
















Impact of Social Distancing on COVID-19 and Other Related Infectious Disease Transmission: A Systematic Review

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Abstract

BACKGROUND: Similar to other coronaviruses, COVID-19 is transmitted mainly by droplets and is highly transmissible through close proximity or physical contact with an infected person. Countries across the globe have implemented public health control measures to prevent onward transmission and reduce burden on health care settings. Social or physical distancing was found to be one of appropriate measure based on previous experience with epidemic and pandemic contagious diseases.

AIM: This study aims to review the latest evidence of the impact of social or physical distancing implemented during COVID-19 pandemic toward COVID-19 and other related infectious disease transmission.

METHODOLOGY: The study uses PRISMA review protocol and formulation of research question was based on PICO. The selected databases include Ovid MEDLINE and Scopus. Thorough identification, screening and eligibility process were done, revealed selected 8 articles. The articles then ranked in quality through Mixed Method Appraisal Tool.

RESULTS: A total of eight papers included in this analysis. Five studies (USA, Canada, South Korea and the United Kingdom) showed physical distancing had resulted in a reduction in Covid-19 transmission. In comparison, three other studies (Australia, South Korea and Finland) showed a similar decline on other infectious diseases (Human Immunodeficiency Virus, other sexually transmitted infections, influenza, respiratory syncytial virus, and Vaccine-Preventive Disease. The degree of the distancing policy implemented differs between strict and lenient, with both result in effectiveness in reducing transmission of infectious disease.

CONCLUSION: Physical or social distancing may come in the form of extreme or lenient measure in effectively containing contagious disease such as COVID-19, however the stricter the measure will give more proportionate impact toward the economy, education, mental health issues, morbidity and mortality of non-COVID-19 diseases. Since we need this measure to ensure the reduction of infectious diseases transmission to help flattening the curve which allow much needed time for healthcare system to prepare adequately to response, "Precision physical distancing" can be implemented which will have more benefit toward the survival of the community as a whole.

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Introduction

2019 novel coronavirus (severe acute respiratory syndrome [SARS]-CoV-2) which causes the disease COVID-19 was first identified in December 2019 [1]. Similar to other coronaviruses, SARS-CoV-2 is transmitted mainly by droplets [2] and is highly transmissible through close proximity or physical contact with an infected person [3], [4]. Without an effective vaccine or treatment, countries across the globe have implemented public health and physical measures to prevent onward transmission and reduce burden on health care settings [5]. These include increased hygiene measures, such as hand washing and respiratory etiquette; travel restrictions and related measures, including border closures and quarantining of people returning from overseas; and

physical distancing. Physical distancing measures apply to both individuals and the community, through restrictions on mass gatherings, restriction in day care centers, closure of schools, workplaces, and public spaces, and recommendations for keeping at least 1.5 m (5 ft) distance from other people [5]. These acts were based on the best evidence available at the time of the introduction. The evidence consisted of global experience and previous pandemics [6]. In some studies, social distancing reduced the spreading of seasonal influenza in workplaces [7]. The real effect of these broad restrictions on the spreading of diseases is not known, but it appeared to decrease the spreading of the novel coronavirus in China in 2020 [8]. In Japan, the influenza season in 2020 was shorter than normal possibly because of the physical distancing [9]. Physical distancing due to COVID-19 also reduces opportunities for all close contact with

others, including for sexual and physical intimacy. The disruption of sexual contacts operates at both an interpersonal and network level, therefore reducing opportunities for sexually transmissible pathogens to spread [10]. This review aims to seek new evidence of social or physical distancing impact as a control measure during this COVID-19 pandemic, and thus new era of globalization toward disease transmission of COVID-19 itself and also other related infectious diseases.

Methodology

Literature review

A systematic review of the literature was conducted to identify relevant studies about the impact of social distancing toward COVID-19 transmission. To conduct a comprehensive search of health science journals, we used Ovid MEDLINE and Scopus databases with no limited timeframe since this is a recent topic. The search strategy involved a combination of the following two sets of key words and identified Medical Subject Heading terms for: (1) COVID-19 OR SARS-CoV-2 OR 2019-nCov OR 2019 novel coronavirus OR coronavirus disease 2019 OR coronavirus disease-19 AND (2) social distancing OR physical distancing OR physical distance. All search stopped on 25th December 2020 with a total of 1565 records.

Selection of research articles

The results were limited to studies that were published in English language with included abstracts. Studies with these characteristics were included in this review: (1) report on the impact of social distancing to COVID-19 transmission; and (2) report on the impact of social distancing to other infectious diseases which we decided to include to analyze on how social distancing as control measures also affect other infectious diseases. Systematic review, narrative review articles, news, letter, editorials, or case studies were excluded from this review.

Data extraction and management

Duplicates were removed and the remaining papers were re-screened by at least two reviewers. Articles were screened in three phases before included in the review. In the first phase, any paper that did not match the inclusion criteria from title screening was excluded. In the second phase, abstracts of the remaining papers were assessed and paper that did not meet our inclusion criteria was excluded from this review. In the final phase, the full-text articles were read thoroughly to exclude any paper that did not meet

our inclusion criteria. Both reviewers must agree that the full papers should be in the review before the data extraction phase. Any differences in opinions were resolved through discussion. All data extraction was performed independently with a standardized and customized data collection table (Appendix A). The following data were recorded: (1) type of study (2) type of infectious disease involve in the study; (3) sample/population of the study; (4) methods; (5) results; (6) comments and conclusion of the study.

Quality appraisal

The final list of studies was ranked for quality according to the Mixed Method Appraisal Tool (MMAT) [11] to ensure the quality of the articles to be reviewed by exploring in detail how the data were extracted for analysis and validation. The MMAT is a developed tool that has demonstrated an intra-class correlation of 0.8 based on a pilot testing in 2009 and has proven to be effective and practical for the quality assessment of a mixed methods review [11]. We performed qualitative analysis and appraisal of the included articles by extracting all relevant information using a predesigned, standardized data extraction form [11]. The MMAT quality scoring scale are scored as Yes (20%), Unsure (10%) and No (0%) for each criterion. The details of this assessment are reported in Appendix B. Overall, scores of the MMAT vary from 70% (three criteria met) to 100% (all criteria met). One author in the team crosschecked the results of the assessment with disagreement resolved via discussion leading to a consensus.

Results

We retrieved 1565 unique citations through our electronic databases search to evaluate the social distancing outcomes in the midst of COVID-19 pandemic. Before titles and abstracts screening, 1319 duplicate articles were removed. A total of 1319 titles and abstracts were screened based on the eligibility criteria of which 1286 were excluded based on irrelevant studied population, intervention characteristics or outcomes. 33 full text articles were then screened for eligibility of which 25 articles were excluded as they are not according to the main objective of social distancing impact towards the transmission of COVID-19 or other infectious diseases. Subsequently, 8 articles remained to be included in the review. Our search PRISMA flowchart is presented in Figure 1.

Study characteristics

A total of 8 studies were included in this analysis (Appendix A). These studies were conducted

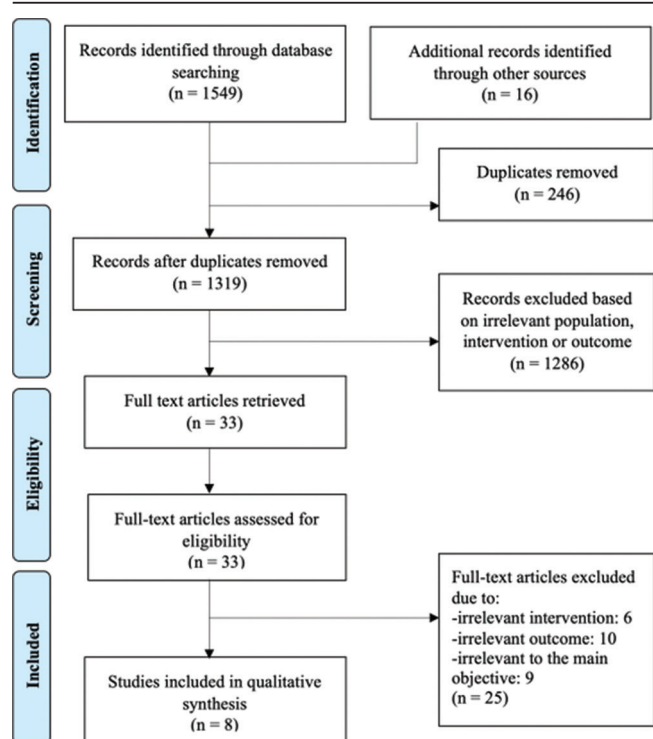


Figure 1: PRISMA flowchart of social distancing impact toward the transmission of COVID-19 or other infectious diseases

globally from United Kingdom [12], Canada [13], America [14], [15], South Korea [16], [17], Australia [18], and Finland [19]. The themes discussed by all studies were the impact of social distancing as a control measure of COVID-19 pandemic toward COVID-19 cases, also on other infectious disease trends. 5 types of study are looking at COVID-19 patterns, namely, time series analysis, modeling study, cohort, and two cross-sectional studies [12], [13], [14], [15], [16]. While other infectious diseases, such as Human Immunodeficiency Virus (HIV), other sexual transmitted diseases, influenza, respiratory syncytial virus (RSV), and Vaccine-Preventive Disease (VPD) are being observed through cohort and cross-sectional studies [17], [18], [19]. There is one multi-country study and two multi-counties study that were conducted to get the overall pattern [12], [14], [15] as compared to the rest of the studies which conducted in only one country or locality [13], [16], [17], [18], [19]. The resultant effect of social distancing can be seen on the general population from five studies [12], [13], [14], [15], [17], while three studies were focussing on the sample population among workplace cases (e.g., workers, customers, patients, and students), gay/bisexual and children [16], [18].

Social distancing impact toward COVID-19

To define the independent variable which are the social distancing or physical distancing, five studies generally used the government policy of distancing that was applied during the pandemic while two studies actually measured or define the distancing through daily cellular telephone movement and data [14], [15].

The impact toward COVID-19 transmission (dependent variable) where measured by assessing the pre and post social or physical distancing intervention incidence rate ratios, attack rate, instantaneous reproduction rate (R_t), incidence rates, and number of cases of COVID-19. Conclusively, all eight studies show social or physical distancing is effective in reducing the transmission of COVID-19 (Appendix A).

Social distancing impact toward other infectious diseases

Other infectious diseases were found to be decreasing in trend along with COVID-19 through social distancing measures. For example, drop in HIV incidences were from reduced sexual contacts, common respiratory viral diseases were noted decreasing from less pediatric emergency department (ER) visits, shorter influenza season and decline in RSV [18] and VPD cases [17] (Appendix A).

Types of social distancing or physical distancing policy applied

Three studies involve a stricter general distancing policy that has been enforced in most countries globally such as closure of school and workplaces, restrictions of mass gatherings, 1.5 m distance from other people, public transport closures and lock down which involve stay at home regulations and restriction of movements within a country [12], [18]. Study in Canada [13] define social or physical distancing more specific which is reducing number of contacts per day (outside of the household), similar with two studies in the US which one [14] define it as percentage change in visits to non-essential business and the other is more elaborate which are daily distance difference of travelling, daily visitation to non-essential business and daily human encounter in 50 m or less [15]. On the other hand, South Korea studies focus on distancing guideline at workplace which are flexible working system, vacation system, minimizing meetings and business trips, case monitoring (temperature and suspicious symptoms), space management (keep 2 m distance from each other), hygiene, disinfection and cleanliness [16]. Finally, another study in South Korea defines their distancing on general population as no draconian restriction of movement; it is either voluntary based or administrative sanction based actions according to infection control policies and guideline [17].

Discussion

Physical and social distancing strategies vary according to countries during this COVID-19

pandemic. Some countries opted for far stricter almost draconian distancing policy while others are not and depend much on individual or organization or company following administration of infection policy and guideline. Previously, these measure of restricting movement of population proven to be highly effective in preventing spread of contagious disease, for example the transmission of SARS which focused more on isolation and quarantine implementation with other distancing policy applied were far more lenient, less elaborate compared to the current policy for COVID-19 that could be due to the much smaller scale of transmission of SARS [19]. The aim of social or physical distancing during COVID-19 is to reduce transmission rate of COVID-19, hence maintain flatten the curve which allow healthcare system to prepare adequately if needed [20]. This review showed that stricter restriction for example total closure of school, workplace and other premises, stay at home enforcement with border closure (domestic and internationally) within a country shows significant impact in reducing COVID-19 transmission [12], [21]. The finding is supported by the recent study, which concluded that social distancing with mask use and city yields a positive impact specifically in reducing daily new cases of COVID-19 [22]. At the other end, we also have countries that have applied more lenient method of distancing policy, such as gathering allowed with workplace, schools, premises remained open according to infection policy, and distancing guideline [16], [17]. Despite the leniency and much depend on individual responsibility and voluntarism, they are still able to reduce transmission rate. Stricter distancing policy or lockdowns that place severe limitations on individual movement and group gathering, closing border and restriction on domestic and international travel came with extra baggage of economic, mental health, and education impact with increase of morbidity and mortality form non-COVID19 diseases [22]. Looking at the effectiveness of both lenient and strict distancing policy, "Precision physical distancing" can be used which is distancing policy tailored and optimized to specific physical, social, cultural, political and economics contexts and to specific groups and settings [22]. Compared to strict or draconian restriction, this method can be one of sustainable long-term solution, that gives both good effect to transmission rates and socioeconomic, allowing partial return to activities with community as trusted and empowered essential partner. Distancing policies also affect other infectious diseases such as HIV, STD, influenza, RSV and VPD which is great news however need to consider the rights of people to have sexual connection with their partner that could affect their quality of life and mental health. Furthermore, there is the possibility of severe case of non-COVID-19 infectious diseases undertreated because patient not seeking appropriate treatment due to COVID-19 scare and strict distancing order thus contributing the low cases detected at hospital or ER.

Conclusion

Physical or social distancing may come in the form of extreme or lenient measure in effectively containing contagious disease such as COVID-19, however the stricter the measure will give more proportionate impact toward the economy, education, mental health issues, morbidity and mortality of non-COVID-19 diseases. Since we need this measure to ensure the reduction of infectious diseases transmission to help flattening the curve which allow much needed time for healthcare system to prepare adequately to response, "Precision physical distancing" can be implemented which will have more benefit toward the survival of the community as a whole.

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Author Contributions

All authors contributed to the design and implementation of the research, analysis of the results and writing of the manuscript.

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Appendix

Appendix A: Characteristics of studies included in this review

Author/year	Type of study/type of infectious disease	Sample/population	Methodology	Types of social distancing/ physical distancing	Results
Islam <i>et al.</i> , 2020	Time series analysis/ COVID-19	149 countries/ conducted in United Kingdom/General population	Comparison of COVID-19 incidence rate before and after implementation of physical distancing intervention or interventions. Conducted on data from 1 st January to May 30, 2020	Closure of schools and workplaces, restrictions of mass gatherings (public events and restrictions to gathering), public transport closures, lockdown (stay at home regulations and restriction of movements within a country) *one of the above	<ul style="list-style-type: none"> Overall reduction of 13% COVID-19 incidence post physical distancing (Incidence rate ratios 0.87, 95% confidence interval 0.85–0.89) Closure of public transport was not associated with additional reduction when other intervention are in place School closure, workplace closure, and mass gathering restriction and lockdown showed significant effectiveness Early implementation of lockdown associated with larger reduction of incidence compare to delayed implementation of lockdown after other physical interventions were in place
Ng, 2020	Age-structured agent-based model/ COVID-19	Canada/General population	A projection modeling that can simulate the impact of public health intervention with COVID-19 transmission	Reducing number of contacts per day, (outside of the household)	<ul style="list-style-type: none"> Other intervention type also studied are case detection and isolation, contact tracing and quarantine, and community closure (not under physical distancing) Enhanced case detection and contact tracing with maintained physical distancing will reduced the total attack rate to 0.2%, the only scenario that kept hospital and intensive care unit bed use under capacity, prevented nearly all deaths and eliminated epidemic.
Rubin <i>et al.</i> , 2020	Cohort/COVID-19	211 counties/General population ([54.8% of US residents])	<ul style="list-style-type: none"> Using publicly de-identified daily incidence case counts data (New York Times) and the outcome was the estimated reproduction number) R_t of COVID-19 in each county. Social distancing was measured using a data set of daily cellular telephone movement, provided by Unacast, (comparison association of social distancing policies with individuals' movement within a county) Percentage change in visits to nonessential businesses (e.g., restaurants, hair salons) within each county compared with visits in a 4-week baseline period 	Measured by percentage change in visits to non-essential business	<ul style="list-style-type: none"> Other variable that is also studied were population density and temperature 50% decrease in visits to nonessential businesses was associated with a 45% decrease in instantaneous reproduction number (R_t), (95% CI, 43%–49%) 70% reduction in visits to nonessential business, 202 counties (95.7%) were estimated to fall below a threshold R_t of 1.0 Social distancing, temperate weather, and lower population density associated with a decrease in the instantaneous R_t of COVID-19 Social distancing have the most substantial association with a reduction in COVID-19 transmission
Kim <i>et al.</i> , 2020	Cross sectional/ COVID-19	South Korea Workplace populations (workers, customers, patients and students)	Data from daily briefings from the Korean Centre for Disease Control (KCDC), Central Disaster Management Headquarters (CDMH), and local governments Group infection in workplace were analyse pre and post introduction of workplace distancing guidelines	Consist of five components which are flexible working system (telework, time off work etc), vacation system (sick leaves, annual leaves), minimizing meetings (avoid gathering, use simple meeting room outside and etc) and business trips (defer or cancel), case monitoring (suspicious symptoms and swift action), space management (keep 2 m distance between workers etc) and disinfection, hygiene and cleanliness	The workplace social distancing policy with timely implementation of specific guidelines was a key to preventing a large outbreak of COVID-19 in Korean workplaces. However, sporadic incidents of COVID-19 are still ongoing, and risk assessment in vulnerable workplaces should be continued
Morley <i>et al.</i> , 2020	Cross-sectional/ COVID-19	County Syracuse, New York with 7 neighboring counties (Cayuga, Cortland, Herkimer, Madison, Oneida, Oswego, and Tompkins)/General population	<ul style="list-style-type: none"> Publicly-available mobile telephone movement data, tracked and graded by Unacast Data assessed use as predictors of weekly average rate of reproduction (R_t) value, from time of first case 	Daily distance Difference (Distance) of travelling, daily visitation difference (visitation) pertaining to non essential visits (retail that is non grocery stores), daily encounters (encounters) pertaining to human encounter (50 meters or less	Social distancing assessed based on these measures that are publicly available (by Unacast) has a significant impact on viral transmission rates

(Contd...)

Appendix A: (Continued)

Author/year	Type of study/type of infectious disease	Sample/population	Methodology	Types of social distancing/ physical distancing	Results
Hammoud et al., 2020	Cohort/HIV and other STD	Men who are gay or bisexual living in Australia	Study promotion by online advertisement through social media, including popular gay "dating" sites and apps, and Facebook. Conducted between 4 th April and 29 th April 2020	Restrictions on mass gatherings, closure of schools, workplaces and public spaces, keep at least 1.5 m distance from other people. Either banned or strongly discourages from visiting sexual partners with whom they did not cohabit	Relative reduction of 84.2% who reported not having sex with casual partners since COVID-19 physical distancing implementation. These behavioral changes will likely result in short term reductions in new HIV and STI diagnoses
Kuitunen, 2020	Cross-sectional/ Influenza (A&B) and RSV	Pediatric ER visits/ Children in Finland	Study was conducted in 2 hospitals, and open national registries for communicable diseases were used. Data analyze pre and post lockdown	The term lockdown were used, consist of prohibition of social gatherings of more than 10 people; universities, high schools and upper elementary schools were closed (lower elementary school classes form Grade 1 to 3 were open only for parents who is in critical profession); day care still open however parent encourage to take care of their children at home; remote work at home; residents over 70 years old ordered to stay at home; borders of Finland were closed; avoid unnecessary visits to healthcare facility with mild respiratory infections guided to stay at home	<ul style="list-style-type: none"> Major decrease in the rate of daily median paediatric ER visits in both hospitals during the nationwide lockdown compared with the study period before the lockdown (Mikkeli, 19 vs. 7, $P < 0.001$; Kuopio, 9 vs. 2.5, $P < 0.001$) The influenza season was shorter (8 weeks from peak to no cases), and the weekly rate of new cases decreased faster compared with the previous 4 influenza seasons Similar decrease in RSV cases No paediatric cases of COVID-19 were found in participating hospitals during the study period.
Yun, 2020	Cross-sectional/ Vaccine-Preventive Disease (VPD) e.g: hepatitis A, hepatitis B, pertussis, mumps, varicella, and invasive pneumococcal disease	Publicly available aggregate data from the National Notifiable Disease Surveillance System/Incidence of VPDs in South Korea/ General population	<ul style="list-style-type: none"> The baseline average monthly of VPD incidence in corresponding months of previous years from 2015 to 2019 was estimated Then comparison was made with the difference in number of monthly VPD incidence in 2020 	No draconian restriction of movement, either voluntary based or administrative sanction based actions. Education system postponed and when opened, it is open step wisely. Public and private places were mandated to follow the infection control policies and guidance	In 2020, there were 44% decline for mumps, 44% decline for varicella, 28% decline for pertussis, 22% decline for IPD, 14% decline in incidence of hepatitis A, and no change for hepatitis B incidences, compared to baseline years (2015–2019). Largest decline of total VPDs was in April (65%) and in May (67%), during the intensified social distancing measures. In the setting of sustained vaccination coverage, social distancing may provide additional public health benefit in controlling the VPDs

Appendix B: The details of mixed method appraisal tool assessment

Author	Type of study	MMAT scores	1.1	1.2	1.3	1.4	1.5	Outcome yes/no
			Is the qualitative approach appropriate to answer the research question?	Are the qualitative data collection methods adequate to address the research question?	Are the findings adequately derived from the data?	Is the interpretation of results sufficiently substantiated by data?	Is there coherence between qualitative data sources, collection, analysis and interpretation?	
Islam et al., 2020	Quantitative non-randomised	90%	Yes	Yes	Yes. Not complete	Yes	Yes	Y
Ng, 2020	Qualitative	70%	Yes	Yes	Yes. Not complete	Yes	Unsure	Y
Rubin et al., 2020	Quantitative non-randomized	100%	Yes	Yes	Yes	Yes	Yes	Y
Kim et al., 2020	Quantitative non-randomized	100%	Yes	Yes	Yes	Yes	Yes	Y
Morley et al., 2020	Quantitative non-randomized	80%	Yes	Yes	Yes	Yes	Unsure	Y
Hammoud et al., 2020	Quantitative non-randomized	100%	Yes	Yes	Yes	Yes	Yes	Y
Kuitunen, 2020	Quantitative non-randomized	100%	Yes	Yes	Yes	Yes	Yes	Y
Yun, 2020	Quantitative non-randomized	70%	Yes	Yes. Not complete	Yes	Yes	unsure	Y