REVIEW ARTICLE

The Practice of Wearing Masks in Community Setting According to the Gross National Income During the COVID-19 Pandemic: A Rapid Review and Meta-analysis

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ABSTRACT

Several countries have eased public and social restrictions due to declining of positive COVID-19 new cases. This review aimed to quantitatively assess the practice of wearing masks in community settings. Identification and selection of studies in MEDLINE and Google Scholar databases were performed according to PRISMA guidelines. A meta-analysis was performed, and subgroup analysis was based on the country's gross national income classification. From the twenty-eight studies, the overall estimate of respondents who responded "yes" to whether they wore masks outside the house or in the public area was 64% (95%CI: 48-78). Subgroup analysis showed 28% (95%CI: 5-74), 74% (95%CI: 55-87), 76% (95%CI: 48-92) and 38% (95%CI: 3-93) in High-Income Countries (HIC), Upper-Middle Income Countries (UMIC), Lower Middle-Income Countries (LMIC), and Low-Income Countries (LIC), respectively. We found that the practice of wearing masks in public varies worldwide. Such differences can help future research to identify variations in the natural history of COVID-19 transmission in different regions of the world.

Keywords: Practice, Face masks, COVID-19, Pandemic, Community awareness

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INTRODUCTION

A novel coronavirus, Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV2), was first identified through isolates from a series of pneumonia cases found in the Wuhan City's fish market in the Hubei province of China in December 2019 (1). Since then, the virus has spread beyond the city of Wuhan and urged World Health Organization (WHO) to declare the Coronavirus disease 2019 (COVID-19) pandemic status in March 2020 (2). Since its establishment as a pandemic, there have been more than 120 million positive cases worldwide spread in more than two hundred countries, with a death toll reaching almost 2.7 million individuals (as of March 15, 2021) (3).

Several countries have shown a declining trend in daily positive cases and hospital admissions, which are then used as the policy basis to ease social restrictions (4). Entering this era of so-called "new normal", people need to adapt to various new rules, primarily related to standard personal precaution such as washing hands, maintaining physical distance, and the use of masks in the public area, to prevent the transmission of SARS-CoV2 while attempting to avoid the emergence of the subsequent wave of infection.

On June 5, 2020, WHO recommended the use of masks in public areas such as shops, social or mass assemblies and in closed areas such as schools, places of worship, and public transportations to control the spread of the novel coronavirus (5). This is an updated version of the recommendation issued on April 6, 2020, which stated that the use of masks in the community is only recommended for people who cough and sneeze or provide care for confirmed COVID-19 patients

(6). WHO stated that masks should be used as part of comprehensive strategy of measures to limit the transmission of SARS-CoV-2 although the use of mask alone is not sufficient to provide an adequate protection against COVID-19 (5).

Each country has its own policy on the use of masks in the society which changes overtime. Prior to the face mask recommendation by WHO, the Chinese government already stated that the use of medical masks was mandatory for people at moderate and low risks whereas the use of cloth masks or no masks was recommended for people at very low risk. Furthermore, people at high risk, such as medics or paramedics, were advised to use appropriate personal protective equipment. In Hong Kong and Singapore, the use of medical masks is limited to people with symptoms of viral infection. In Japan, it is recommended to use masks in a closed area with poor ventilation. In United States of America, it is advised to use cloth masks in public and use medical masks for people who are ill. In the United Kingdom, the use of masks is only mandatory in the area of health facilities, and there is insufficient evidence in Germany whether or not the mask wearing can reduce the risk of becoming infected with the virus (7).

COVID-19 is a widely spread infectious disease affecting almost every part of the world's regions. The impacts of COVID-19 pandemic to every country may be different, based on the country's characteristics. From various characteristics, country's income according to the gross national income stratified by the World Bank can show a nation's economic status. The economic status has been known to influence the community's knowledge and practice. The compliance of using masks in public areas may be one of the indicators whether a community is well prepared and ready to embrace the new normal. The purpose of this review is to quantitatively report the practice of wearing masks in the community setting to prevent further transmission of the SARS-CoV2.

METHODS

This review mainly studied the knowledge and practice of wearing mask in the community during the recent COVID-19 pandemic worldwide. Therefore, we focused on identifying studies that assessed the practice of using face masks in public during COVID-19 pandemic.

Searching strategy

A systematic literature search was conducted between 10-12 June 2020 to the electronic databases of MEDLINE and Google Scholar using the following keywords: "knowledge"; "attitude"; "practice"; "mask*"; "COVID-19"; "SARS-CoV2".

Study inclusion and exclusion criteria

Article searches were limited to scientific publications from December 2019 to June 2020. Only articles that provided information in English by answering specific question: "Do you wear a mask outside your house or in public areas?" were included in this review. Research designs such as longitudinal studies, cross-sectional studies, case-control studies and descriptive studies were considered for inclusion. Other types of articles such as opinion, letter to editor, review, and protocols were excluded. In addition, articles not in English were also excluded.

The screening of titles and abstracts was performed by two reviewers (DBN and FK) using free online software called Abstrackr (8). If there was a disagreement between the two reviewers, a third reviewer (FF) was invited for discussion in deciding whether to include or exclude the article. A summary of information for the articles included in this review was compiled using a data collection form, elaborated from the review protocol.

Study analysis

The study characteristics were extracted from each included study including information about authors, year of publication, the total number of respondents, number of correct answers (respondents who answered "yes") regarding whether the respondent wore a mask when they were outside the home, location of the study, brief characteristics of the research subjects, and study design.

Quantitative analysis was done using the Dersimonian-Laird method to measure the random and fixed effects of the total pooled estimates. Statistical analysis I^2, was used to test for heterogeneity in each and among included studies with a confidence level of 95%. The meta-analysis for single proportions was presented in a forest plot. A subgroup analysis was performed based on the economic classification determined by the country's gross national income (9). The publication bias was visually assessed by a Funnel plot, and statistically by Egger's test. Each study was assessed by an author using Critical Appraisal Skills Program (CASP) checklist and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) for the risk of bias and the reporting assessment of the observational studies, respectively (10,11). All statistical analyses including data visualization were conducted using Rstudio software (RStudio, PBC., Boston, MA, USA).

RESULTS

A total of 1,495 articles were retrieved from both MEDLINE and Google Scholar databases during the initial literature search. There were 232 articles that were removed due to duplication. All remaining articles were screened by reading the titles and abstracts. As many as 1,214 articles were eliminated because they were irrelevant. After evaluating the full texts of the remaining articles, another 21 studies were excluded due to unavailable data for quantitative analysis, research

were performed on health care workers, and inadequate information on the questionnaire. As a result, there were 28 eligible studies that met the inclusion criteria with a total of 72,607 included subjects for quantitative analysis. Figure 1 shows a summary of the search results following the recommended PRISMA statement (12).

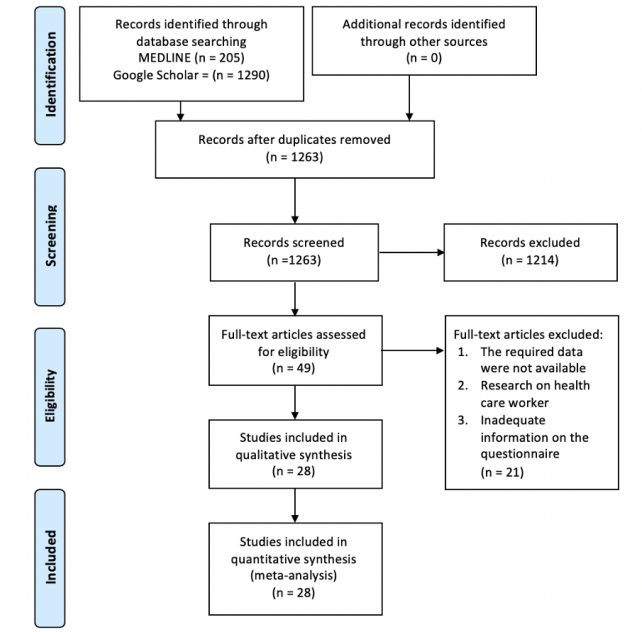

Figure 1: Preferred reporting items for systematic reviews and meta-analyses (PRISMA) diagram flow of this study

This review provided the current practice of wearing mask in the community in response to COVID-19 pandemic and included individual studies from 25 different countries worldwide; six studies were performed in China, two studies were conducted in Pakistan, two studies were reported from Jordan, and one study was found from the following countries: United States of America (USA), Saudi Arabia, Bangladesh, India, Philippines, Indonesia, Uganda, Nigeria, Ethiopia, Syria, Vietnam, Georgia, Malaysia, a combination of Middle Eastern countries, and a combination of European countries and USA with a total of 72,607 respondents. The characteristics of these studies are provided in Table I.

The included studies were categorized based on the economic classification of the respective country. Twelve countries were categorized as Upper-Middle Income Countries (UMIC) classification; nine countries as Lower Middle-Income Countries (LMIC); five countries as High-Income County (HIC), and another three countries as Low-Income Countries (LIC). Most of the included studies were performed in the general public although there were some studies that only included university students as respondents.

The event was described as the number of respondents who replied or answered yes to the following question: whether they wear a mask when they are outside the house or in a public area. Each study used different types of surveys and questionnaires; only studies that included questions about the practice of wearing masks were eligible for this review. For studies that used a scale in assessing the practice of using masks, we only included the extreme options as the answer that most likely matched a yes/no response.

All the reports included in this review were mainly cross-sectional research using surveys and questionnaires to collect data. Surveys and questionnaires were disseminated online to respondents (13-34), by telephone (35,36) or via paper-based (37-40) questionnaires. Most of the research included in this review use convenience and snowball technique as the sampling methods (13-32, 34,36). Only three studies were using the random sampling technique (33, 35, 39). To ensure generalizability and representativeness of the study, two studies used a stratified and proportional sampling method (22, 36). Cronbach alpha statistical analysis was used in almost all studies as a reliability index to assess the internal consistency of the questionnaire (14,15,16 ,18,19,20,22,23,24,25,26,29,33,3637,38,39,40). Most studies performed a reliability test on the questionnaire by first conducting a pilot study.

A meta-analysis was conducted on the 28 included articles in this review. Furthermore, subgroup analysis was performed based on the economic classification of each country in which the study was conducted (Figure 2).

With a very high level of heterogeneity as indicated by I^2 results of 100%, the total and subgroup data synthesis was based on a random effect model analysis, assuming that the observed data from the included studies were normally distributed. The differences in the implementation of each included study are the most significant source of heterogeneity. Furthermore, we used Buojat plots and influences analysis to investigate potential sources of heterogeneity (data not shown). We discovered that the most heterogeneous sources of heterogeneity came from studies from Thang et al., 2020 (28) and Perrotta et al., 2020 (31).

Based on the pooled estimation analysis, 64% (95% CI: 48-078) of respondents answered "yes" for questions about the practice of using masks in public areas. There were differences in the estimates when the studies were divided into subgroups; the percentage of the "yes" answer was 28% (95% CI: 5-74), 74% (95% CI: 55-87), 76% (95% CI: 48-92) and 38% (95% CI: 3-93) in HIC, UMIC, LMIC and LIC countries, respectively.

There was no publication bias formed in the funnel plot supported by the Egger's test results that showed a statistically non-significant result (Figure 3). Each study met at least 50% score in STROBE for reporting assessment in observational studies and eight out of ten

Table 1: Characteristics of the included studies

References	Total	Events	Location	Economies classification	Subject	Study design
Yang et al., 2020 (13)	8252	7427	Wuhan, China	UMIC	Students from four key national universities located in Wuhan	Cross-sectional
Baloran, 2020 (14)	530	318	Philippines	LMIC	Students Collage and High School	Cross-sectional
Zhong et al., 2020 (15)	6919	6781	China	UMIC	Chinese citizen/Chinese nationality, were aged 16 years or more,	Cross-sectional
Wang et al., 2020 (16)	1210	724	China	UMIC	Chinese Citizen	Cross-sectional
Chen et al., 2020 (17)	4016	3759	China	UMIC	Anhui Province Residents	Cross-sectional
Cowling et al., 2020 (35)	3013	2718	Hongkong	UMIC	General Adult population in Hong Kong	Cross-sectional
Clements, 2020 (18)	1034	248	USA	HIC	US Residents	Cross-sectional
Azlan et al., 2020 (19)	4850	2461	Malaysia	UMIC	Malaysian residents	Cross-sectional
Hayat et al., 2020 (20)	1257	1079	Pakistan	LMIC	Individuals / Pakistan residents	Cross sectional
Liu et al., 2020 (21)	608	509	China	UMIC	China Residents	Cross-sectional
Kantor and Kantor, 2020 (22)	1005	71	USA	HIC	The general US population	Cross-sectional
Naser et al., 2020 (23)	1208	605	Middle Eastern (Jordan, Saudi Arabia and Kuwait)	HIC	Middle Eastern population	Cross-sectional
Kebede et al., 2020 (37)	247	35	Southwest Ethiopia	LIC	The Jimma University medical center (JUMC) visitors of all kinds	Cross-sectional
Butsashvili et al., 2020 (24)	5228	1174	Georgia	UMIC	The whole country and the language used was Georgian	Cross-sectional
Alzoubi et al., 2020 (25)	592	383	Jordan	UMIC	University students from medical and non-medical colleges in Jordan	Cross-sectional
Salman et al., 2020 (38)	417	76	Lahore, Pakistan	LMIC	Undergraduate and postgraduate students and employees	Cross-sectional
Iorfa et al., 2020 (26)	1554	295	Nigeria	LMIC	Nigerian	Cross-sectional
Nazli et al., 2020 (27)	304	231	different parts of the country (India)	LMIC	Participated in the survey during the lock-down period of 21 days (community)	Cross-sectional
Wadood et al., 2020 (39)	305	164	Rajshahi University, Bangladesh	LMIC	Non-medical students of Rajshahi University	Cross-sectional
Thang et al., 2020 (28)	2165	2154	Vietnamese	LMIC	Adult Vietnamese population	Cross-sectional
Malik, 2020 (40)	200	156	Pakistan	LMIC	Adult Pakistani population	Cross-sectional
Baig et al., 2020 (29)	2006	1806	Jeddah, Saudi Arabia	HIC	Jeddah population more than 18 years old	Cross-sectional
Ssebuufu et al., 2020 (30)	1763	259	Uganda	LIC	18 years above literate Ugandans	Cross-sectional
Perrotta et al., 2020 (31)	14021	559	Belgium, France, Germany, Italy, Netherlands, Spain, United Kingdom, United States	HIC	Facebook users	Cross-sectional
Laksono et al., 2020 (32)	3407	3288	East Java, Indonesia	LMIC	People who live in East Java, Indonesia	Cross sectional
Mohsen et al., 2020 (33)	3586	3202	Syria	LIC	Residence in Syria with no known history of COVID-19 infection	Cross-sectional
Qian et al., 2020 (36)	1020	728	Wuhan, China	UMIC	Residents in Wuhan and residents in Shanghai aged above 18	Cross-sectional
Khasawneh et al., 2020 (34)	1404	851	Jordan	UMIC	Medical students from all the six medical schools in Jordan	Cross-sectional

criteria in CASP for the methodological bias.

DISCUSSION

The use of masks is part of the standard precaution aimed at preventing and controlling the transmission of various types of viruses, including SARS CoV-2, which is mainly transmitted person-to-person through airway droplets via close contact of less than one meter with an infected individual either through coughing or sneezing. Furthermore, recent studies also indicated the possibilities that this virus could have other modes of transmission including airborne, bloodborne, fecal-oral, mother-to-child, and animal to-human (41). The transmission may occur most commonly from symptomatic patients to someone who does not use adequate personal protective equipment. Moreover, the evidence showed that virus could also be transmitted from patients who are asymptomatic (42). Thus, the use of masks plays an essential role in protection against SARS CoV-2 infection, as a part of personal protective equipment.

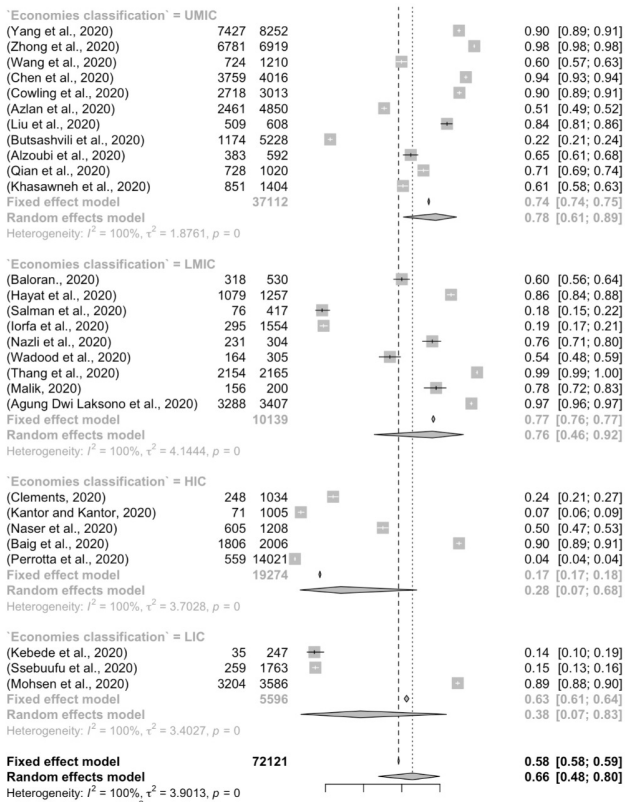

Figure 2: A meta-analysis on the practice of wearing masks in public. Forest plot of correct answer proportion on the practice of wearing masks in the public. Legend: Study Name (first author, year of publication); The size of square is proportional to the weight of the study and error bars indicate confidence interval of 95%.

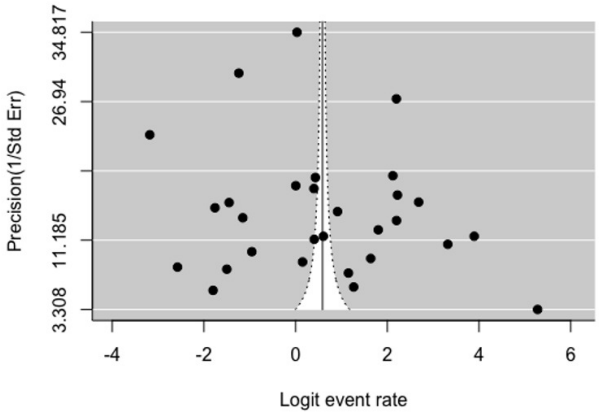

Figure 3: No publication bias was found indicated by the absence of asymmetry from the funnel plot which also supported by the results of the non-statistically significant Eggers test (p = 0.3475)

Even though scientific evidence such as randomized control trials that include a large number of population to support the use of face masks in preventing the transmission of SARS CoV-2 is still limited (43), WHO recommends the use of cloth face masks by the general public. In addition to being affordable, easy to use and potentially effective, masks can have a substantial impact on the viral transmission with minimal social and economic consequences (44). A computational model predicted that if 80 to 90% of the population wears a face mask during the outbreak, then this creates a flat curve and can prevent the spread of virus transmission and restore normal life as before (45).

The results of this review were highly variable, and some studies showed high participation rates in mask use (13,14,15,17,20,21,25,27,28,29,31,32,35,36,40) but other countries showed low participation (16,18,19,22,23,24,26,30,34,37,38,39). When divided into subgroups based on economic classifications, the variation within groups was still considerable. The upper-middle-income country subgroup showed the highest pooled estimation, where 74% of the total 37,598 respondents answered that they always wear masks when leaving the house or in public areas. This was partially attributed to the mandatory use of masks in several countries, i.e., six studies were conducted in China (13,15,16,17,21,36), showing an average of 86% answers in which the respondents answered "yes" with a total of 25,855 respondents.

Surprisingly, the high-income country subgroups showed the lowest pooled estimation among other subgroups, with only 28% of the 19,274 respondents who answered yes. The low participation in the use of masks could be caused by the scarcity of masks on the market, or there was no recommendation from the authorities regarding the use of masks at the time when the study was conducted. Policy differences and epidemic stages also affected the heterogeneity of this review, in which several studies were done before guidelines or recommendations regarding the use of masks in public places were enacted.

Until now, there is still much debate about the need for the use of masks on a broader society. A study by Zhang et al. in 2020 said that COVID-19 could only be transmitted by air / airborne, and the use of masks can reduce transmission both by aerosol and droplet. According to researchers, the use of this mask is very crucial in reducing infection rates rather than just promoting a safe distance (46). However, the European Center for Disease Prevention and Control (ECDC) and WHO stated this information could cause a false sense of security where people tend to feel calm by wearing a mask alone without doing other standard health protocols that are also important (6,47). In addition, a recent study highlighted that wearing a face mask in public provides double protection against SARS-CoV-2 transmission for the barrier of oneself and others (48).

Although there are various controversies about the use of masks in society, Cheng et al. in 2020 reported that there was a lower incidence of COVID-19 in Hong Kong compared to other countries (49). One potential cause was due to the awareness and compliance of the community with the use of masks in a public area

that contributed to the reduction spread of saliva and droplets from infected individuals (49). In addition, data on April 12, 2020, showed that Taiwan had good control in handling SARS-CoV-2 infection and transmission, considering that the Taiwan Centers for Disease Control has promoted the use of masks in the community whenever it is not possible to do physical distancing (50). The ECDC recommends the correct method of using a face mask by covering all areas of the face from the nose to the chin. The correct use of face masks in the society during the pandemic era can reduce transmission of the droplets from individuals who are asymptomatic and with minimal symptoms (47). A study in Beijing found the benefits of wearing masks, physical distancing, and doing regular disinfection in the house against the risk of transmission of pre-symptomatic COVID-19 patients to their families as well as to prevent secondary transmission (51). With various debates about the use of masks in the community, a study found that, with mathematical calculations, the use of masks is useful in controlling the source of infection from asymptomatic patients and also preventing infection of healthy people in public areas compared to no masks (52).

A limitation of this review is that most of the answers from the respondents were self-reported, which may cause bias. Moreover, most of the studies used online and phone surveys as data collection modalities, which limit the coverage to only respondents who have access to the internet, telephone, and Smartphone, thereby restricting the generalizability of this review. The type of mask used as well as another personal protection equipment, such as face shield, hand sanitizer, etc could be further studied. In this review, the authors searched only in two electronic databases. Therefore, there is a possibility of relevant individual studies that were not included during the articles searching process. Due to the nature of this study as a rapid review, most of the included studies were cross sectional. Therefore, the results of this study may only represent the acute response of wearing masks in COVID-19 pandemic era.

CONCLUSION

The 'new normal' era means that countries across the world are gradually returning to business as usual with the potential to increase the risk of transmission of SARS-CoV-2 as well as the emergence of the second wave. The practice of using masks in public differs in various areas of the world, with an overall estimate that is relatively low. These differences may help future research to find out if there are also differences in the natural history of COVID-19 transmission in such regions.

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