

Impact of Social Distancing in Curbing COVID-19 Pandemic: A Systematic Review

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Abstract

Currently, no pharmaceutical treatment or vaccine is approved for the treatment of Coronavirus. Due to these reasons, most countries turn to non-pharmaceutical approach such as social distancing. Social distancing includes strategies to ban public gatherings and advise individuals to stay at their home or maintain distance to one another by at least 1-2 meters. This study aims to intend to assess all the available evidence of social distancing in decreasing COVID-19 transmission in the general population. This study is a systematic review that was conducted an electronic search of published literature using MEDLINE/Pubmed, Science direct, PMC, Wiley, and Google Scholar and we use Joanna Briggs Institute (JBI) critical appraisal checklist to assess methodological qualities. A total of 7 articles were decided to be included in this study. Social distancing has curb down the number and saved approximately 10 thousand Brazilian lives. A study by VoPham et al on the association of social distancing and COVID-19 incidence found higher social distancing was associated with a 29% reduction of COVID-19 incidence (adjusted IRR 0.71;95% CI (0,57-0,87) and 35% reduction of COVID-19 mortality (adjusted IRR 0,65; 95% CI 0,55-0,76). Social distancing is one of the major policies implemented for long-term behavioral adjustment in managing the COVID-19 pandemic. Passive social distancing is not enough to drag down the number, there needs to be large scale testing, isolation, and contact tracing. However, we believe we have illuminated the impact of social distancing on the COVID-19 pandemic and add to the available literature the basis of social distancing in reducing transmission of COVID-19.

Keywords: COVID 19, social distancing, transmission.

1. Introduction

Coronavirus disease 2019 (COVID-19) is a disease caused by severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) that first emerged on December 2019 in Wuhan, China. Over the span of a few months, despite interventions from the Chinese government, the disease spreads all over the world and finally declared as a pandemic by World Health Organisation.¹ By the time of writing, 13 July 2020, Coronavirus has infected 13 millions people worldwide with more than 500 thousand fatalities.²

Currently, no pharmaceutical treatment or vaccine is approved for the treatment of Coronavirus. Due to these reasons, World Health Organisation (WHO) recommends every country to employ aggressive tracing, case finding, isolation and quarantine of close contacts to mitigate the case numbers.³ Social

distancing is a method to minimize crowd interactions and prevent the spread of disease within groups of people. This is a common practice which has been carried out over generations, to minimize the spread of virus by limiting its reproduction rate (R0) among communities.⁴ However these strategies need large resources, something most developing countries often lacked. Due to these reasons, most countries turn to non-pharmaceutical approach such as social distancing to flatten the curve. Social distancing includes strategies to ban public gatherings and advise individuals to stay at their home or mantain distance to one another by at least 1-2 meters. By reducing number of potentially infectious individual, social distancing may buy enough time for the development of more definitive treatment like

vaccine and decreasing risk of overloading the healthcare system.^{2,5}

There are few studies on social distancing that has been published. A study carried out by Jianhong et al estimates confirm that social distancing measures have helped mitigate transmission by reducing daily infection contact rate.⁵ However, to our knowledge, there hasn't been one investigating effectiveness of social distancing on COVID-19 transmission. A recently published systematic review on social distancing instead focus on investigating the optimum distance to avoid person to person transmission.⁷ Another study by Koo, Cook and Park did mathematical modelling of COVID-19 transmission and found combined intervention, in which quarantine, school closure and workplace distancing implemented, was most effective compared to no intervention at all.⁸

It is still uncertain whether the social distancing that has been employed has been sufficient in curbing COVID-19 number. Therefore, we intend to assess all the available evidence of social distancing in decreasing COVID-19 transmission in general population.

2. Method

2.1. Protocol and registration

This study will utilise a systematic review (SR) design study. The systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement

2.2. Eligibility criteria

The inclusion criteria included studies containing how social distancing manage to impact COVID-19 pandemic. Studies must be published in English language and included cross sectional, case control and cohort design. Studies also needs to have abstract and full text available. Exclusion criteria included the following: letters, commentaries, opinion, reviews, editorial, case report and case series also qualitative studies and experimental design. Studies on social distancing that did not answer how the impact of social distancing on COVID-19 pandemic is excluded.

2.2. Selection of studies

Authors independently conducted electronic search of published literature using MEDLINE/Pubmed, Science direct, PMC, Wiley and Google Scholar. The keywords are listed in Table 1. Literature selection was performed without time limitation and restricted the searches to only published English studies. The citations will be imported to Mendeley Reference and screened twice (i) screening of titles and abstract matched with inclusion criteria and ii) review of full text. We will use the standard PRISMA flow diagram to provide the process of study selection

Table 1. Terminology used in search queries

Location	Terminology	Hits	Selected
Pubmed	Social distancing AND COVID-19 AND SARS-CoV-2	401	1
Scencedirect	Social distancing AND COVID-19	3100	4
PMC	Social distancing AND COVID-19 AND Effectiveness	40	4
Wiley	Social distancing AND COVID-19	17	1
Google Scholar	Social distancing AND COVID-19 AND (Efficacy OR Effectiveness)	24800	6

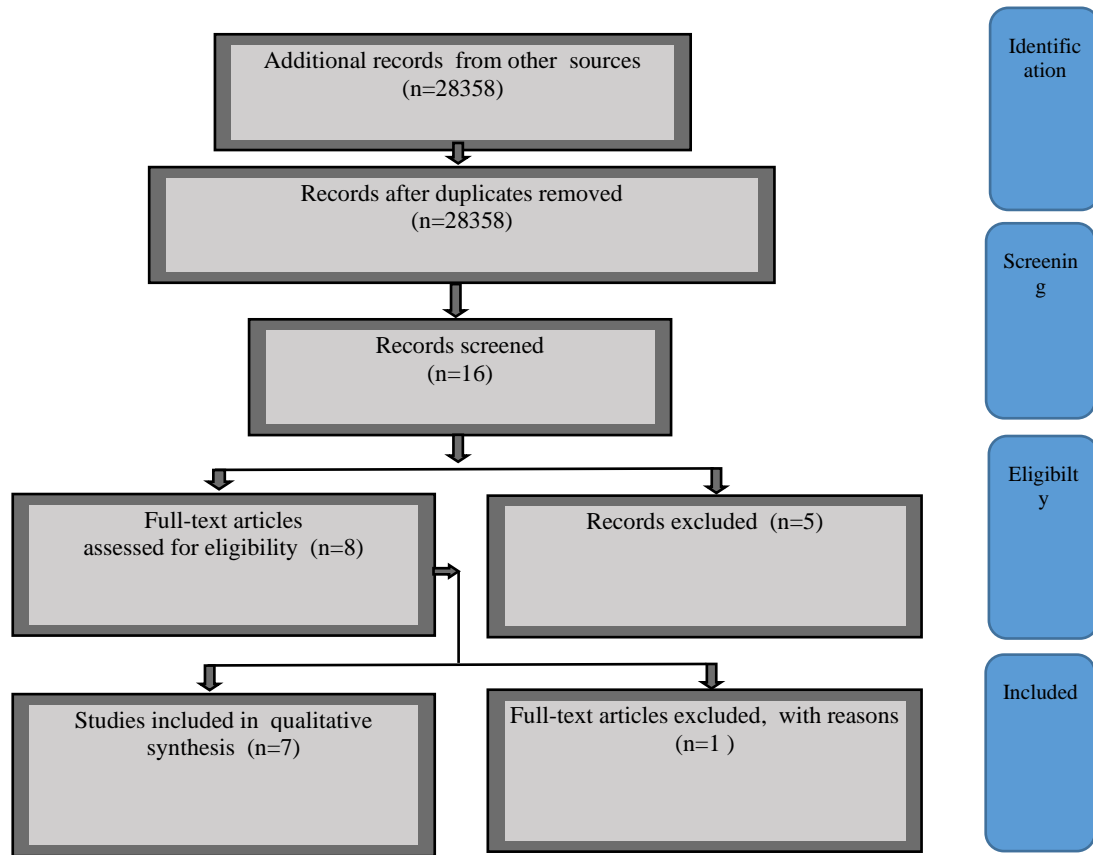


Figure 1. PRISMA 2009 Flow Diagram of search and data extraction

2.3. Quality assesment

We use Joanna Briggs Institue (JBI) critical appraisal checklist to assess methodological qualities. All included studies will be assessed by reviewers (MA & LL) using standardised questions and the results will be synthesis and interpreted.

3. Results and Discussion

Our search results identified 16 publications. After screening by title and abstract, a total of 8 studies matches the eligibility criteria. After reading the full text, 7 articles were decided to be included in the study. We use PRISMA flow diagram for searching and extracting data and presented on the PRISMA flow diagram (Figure 1). Social distancing is an umbrella term encompassing several strategies, including case isolation, quarantine, school closure, distance working

and contact reduction. Several studies examined the efficacy of social distancing on COVID-19 pandemic. Delen et al used the cross-national mobility trends to analyse the efficacy of social distancing and found 47% variation in COVID-19 transmission is due to change in mobility patterns from enforcing social distancing with mobility in public places such as restaurants, grocery stores, public transport being the most important determinants of transmission rate.⁹

Author	Objective	Population	Design	Instrument	Result
Jianhong wu et al ⁶	Equip local public health decision- and policy-makers with mathematical model-based quantification of implemented public health measures and estimation of the trend of COVID-19 in Ontario to inform future actions in terms of outbreak control and de-escalation of social distancing.	Data of cumulative reported COVID-19 infected cases in Ontario, Canada, from the Government of Canada	Cross sectional	The study obtained the data of cumulative reported COVID-19 infected cases in Ontario, Canada, from the Government of Canada. The data were released and analyzed anonymously.	The study conclude social distancing measures have helped mitigate ransmission by reducing daily infection contact rate, but the disease transmission probability per contact remains as high as 0.145 and case detection rate was so low that the effective reproduction number remained higher than the threshold for disease control until the closure of non-essential business in the Province.
Delen et al ⁹	The aim of this paper was to integrate multiple transactional data sets (GPS mobility data from Google and Apple as well as disease statistics from the European Centre for Disease Prevention and Control) to study the role of social distancing policies in 26 countries and analyze the transmission rate of the coronavirus disease (COVID-19) pandemic over the course of 5 weeks.	Nationwide, de-identified, smarphone GPS data (N=130;26 countries, 5 weeks per country)	Cross sectional	Relying on the susceptible-infected-recovered (SIR) model and official COVID-19 reports, we first calculated the weekly transmission rate (β) of COVID-19 in 26 countries for 5 consecutive weeks. Then, we integrated these data with the Google and Apple mobility data sets for the same time frame and used a machine learning approach to investigate the relationship between the mobility factors and β values.	Gradient boosted trees regression analysis showed that changes in mobility patterns resulting from social distancing, Consistent with simulation-based studies, real cross-national transactional data confirms the effectiveness of social distancing
Valenti et al ¹⁰	This research analyzed whether social distance had an influence on the outcome of expected deaths related to COVID-19.	Secondary data taken from Worldodmeter of COVID-19 mortality rate in Brazil	Cross sectional	This is a study of mathematical projection and secondary data. COVID-19 mortality data, which occurred in Brazil, were obtained from the Worldometer website (www.worldometer.info).	It is concluded measures promoted by the Brazilian public managers contributes to the reduction in approximately ten thousand deaths related to COVID-19 in the current pandemic scenario.
VoPham et al ¹¹	Examined the associations between statewide policies and objective measures of social distancing, and objective social distancing and COVID-19 incidence and mortality.	Nationwide, de-identified smartphone GPS data to estimate county-level social distancing. COVID-19 incidence and mortality data were from the Johns	Cross sectional	This study used nationwide, de-identified smartphone GPS data to estimate county-level social distancing. COVID-19 incidence and mortality data were from the Johns Hopkins Coronavirus Resource Center. Generalized linear mixed models were used to estimate	Higher social distancing was associated with a 29% reduction in COVID-19 incidence (adjusted IRR 0.71; 95% CI 0.57- 0.87) and a 35% reduction in COVID-19 mortality (adjusted IRR 0.65; 95% CI 0.55-0.76)

		Hopkins Coronavirus Resource Center.		incidence rate ratios (IRRs) and 95% confidence intervals (CIs) for the association between objective social distancing and COVID-19 incidence and mortality.	
Martin-Calvo ¹²	Our report contains preliminary results that aim at answering the following questions in relation to the spread and control of the COVID-19 pandemic: what is the expected impact of current social distancing strategies, how long should such measures need to be in place, how many people will be infected and at which social level, how do R(t) and the epidemic dynamic change based on the adopted strategies, what is the probability of having a second outbreak, i.e., a reemergence, if there is a reemergence, how much time do we have to get ready, and what is the best strategy to minimize the current epidemic and get ready for a second wave.	Mobility data and sociodemographic data from the Boston area, from Cuebiq and US Census, respectively. We use it to generate one networked subpopulation that describes the contact patterns of about 100.000 agents in the Boston area during a period of four months and three layers (Community, Households and Schools).	Cross sectional	This study used detailed mobility data and sociodemographic data from the Boston area, from Cuebiq and US Census, respectively. They use it to generate one networked subpopulation that describes the contact patterns of about 100.000 agents in the Boston area during a period of four months and three layers (Community, Households and Schools). The community layer is based on mobility data and measures exposure of individuals happening at different points of interests, from restaurants to work places; households are built using census data and, lastly, children belonging to the same geographical location are linked together to create the school layer.	Social distancing strategies such as school closures doesn't have major impact on controlling epidemic as infection can still occur household. Passive social distance strategies are not enough to contain the pandemic. There needs to be active strategies such as large scale testing, isolation and contact tracing
Tran Phuoc Bao ¹³	This study aims to present the effect of the promulgation of social distancing measures on the spread of COVID-19 in the cases of 10 highly infected countries.	10 countries that had high level of COVID-19 infection and still persisting according to WHO statistic.	Cross sectional	The authors of this study focus on the statistics of the COVID-19 confirmed-cases and deaths in 10 highly infected countries, including The U.S., Spain, Italy, The U.K., France, Germany, Russia, Turkey, Iran and China, and the response to the pandemic of these countries in the period from January 11 to May 2, 2020. The relationships between the social distancing measures and the statistics of COVID-19 confirmed-cases and deaths were analyzed in order to elucidate the effectiveness of the social distancing measures on the spread of COVID-	It took 4 weeks since promulgation of highest level of social distancing till number of daily cases begin to decrease. It took Iran and Turkey only one week since the highest level of the social distancing measures were promulgated until the number of daily confirmed-cases started to decrease. The number of weeks before observable recovery in Germany, France, Spain, China and Italy were 1.5, 2, 2.5, 2.5 and 3.5 respectively. eanwhile, it took

				19 in 10 highly infected countries.	The U.K. and The U.S. about 4 weeks since the highest level of the social distancing measures were promulgated until the number of daily confirmed-cases started to stop rising.
Courtemanche et al ¹⁴	State and local governments imposed social distancing measures in March and April 2020 to contain the spread of the novel coronavirus disease (COVID-19). These measures included bans on large social gatherings; school closures; closures of entertainment venues, gyms, bars, and restaurant dining areas; and shelter-in-place orders. This study evaluated the impact of these measures on the growth rate of confirmed COVID-19 cases across US counties between March 1, 2020, and April 27, 2020.	US counties	Cross sectional	The unit of observation was daily US counties or county equivalents. Although there are 3,142 US counties, official COVID-19 records report New York City as a whole instead of dividing it into five counties, reducing this number to 3,138. Their data set tracked counties over the course of fifty-eight days from March 1, 2020, to April 27, 2020, leading to a sample size of 182,004. They chose March 1 as the start date because no new cases were reported in the entire US on most days in January and February. They chose the April 27 end date to coincide with the first removal of one of the four types of restrictions they analyzed (the reopening of restaurants and other entertainment facilities in Georgia). Each county observation was weighted by population, using 2018 estimates from the Department of Agriculture's Economic Research Service.	Holding the amount of voluntary social distancing constant, these results imply that there would have been ten times greater spread of COVID-19 by April 27 without shelter-in-place orders (ten million cases) and more than thirtyfive times greater spread without any of the four measures (thirty-five million cases).

However, the studies have a fairly small sample size for the limitation of the studies. Similarly, Valenti et al found in the mathematical model made to predict effects of social distancing on estimated death in Brazil, it was predicted that on May 24 there would be 32,825 total number of deaths related to COVID-19 compared to actual numbers 22,965.¹⁰ This suggest social distancing has curb down the number and saved approximately 10 thousand of Brazilian lives. Another studies by Jianhong Wu found reproduction number estimate decreasing during time interval from 3.25 to 2.97 to 2.84 indicating a gradually efficacy of interventions adopted.⁶ The study also predicted the number of cumulative confirmed cases per 7 April to be 6132 (95% CI 4250-8000) and could be reduced further by decreasing contact rates further by 90%. Study by VoPham et al on association of social distancing and COVID-19 incidence found higher social distancing was associated with 29% reduction of COVID-19 incidence (adjusted IRR 0.71;95% CI (0,57-0,87) and 35% reduction of COVID-19 mortality (adjusted IRR 0,65; 95% CI 0,55-0,76).¹¹

Contrary to the previous studies, Martin Calvo found social distancing strategies doesn't effectively controlled the epidemic as infection can still occur somewhere else, for example in household.¹² Therefore, passive social distancing is not enough to drag down the number, there needs to be large scale testing, isolation and contact tracing. Tran Phuoc Bao found social distancing has worked on 10 countries although the effect showed after 1-4 weeks.¹³ Courthemanche argued without social distancing being issued, there would be 10 times greater the number of COVID-19 infection and more than 35 times spread.¹⁴

COVID-19 arguably has changed the way the world works. Social distancing is one of the major policies implemented for long-term behavioural adjustment in managing COVID-19 pandemic. Due to the risk carried by the virus, every individual of a community needs to protect the vulnerable groups such as comorbid

group, homeless, etc to decrease transmission of COVID-19.

Social distancing is the method to minimize crowd interaction and therefore decrease the spread of a disease within people.¹⁵ COVID-19 outbreak isn't the first time social distancing has been implemented. Previous occurrence includes 1918 influenza pandemic in which, 50-100 million deaths were reported worldwide. Although official social distancing order hadn't been issued, the crowd initiate social distancing on their own that made it possible to decrease mortality of the outbreak.¹⁶

The potential limitation of our systematic review is majorities of the studies assessing effectiveness of social distancing is done via simulations and use estimated parameters to predict the number of cases averted after the implementation. This should be interpreted with caution as the number is subject to high level of uncertainty that's difficult to quantify. Another possible limitation would be some studies had small sample size which may impact generalization.

4. Conclusion

In conclusion, social distancing is one of the major policies implemented for long-term behavioural adjustment in managing COVID-19 pandemic. Passive social distancing is not enough to drag down the number, there needs to be large scale testing, isolation and contact tracing. However, we believe we have illuminated the impact of social distancing on COVID-19 pandemic and add to the available literature the basis of social distancing in reducing transmission of COVID-19.

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