Nevertheless, previous studies indicated that any amount of heterogeneity is acceptable if both accurate data and predefined eligibility criteria were provided (39, 40). Second, we followed the WHO definition of COVID-19 infection and only included infections detected by RT-PCR, while the availability of RT-PCR is restricted in many countries (41). Increasing number of studies reported the results of antibody-based rapid diagnostic tests, yet they were not included in our meta-analysis. Third, our meta-analysis focused on real-world evidence and observational studies, in which subjects with more severe and easily recognized symptoms are more likely to be selected. The collider bias caused by non-representative sampling strategies (such as sampling conditional on testing and prognosis conditional on hospitalization) in existing observational studies on COVID-19 has been deeply discussed in (34). Forth, cross-sectional studies included in this

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review might mis-classified pre-symptomatic cases as 'asymptomatic', hence result in a certain degree of overestimation on the asymptomatic infection rate. With additional information of the exposure and reporting dates of each case, we remark our estimation can be extended to a right censoring version to further address some potential bias in the existing frameworks (12).

Conclusions

We estimated the asymptomatic infection rate of 23.6%, which decreased to 21.7% after excluding pre-symptomatic cases. Subgroup analysis indicates that pregnant women, children, African residents, screening programmes, and studies conducted after 01 March 2020 had higher asymptomatic infection rates. Our findings provide further insights on the distribution of asymptomatic COVID-19 infections in different groups of individuals, which bear significance on public health policies that aim to achieve early identification and more stringent containment of the pandemic.

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Declarations

Patient and Public Involvement

Not applicable.

Ethics approval and consent to participate

Not applicable.

Availability of materials

All data relevant to the study are included in the article or uploaded as supplementary information.

informationConsent for publication

Not applicable.

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Disclaimer

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Conflict of interests

DH received a grant from Alibaba (China) Co. Ltd., Collaborative Research grant. Other authors declared no conflict of interest.

Author's contributions

XC and ZH designed the study and searched the literature. XC, ZH, and JW extracted the data and evaluated the quality. XC conducted the statistical analysis. XC, ZH, and JW wrote the full manuscript. SZ, MSCW, MKCC, DH, and JL provided critical revision of the manuscript for important intellectual content. All authors discussed the results, and approved the final version of the manuscript for publication.

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Table 1 Results of univariate and multivariate meta-regression analysis

Figure 1 The process of study selection for the meta-analysis

Figure 2 Meta-analysis of the asymptomatic ratio among ascertained COVID-19 infections (including and excluding pre-symptomatic infections)

Figure 3 Asymptomatic ratio among ascertained COVID-19 infections by patient group, age group, screening study, region, and time trend

Supplementary Table 1 Search strategy for systematic review

Supplementary Table 2 Characteristics of the studies included for meta-analysis

Supplementary Table 3 Quality assessment of selected articles

Supplementary Table 4 Results of sensitivity analysis

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Table 1 Results of Univariate and Multivariate Meta-regression Analysis

Variable	Univariate Regression Analysis				Multivariate Regression Analysis		
	No. of Studies (%)	Crude Meta-RR	95% CI	*p*-value	Adjusted Meta-RR	95% CI	*p*-value
Patient Group							
Children	30 (12.45%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
Pregnant	17 (7.05%)	1.16	(0.99-1.37)	0.074	1.02	(0.75-1.10)	0.901
Adults	194 (80.50%)	0.91	(0.82-1.00)	0.057	0.83	(0.63-1.11)	0.209
Age							
⩽18y	30 (12.45%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
19-45y	102 (42.32%)	0.98	(0.88-1.09)	0.682	1.12	(0.84-1.48)	0.446
>45y	68 (27.39%)	0.87	(0.77-0.97)	0.015	1.09	(0.82-1.45)	0.539
NM	43 (17.84%)	0.93	(0.83-1.05)	0.252	1.13	(0.85-1.49)	0.393
Screening							
Non-screening studies	176 (73.03%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	

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Screening studies	65 (26.97%)	1.16	(1.08 -1.25)	<0.001	1.08	(1.01-1.17)	0.031
Region							
Africa	12 (5.00%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
America	25 (10.42%)	0.78	(0.67-0.90)	0.001	0.71	(0.62-0.82)	<0.001
Asia	175 (72.92%)	0.64	(0.56-0.72)	<0.001	0.78	(0.68-0.89)	<0.001
Europe	28 (11.67%)	0.71	(0.62-0.82)	<0.001	0.69	(0.60-0.78)	<0.001
Time Trend							
Before March 2020	95 (39.42%)	1 (Reference)	1 (Reference)		1 (Reference)	1 (Reference)	
March 2020 afterwards	68 (28.22%)	1.33	(1.24-1.43)	<0.001	1.29	(1.17-1.43)	<0.001
NM	78 (32.37%)	1.07	(1.00-1.14)	0.092	1.05	(0.98-1.12)	0.158

NM, not mentioned.

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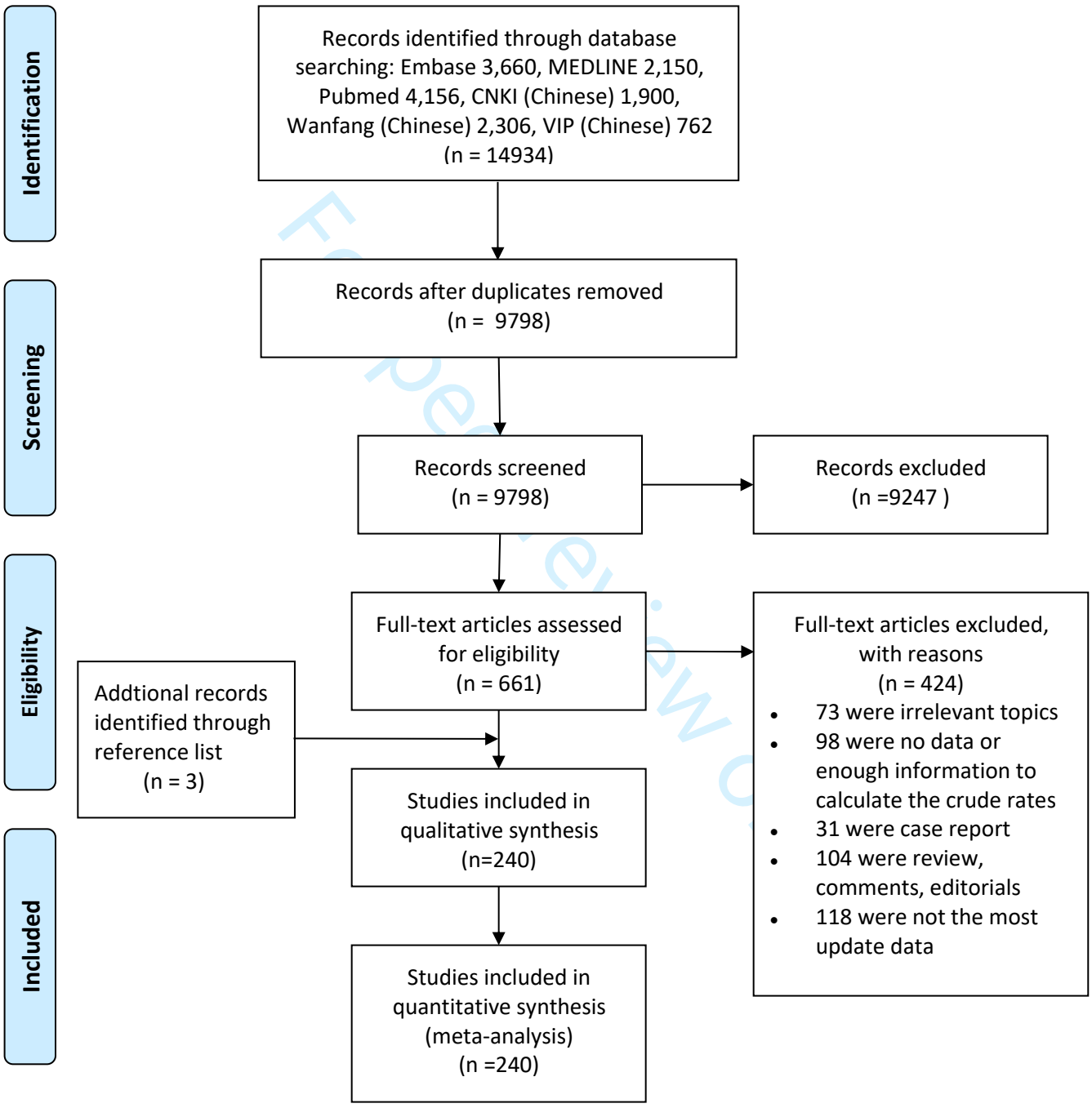
PRISMA 2009 Flow Diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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Figure 2 Meta-analysis of the asymptomatic ratio among COVID-19 patients (including and excluding pre-symptomatic infections)

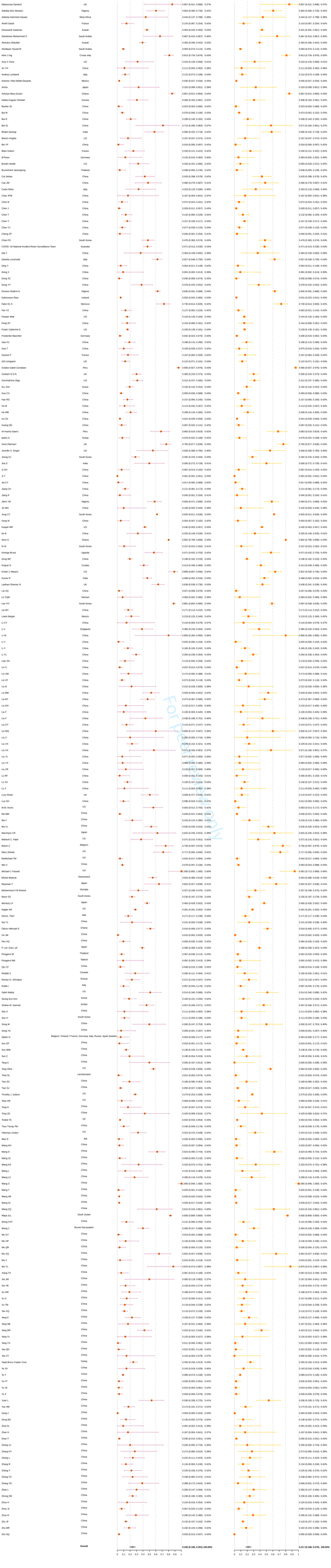

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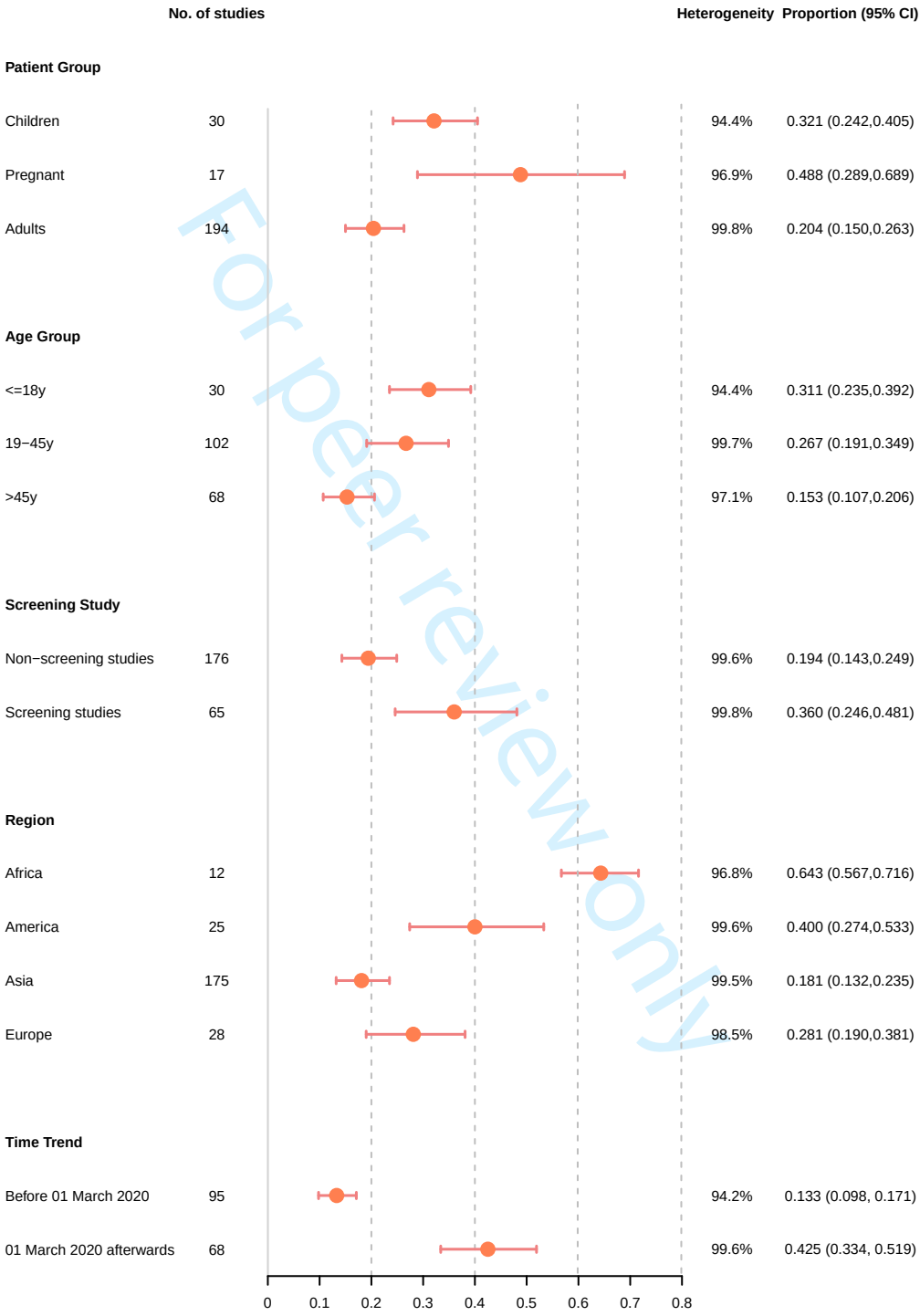
Figure 3 Asymptomatic ratio among COVID-19 patients by patient group, age group, screening study, region, and time trend



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Supplementary Tables and Figure Legends

Supplementary Table 1 Search strategy for systematic review

Supplementary Table 2 Characteristics of the studies included for meta-analysis

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Supplementary Table 4 Results of sensitivity analysis

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Supplementary Table 1 Search strategy for systematic review

Medline (n=2,150)

# ▲	Searches	Results
1	SARS-CoV-2.tw.	22572
2	COVID-19.tw.	68487
3	2019-nCoV.tw.	811
4	novel coronavirus.tw.	4999
5	coronavirus 2019.tw.	928
6	2019 coronavirus.tw.	368
7	Wuhan coronavirus.tw.	15
8	Wuhan pneumonia.tw.	8
9	COVID 19.tw.	68487
10	Coronavirus Disease-19.tw.	716
11	SARS Coronavirus 2 Infection.tw.	4
12	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11	75773
13	Asymptomatic.tw.	140452
14	Asymptomatic Carrier*.tw.	3332
15	Asymptomatic positive*.tw.	45
16	No symptom*.tw.	8151
17	No sign*.tw.	655183
18	Asymptomatic individual*.tw.	3748
19	Asymptomatic person*.tw.	742
20	Asymptomatic patient*.tw.	14504
21	Asymptomatic case*.tw.	1406
22	Asymptomatic carriage.tw.	560
23	Asymptomatic proportion.tw.	9

24	Asymptomatic transmission.tw.	92
25	Symptomless.tw.	1961
26	Asymptomatic contact.tw.	62
27	No respiratory symptom*.tw.	263
28	Inapparent Infection*.tw.	365
29	Subclinical Infection*.tw.	1807
30	Presymptomatic*.tw.	3821
31	Asymptomatic State*.tw.	222
32	Pre-Symptomatic Disease*.tw.	31
33	13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32	805657
34	12 and 33 to yr="2019 - 2020"	2150

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PubMed (n=4,156)

# ▲	Searches	Results
1	Search: SARS-CoV-2 [Text Word]	83767
2	Search: COVID-19 [Text Word]	129668
3	Search: 2019-nCoV [Text Word]	1629
4	Search: novel coronavirus [Text Word]	8709
5	Search: coronavirus 2019[Text Word]	1522
6	Search: 2019 coronavirus [Text Word]	525
7	Search: Wuhan coronavirus [Text Word]	15
8	Search: Wuhan pneumonia [Text Word]	8
9	Search: COVID 19 [Text Word]	129668
10	Search: Coronavirus Disease-19 [Text Word]	1402
11	Search: SARS Coronavirus 2 Infection [Text Word]	8
12	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11	134001
13	Search: Asymptomatic [Text Word]	168176
14	Search: Asymptomatic Carrier*[Text Word]	4055
15	Search: Asymptomatic positive*[Text Word]	56
16	Search: No symptom*[Text Word]	10181
17	Search: No sign*[Text Word]	753877
18	Search: Asymptomatic individual*[Text Word]	4437
19	Search: Asymptomatic person*[Text Word]	831
20	Search: Asymptomatic patient*[Text Word]	16575
21	Search: Asymptomatic case*[Text Word]	1792
22	Search: Asymptomatic carriage [Text Word]	655
23	Search: Asymptomatic proportion [Text Word]	12
24	Search: Asymptomatic transmission [Text Word]	145

25	Search: Symptomless [Text Word]	2890
26	Search: Asymptomatic contact [Text Word]	73
27	Search: No respiratory symptom*[Text Word]	306
28	Search: Inapparent Infection*[Text Word]	396
29	Search: Subclinical Infection*[Text Word]	2030
30	Search: Presymptomatic*[Text Word]	5647
31	Search: Asymptomatic State*[Text Word]	264
32	Search: Pre-Symptomatic Disease*[Text Word]	36
33	13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32	1029910
34	12 and 33 yr="2019/11/01 - 2020/12/31"	4156

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Embase (n=3,660)

# ▲	Searches	Results
1	SARS-CoV-2.tw.	35873
2	COVID-19.tw.	112478
3	2019-nCoV.tw.	1252
4	novel coronavirus.tw.	7926
5	coronavirus 2019.tw.	1403
6	2019 coronavirus.tw.	494
7	Wuhan coronavirus.tw.	24
8	Wuhan pneumonia.tw.	11
9	COVID 19.tw.	112478
10	Coronavirus Disease-19.tw.	1309
11	SARS Coronavirus 2 Infection.tw.	7
12	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11	123709
13	Asymptomatic.tw.	236862
14	Asymptomatic Carrier*.tw.	4966
15	Asymptomatic positive*.tw.	88
16	No symptom*.tw.	15110
17	No sign*.tw.	1097376
18	Asymptomatic individual*.tw.	6175
19	Asymptomatic person*.tw.	1038
20	Asymptomatic patient*.tw.	24930
21	Asymptomatic case*.tw.	2480
22	Asymptomatic carriage.tw.	794
23	Asymptomatic proportion.tw.	17
24	Asymptomatic transmission.tw.	119

25	Symptomless.tw.	2478
26	Asymptomatic contact.tw.	85
27	No respiratory symptom*.tw.	536
28	Inapparent Infection*.tw.	374
29	Subclinical Infection*.tw.	2235
30	Presymptomatic*.tw.	5955
31	Asymptomatic State*.tw.	363
32	Pre-Symptomatic Disease*.tw.	69
33	13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32	1346922
34	13 and 42 yr="2019 - 2020"	3660

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CNKI (n=1,900)

FT=("新型冠状病毒"+"新冠肺炎"+"新型冠状病毒肺炎"+"严重急性呼吸综合征冠状病毒2"+"2019-nCov"+"2019 新型冠状病毒 "+"2019 冠状病毒 "+"corona virus disease-19"+"COVID-19"+"SARS-COV-2"+"novel coronavirus pneumonia"+"NCP")and FT=("无症状"+"无症状携带者"+"无症状患者"+"无症状阳性"+"无症状的阳检测病例"+"检测患者"+"没有症状"+"无症状感染"+"无症状感染者"+"无临床症状"+"无感染症状"+"无相关感染症状"+"无临床特征"+"没有临床特征"+"无明显症状"+"没有明显症状"+"隐性感染"+"隐性感染者")

WanFang (n=2,306)

(全部:(新型冠状病毒+新冠肺炎+新型冠状病毒肺炎+严重急性呼吸综合征冠状病毒2+2019-nCov+2019 新型冠状病毒 +2019 冠状病毒 +corona virus disease-19+COVID-19+SARS-COV-2+novel coronavirus pneumonia+NCP)*全部:(无症状+无症状携带者+无症状患者+无症状阳性+无症状的阳检测病例+检测患者+没有症状+无症状感染+无症状感染者+无临床症状+无感染症状+无相关感染症状+无临床特征+没有临床特征+无明显症状+没有明显症状+隐性感染+隐性感染者)) *Date:2019-

VIP (n=762)

(U=(新型冠状病毒 OR 新冠肺炎 OR 新型冠状病毒肺炎 OR 严重急性呼吸综合征冠状病毒2 OR 2019-nCov OR 2019新型冠状病毒 OR 2019冠状病毒 OR corona virus disease-19 OR COVID-19 OR SARS-COV-2 OR novel coronavirus pneumonia OR NCP)) AND (U=(无症状 OR 无症状携带者 OR 无症状患者 OR 无症状阳性 OR 无症状的阳检测病例 OR 检测患者 OR 没有症状 OR 无症状感染 OR 无症状感染者 OR 无临床症状 OR 无感染症状 OR 无相关感染症状 OR 无临床特征 OR 没有临床特征 OR 无明显症状 OR 没有明显症状 OR 隐性感染 OR 隐性感染者))

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Supplementary Table 2 Characteristics of the studies included for meta-analysis

Author	City/Province	Country	Sample size	Age (mean or median [± SD or IQR]; range)	Study population	Male (%)	Positive patient (n)	The number of test-positive and asymptomatic patients (n)	The number of presymptomatic infections (n)	Confirmed date
Abeysuriya Sanduni(1)	London	UK	180	Mean:29.9y (±7.4）	Pregnant	0.0	7	6	0	2020/04/22-2020/05/05
Adedeji Idris Abiodun(2)	Bauchi State	Nigeria	53	Mean:12.63y (±4.31）	Children	52.8	53	32	0	2020/03/-2020/06
Adetola Hammed Hassan(3)	northern Sierra Leone	West Africa	30	Mean: 69.0 months (±51.7)	Children	55.6	9	4	0	2020/04/24-2020/09
Aherfi Sarah(4)	Marseille	France	63	Mean: 45y	Adult	NA	63	9	0	2020/03/15-2020/03/30
Almazeedi Sulaiman(5)	South Surra	Kuwait	1096	Median: 41y	Adult	81.0	1096	507	35	2020/02/24-2020/04/20
Alshahrani Mohammed S(6)	Alkhobar	Saudi Arabia	301	Mean: 32.9y (±8.7)	Adult	38.9	18	12	0	2020/05/01-2020/06/15
Alshukry Abdullah(7)	South Surra	Kuwait	417	Median: 47y（IQR:32-60y）	Adult	62.8	417	164	0	2020/02/24-2020/05/24
Alsofayan Yousef M(8)	NA	Saudi Arabia	825	Median: 36y	Adult	54.3	825	77	0	2020/03/01-2020/03/31
Alvin J Ing(9)	Cruise ship	Cruise ship	217	NA	Adult	NA	128	104	0	2020/04/03
Amy V. Dora(10)	Los Angeles, California	US	19	Median: 75y (66–85y)	Adult	100.0	19	6	0	2020/3/29-2020/3/21
An YH(11)	Beijing	China	54	Median: 48y (37-87y)	Adult	44.0	9	1	0	2020/01/21-2020/03/04
Andrea Lombardi(12)	Lombardy	Italy	1573	Mean: 44.5y	Adult	35.8	139	17	0	2020/02/24-2020/03/31
Antonio-Villa Neftali Eduardo(13)	NA	Mexico	35095	Mean:40.2y (±10.7）	Adult	37.0	11226	341	0	till 2020/07/05
Arima(14)	Japan	Japan	566	NA	Adult	NA	12	4	0	2020/1-2020/2

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Ashinyo Mary Eyram(15)	Greater Accra	Ghana	307	Mean: 37.9y (±16.3）	Adult	56.7	307	263	0	2020/03/23-2020/06/29
Atakla Hugues Ghislain(16)	Conakry	Guinea	36	Mean:9.66y (±1.32）	Children	55.6	36	11	0	2020/01/01-2020/09/30
Backer JA(17)	Wuhan	China	88	Range: 2-72y	Adult	65.0	88	2	0	2020/01/22-2020/01/29
Bai M(18)	Wuhan	China	472	Mean: 50.7y (±11.6)	Adult	46.0	472	37	2	2020/02/12-2020/03/08
Bai R(19)	Xian	China	120	Mean: 43y (range: 1.5-93y)	Adult	48.0	120	25	0	2020/01/01-2020/03/06
Bai SL(20)	Gansu	China	8	Median: 50.5y (range: 2-82y)	Adult	50.0	7	5	1	2020/01/22-2020/01/31
Bhakti Sarangi(21)	Maharashtra	India	50	Median:6y(IQR:2-12y）	Children	56.0	50	29	0	2020/04/01-2020/05/20
Bianco Angela(22)	New York	US	155	Mean: 32.7y (±6.4)	Pregnant	0.0	24	4	0	2020/04/04-2020/04/15
Bin YF(23)	Wuhan	China	55	Mean: 53.9y (±17. 1)	Adult	56.0	55	1	0	2020/01/29-2020/02/16
Blain Hubert(24)	Montpellier	France	113	Mean: 86y (±15.5)	Adult	NA	36	9	0	2020/03/03-2020/03/06
Böhmer(25)	Bavaria	Germany	16	Median: 35y (range: 2-58y)	Adult	75.0	16	2	1	2020/1/1-2020/2/19
Breslin Noelle(26)	New York	US	43	Mean: 29.7y (±6.0)	Pregnant	0.0	43	14	10	2020/03/12-2020/03/27
Bruminhent Jackrapong(27)	Bangkok	Thailand	405	Mean: 36y (±10)	Adult	34.0	53	2	0	2020/03/23-2020/04/07
Cai Jiehao(28)	Shanghai	China	49	Mean: 11.5y (±5.12)	Children	57.1	49	21	0	2020/01/19-2020/04/30
Cao JM(29)	Nanchong	China	25	Range: 10-77y	Adult	48.0	25	12	0	2020/01/21-2020/02/18
Carla Felice(30)	NA	Italy	98	NA	Adult	39.0	18	6	0	NA
Chan JFW(31)	Wuhan	China	7	Mean: 46.17y(range: 10-66y)	Adult	50.0	6	1	0	2020/01/10-2020/01/15

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Chen B(32)	Hainan	China	69	Median: 51y (range: 28-83y)	Adult	59.0	69	5	0	2020/01/18-2020/02/29
Chen J(33)	Shanghai	China	249	Median: 51y (36-64y)	Adult	51.0	249	7	0	2020/01/20-2020/02/06
Chen T(34)	Wuhan	China	76	Mean: 59.5y (range: 28-86y)	Adult	57.0	76	10	0	2020/01-2020/02
Chen Y(35)	Ningbo	China	187	Median: 12y(range: 30-70y)	Adult	NA	191	30	0	2020/01/21-2020/03/06
Chen YJ(36)	Chongqing	China	143	Mean: 45.13y (range: 15-79y)	Adult	51.0	143	11	0	2020/01/23-2020/02/08
Cheng ZP(37)	Yantai	China	25	Median: 42y (±12)	Adult	56.0	25	1	0	2020/01-2020/02
Choe PG(38)	Seoul	South Korea	113	Median:25y (IQR: 21.5-39.5y)	Adult	47.8	113	54	0	2020/03/05-2020/04/09
COVID-19 National Incident Room Surveillance Team(39)	NA	Australia	295	Median: 47y (range: 0-94y)	Adult	50.0	295	139	0	2020/01/21-2020/03/14
Dai Y(40)	Guangxi	China	11	Median:6.1y(range: 0.25-15y）	Children	36.3	11	4	0	2020/01/19-2020/03/11
Daniela Loconsole(41)	Apulia	Italy	166	Median:11y(range: 0-17y)	Children	48.8	166	104	0	2020/03/01-2020/06/01
Ding Y(42)	Wuhan	China	56	Mean: 54.6y (range: 24-86y)	Adult	54.0	56	3	0	2020/01/01-2020/02/03
Dong X(43)	Wuhan	China	11	Median: 43y (range: 2-69y)	Adult	45.0	11	1	0	2020/01/20-2020/02/29
Dong XC(44)	Tianjin	China	135	Mean: 48.62y (range:8-90y)	Adult	53.0	135	4	0	2020/01/13-2020/02/20
Dong YY(45)	Yangzhou	China	37	Mean: 38.64y (range: 1-74y)	Adult	59.0	37	14	0	2020/01-2020/02
Erinoso Olufemi A.(46)	Lagos State	Nigeria	632	Median:40y（IQR:30.5-49y）	Adult	60.1	632	398	0	2020/04/01-2020/05/31
Eythorsson Elias(47)	NA	Iceland	1564	Median:40y(IQR:26-53y, range: 0-103y）	Adult	51.0	1564	83	34	2020/03/17-2020/04/30
Fakiri EL K(48)	Marrakesh	Morocco	74	Mean: 7y (±1.5)	Children	54.1	74	54	0	2020/03/02-2020/04/01

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Fan YZ(49)	Luan	China	79	NA	Adult	NA	79	10	5	2020/01/20-2020/02/20
Feaster Matt(50)	California	US	1093	NA	Adult	35.5	631	97	0	2020/04-2020/05
Feng XP(51)	Jingzhou	China	52	Median: 46y (30-63y)	Adult	64.0	52	8	0	2020/01/23-2020/03/08
Foster Catherine E.(52)	Texas	US	16544	Median:7.1y(IQR:1.7-13.8y）	Children	51.4	1215	193	0	2020/03/10-2020/06/28
Friederike Maechler(53)	Berlin	Germany	5179	Median:34y(24-67y)	Adult	49.1	333	14	2	2020/03/03-2020/04/13
Gao HJ(54)	Ganzizhou	China	54	Mean:42.69y (±17.94）	Adult	55.1	96	18	0	till 2020/02/28
Gao T(55)	Liaocheng, Xianyang	China	40	Mean: 41y	Adult	48.0	40	4	1	2020/1/21-2020/2/16
Gautret P(56)	NA	France	36	Mean: 45.1y	Adult	42.0	36	6	0	2020/3/1-2020/3/16
Gill Livingston(57)	UK	UK	344	Mean:75.3y (±8.2）	Adult	48.0	131	16	0	2020/03/01-2020/04/30
Grados Isabel Zumalave(58)	Callao	Peru	671	Mean:27.2y（range:14-45y）	Pregnant	0.0	317	303	0	2020/05/01-2020/0731
Graham N.S.N.(59)	London	UK	313	NA	Adult	NA	180	54	0	2020/03-2020/04/09
Grechukhina Olga(60)	New Haven	US	1567	Median:30y（IQR:25-34y）	Pregnant	0.0	141	44	0	2020/03/03-2020/05/11
Gu. Kim(61)	Daegu	Korea	213	NA	Adult	NA	213	41	0	NA
Guo CX(62)	mainland China	China	341	Median:7y（4 days to 14 years）	Children	53.7	341	20	0	2020/1/15-2020/3/15
Han RD(63)	Haozhou	China	108	Median:42y (range: 5-86y)	Adult	48.2	108	17	0	2020/01/21-2020/03/05
He M(64)	Beijing	China	35	Mean: 7.1y (±4.2; range:0.5-15y)	Children	51.4	35	4	0	2020/01-2020/06
He WB(65)	Zhuzhou	China	101	Range: 3-88y	Adult	47.5	101	21	0	2020/01/01-2020/05/15

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Hu SX(66)	Hunan	China	888	Median: 35y (2-88y)	Adult	44.4	888	36	0	2020/01/01-2020/02/08
Huang DD(67)	Chongqing	China	89	Median: 48.2y (±17.9)	Adult	58.0	89	6	0	2020/01/22-2020/02/17
IH Huerta Saenz(68)	Lima	Peru	41	Mean:32.3y	Pregnant	0.0	41	28	0	2020/03/24-2020/05/07
Ipekci A(69)	Istanbul	Turkey	87	Mean: 51.27y(±6.45)	Adult	72.5	51	4	0	2020/03/20-2020/04/01
Irene Petersen(70)	UK	UK	36061	NA	Adult	NA	115	88	0	2020/04/26-2020/06/27
Jennifer S. Singer(71)	LA	US	4751	Median:58y	Adult	50.0	18	10	0	2020/04/07-2020/05/21
Jeong SJ(72)	Seoul	South Korea	234	Mean: 37.78y (±15.57)	Adult	39.7	234	66	0	2020/03/15-2020/04/10
Jha S(73)	NA	India	3667	IQR: 18-40y	Adult	52.1	20	10	0	2020/03/23-2020/04/30
Ji GH(74)	Jingzhou	China	45	Mean: 45.4y(range: 21-67y)	Adult	60.0	45	3	0	2020/1/19-2020/2/1
Ji T(75)	Huangshi,Wuhan	China	51021	NA	Adult	NA	51021	50	0	2020/01/10-2020/03/27
Jia CY(76)	Beijing	China	60	Median: 59.5y (28-91y)	Adult	40.0	60	1	0	2020/01/20-2020/02/20
Jiang CH(77)	Wuhan	China	214	Median:51y(range: 11-82y)	Adult	40.0	214	26	0	2020/02/05-2020/03/10
Jiang R(78)	Guangzhou	China	25	Mean: 44.2y (range:12-86y)	Adult	44.0	25	1	0	2020/01/25-2020/03/25
Jibrin YB(79)	Bauchi	Nigeria	84	Mean: 41.0y(±10.5)	Adult	72.0	84	49	0	2020/03/01-2020/06/30
Jin MH(80)	Huzhou	China	10	Median: 32y (range: 0.58-56y)	Adult	50.0	10	1	0	2020/01/25-2020/02/07
Jung CY(81)	South Korea	South Korea	10237	Mean: 45y (±19.8）	Adult	39.9	10237	6350	0	2020/01/24-2020/04/09
Kang M(82)	Shenzhen, Guangzhou, Foshan, Yangjiang, Shaoguan	China	37	Median: 58y (range:10-78y)	Adult	49.0	37	2	0	2020/01/12-2020/01/23

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Kasper MR(83)	Theodore Roosevelt aircraft carrier	US	4779	Mean: 27y	Adult	78.3	1331	572	0	2020/03/23-2020/05/18
Ke B(84)	Chongqing	China	25	Median: 11.0y (range: 0.6-17y)	Children	56.0	25	8	0	2020/1/19-2020/3/12
Kenu E(85)	NA	Ghana	17736	Median:33y (IQR: 0.1-85y)	Adult	57.8	17763	14242	0	2020/03/12-2020/06/30
Ki M(86)	Seoul, Goyang, Siheung, Bucheon, Gwangju, Suwon, Incheon, Pyeongtaek, Gunsan, Guri, Naju, Evacuated from Wuhan	South Korea	28	Median: 42y (range: 20-73y)	Adult	54.0	28	3	0	2020/01/20-2020/02/10
Kirenga Bruce(87)	Entebbe	Uganda	56	Mean:34.2y（±15.5; range:25-43y）	Adult	67.9	56	32	0	till 16 May 2020
Kong WF(88)	Sichuan	China	511	Range:1 month to 87 years	Adult	55.0	511	100	0	2020/01/25-2020/02/20
Krajcar N(89)	NA	Croatia	289	Median:10y (IQR: 4.6-15.7y)	Children	43.1	230	95	0	2020/03/12-2020/07/19
Kristin J. Meyers(90)	Indianapolis Metropolitan	US	2953	Mean:48.1y (±16.3）	Adult	36.3	91	81	23	2020/04/07-2020/05/16
Kumar R(91)	New Delhi	India	231	Mean: 39.8y(±13.6)	Adult	78.3	231	108	0	2020/03/20-2020/04/30
Ladhani Shamez N(92)	London	UK	264	Median:47y(IQR:35-56y)	Adult	21.9	105	67	21	2020/04/10-2020/04/13
Lai XQ(93)	Wuhan	China	110	Median: 36.5y (30.0-47.0y)	Adult	28.0	110	3	0	2020/1/1-2020/2/9
Le TQM(94)	Vinh Phuc Province, Thanh Hoa Province	Vietnam	12	Median: 30y (range: 0.25-55y)	Adult	33.0	12	1	0	2020/01/21-2020/01/27
Lee YH(95)	Daegu	South Korea	632	Mean: 40.6y (±17.3）	Adult	32.0	632	557	186	2020/03/02-2020/04/30
Lei MY(96)	Guizhou	China	146	NA	Adult	NA	146	25	0	2020/01/21-2020/03/10
Lewis Megan(97)	Texas	Mexico	231	Median:22y（range:19-62y）	Adult	55.0	64	14	0	2020/03/26-2020/04/05

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Li CY(98)	Xuzhou	China	7	Median: 42y (range: 21-62y)	Adult	57.0	7	1	0	2020/01/25-2020/01/31
Li J(99)	NA	Singapore	39	NA	Children	60.0	39	15	0	2020/01-2020/05
Li W(100)	Zhuhai	China	5	Median: 3y (1.4-6y)	Children	80.0	5	4	0	2020/01/28-2020/02/08
Li Y(101)	Wuhan	China	53	Mean: 58y (range: 26-83)	Adult	55.0	51	1	0	2020/01/23-2020/01-29
Li Y(102)	Wuhan	China	127	Median: 6y(range:0.17-15y)	Children	57.0	127	21	0	2020/1/28-2020/3/12
Li YL(103)	Hubei	China	252	Median:46y(range: 8-65y)	Adult	49.6	252	74	0	2020/02/22-2020/03/08
Liao XN(104)	wuhan	China	42	Median:51.6y (22-69y)	Adult	69.0	42	5	0	2020/01/16-2020/02/18
Lin S(105)	Shanghai	China	161	Median:45y(range:1-84y)	Adult	49.7	161	6	0	till 2020/02/17
Lin XM(106)	Zhaoqing	China	23	Range: 3-65y	Adult	56.5	23	4	0	2020/01/23-2020/05/06
Lin ZF(107)	Yichang	China	205	Median: 56.0y (range: 1.25-88y)	Adult	55.0	205	15	0	2020/01/24-2020/03/09
Liu B(108)	Shunde	China	9	Range: 21-61y	Adult	44.4	9	2	0	2020/01/22-2020/02/20
Liu BM(109)	Wuhan	China	68	Mean: 44.3y (±16.4)	Adult	37.0	68	36	0	2020/2/7-2020/3/26
Liu BY(110)	Zhejiang	China	91	Mean: 33.66y (range: 7-73y)	Adult	53.0	91	43	0	2020/03/01-2020/04/07
Liu DH(111)	Wuhan	China	15	Mean: 32y (range:23-40y)	Pregnant	0.0	15	2	0	2020/01/20-2020/02/10
Liu F(112)	Hangzhou	China	10	Median: 42y (34–50y)	Adult	40.0	10	1	0	2020/01/22-2020/02/22
Liu F(113)	Wuhan	China	44	Mean: 30y (range:22-43y)	Pregnant	0.0	16	7	0	2020/01/11-2020/02/13
Liu GT(114)	Ningxia	China	70	Mean: 40y (range: 3-77y)	Adult	53.0	70	10	0	2020/01/22-2020/02/17

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Liu MQ(115)	Chongqing	China	5	Median: 5.2y (range: 0.58-13y)	Children	60.0	5	3	0	NA
Liu X(116)	Chenzhou	China	5	Mean: 30y (range:2.5-56y)	Adult	40.0	5	1	0	2020/01/31-2020/02/06
Liu XX(117)	Hefei	China	105	Median: 45y (range: 21-87 years)	Adult	0.0	105	24	0	till 2020/03/06
	Hefei	China	7	Median: 10y (range: 5-10y)	Children	NA	7	4	0	till 2020/03/06
Liu YL(118)	Hubei, Fujian, Shanxi, Beijing, Guangdong, Jiangxi, Heilongjiang, Anhui	China	12	Median: 30y (22-36)	Pregnant	0.0	13	1	0	2019/12/08-2020/02/25
Liu YX(119)	Shenzhen	China	12	Median: 62.5y (range: 10-72y)	Adult	67.0	12	1	0	2020/01/11-2020/01/20
Liu ZR(120)	Anhui	China	15	Median: 42y (range:14-84y)	Adult	47.0	15	2	0	2020/02/04-2020/02/12
Lu RF(121)	Nantong	China	28	Median: 50y (range: 26-73y)	Adult	61.0	28	1	0	2020/1/23-2020/2/26
Lu XX(122)	Wuhan	China	1391	Median: 6.7y (range: 0-15y)	Children	61.0	171	27	0	2020/01/28-2020/02/26
Lu Y(123)	Guangzhou	China	9	Mean: 7.8y (range: 0.17-15y)	Children	56.0	9	1	0	2020/1/22-2020/2/9
Lucy Rivett(124)	UK	UK	1270	NA	Adult	0.0	61	31	24	2020/04/06-2020/04/24
Luo SH(125)	Anqing	China	83	NA	Adult	NA	83	8	7	till 2020/02/21
M.M. Arons(126)	King County	US	76	Mean: 78.6y (±9.5)	Adult	NA	48	27	24	2020/3/3-2020/3/26
Ma MM(127)	Guangzhou	China	347	Median: 48y	Adult	49.8	361	14	0	till 2020/03/11
Ma Y(128)	Jinan	China	47	Median: 34y (range: 1-72y)	Adult	43.0	47	11	0	2020/1/23-2020/3/10
Ma YL(129)	Wuhan	China	115	Range: 1.67-5y	Children	64.0	115	61	0	NA

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MacIntyre CR(130)	NA	Japan	565	NA	Adult	NA	8	5	0	2020/01/29-2020/01/31
Mahesh C. Patel(131)	DuPage, Illinois	US	126	Median:82y(IQR:75-92y）	Adult	31.0	35	13	0	2020/03/11-2020/03/15
Martin C(132)	Brussels	Belgium	326	Mean: 36y (range: 21-59y)	Adult	24.0	41	31	0	2020/04/15-2020/05/18
Maru Sheela(133)	New York	US	124	Mean: 30.2y	Pregnant	0.0	46	33	0	2020/03/29-2020/04/22
McMichael TM(134)	King County	US	167	Median: 72y (range: 21-100y)	Adult	33.0	167	7	0	2020/02/28-2020/03/18
Mei X(135)	Shanghai	China	494	Median:40y(6-88y）	Adult	53.8	494	39	8	2020/01/20-2020/03/31
Michael J. Fassett(136)	Southern California	US	3923	Mean: 31.2y (±5.29）	Pregnant	0.0	17	17	1	2020/04/06-2020/05/11
Michel Bielecki(137)	Swiss Army Base in Airolo	Switzerland	508	Median: 21y (18-28y)	Adult	92.0	228	126	0	2020/3/11-2020/5/3
Miyamae Y(138)	Tokyo	Japan	23	Median: 67y (29-79y)	Adult	43.0	23	15	0	2020/02/18-2020/02/25
Mohammed A M Ahmed(139)	Somalia	Somalia	182	Mean: 22y (±4)	Adult	66.0	49	16	0	2020/4/23-2020/5/7
Moon SS(140)	Gyeongsangbuk-do	South Korea	352	Mean: 56 y (range: 14–95y)	Adult	40.9	352	81	0	2020/02/18-2020/06/30
Moriarty LF(141)	Yokohama	Japan	3711	Range: 29-73y	Adult	55.0	712	331	0	2020/02/05-2020/02/20
Nagler AR(142)	Long Island, Brooklyn, Long Island	US	14746	NA	Adult	NA	1905	536	0	2020/03/25-2020/05/18
Niccolò Parri(143)	Italy	Italy	170	Median:3.75y（IQR:4 months-10.7y）	Children	56.0	170	29	0	2020/03/02-2020/05/02
Niu YL(144)	Suqian	China	13	Mean: 32.3y (range: 12-48y)	Adult	46.0	13	3	0	2020/01/25-2020/03/03
Oduro-Mensah E(145)	NA	Ghana	275	Mean: 40.7y±16.4	Adult	54.5	275	142	0	2020/03-2020/05
Ou JM(146)	Fujian	China	298	Median: 42y (range: 0.42-93y)	Adult	55.0	298	3	0	till 2020/02/21

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Pan XQ(147)	Wenzhou	China	64	Mean: 48.8y (±12.9)	Adult	61.0	64	6	0	2020/02/05-2020/02/20
Pérez-GarcíaF(148)	Madrid	Spain	2963	NA	Adult	24.7	884	345	0	2020/03-2020/05
Pongpirul W(149)	NA	Thailand	193	Median: 37y (IQR: 29–53y)	Adult	58.5	193	13	3	2020/01/08-2020/04/16
Pongpirul WA(150)	Bangkok	Tailand	11	Median: 61y (range: 28-74y)	Adult	55.0	11	1	0	2020/01/08-2020/01/31
Qiu CF(151)	Hunan	China	104	Mean:43y (±7.54）	Adult	47.1	104	5	0	2020/01/22-2020/02/12
Redditt V(152)	Toronto	Canada	60	Mean: 36.0y(±10.0)	Adult	80.0	25	7	3	2020/4/20
Roman G. Shmakov(153)	Moscow	Russia	66	Mean:30.3y (±6.25）	Pregnant	0.0	66	15	0	NA
Rubbi I(154)	Ravenna	Italy	93	Mean: 45.96y ± 10.71	Adult	29.0	93	9	0	2020/03/25-2020/05/05
Salim Mattar(155)	Colombia	US	686	Mean:43y（range:1-95y）	Adult	NA	35	18	0	2020/04/09-2020/05/16
Seong Eun Kim(156)	NA	Korea	71	Median: 31y (17.8-55.8y)	Adult	46.0	71	13	3	NA
Shaher M. Samrah(157)	Jordan	Jordan	81	Mean:39.95y (±16.59; range:18-80y）	Adult	45.7	81	37	0	2020/03/17-2020/04/02
She X(158)	Suining	China	9	Mean: 29y (range: 24-35y)	Adult	33.0	9	1	0	2020/01/20-2020/02/12
Son H(159)	Busan	South Korea	18303	NA	Adult	45.4	108	12	0	2020/02/21-2020/03/24
Song W(160)	Xiangyang	China	16	Median: 8.5y range:0.96-14y)	Children	63.0	16	8	0	2020/01/01-2020/03/17
Song YS(161)	Zhengzhou	China	17	Mean:47y (range: 12-83y)	Adult	58.8	17	1	0	2020/02-2020/03
Spiteri G(162)	NA	Belgium, Finland, France, Germany, Italy, Russia, Spain,Sweden	38	Median: 42y (2-81y)	Adult	66.0	38	2	0	2020/01/17-2020/02/21

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Sun DF(163)	Jiaxing	China	30	Mean: 49y (range: 30-71y)	Adult	50.0	30	1	0	2020/01/24-2020/02/06
Sun WW(164)	Zhejiang	China	391	NA	Adult	41.0	391	54	0	2020/01/08-2020/02/06
Sun Z(165)	Anhui	China	21	Mean: 40.52y (±17.14)	Adult	52.0	21	4	0	2020/01/23-2020/03/08
Tang A(166)	Zhoushan	China	10	Mean: 50.9y (range: 28-67y)	Adult	70.0	10	5	5	till 2020/02/17
Tang Olive(167)	Baltimore	US	1970	Median:73.9y（IQR:21.9-105.4y）	Adult	57.0	752	424	0	2020/03/01-2020/06/12
Thiel SL(168)	NA	Liechtenstein	95	Median: 39y (IQR: 28-56y)	Adult	51.6	95	2	0	2020/03/02-2020/04/23
Tian SC(169)	Liaocheng	China	37	Mean:44.3y (±1.67）	Adult	45.9	37	7	0	NA
Tian SJ(170)	Beijing	China	262	Median: 47.5y (range: 1-94y)	Adult	49.0	262	13	0	till 2020/02/10
Timothy J. Judson(171)	San Francisco	US	1129	NA	Adult	NA	1129	315	0	NA
Tolia VM(172)	San Diego	US	283	NA	Adult	53.0	29	2	0	20020/03/10-2020/03-19
Tong H(173)	Bengbu	China	24	Mean: 53y (range: 17-74y)	Adult	63.0	24	4	0	2020/01/10-2020/02/15
Tong ZD(174)	Zhoushan	China	7	Median: 28.5y (12-45y).	Adult	43.0	7	3	0	2020/1/1
Treibel TA(175)	London	UK	1523	NA	Adult	NA	1523	65	0	since2020/3/23
Tsou Tsung-Pei(176)	Taiwan	China	100	Median:44y(range:11-88y)	Adult	44.0	100	10	0	2020/01/11-2020/03/16
Viktoriya London(177)	New York	US	156	Range:24.5-34.8y	Pregnant	0.0	68	22	0	2020/03/15-2020/04/15
Wan R(178)	Hunan	China	78	NA	Adult	NA	78	2	0	NA
Wang AH(179)	Chongqing	China	29	Mean: 48.19y (range: 3-89y)	Adult	64.0	90	3	0	till 2020/03/01

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Wang D(180)	Chongqing	China	576	Mean: 54.79y	Adult	41.0	61	38	0	2020/1/24-2020/3/10
Wang JC(181)	Nanjing	China	52	Mean: 44y (range: 13-73y)	Adult	56.0	52	2	0	2020/01/19-2020/02/03
Wang KS(182)	Pingyang	China	138	Median: 48y (33-68y)	Adult	22.0	9	3	0	2020/01/19-2020/02/03
Wang L(183)	Zibo	China	244	Range: 23-84y	Adult	68.8	16	2	0	2020/01/10-2020/02/14
Wang LZ(184)	Liaocheng	China	26	Median:42y(IQR:34-53y)	Adult	42.3	26	7	0	2020/01/31-2020/02/12
Wang S(185)	Yichang	China	738	Range: 0.58-91y	Adult	51.0	70	70	0	2020/02/11-2020/02/23
Wang T(186)	Jilin	China	50	Mean: 44.52y (range: 16-87y)	Adult	60.0	50	1	0	2020/01/28-2020/02/21
Wang XB(187)	Wuhan	China	1012	Median:50y(IQR:39-58y;range:16-89y）	Adult	52.0	1012	30	16	2020/02/07-2020/02/12
Wang XL(188)	Beijing	China	7432	Median:39y(IQR:27-56y)	Adult	45.8	602	17	0	2020/01/19-2020/04/02
Wang ZQ(189)	Wuhan	China	30	Median:29.9y (26.8–33.3y)	Pregnant	0.0	13	8	0	2019/12/08-2020/04/01
Waya JLL(190)	NA	South Sudan	1330	Mean: 37.1y	Adult	77.0	1330	1104	0	2020/04/05-2020/06/03
Wong HYF(191)	Hongkong	China	64	Mean: 56y (range: 16-96y)	Adult	41.0	64	9	0	2020/1/1-2020/3/31
Wong J(192)	NA	Brunei Darussalam	135	Median: 36y (range:0.5–72y)	Adult	60.7	135	54	13	2020/03/09-2020/04/05
Wu GY(193)	Wenzhou	China	104	Mean: 45y (±13)	Adult	57.0	104	2	0	2020/01/17-2020/02/04
Wu HP(194)	Jiangxi	China	23	Range: 0.25-17.67y	Children	39.0	23	3	0	2020/01/21-2020/02/29
Wu QR(195)	Ganzhou	China	55	Mean: 45.22y (range: 0.25-79y)	Adult	51.0	55	2	0	2020/1/23-2020/3/2
Wu XQ(196)	Wuhan	China	23	Median: 29y (21-37)	Pregnant	0.0	23	15	0	2019/12/31-2020/03/07

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Wu Y(197)	Nantong	China	23	Median: 48y (26-68y)	Adult	65.0	23	1	0	NA
Wu YL(198)	Chengde	China	8	Range: 22-56y	Adult	50.0	8	7	0	2020/1/24-2020/3/31
Xiang TX(199)	Jiangxi	China	49	Mean: 42.9y (18-78y)	Adult	NA	49	3	0	2020/1/21-2020/1/27
Xie JW(200)	Chongqing	China	6	Median: 46y (40-67y)	Adult	67.0	6	3	2	2020/01/29-2020/02/03
Xie YB(201)	Yongjia	China	39	Median: 52y (22-87y)	Adult	56.0	39	5	0	2020/01/20-2020/02/10
Xu HM(202)	Chongqing,Shanxi,Guizhou,Sichuan	China	32	Mean:8.7y (±4.7）	Children	53.0	32	6	0	2020/01/24-2020/02/12
Xu S(203)	Wuhan	China	34	Range: 20-40y	Pregnant	0.0	34	5	0	2020/01/15-2020/03/15
Xu TM(204)	Changzhou	China	51	NA	Adult	33.0	51	6	0	2020/1/23-2020/2/18
Yan XQ(205)	Hunan	China	218	Median:43y(IQR:32-52y）	Adult	NA	218	24	0	2020/01/21-2020/06/27
Yang K(206)	Nanjing	China	57	Median: 37y (range: 5-97y)	Adult	51.0	57	13	0	NA
Yang NB(207)	Ningbo	China	12	Median:33y	Adult	30.0	12	2	0	2020/01/25-2020/02/28
Yang RR(208)	Wuhan	China	78	Median: 37y (26-45y)	Adult	33.0	78	33	0	2019/12/24-2020/02/24
Yang YL(209)	Chongqing	China	8	Median: 53y (range: 9-67y)	Adult	63.0	8	1	0	2020/02/01-2020/02/16
Yang YX(210)	Chibi	China	88	Range: 10-89y	Adult	60.0	88	1	0	2020/01-2020/02
Yao QD(211)	Wuhan	China	45	Mean: 47.7y (range: 25-88y)	Adult	36.0	45	1	0	2020/01/25-2020/02/22
Yao XY(212)	Baotou	China	7	Median: 51y (36-68y)	Adult	43.0	7	1	1	2020/02/01-2020/02/08
Yayla Burcu Ceylan Cura(213)	NA	Turkey	220	Median:10y(range: 0-17y)	Children	48.2	220	55	0	2020/03/11-2020/06/23

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Ye XX(214)	Yongjia	China	17	Median: 48.8y (31-87y)	Adult	65.0	14	2	0	2020/01/24-2020/02/09
Ye Y(215)	Henan	China	1272	NA	Adult	NA	1272	113	0	till 2020/03/09
Yu FT(216)	Beijing	China	127	Median: 40y (range: 0.5-92y)	Adult	50.0	77	2	0	2020/02/05-2020/02/19
Yu JX(217)	Hangzhou	China	87	Mean: 42.89y (±17.02; range:4-88y)	Adult	46.0	87	2	0	2020/1/21-2020/2/12
Yu X(218)	Guangxi	China	108	Median: 41y (range: 0.25-85y)	Adult	40.0	108	3	0	2020/02/06-2020/04/16
Yuan L(219)	Wuhan	China	28	Mean: 29.75y (±3.5)	Pregnant	0.0	28	15	0	2020/01/30-2020/03/14
Yue HM(220)	Gansu	China	86	Median:41y(IQR:31-54.3y)	Adult	44.2	86	15	0	2020/01/21-2020/02/11
Zeng J(221)	Sichuan	China	24184	NA	Adult	NA	226	1	0	NA
Zeng WZ(222)	Yongzhou	China	44	Mean: 39.1y (±14.5)	Adult	64.0	44	6	0	2020/01/21-2020/03/05
Zhai HL(223)	Fuyang	China	11	Mean: 11.76y (range: 0.33-17y)	Children	64.0	11	1	0	2020/01/22-2020/02/24
Zhan H(224)	Shiyan	China	6	Median: 8.5y (range: 0.5-11y)	Children	50.0	6	1	0	2020/2/1
Zhan T(225)	Wuhan	China	405	Median:56y(17-95y)	Adult	45.9	405	12	0	2020/01/12-2020/03/08
Zhang JJ(226)	Beijing	China	5	NA	Adult	NA	5	1	0	2020/01/24-2020/02/29
Zhang KY(227)	Kunming	China	11	Mean: 42y (range: 8-67y)	Adult	45.0	11	3	0	2020/01/26-2020/02/20
Zhang L(228)	Anhui	China	33	Mean:9.59y (±5.12)	Children	48.5	33	8	0	till 2020/02/16
Zhang R(229)	Liaoning	China	2784	NA	Adult	49.0	67	9	0	2020/01/22-2020/02/29
Zhang Y(230)	NA	China	41	Mean:5.93y(range:0.5-14y)	Children	73.2	41	9	0	2020/01-2020/02

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Zhang YC(231)	Nanjing, Xuzhou	China	21	Median:25y (range: 10-61y)	Adult	60.0	21	5	0	2020/01/25-2020/03/18
Zhang YD(232)	Qinghai	China	18	Range: 7-47y	Adult	67.0	18	7	6	2020/01/24-2020/02/05
Zhao L(233)	Shijiazhuang	China	30	NA	Adult	63.0	30	9	0	2020/01/21-2020/02-25
Zhong ZM(234)	Wuhan, Nanning, Liuzhou	China	193	Mean: 48.1y (range: 3-95y)	Adult	58.0	193	46	0	2020/01/03-2020/03/04
Zhou H(235)	Qujing	China	13	Mean: 28y (±11.83)	Adult	46.0	13	2	0	2020/01/23-2020/02/27
Zhou JL(236)	Xinyang	China	149	Mean: 52y (±15.48)	Adult	57.1	149	10	0	2020/01/13-2020/03/02
Zhou R(237)	Guangzhou	China	31	NA	Adult	NA	31	9	0	2020/01/23-2020/03/03
Zhu JF(238)	Shanxi, Qinghai, Tibet, Xinjiang, Ningxia, Gansu, Inner Mongolia, Hubei	China	617	Median:42y(1 to 94 years）	Adult	52.0	617	82	0	2020/01/21-2020/03/11
Zhu MR(239)	Shanghai	China	77	Range: 14-62y	Adult	70.1	77	14	0	2020/03/14-2020/07/03
Zhu SQ(240)	Shenzhen	China	417	Mean: 45.3y (range:1-86y)	Adult	47.0	417	11	11	2020/01/01-2020/02/14

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Supplementary Table 3 Quality assessment of selected articles

	Introduction		Methods										Results			Discussion			Other	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Abeysuriya Sanduni	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	N
Adedeji Idris Abiodun	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Adetola Hammed Hassan	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Aherfi Sarah	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Almazeedi Sulaiman	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Alshahrani Mohammed S	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Alshukry Abdullah	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Alsofayan Yousef M	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Alvin J Ing	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Amy V. Dora	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
An YH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Andrea Lombardi	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Antonio-Villa Neftali Eduardo	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Arima	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Ashinyo Mary Eyram	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Atakla Hugues Ghislain	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	N
Backer JA	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Bai M	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Bai R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Bai SL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
BHAKTI SARANGI	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y

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Bianco Angela	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Bin YF	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Blain Hubert	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
Böhmer MM	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM
Breslin Noelle	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Bruminhent Jackrapong	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	NM	Y	Y	Y	N	Y
Cai Jiehao	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Cao JM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Carla Felice	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Chan JFW	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Chen B	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Chen J	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Chen T	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Chen Y	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Chen YJ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Cheng ZP	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	NM	Y	Y	Y	N	Y
Choe PG	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y
COVID-19 National Incident Room Surveillance Team	NM	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	N	N	NM	NM
Dai Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Daniela Loconsole	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Ding Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Dong X	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Dong XC	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Dong YY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM

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Erinoso Olufemi A.	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Eythorsson Elias	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Fakiri EL K	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Fan YZ	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Feaster Matt	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Feng XP	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Foster Catherine E.	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Friederike Maechler	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Gao HJ	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	NM
Gao T	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Gautret P	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Gill Livingston	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Grados Isabel Zumalave	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Graham N.S.N.	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Grechukhina Olga	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM
Gu. Kim	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Guo CX	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Han RD	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
He M	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
He WB	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Hu SX	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Huang DD	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
IH Huerta Saenz	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Ipekci A	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Irene Petersen	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y

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Jennifer S. Singer	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Jeong SJ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM
Jha S	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Ji GH	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Ji T	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Jia CY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Jiang CH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Jiang R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Jibrin YB	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Jin MH	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Jung CY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Kang M	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	Y
Kasper MR	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Ke B	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Kenu E	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Ki M	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Kirenga Bruce	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Kong WF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Krajcar N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Kristin J. Meyers	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Kumar R	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Ladhani Shamez N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Lai XQ	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Le TQM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Lee YH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM

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Lei MY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Lewis Megan	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	NM
Li CY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	N	N	NM	NM
Li JH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Li W	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Li Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Li Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Li YL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Liao XN	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Lin S	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Lin XM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Lin ZF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Liu B	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Liu BM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Liu BY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Liu DH	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Liu F	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Liu F	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Liu GT	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Liu MQ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	NM
Liu X	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Liu XX	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Liu YL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Liu YX	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Liu ZR	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM

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Lu RF	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Lu XX	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	N	N	NM	NM
Lu Y	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Lucy Rivett	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Luo SH	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	Y
M.M. Arons	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Ma MM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM
Ma Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Ma YL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
MacIntyre CR	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	NM	Y	N	N	N	NM
Mahesh C. Patel	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Martin C	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Maru Sheela	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
McMichael TM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Mei X	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Michael J. Fassett	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Michel Bielecki	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Miyamae Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Mohammed A M Ahmed	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM	NM	Y	Y	Y	N	Y
Moon SS	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Moriarty LF	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	NM	N	NM
Nagler AR	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Niccolò Parri	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Niu YL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Oduro-Mensah E	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y

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Ou JM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Pan XQ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Pérez-GarcíaF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Pongpirul W	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Pongpirul WA	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Qiu CF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Redditt V	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Roman G. Shmakov	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Rubbi I	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Salim Mattar	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Seong Eun Kim	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Shaher M. Samrah	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
She X	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Son H	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Song W	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Song YS	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	N	Y
Spiteri G	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Sun DF	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Sun WW	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NM	Y	Y	NM	NM	NM
Sun Z	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tang A	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tang Olive	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM
Thiel SL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Tian SC	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Tian SJ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y

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Timothy J. Judson	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Tolia VM	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Tong H	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tong ZD	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Treibel TA	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Tsou Tsung-Pei	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Viktoriya London	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Wan R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang AH	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	Y
Wang D	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang JC	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Wang KS	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM	NM
Wang L	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Wang LZ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang S	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Wang T	Y	Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Wang XB	Y	Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang XL	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wang ZQ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Waya JLL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Wong HYF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Wong J	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	Y
Wu GY	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	Y
Wu HP	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Wu QR	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM

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Wu XQ	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Wu Y	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Wu YL	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Xiang TX	Y		Y	N	Y	Y	Y	Y	Y	NM	Y	Y	Y	Y	Y	NM	Y	Y	N	N	NM
Xie JW	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Xie YB	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Xu HM	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Xu S	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Xu TM	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	NM
Yan XQ	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Yang K	Y		Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yang NB	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Yang RR	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Yang YL	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yang YX	Y		Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yao QD	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	NM
Yao XY	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Yayla Burcu Ceylan Cura	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Ye XX	Y		Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Ye Y	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM
Yu FT	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM
Yu JX	Y		Y	N	Y	Y	Y	Y	Y	NM	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Yu X	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Yuan L	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Yue HM	Y		Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y

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Zeng J	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zeng WZ	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Zhai HL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhan H	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhan T	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Zhang JJ	Y	Y	N	Y	Y	Y	Y	N	NM	N	Y	Y	Y	Y	NM	Y	N	N	N	Y
Zhang KY	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Zhang L	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Zhang R	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhang Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Zhang YC	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y
Zhang YD	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhao L	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NM	NM
Zhong ZM	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	N	NM
Zhou H	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhou JL	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhou R	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	N	NM	Y
Zhu JF	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	Y	N	Y
Zhu MR	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NM	Y	Y	N	NM	NM
Zhu SQ	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	NM	Y	Y	Y	NM	NM

Y, Yes; N, Not; NM, not mentioned.

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According to quality of cross-sectional studies (AXIS) scale (Downes MJ, Brennan ML, Williams HC, Dean RS. Development of a critical appraisal tool to assess the quality of cross-sectional studies (AXIS). *BMJ open* 2016; **6**(12): e011458.):

Introduction

1. Were the aims/objectives of the study clear?

Methods

2. Was the study design appropriate for the stated aim(s)?
3. Was the sample size justified?
4. Was the target/reference population clearly defined? (Is it clear who the research was about?)
5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?
6. Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?
7. Were measures undertaken to address and categorise non-responders?
8. Were the risk factor and outcome variables measured appropriate to the aims of the study?
9. Were the risk factor and outcome variables measured correctly using instruments/ measurements that had been trialled, piloted or published previously?
10. Is it clear what was used to determined statistical significance and/or precision estimates? (eg, p values, CIs)
11. Were the methods (including statistical methods) sufficiently described to enable them to be repeated?

Results

12. Were the basic data adequately described?
13. Does the response rate raise concerns about non-response bias?
14. If appropriate, was information about non-responders described?
15. Were the results internally consistent?
16. Were the results for the analyses described in the methods, presented?

Discussion

17. Were the authors' discussions and conclusions justified by the results?
18. Were the limitations of the study discussed?

Other

19. Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?
20. Was ethical approval or consent of participants attained?

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Supplementary Table 4 Results of sensitivity analysis

Study omitted	Estimate	[95% Conf.	Interval]
Abeysuriya Sanduni	0.24138328	0.2359522	0.2468143
Adedeji Idris Abiodun	0.24126983	0.2358378	0.2467018
Adetola Hammed Hassan	0.24140392	0.2359729	0.246835
Aherfi Sarah	0.24146682	0.2360346	0.246899
Almazeedi Sulaiman	0.2395409	0.234087	0.2449948
Alshahrani Mohammed S	0.24135832	0.2359271	0.2467896
Alshukry Abdullah	0.24093036	0.235491	0.24637
Alsofayan Yousef M	0.2423633	0.236915	0.247811
Alvin J Ing	0.24085474	0.235421	0.246288
Amy V. Dora	0.2414076	0.235976	0.246839
An YH	0.24142824	0.235997	0.246859
Andrea Lombardi	0.24154645	0.236113	0.24698
Antonio-Villa Neftali Eduardo	0.26132575	0.2556445	0.267007
Arima	0.24140991	0.2359788	0.2468411
Ashinyo Mary Eyram	0.2399627	0.2345254	0.2454
Atakla Hugues Ghislain	0.24140076	0.2359691	0.2468324
Backer JA	0.24156743	0.236135	0.247
Bai M	0.24201234	0.236572	0.247453
Bai R	0.24144937	0.236016	0.246883
Bai SL	0.24139151	0.23596	0.246823
Bhakti Sarangi	0.24128741	0.235855	0.246719
Bianco Angela	0.2414328	0.236001	0.246864
Bin YF	0.24151391	0.236082	0.246946
Blain Hubert	0.24141634	0.235985	0.246848
Böhmer	0.24143349	0.236002	0.246865
Breslin Noelle	0.24139062	0.235959	0.246822
Bruminhent Jackrapong	0.24150243	0.2360704	0.2469344
Cai Jiehao	0.24134758	0.235916	0.246779
Cao JM	0.24137202	0.235941	0.246803
Carla Felice	0.24140568	0.235974	0.246837
Chan JFW	0.24142247	0.235991	0.246853
Chen B	0.24150895	0.236077	0.246941
Chen J	0.24182814	0.236392	0.247264
Chen T	0.24148329	0.236051	0.246916
Chen Y	0.24154295	0.236108	0.246978
Chen YJ	0.24160017	0.236166	0.247034
Cheng ZP	0.24145818	0.236027	0.24689
Choe PG	0.2412125	0.235779	0.246646
COVID-19 National Incident Room Surveillance Team	0.24089625	0.2354592	0.2463333

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Dai Y	0.24140795	0.235977	0.246839
Daniela Loconsole	0.24092582	0.235491	0.24636
Ding Y	0.24150026	0.236068	0.246932
Dong X	0.24143203	0.236001	0.246863
Dong XC	0.2416393	0.236206	0.247073
Dong YY	0.24137929	0.235948	0.246811
Erinoso Olufemi A.	0.23952371	0.23408	0.244968
Eythorsson Elias	0.24370873	0.238245	0.249173
Fakiri EL K	0.24113926	0.235707	0.246572
Fan YZ	0.24148887	0.236056	0.246921
Feaster Matt	0.24184601	0.236402	0.24729
Feng XP	0.24145405	0.236022	0.246886
Foster Catherine E.	0.24219659	0.2367402	0.247653
Friederike Maechler	0.24145871	0.236026	0.246892
Gao HJ	0.24146272	0.236031	0.246894
Gao T	0.24143969	0.236008	0.246871
Gautret P	0.24153928	0.236106	0.246973
Gill Livingston	0.23967291	0.2342354	0.2451104
Grados Isabel Zumalave	0.24133743	0.235903	0.246772
Graham N.S.N.	0.2413419	0.235908	0.246776
Grechukhina Olga	0.24149908	0.236064	0.246934
Gu. Kim	0.24189922	0.236461	0.247337
Guo CX	0.24148878	0.236056	0.246922
Han RD	0.24145339	0.236022	0.246885
He M	0.24144486	0.236012	0.246878
He WB	0.24279851	0.237349	0.248248
Hu SX	0.24153839	0.236106	0.246971
Huang DD	0.24127801	0.235846	0.24671
IH Huerta Saenz	0.24148321	0.236051	0.246915
Ipekci A	0.24095382	0.235521	0.246387
Irene Petersen	0.24137411	0.235943	0.246805
Jennifer S. Singer	0.24134545	0.23591	0.246781
Jeong SJ	0.24137802	0.235947	0.246809
Jha S	0.24147981	0.236048	0.246912
Ji GH	0.39626896	0.389306	0.403232
Ji T	0.24152319	0.236091	0.246955
Jia CY	0.24161656	0.236181	0.247052
Jiang CH	0.23967837	0.234267	0.24509
Jiang R	0.24145818	0.236027	0.24689
Jibrin YB	0.24119677	0.235764	0.246629
Jin MH	0.24143013	0.235999	0.246861
Jung CY	0.20909713	0.203439	0.214755
Kang M	0.24147271	0.236041	0.246904

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Kasper MR	0.23947349	0.234015	0.244932
Ke B	0.24140336	0.235972	0.246835
Kenu E	0.15292338	0.147079	0.158767
Ki M	0.24144812	0.236017	0.24688
Kirenga Bruce	0.24127552	0.235843	0.246708
Kong WF	0.24159901	0.236157	0.247041
Krajcar N	0.24111447	0.235679	0.24655
Kristin J. Meyers	0.2409627	0.23553	0.246395
Kumar R	0.24101612	0.23558	0.246452
Ladhani Shamez N	0.24109717	0.235664	0.24653
Lai XQ	0.24160057	0.236167	0.247034
Le TQM	0.24143392	0.236003	0.246865
Lee YH	0.23829599	0.232852	0.24374
Lei MY	0.24149777	0.236064	0.246932
Lewis Megan	0.24142997	0.235998	0.246862
Li CY	0.24142441	0.235993	0.246855
Li J	0.2413753	0.235944	0.246807
Li W	0.24139515	0.235964	0.246826
Li Y	0.24150647	0.236075	0.246938
Li Y	0.24149327	0.23606	0.246927
Li YL	0.24131729	0.235881	0.246753
Liao XN	0.24145868	0.236027	0.24689
Lin S	0.2416722	0.236238	0.247106
Lin XM	0.24143092	0.236	0.246862
Lin ZF	0.24168462	0.236249	0.24712
Liu B	0.24142013	0.235989	0.246851
Liu BM	0.24126719	0.235835	0.2467
Liu BY	0.24125627	0.235823	0.246689
Liu DH	0.24143161	0.236	0.246863
Liu F	0.24143013	0.235999	0.246861
Liu F	0.24139389	0.235963	0.246825
Liu GT	0.24147211	0.23604	0.246904
Liu MQ	0.24140359	0.235973	0.246835
Liu X	0.24142049	0.23599	0.246851
Liu XX	0.24142915	0.235996	0.246862
Liu XX	0.24139974	0.235969	0.246831
Liu YL	0.2414358	0.236005	0.246867
Liu YX	0.24143392	0.236003	0.246865
Liu ZR	0.24143161	0.236	0.246863
Lu RF	0.24146377	0.236032	0.246895
Lu XX	0.24152887	0.236094	0.246963
Lu Y	0.24142824	0.235997	0.246859
Lucy Rivett	0.2412927	0.235861	0.246725

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Luo SH	0.24151178	0.236079	0.246944
M.M. Arons	0.24129912	0.235867	0.246731
Ma MM	0.24198274	0.236544	0.247421
Ma Y	0.24142143	0.23599	0.246853
Ma YL	0.24116221	0.235729	0.246596
MacIntyre CR	0.2413937	0.235963	0.246825
Mahesh C. Patel	0.24138328	0.235952	0.246815
Martin C	0.24125469	0.235823	0.246686
Maru Sheela	0.24124874	0.235817	0.246681
McMichael TM	0.24167565	0.236241	0.24711
Mei X	0.24203795	0.236597	0.247479
Michael J. Fassett	0.2413168	0.235886	0.246748
Michel Bielecki	0.24087179	0.235436	0.246307
Miyamae Y	0.24134462	0.235913	0.246776
Mohammed A M Ahmed	0.24144942	0.236011	0.246888
Moon SS	0.24018952	0.234744	0.245635
Moriarty LF	0.24082564	0.235355	0.246297
Nagler AR	0.24151158	0.236077	0.246946
Niccolò Parri	0.24141984	0.235989	0.246851
Niu YL	0.24141984	0.2359887	0.246851
Oduro-Mensah E	0.24083592	0.235399	0.246273
Ou JM	0.24195018	0.236513	0.247387
Pan XQ	0.2414919	0.23606	0.246924
Pérez-GarcíaF	0.24040096	0.234952	0.24585
Pongpirul W	0.24167772	0.236243	0.247113
Pongpirul WA	0.24143203	0.236001	0.246863
Qiu CF	0.24157399	0.236141	0.247007
Redditt V	0.24141118	0.23598	0.246843
Roman G. Shmakov	0.24152265	0.23609	0.246955
Rubbi I	0.24134435	0.235913	0.246776
Salim Mattar	0.24145077	0.236018	0.246883
Seong Eun Kim	0.24128388	0.235851	0.246716
Shaher M. Samrah	0.24142824	0.235997	0.246859
She X	0.24152738	0.236094	0.246961
Son H	0.24138598	0.235955	0.246817
Song W	0.24144328	0.236012	0.246875
Song YS	0.24147455	0.236043	0.246906
Spiteri G	0.24146748	0.236036	0.246899
Sun DF	0.24173021	0.236291	0.247169
Sun WW	0.24142715	0.235996	0.246858
Sun Z	0.24139789	0.235967	0.246829
Tang A	0.23954514	0.234099	0.244992
Tang Olive	0.24158044	0.236148	0.247013

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Thiel SL	0.24143378	0.236002	0.246865
Tian SC	0.24143378	0.236002	0.246865
Tian SJ	0.24180609	0.23637	0.247242
Timothy J. Judson	0.24145781	0.236026	0.246889
Tolia VM	0.2414328	0.236001	0.246864
Tong H	0.24140796	0.235977	0.246839
Tong ZD	0.24377097	0.238308	0.249234
Treibel TA	0.24152794	0.236095	0.246961
Tsou Tsung-Pei	0.24154887	0.236116	0.246981
Viktoriya London	0.24156342	0.236131	0.246996
Wan R	0.24154887	0.236116	0.246981
Wang AH	0.24156342	0.236131	0.246996
Wang D	0.24123849	0.235806	0.246671
Wang JC	0.24150059	0.236069	0.246933
Wang KS	0.24141203	0.235981	0.246843
Wang L	0.24143349	0.236002	0.246865
Wang LZ	0.24141307	0.235982	0.246845
Wang S	0.24100789	0.235576	0.24644
Wang T	0.24150462	0.236073	0.246937
Wang XB	0.24307795	0.237626	0.24853
Wang XL	0.24240948	0.236966	0.247853
Wang ZQ	0.24137998	0.235949	0.246811
Waya JLL	0.23534326	0.229884	0.240802
Wong HYF	0.24146868	0.236036	0.246901
Wong J	0.24125358	0.23582	0.246687
Wu GY	0.24159715	0.236164	0.24703
Wu HP	0.24143876	0.236007	0.24687
Wu QR	0.24150616	0.236074	0.246938
Wu XQ	0.24134462	0.235913	0.246776
Wu Y	0.24145445	0.236023	0.246886
Wu YL	0.24137738	0.235946	0.246808
Xiang TX	0.24148725	0.236055	0.246919
Xie JW	0.24140583	0.235975	0.246837
Xie YB	0.24145308	0.236021	0.246885
Xu HM	0.24143219	0.236001	0.246864
Xu S	0.24144374	0.236012	0.246875
Xu TM	0.2414677	0.236036	0.2469
Yan XQ	0.24163942	0.236204	0.247075
Yang K	0.24142464	0.235993	0.246857
Yang NB	0.24142592	0.235995	0.246857
Yang RR	0.24130918	0.235877	0.246742
Yang YL	0.24142633	0.235995	0.246857
Yang YX	0.24157517	0.236142	0.247008

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Yao QD	0.24149534	0.236064	0.246927
Yao XY	0.24142441	0.235993	0.246855
Yayla Burcu Ceylan Cura	0.24140419	0.2359687	0.2468397
Ye XX	0.24142972	0.235999	0.246861
Ye Y	0.2429242	0.237467	0.248382
Yu FT	0.24154702	0.236115	0.24698
Yu JX	0.24156559	0.236133	0.246998
Yu X	0.24159686	0.236164	0.24703
Yuan L	0.24135433	0.235923	0.246786
Yue HM	0.24146326	0.236031	0.246896
Zeng J	0.2418316	0.236396	0.247267
Zeng WZ	0.24145465	0.236023	0.246886
Zhai HL	0.24143203	0.236001	0.246863
Zhan H	0.24142247	0.235991	0.246853
Zhan T	0.24208018	0.236641	0.24752
Zhang JJ	0.24142049	0.23599	0.246851
Zhang KY	0.24141598	0.235985	0.246847
Zhang L	0.24141848	0.235987	0.24685
Zhang R	0.24147427	0.236042	0.246907
Zhang Y	0.24142572	0.235994	0.246857
Zhang YC	0.24141929	0.235988	0.246851
Zhang YD	0.24139778	0.235967	0.246829
Zhao L	0.24140501	0.235974	0.246837
Zhong ZM	0.24142331	0.235988	0.246858
Zhou H	0.24142781	0.235997	0.246859
Zhou JL	0.24161904	0.236185	0.247053
Zhou R	0.2414069	0.235975	0.246838
Zhu JF	0.24193569	0.236492	0.247379
Zhu MR	0.24145423	0.236022	0.246887
Zhu SQ	0.24211027	0.236671	0.24755
Combined	0.24141874	0.235988	0.24685

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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	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.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5-6
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.	/
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.	7
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.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	6
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).	7
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.	7-8
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	7-8
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.	9
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	9
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.	9

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PRISMA 2009 Checklist

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).	9
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	9
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.	9-10
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.	10
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).	12
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.	10-11
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	10-12
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	12
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	11-12
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).	12
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).	15-16
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	16
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.	17

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

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