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Implications of Covid-19 Pandemic and Lockdown on the Components of Population Change: A Parsimonious Framework for Research

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Abstract: The COVID-19 pandemic, which originated in China, is unprecedented, the likes of which man has not seen in the last 100 years. It has affected over 200 hundred countries, resulting in 11 million infected cases and 500 thousand deaths and devastated economies without exception. India with a population of 1.2 billion enforced a full lockdown in the early stages of the epidemic in the hopes of preventing an avalanche of infected cases all at once. The effect of the lockdown on the demographic, social, economic and health indicators are likely to be as remarkable as that from the disease itself. The study explores channels through which the epidemic and lockdown impacts on the three demographic processes of fertility, mortality and migration in India. The impacts will depend on whether we are measuring them during the time of the epidemic and lockdown, the intermediate period immediately after the epidemic crisis is over and the lockdown is lifted, and the long-term. The generic framework through which such an impact can be measured is also presented, which will be useful when the data become available.

Keywords: COVID-19 Pandemic, Fertility, Mortality, Migration, Epidemic impact, Demographic Framework.

Introduction

Throughout the ages, epidemics and pandemics have been very much part of societal experience. There have been well documented outbreaks of plague, cholera, tuberculosis, poliomyelitis, malaria, avian flu, dengue, small pox and the HIV-AIDs, to name a few, that have affected many nations at various points in time, causing enormous loss of lives and physical, mental, and economic hardship among survivors. In the first twenty years of the 21st century, mankind has been witness to numerous outbreaks of novel viruses, such as those causing SARS, MERS, Swine Flu, Dengue, and Zika fever, which have affected many countries across continents, irrespective of a country's level of economic and social development. However, man has known only two pandemics in the last 100 years that have wreaked utter havoc worldwide, leaving no country unscathed. One was the Spanish influenza of 1918, which annihilated approximately 50 million of the world's population (McMillen, 2016) and incapacitated millions more, and the second, the coronavirus, or the COVID-19, pandemic that began late in 2019 and continues unabated through the third quarter of 2020.

Undeniably, a disease, whether acute or chronic, inflicts physical pain and mental suffering on the sick. In the case of an outbreak caused by a novel pathogen, there is limited prior knowledge on the etiology of the disease and no past experience to rely on; hence countermeasures adopted against the outbreak initially tend to be nonmedical and rudimentary, relying on a common-sense approach such as hand washing, maintaining personal hygiene and clean surroundings, self-quarantining, and intake of nutritious food. However what makes pandemic such as the one caused by COVID-19 unique in anon-epidemiological sense is the immediate response measures taken by governments throughout

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the world, once the outbreak spread beyond the borders of the country where it originated. At no time in human history, as far back as we know, has there been a worldwide cessation of social and commercial activities as one nation after another imposed a full lockdown. All domestic and international travel was banned; offices and stores selling nonessential items, movie theatres, malls, and restaurants were shut down; and compulsory physical and social distancing and use of face masks in public spaces were enforced to prevent infected cases from entering a country and stop community spread. Even at the peak of the SARS outbreak in 2003, which affected twenty-nine countries across five continents, commerce, trade, domestic and international travel, and other social and personal activities remained largely unaffected, with quarantine and physical and social distancing restricted to infected individuals and family members and high-risk population such as the elderly.

In any novel virus outbreak, the uncertainty of not knowing what one is dealing with and what to expect are likely to induce or exacerbate anxiety and stress in people. Although COVID-19 disease is novel; the collective response of mankind to the outbreak is equally unprecedented. The impact of sudden and severe countermeasures adopted by every country on the demographic outcomes of the country is likely to be as enormous as those caused by the disease itself.

In the present study, we highlight the anticipated consequences of the COVID-19 epidemic and government response to the epidemic on the three components of population change, fertility, mortality and migration, drawing on past experience of individual and collective responses to large-scale disasters, wars and disease outbreaks. The issues raised here are to be considered as hypothesis and need to be validated through qualitative and quantitative studies conducted during and after the pandemic crisis.

COVID-2019 Pandemic: An overview

The COVID-19 outbreak which surfaced in the city of Wuhan in Hubei province in China sometime in late 2019 is a novel and lethal pathogen against which no society has developed herd immunity. Initially thought to be pneumonia of unknown etiology, it rapidly assumed epidemic proportions within China. Around January 14 2020, when data on infected and fatality rates were publically available, a total of 44 patients with pneumonia-like symptoms were reported. China reported to the World Health Organization on January 7, 2020 that a new type of corona virus, 2019-nCoV, that causes the COVID-19 disease, had been identified. Soon confirmed cases of COVID-19, exported through Wuhan city, were found in Thailand, Taiwan, South Korea, and Japan and rapidly spreading to Europe, the United States of America and beyond. With the alarming rapidity of the spread of the virus and severity of infected cases, WHO finally declared the outbreak of COVID-19 as a pandemic on March 11, 2020 and in response, India announced a full lockdown on March 21, 2020.

In a narrow sense, the COVID-19 outbreak is similar to the one caused by H1N1 influenza virus (also known as the Spanish Flu) in 1918; no person had immunity against the COVID-19 disease when it first broke out and neither did anyone at the time of the outbreak of the Spanish influenza. But therein ends the similarity; in 1918, mankind's cumulative knowledge on the causes of diseases, transmission routes, and risk factors was limited. There was very little understanding of the interplay of biological, social, economic and environmental factors in the transmission of infectious diseases and the effectiveness of basic public health measures in stopping the spread of a pathogen. The deplorable post-world war

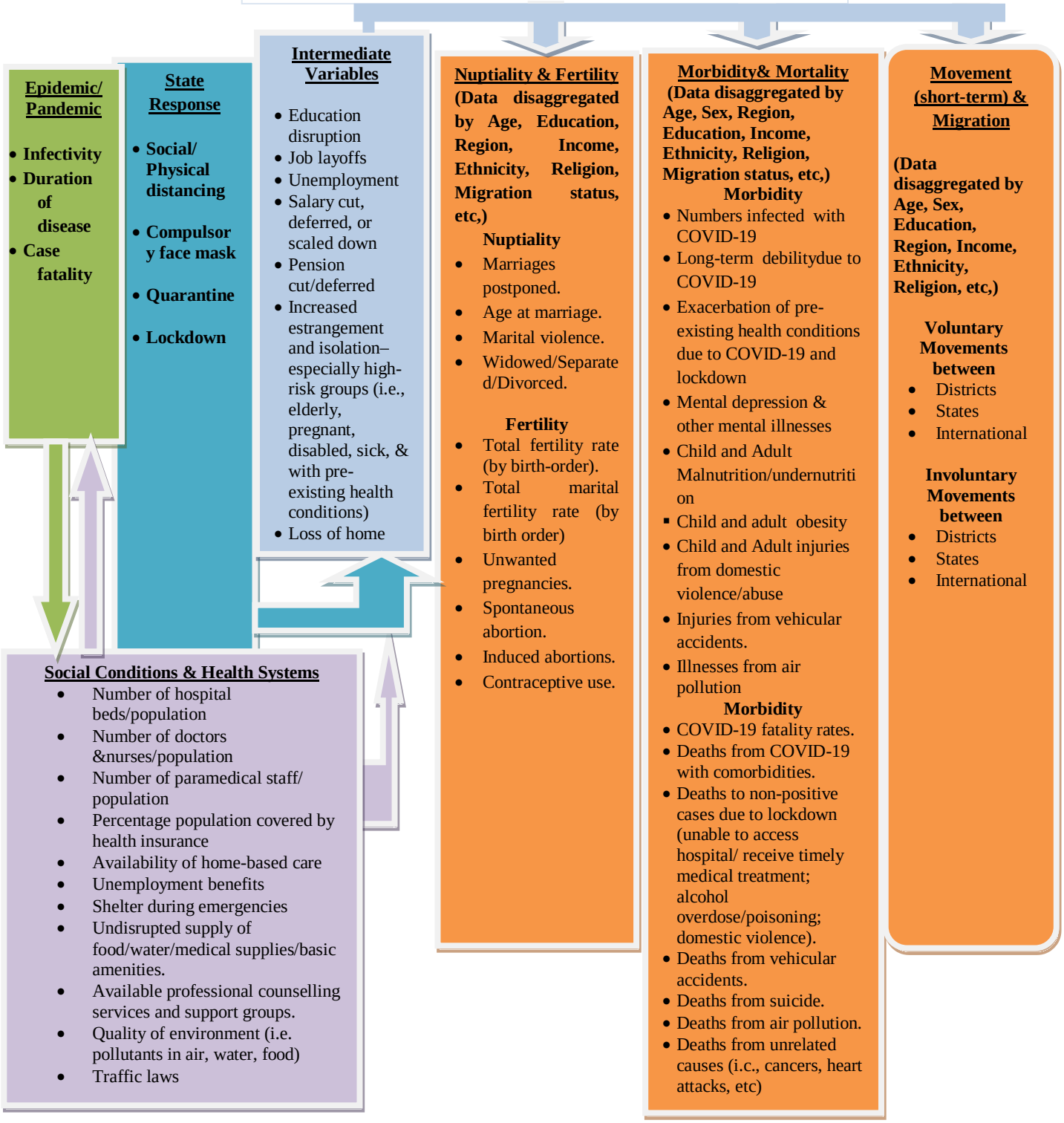
one conditions around the world laid fertile ground for the transmission of the influenza virus to escalate to epic proportions, as soldiers carrying the virus returned from battleground to their countries and infected the unimmuned populations at home.

Since then, our body of knowledge on diseases and prevention, treatment, and containment, strongly backed by observational and experimental evidence, has grown enormously. There have been tremendous advancements in public health surveillance, medical technology, and pharmacology and, importantly, there was the creation of international scientific bodies, such as the WHO and CDC, whose chief responsibilities are international disease surveillance, monitoring actual and potential outbreaks, and disseminating timely warning and information to countries to prevent small outbreaks from becoming epidemics or pandemics. However, despite all these impressive advances, the COVID-19 has taken the world by surprise and exposed the extent of mankind's vulnerability and unpreparedness in combating a novel disease, particularly one that can transmit quickly from person to person and has a case fatality rate higher than that of the seasonal flu (i.e., 0.1%). The COVID-19 was able to spread from the epicentre in China to other countries with alarming rapidity that can only be attributed to technological advancements and improvements in transportation, making short and long distance travel faster, easier, and more convenient, and a normal and essential part of human existence (Le Duc and Nathanson, 2016).

By the end of the first quarter of 2020, the COVID-19 disease had spread to over 200 countries. The total number of infected cases and deaths worldwide, as on June 30 2020, was 11,468,979 and 535,181, respectively, with the United States topping the list with 2,537,636 infected cases, followed by Brazil with 1,344,143 cases, and Russia with 647,849 cases. India, which had only 283 total cases on the day the lockdown was implemented, as against 1,219 cases in the USA, 24,926 cases in Spain, 53,758 cases in Italy, and 21,463 cases in Germany on that day, climbed to the fourth place as soon as some of the lockdown restrictions were relaxed in the month of June, immediately prompting some states with surge in daily cases to clamp down hard again on nonessential travels and commercial and social activities.

Although the lockdown and other countermeasures are adopted to curb community spread of disease and "flatten the curve", by preventing explosion of cases all at once, one cannot discount the fact that these measures will have substantial consequences for the demographic outcomes in the country, over and above the effects of the COVID-19 disease on morbidity and mortality. Although the magnitude and nature of effects can be known fully only after the epidemic has run its course and data for all the key demographic indicators are collected, the crisis effects on the three components of population change, fertility, mortality and migration, and prevailing social and health conditions that moderate the relationships, are explored here in a parsimonious theoretical framework (Figure 1). The mechanisms of the various relationships are discussed throughout the text.

Figure 1: Outbreak impact on demographic components



The Framework

A. Components of demographic change

Mortality and Morbidity

In order to assess the virulence of the COVID-19 disease and adequacy of the healthcare system, the death rates during the epidemic period need to be broken down by: (i) deaths entirely due to COVID-19, (ii) deaths to COVID-19 positive patients triggered by comorbidities, (iii) deaths from non-COVID causes but related in a way to the crisis, such as due to inaccessibility of hospitals, and unavailability, or postponement, of critical medical procedures due to the epidemic and lockdown, and (iv) from other causes such as accidents, heart attacks, liver diseases, kidney failure, and terminal cancers.

Demographically, the coronavirus, like most infectious agents with high potential to affect the lungs, poses greatest morbidity and mortality risks to the oldest-old and very young. As observed during the SARS outbreak in China in 2002 (Karl, Chong and Lai,2004), the number of cases infected with 2019-nCoV virus and deaths from the disease are disproportionately higher for males, especially those ages 65 years and above, possibly attributable to the genetic differences in immune responses between sexes and differences in lifestyle behaviours and other sex related stressors. Data on COVID-19 deaths by 5-year age intervals from the United States show that the rates of death among males is twice that among females in every age group between ages 5 and 75. The sex differential narrows after the age of 75 and broadens in the oldest age group, 85 years and above, when the death rates are higher among females (Table 1). This pattern of sex-age differentials in mortality rate is also observed in other countries having complete death registration systems and significant deaths from COVID-19 to enable the breakdown of data. The COVID-19's long-term impact on morbidity and mortality among other equally vulnerable populations, such as pregnant women and their unborn child and new mothers and their infants, are yet to be understood. As observed among survivors of SARS (Zhang et al., 2020) and H7N9 viruses (Chen et al., 2017), the COVID-19 disease is likely to have long term negative health consequences for the survivors because of lung scarring and tissue damage and the intensity and duration of damage are likely to depend on the survivor's age and comorbidities.

Table 1: Age-Sex differentials in COVID-19 deaths in the US from February 1 to June 27, 2020

Age group	Males			Females		
	COVID-19 Deaths	Total Deaths	Percentage COVID deaths to Total deaths	COVID-19 Deaths	Total Deaths	Percentage COVID deaths to Total deaths
Under 1 year	5	3853	0.13	4	3031	0.13
1-4 years	3	761	0.39	3	564	0.53
5-14 years	11	1209	0.91	3	786	0.38
15-24 years	91	9142	1.00	51	3226	1.58
25-34 years	521	18397	2.83	249	7860	3.17
35-44 years	1397	24470	5.71	575	12845	4.48
45-54 years	3844	44163	8.70	1644	26191	6.28
55-64 years	8888	101007	8.80	4577	63052	7.26
65-74 years	14463	145787	9.92	8870	105400	8.42
75-84 years	16252	161518	10.06	13527	149380	9.06
85 years and over	14507	151854	9.55	22738	242323	9.38
All ages	59982	662161	9.06	52241	614658	8.50

The lockdown in India has hit the poorer sections of the society the hardest. Particularly vulnerable are the school going children from rural families, most of who depend on the mid-day meal scheme provided at the school to meet their daily nutritional requirements. With prolonged closure of schools, 115 million children[2] in India enrolled in the Government of India's mid-day meal scheme are left vulnerable to malnutrition and undernutrition, particularly if their parents are daily wage workers who have lost their livelihood because of the lockdown.

Having to deal with a disease, especially those causing severe symptoms, is physically and mentally exhausting and stressful for the sick. Compounding to this is the psychological impact of estrangement and isolation of the infected individuals and those stranded away from home because of enforced quarantine and lockdown (Chua et al, 2004). Moreover, when dealing with a novel disease, the process of understanding the disease and progress in coming out with effective pharmacological treatments are slow and faltering. As a result, the public are bombarded by mainstream and social media with inconsistent and often misleading information and news bordering on sensationalism on the pandemic crisis, further contributing to confusion, stress, anxiety, and depression (Duan, Linder and Huremović, 2019).

Previous studies (Linn, Sandifer, and Stein, 1985; Rodriguez, Frongillo and Chandra, 2001; Frone, 2018) have shown connection between job loss, prolonged unemployment, and economic uncertainties, and physical and mental wellbeing of individuals, and how these factors can elevate the risks of substance abuse, depression and anxiety disorders, and suicide. This is particularly likely to be true in developing countries where a large percentage of the labour force do menial work, have very little life savings, and depend on the daily earnings to survive.

Prolonged self-isolation and estrangement from family and friends during lockdown and quarantine, fear of the unknown, job loss, and economic uncertainty are likely to trigger depression and anxiety disorders, or exacerbate pre-existing mental illnesses. Media reports from western countries on cases of deaths by suicide during the lockdown prompts careful scrutiny of mortality data on suicides in 2020, specifically for abnormal peaks during the first two quarters of the year.

Not all of the effects of the pandemic and full lockdown are expected to be negative. The severe restriction in movement and closure of all factories and non-essential stores are likely to push down levels of morbidity and mortality caused by vehicular accidents; exposure to serious pathogens from frequent, often unnecessary, visits to hospitals; and alcohol poisoning and overdose, below that of the first two quarters of the year. Since dangerous pollutants in the air and road accidents contribute significantly to morbidity and mortality rates, the most remarkable improvements in health, possibly offsetting increases in morbidity and mortality from the COVID-19 epidemic, are going to be from improved clean air and fewer vehicular accidents because of the full lockdown. Thousands of people die every year in India from road accidents, caused mainly by speed driving, driving under the influence of alcohol, and disregard for basic road safety. In 2018 alone, the number of roads accidents in the country was 467,044 and resulted in 151,417 deaths, mostly among males between the ages 18 and 65 years (Ministry of Road Transport and Highways, GOI, 2019).

[2]Accessed from Ministry of Human Resource Development, Government of India website http://mdm.nic.in/mdm_website/.

With the forceful clampdown on unnecessary road travel and closure of all factories for several months at length, the number of road accidents has come down and the quality of air has improved dramatically in few months.

People that are most likely to benefit, health wise, from the lockdown are those that can work from home. This sizable group has not only kept their jobs and receive monthly pay, but also do not have to deal with the daily stress of workplace pressures and battling traffic at peak hours during the long commute to work and back home. By working from home, they have more time to spend with family; enjoy home-cooked meals; and incorporate exercise, hobby or other non-work activities in their daily routine, to balance work and personal life. These positive changes in lifestyle are likely to prevent many stress-induced chronic diseases, psychosomatic disorders, and mental illnesses. There is some evidence that the suicide rate in the highly work driven Japanese society has come down during the lockdown period for some of the reasons cited above (Farhart, 2020), although some of this immediate advantage may be offset in the long-run by stresses related to the looming economic recession, job insecurities, and high unemployment rates.

It is however premature to conclude that these health gains will be sustained; once the lockdown is lifted, all commercial, manufacturing, and construction activities and work related and leisure travel may resume at a much more frenzied pace, to compensate for economic losses and social isolation endured in the previous months.

Fertility and Nuptiality

In India, marriages are mostly arranged. In traditional Hindu families, the marriage date is fixed based on astrological favourability, with peak marriage seasons typically between November and January and between April and June. The months from July to October are considered to be astrologically unfavourable and hence no marriage is conducted during this period. During the COVID-19 epidemic and full lockdown from March 21, many marriages that typically would have been held between March and end of June are likely to have been postponed. On the one hand, since almost all childbearing in India occurs within marriage (Srinivasan and James, 2015), we can expect to see the birth rate in the early part of 2021 fall below the expected annual rate because of the postponement of marriages. Since for cultural reasons, the first pregnancy in Indian society is never intentionally delayed, the later childbearing (or the tempo effect) is likely to be more pronounced for the first born. This dip is likely to be followed by a small peak in the number of births in late 2021 in a catch-up effect, assuming the pandemic crisis is over and life returns to normal by end of 2020.

Assuming the "fertility recuperation theory", used to explain the post-World War II baby boom in western countries (Van Bavel and Reher, 2013),holds relevance in a pandemic situation, the number of births may continue to show decline seven after the lockdown is lifted, because of worldwide economic recession and high unemployment rates, triggering great uncertainty about the future (OECD, 2020). Fertility studies have highlighted the depressing effects that economic shocks have on the birth rates (Kreyenfeld, 2015), as marriages and childbearing are put on hold during the crisis.

On the other hand, we might witness an increase in the marital fertility rate (i.e., of couples who were already married before end of March) during lockdown as a result of unplanned, or mistimed, second and higher order pregnancies. One should not discount the fact that the risks of marital violence and abuse are likely to increase substantially during full

lockdown, leading to unintended pregnancies that result in either unwanted children being born or spontaneous and induced abortions.

The effects of the epidemic and lockdown on fertility cannot be thought as proceeding in only one, predictable direction. For example, the marriage rate or total fertility rate may dip during lockdown, peak immediately after the lockdown is lifted and continue to oscillate or fluctuate slightly for a while before stabilizing to either the pre-pandemic normal, or a new normal defined by a changed world.

Migration

While outbreaks impact morbidity and mortality directly, migration is largely affected by non-medical responses, such as lockdowns, quarantines and social distancing, against the outbreak. When lockdowns were enforced simultaneously across countries, Indian citizens, specifically students, contract workers, and tourists, stranded abroad were brought back to the country during the peak of the pandemic crisis, suddenly reversing the migration flow from India to other more developed countries, resulting in an influx of positive cases into the country. However, the most severely impacted by the lockdown were the internal migrant workers, most of whom were living in the large metro-cities in the country at the time of the lockdown.

Migration data from Census 2011 show that there are over 17 million migrants in India, ages 9 years and above, who had moved specifically for work reasons. The bulk of these migrant workers are from within state (66%) and from rural areas (64%) and are more likely to be seasonal workers who take up menial jobs in the city during the off-peak farming season and return home during the peak farming season. There are also sizable numbers of economic distress migrants from rural and semi-urban areas who are forced to move to the cities to take up any kind of menial work because they have lost their agricultural land; have huge debts to pay off; have large expenses; and/or they have no livelihood opportunities back home. During the COVID-19 pandemic, most of the migrant workers lost their jobs and were unable to support themselves in the cities during the extended lockdown period. While no one knows the exact numbers, some demographers estimate that there may have been around 42 million[3]internal migrants in the large cities who were forced to return home because of the lockdown. According to the Ministry of Home Affairs of the Government of India[4], around 10.5 million domestic migrant workers were transported back to their homes via special trains and buses. If these estimates are anywhere close to the actual figures, the mass movement of people across borders, within short span of time, would be the biggest in the history of India, outside of what transpired in 1947 during the partition of the country.

While it is easy to conjecture the short-term (within next six months) epidemic and lockdown effects on migration rates, the long-term effects are not that easy to identify. The trauma of losing their jobs, wages, and livelihood prospects, coupled with trying to navigate

[3] This figure is estimated from an interview given by demographer Professor Irudaya Rajan to the news media. Professor Rajan estimates, based on 2011 census, that there are around 140 million internal migrants in the large cities currently, out of which 30% are likely to have returned home during lockdown period.https://www.news18.com/news/india/lockdown-left-millions-of-migrants-empty-handed-govt-should-give-rs-25000-to-each-of-them-irudaya-rajan-2657853.html

[4] This figure is based on a television interview given by the Minister of Home Affairs of the Government of India, Mr. Amit Shah, on June 28 2020. https://www.youtube.com/watch?v=i5ETwNBV1Js.
The GOI's response to a writ petition on *problems and miseries of migrant labourers* submitted to the Supreme Court of India states that 9.8 million migrant workers were transported back to their homes via special trains and buses. https://main.sci.gov.in/daily-order

their way back home hundreds of miles away without institutional and infrastructural support and, in most cases, transport is likely to leave many migrants with deep emotional scars and make them hesitant to seek work outside their home state, at least for some months after the epidemic is over. In the next few years, or until the memories of their harrowing experiences fade and the economic situation in the country improves considerably, most employment-related move by the unskilled is likely to be confined to within state and, most probably, to cities and towns nearer home. As for the Indian migrant workers, skilled and semi-killed, who lost their jobs in other countries because of lockdowns and had to return home, they are likely to find fewer job opportunities again outside the country because of economic recession and high unemployment rates throughout the world. Consequently, international outmigration of Indians to the west and the middle-east is likely to slow down in the next few years, while distress migration of unskilled young adults from neighbouring, poorer countries into India are likely to see substantial increase.

B. Health and social conditions as Moderators

Although severity of an epidemic is determined by the reproduction rate of the pathogen, duration of disease, and case fatality rate, its ill effects on health can be mitigated to large extent if the country has high quality health care system and favourable social and economic conditions. In India, the basic healthcare system, specifically infrastructure, is seriously inadequate. When both public and private sectors are taken together, there are 69,265 hospitals in the country contributing a total of 1,929,692 beds (Kapoor et al, 2020). Based on the above estimates, India has only 14.86 hospital beds for every 10,000 people (Table 2). The number of hospital beds available in the country, at the time of an epidemic crisis of this scale, is grossly insufficient and considerably below what is available in other large countries with comparable numbers of infected cases. Despite the fact that India sees a continuous growth in the number of newly established hospitals, nearly 63% of the hospitals are privately-owned and 62% of the hospital beds are in the private sector, making hospital-based care expensive and unaffordable for most people in the country. Overwhelming majority of hospital beds are also in urban areas, because private hospitals, which contribute the most beds to the health infrastructure, are disproportionately in urban areas. An avalanche of infected cases, in the absence of a lockdown, would have resulted in the collapse of the health care delivery system and led to a mortality crisis.

Table 2: Number of hospital beds per 10,000 population for ten countries with the highest number of total infected cases of COVID-19 as on June 30 2020

Country	Total infected cases (as on June 30, 2020)	Total deaths (as on June 30, 2020)	Hospital beds/10,000 population
USA	2537636	126203	28.7[1]
Brazil	1344143	57622	20.9[1]
Russia	647849	9320	71.2[2]
India	566840	16893	14.8[4]
UK	311969	43575	24.6[3]
Peru	279419	9317	15.9[1]
Chile	275999	6384	20.6[2]
Spain	248970	28346	29.7[2]
Italy	240436	34744	31.4[2]
Iran	225205	10670	15.6[1]

Data: WHO https://covid19.who.int/, https://www.who.int/data/gho/data/indicators/indicator-details/GHO/hospital-beds-(per-10-000-population), [1]2017, [2]2018,[3]2019,[4]Figures for hospital beds taken from Kapoor et al (2020) and projected population of India in 2018 from National Health Profile 2018, 13th Issue, Government of India.

People living in countries that are able to provide universal healthcare and insurance; financial safety nets for the poor, unemployment benefits; and high quality, affordable and easily accessible healthcare facilities, along with options for homecare and counselling services; shelters for the temporarily homeless; and undisrupted supply of water, food, and electricity during the entire crisis period will be able to weather the storm, especially when the health crisis calls for a response measure as extreme as a full and long lockdown.

The WHO estimates that 7 million deaths in 2012 are from diseases linked to air pollution and 3.7 million deaths alone are caused by outdoor air pollutants (WHO, 2014). Forty percent of deaths from Ischemic heart disease, 40% from strokes, 11% from COPD, and 6% from lung cancer worldwide are attributable to harmful pollutants in the air. This is particularly a big health problem in countries, such as India, where over urbanization and weak or poorly enforced environmental protection laws result in massive loss of human lives caused by diseases related to the high levels of pollutants in the air and a large proportion of the population living permanently with debilitating health conditions. According to WHO, there were 1.5 million deaths in India in 2012 associated with air pollution. By contrast, countries with clean environments are less likely to witness heavy casualties from epidemics, specifically those caused by viruses, such as the 2019-nCoV virus, that severely affect the respiratory tract and can be fatal for those with compromised immunity and pre-existing comorbidities.

Conclusion and future work

The generic framework postulated here will help streamline future research work in the demographic areas most likely to be impacted or altered by the recent COVID-19 pandemic. It identifies the key demographic outcomes where change is anticipated and explores the mechanisms of the relationships between epidemic, countermeasures, health and social conditions, and components of population change.

It is more than four months since full lockdown was declared when the number of infected cases in the country was less than 100. Since then, India has continued to see a daily surge in infected cases, even though the death rate from COVID-19 has more or less stabilized except for occasional peaks. Despite the continued escalation of cases in the country, the relatively low numbers of total infected cases and deaths in relation to population size has puzzled many, considering that India is the second largest country in the world in population size, next to China, and has some of the world's most densely populated cities that see relentless migration from rural and semi-urban areas within the country and from less developed and war-torn neighbouring countries. India also has a poor quality and inequitable healthcare system that would be unable to withstand a large explosion of infected cases, as is typically the situation in an unprecedented disease outbreak. Under such conditions, one would not be wrong in assuming that the official numbers on the infected cases and deaths in India are understated. The key reasons why this may be the case has been put forth by some demographers (Srinivasan, 2020). The first contributing factor is that there have been far fewer tests done in the country proportionate to the population size to reflect the reality accurately. Second, India has an incomplete death registration system, with only 80% national coverage, which also varies widely across states. Many deaths from COVID-19 occurring outside of hospitals are not likely to be reported and hence not included in the official statistics. Third, there are gaping irregularities and inconsistencies across hospitals in the way deaths due to COVID-19 and comorbidities are reported. One should also probably factor in the use of faulty testing equipment that increases the number of false positives, or

false negatives. However, simulation studies on the COVID-19 growth rate and trends in daily cases suggest that enforcing a complete lockdown, specifically a freeze on all social activities and mass congregation, during the early stage of the epidemic may have prevented an unmanageable explosion of infected cases and kept the number of deaths relatively low (PIB, Government of India, 2020). This is also partly a result of the worldwide media coverage on the COVID-19 pandemic that enabled India as well as other countries to swiftly put into place stringent public health measures before the situation could worsen in their country. Such extensive media coverage was not available in many countries during earlier pandemics.

The demographic changes India can expect to see as a result of the pandemic and lockdown will also depend on the quality of data on the variables used in study. It is unfortunate that after many months of the epidemic crisis, only rudimentary data on morbidity and mortality are available in the country, whereas, during the same time period, data broken down by important demographic characteristics, such as sex, age, race, ethnicity, pregnancy-status, and region were made available to the public in many developed countries. Without such details, it is impossible to identify populations that have been most vulnerable to the epidemic and lockdown, assess how effectively the country is or has been able to handle the crisis, and whether the interventions and aid were directed towards those most in need.

From morbidity and mortality data from other countries, we know that the pandemic has significant impact on the age and sex distributions of population. The hospital records from many western countries show that older males are most vulnerable to the disease and have higher mortality than females in the corresponding age groups. However, we do not know whether the same mortality by sex pattern is observed in India, where gender inequalities in nutrition, health care, and economic and social status have made women more susceptible to illnesses and severely undermined the female survival advantage from biological factors. We have also yet to identify other populations susceptible to the virus and the long-term health of survivors of all ages. Unless and until we are able to scrutinise the death records and do follow-up studies on the survivors of COVID-19, as done in China in 2002-2003 among survivors of the SARS epidemic, we will be unable to learn all that we need to know about COVID-19 and its target populations.

The prevailing social conditions and health systems play critical roles in mitigating the severity of the epidemic and full lockdown on people, specifically stress and physical hardships caused by job layoff; salary cut or deferment, pension cut; loss of home; unavailability of work; disruption in education; and isolation and estrangement from family. The quality of the health care system is important in increasing the survival chances of the sick, especially in the case of novel diseases where there is no one standardised treatment protocol and the approach is through trial and error.

The framework discussed here is a macro model that can be aggregated at state, district and/or national levels. Since the epidemic is in progress, we will not be able to put to test the usefulness and validity of the model by measuring the parameters. Although the framework throws a spotlight on the demographic measures most likely to be affected by the COVID-19 pandemic and response measures, it makes no stolid predictions about the direction of impact on the various measures of fertility, mortality and migration for two reasons. First, the nature of impact is also likely to depend on the socioeconomic and demographic characteristics of the study population. For example, unlike for the poor and

daily wage workers, whose subsistence and physical survival under threat during peak lockdown, the crisis is less likely to undermine the physical wellbeing of the more affluent social classes, who have secure jobs and comfortable lifesavings to help them tide over the lockdown period.

The second, and possibly the most important reason, is, although the effects discussed here convey a linear, sequential demographic response to the pandemic crisis and countermeasures, in reality, for most demographic outcomes, we are likely to see an immediate effect during the lockdown, followed by intermediate, fluctuating effects immediately following the lifting of the lockdown, and then a long-term stabilization at newer norms. The immediate, intermediate, and long-term impact to a new a normal may be applicable to all three demographic processes – fertility, mortality and migration.

If anything, this pandemic has certainly forced many countries to take stock of and evaluate the adequacy of and vulnerabilities in their existing healthcare system, public health surveillance system, public and private support systems for poor migrant workers, institutional and home care for the elderly, and laws on conservation and protection of environment and sustainable use of natural resources and the enforcement of the laws. The re-evaluation and retrospection are likely to encourage governments to change the way they function that will enable them to address the immediate and intermediate health, economic and social challenges from the COVID-19 pandemic and lockdown in their country and plan for long term goals in the health and economic sectors. India currently spends less than 2% of the GDP in health care. In February, before the start of the pandemic, the government pledged to increase the spending to 2.5% of the GDP by 2025. This would still be inadequate to meet the newly emerging health challenges in the country; hopefully, the current pandemic will now force the government to shift their priorities even more towards health.

In all likelihood, we will see epidemics and pandemics in future (Nathanson, 2016), but whether or not any one of them will turn out to be of the COVID-19 scale cannot be predicted. However, studying the impact of the current pandemic crisis and global response to the outbreak on the demographic components of population change will enable us to put things in perspective and help push future research agenda in the necessary direction.

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