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India Diverges in Gender Proportion in COVID-19: A Health Management Study

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Abstract

The primary objective of this study was to investigate the male and female proportion for various countries and India. The secondary aim of the study was to identify the multiple influencing factors that are playing a role in the male to female ratio and how India differs from other countries. For this study, we have used the available data and reports from various countries, health organisations and WHO from Dec 2019 to May 2020 for comparison and interpretation. There are multiple influencers for women getting less infected by COVID-19. There are biological reasons such as chromosomes and oestrogen; lifestyle reasons such as smoking and drinking habits, and controlled food habits; social causes such as working hard in rural areas, less exposure to the crowd and minimal international travelling opportunities; cultural reasons such as less social gathering, default social distancing system and also there is an assumption that Indian women are culturally more disciplined. It is vital to understand gender-based differences in the human immune systems and how it affects the spread of the virus. Knowing the steps and precautionary measures can help us to prevent the spread of coronavirus. Prevention is always better than cure. By following the advisories from WHO and other nation's health organisation, making a collaborative effort, we all should be able to manage better.

Keyword: Coronavirus, COVID-19, Gender proportion, Influencing factors, Immune system.

Introduction

Cambridge dictionary has defined coronavirus as 'a type of virus that causes diseases in humans and animals. In humans, it usually causes respiratory infections that are not serious, but that can sometimes cause more serious infections that can kill people'¹

COVID-19 is an infectious disease caused by a newly discovered novel coronavirus. People infected with the COVID-19 virus experience mild to moderate respiratory illness, and most of the times recover without any special treatment. Aged people and others who have underlying medical problems like cardio disease, diabetes, chronic respiratory disease or cancer are more likely to develop serious illness. Protect yourself and others from infection by washing your hands or using an alcohol-based rub frequently and not touching your face. The COVID-19 virus spreads primarily through the droplets of saliva or discharge from the nose when an infected person coughs or sneezes, so it is essential that you also practice respiratory etiquette. Currently, there are no specific vaccines or treatments for COVID-19. However, various clinical trials are being conducted for evaluating potential treatment opportunities².

Coronavirus is a type of common virus that infects humans, usually leading to an upper respiratory infection. So far, seven different types of human coronavirus have been identified. Majority of people can be infected with at least one type of coronavirus in their lifetime. The viruses are blown out in the air by coughing and sneezing and touching an object or surface contaminated with the virus, personal contact or by faecal contamination, one can

get infected. The sickness caused by most coronaviruses usually lasts a short time and is identified by a runny nose, fever, cough and sore throat.

Human coronaviruses may cause severe symptoms to include MERS-CoV (Middle East Respiratory Syndrome), SARS-CoV (Severe Acute Respiratory Syndrome) and the COVID-19 outbreak, which began in Wuhan, China. The WHO announced COVID-19 as a pandemic on 11 March. This led to an unprecedented closure of

schools, industries, banks, businesses and public life in the USA, the UK and also other nations have started practising social distancing to reduce or prevent infection. SARS-CoV-2. Also called COVID-19, causes a possibly deadly respiratory infection identified for the first time in the Wuhan City of China in December 2019. The virus spread in a short time to the majority of the countries³.

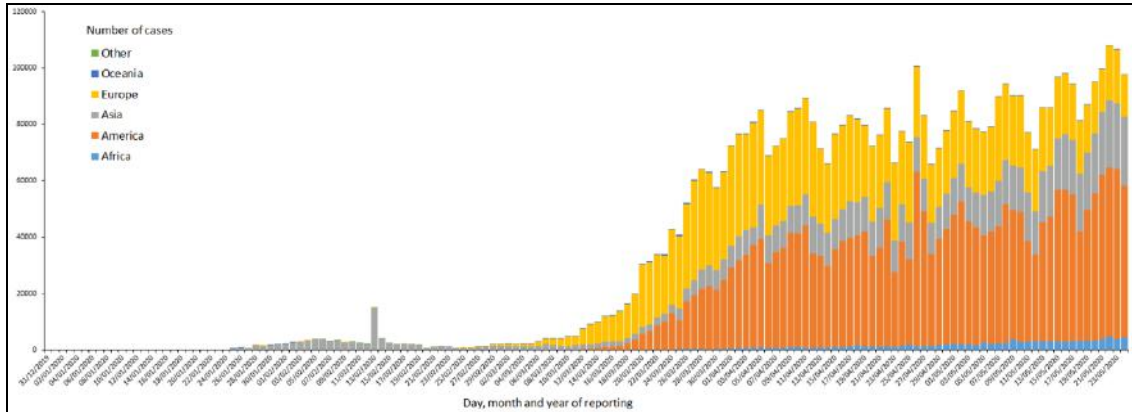


Figure 1. Geographical distribution of COVID-19³¹.

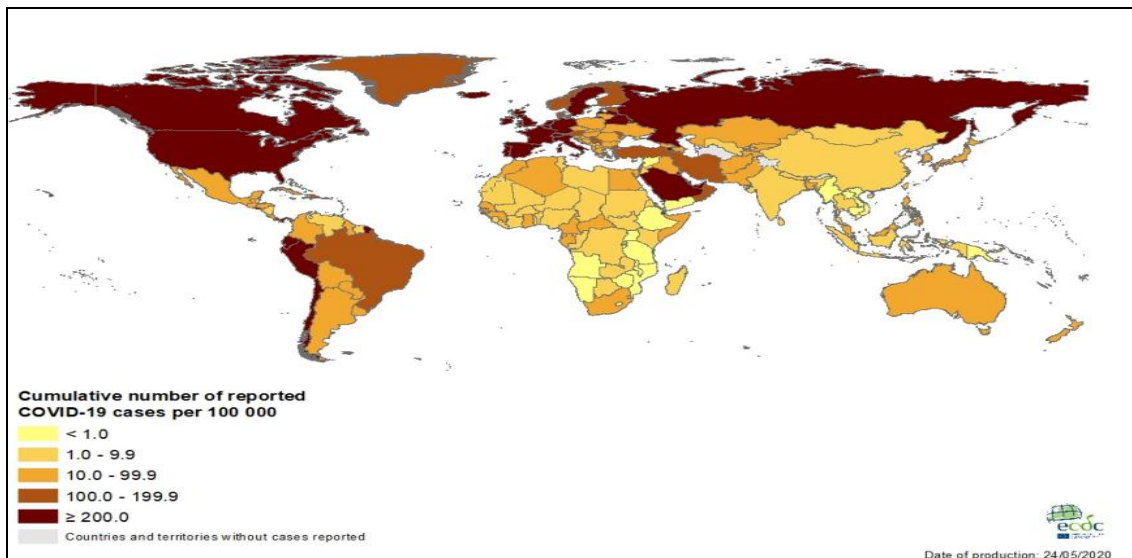


Figure 2. Cumulative number of reported COVID-19 cases³¹

So far, 213 countries and territories around the world have reported a total of 5,447,674 confirmed cases of COVID-19 and a death toll of 344,773. Below are the top 10 coronaviruses affected countries⁴.

Country	Cases	Deaths	Region
United States	1,672,386	98,792	North America
Brazil	352,163	22,214	South America
Russia	344,481	3,541	Europe
Spain	282,370	28,678	Europe
United Kingdom	257,154	36,675	Europe
Italy	229,327	32,735	Europe
France	182,469	28,332	Europe
Germany	180,084	8,371	Europe
Turkey	155,686	4,308	Asia
India	137,608	4,004	Asia

Table 1. Country-wise confirmed cases of COVID-19⁴.

Motivation

COVID-19 is hitting almost all countries and regions. The number of affected people is increasing day by day. Irrespective of age, sex, nation, lifestyle and economic status, the coronavirus is affecting human beings and even, nowadays, birds and animals too. Without partiality, this virus has affected people from the front-line workers to prime ministers. There are no standard patterns to understand which gender is being affected more as it varies from country to country. However, overall, men are affected more than women in most of the regions; this applies to both confirmed cases and death cases. But in India, there is a considerable difference in the proportion of male and female, i.e., 75% of men and 25% female, which is diverging from the global statistics. This tremendous gap motivates us to study in deep to understand the reason or influencers better.

Approach

In this article, we investigate in detail the COVID-19 statistics for confirmed as well as death cases across the globe and particularly in India. By doing this analysis, we try to understand the proportion of affected men and women. Primarily, we do this analysis in two parts. One part is globally seeing the ratio of men and women affected by COVID-19. Another part is to understand in what ways India differs from various other nations. It is evident that in most of the countries, more men are affected; however, the proportion difference between men and women is enormous in India. From various sources, it is evident that there are numerous known reasons for this pattern. However, it is critical to understand completely what makes India to differ from other nations and to identify the influencing factors.

Objectives of the study

1. To understand the men and women proportion in COVID-19 confirmed and death cases globally.
2. To identify the cause for less women affected and died less in India due to COVID-19.

Facts and Figures: Male vs Female

In India, the report of COVID-19 cases and fatalities shows that men are more susceptible to the infection than women. Of the total infected cases so far, 76% were males and 24% females.

Also, men accounted for more deaths at 73% than women, at 27%. The infection ratio is 3:1 (as of 7 April 2020)⁵.

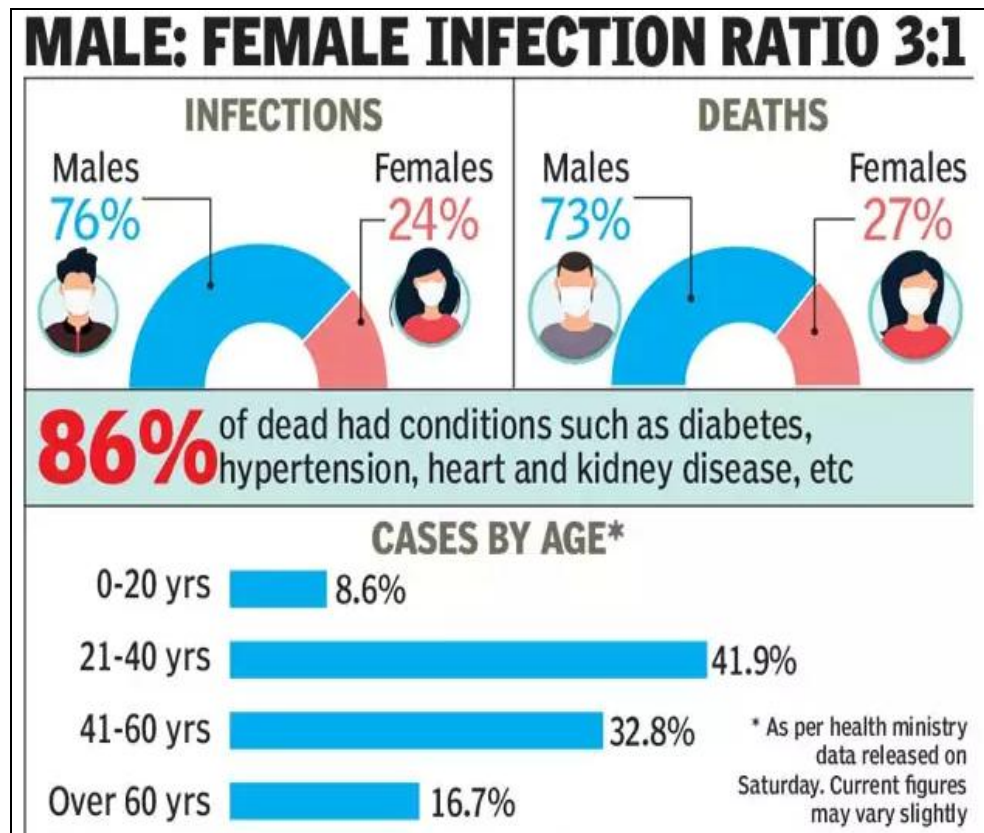


Figure 3. The male and female infection ratio⁵.

Data collected from various countries that are affected by COVID-19ⁱ indicates that men are at a higher risk of having severe symptoms and dying compared to women. Based on the information from various countries, more men are losing lives to the disease. For example, in Italy, so far, 71% of the dead are men and 29% are women. When we look at Spain, which is another major global hotspot, it has seen 65% deaths of men and only 35% women (as of 3 April 2020)

It is well known to the medical professionals that men can be more susceptibleⁱⁱ to infections than women. Women generally tend to have a more robust immune system, though this perception is still qualified for argument. Genetic and hormonal factors may play a vital role in this; however, environmental factors could also influence a more robust immune system. It is also a fact that while women tend to have a more robust immune system, more than 80% of all autoimmuneⁱⁱⁱ diseases (rheumatoid arthritis, systemic lupus erythematosus (lupus), inflammatory bowel disease (IBD), multiple sclerosis (MS), type 1 diabetes mellitus, Guillain-Barre syndrome, chronic inflammatory demyelinating polyneuropathy and psoriasis) are attributed to women^{6,7,8,9,10}.

ⁱ <https://www.statista.com/topics/5994/the-coronavirus-disease-covid-19-outbreak/>

ⁱⁱ <https://www.scientificamerican.com/article/infections-reveal-inequality-between-the-sexes/>

ⁱⁱⁱ <https://www.webmd.com/a-to-z-guides/autoimmune-diseases>

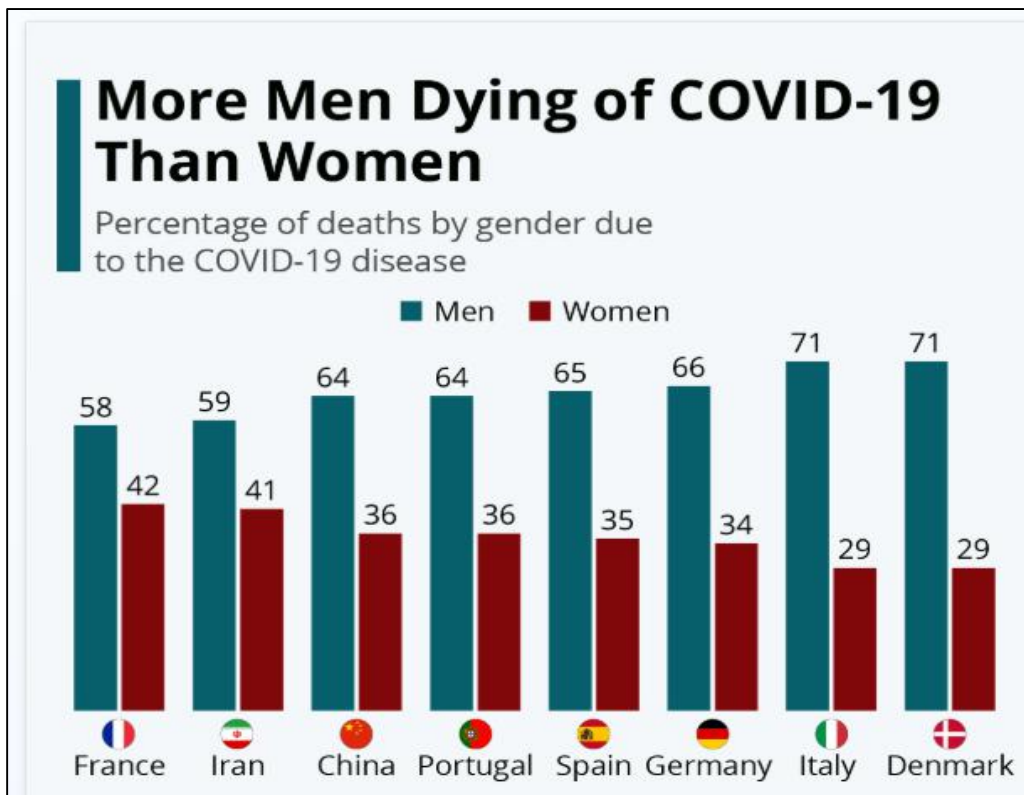


Figure 4. The male and female death ratio in various nations⁶

A research report from China says that COVID-19 is infecting men and women in about equal numbers; however, it looks like fewer women die from the virus than men. A study comprised of 44,600 people affected by COVID-19 (The Chinese Center for Disease Control) shows that the death rate of the men was 2.8%, compared with 1.7% for women. As per scientists, there could be multiple reasons for this difference, which includes biological and lifestyle factors. It appears that Chinese men smoke more, which can deteriorate their immune system. On another side, naturally, women tend to have a more robust immune system against the virus. However, the virus appears to affect women too. This could be because of the fact that the fight against COVID-19 continues and more women are working as a front-line warrior^{11,12,13}.

Authorities from China have sent around 41K health workers from around the country to assist medical staff at the epicentre in Hubei province. According to the Shanghai Women's Federation, as of 24 February, 3,387 health workers in China were infected with COVID-19, around 90% of them in Hubei. In the total health sector workforce in Hubei province, 90% of the nurses and 50% of the doctors are women. To be precise, women make up the majority of workers in the health sector, around 70% in 104 countries as analysed^{iv} by the WHO.

^{iv} <https://apps.who.int/iris/bitstream/handle/10665/311314/WHO-HIS-HWF-Gender-WP1-2019.1-eng.pdf?sequence=1&isAllowed=y>

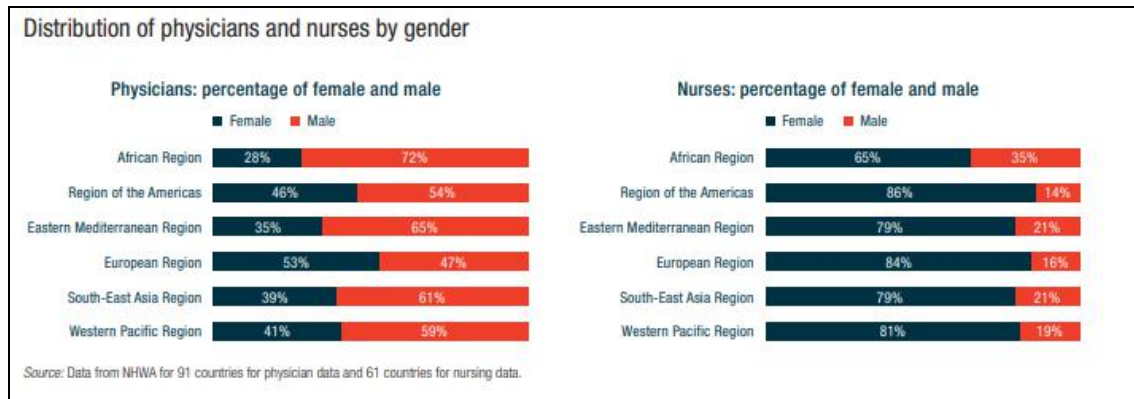


Figure 5. The distribution of the workforce in the health sector globally¹²

In contrast with many countries, in India, more men appear disproportionately likely to test positive for COVID-19 than women. This may be a statistical reflection of a relatively low number of testing for this particular disease in India. As of 6 April, the Health Ministry said that 76% of the confirmed cases in India were men. Many countries, including the UK and the US, are publicising data on cases and death rates do not have sex-disaggregated national data. However, 40 countries have shared such data. Global Health 50/50, an independent research initiative that tracks gender and health, suggest that the gender-split in all countries is roughly 50-50, barring two exceptions: India and Pakistan, and 72% of Pakistan's 4,004 cases have been confirmed in men.

Out of the 17,551 cases in Greece, 55% are men. Out of the 124,547 cases, 53% are men in Italy. In China, though the data has not been updated since 28 February, out of the 55,924 cases, the ratio is 51:49 for men to women. An unusual pattern is observed in South Korea, the country that has conducted the maximum number of tests. They have found that more women confirmed positive than men, i.e., 60%. Germany too, has tested significantly and found a 50:50 ratio in its total cases of 99,255.

Overall, in most of the countries, men were more likely to die than women, which is almost twice (from the data available for 18 countries). India did not share its national figures on COVID-19 mortality rates in men and women. Giridhar Babu, an epidemiologist, associated with the Public Health Foundation of India, mentioned that it could be because of most countries may have more international travellers, which could be a significant source for infections and that is why the numbers were almost likely to be equal in men or women. Possibly it could be the reflection of employment trends in India as women are much less likely involved in international travel¹⁴.

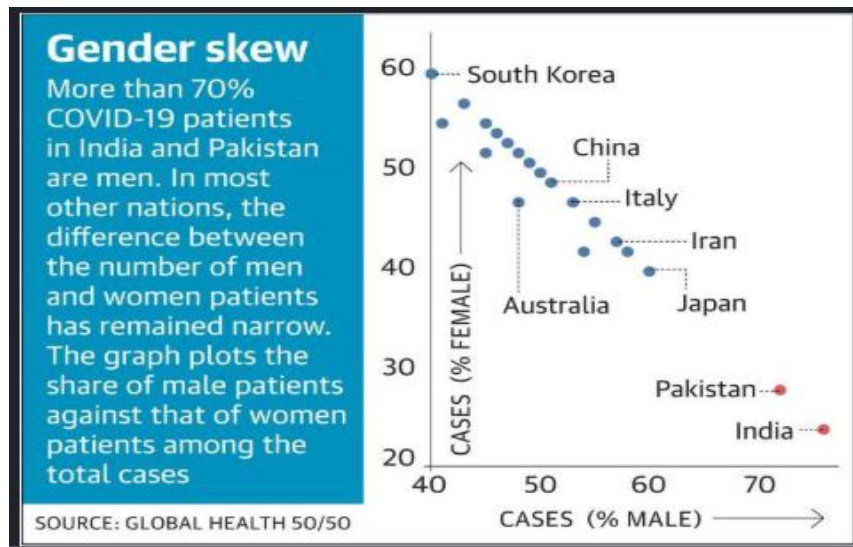


Figure 6. The proportion of male and female patients in various nations²³

Novel coronavirus has affected over two million people globally. The global data indicate that the mortality rate is much higher in men than women. Dr Sharon Moalem, a physician and rare disease specialist, explained why women managed better in fighting COVID-19 than men. 'X chromosomes are necessary for survival and contain important genes related to the brain. Y chromosomes are found only in males and are not crucial for survival. Females have two X chromosomes, whereas males have one X and one Y chromosome. Men are more biologically breakable due to this'. In countries like South Korea, though more women tested positive for COVID-19, more men have died. 'Men have more muscle mass and physical strength, but that doesn't help for long life. However, women are born with the advantage of longevity because they have XX chromosome,' Dr Moalem said. Another reason why women are genetically stronger than men is that they have a more robust immune system due to oestrogen in their body. Along with two X chromosomes and oestrogen, women are stronger and fight against diseases. Men have testosterone, which reduces immunity and hence are biologically fragile¹⁵.

'Mortality in males seems to be high on (twice) every age group of females', Dr Deborah Birx, the coronavirus task force coordinator at the White House, mentioned during a Friday briefing. As per Italy's public health^v research agency, so far, 60% of coronavirus confirmed cases and 70% of deaths in the country are men. 64% of deaths in China have been of men according to recent data from China's Center for Disease Control. 'While we have no idea about the causes of increased mortality in men, we are much aware that being male and also older is a risk factor for more severe health issues from COVID-19', Sabra Klein, a professor (molecular microbiology and immunology) at Johns Hopkins Bloomberg School of Public Health, said to ABC News^{16,17}.

At this point, currently, most theories about why this virus is hitting men harder than women are hypothetical, stressed Dr Carlos del Rio (infectious diseases expert) at Emory University. 'Females usually having greater immune responses than males', Klein noted, although she mentioned this has to be proven in case of COVID-19. Del Rio seemed to agree, 'Women oppose better with other diseases than men', he said. Men are likely to suffer from some obscuring conditions such as cardio disease, stroke and hypertension, which put them at severe risk for bad consequences from contracting coronavirus, Klein explained. 'Hypertension, in particular, has been suggested as an important risk factor and is more predominant in men than women', she said. 'This could be reflective of our biology as well as behaviours'.

Seven in every 10 COVID-19 confirmed and death cases in India involve males, while women are currently sharing the lesser burden of the lethal viral disease. The first gender-based analysis of the COVID-19 cases in India released by the health ministry has revealed that 76% (of India's current 4,067 cases) are males and 24% are females. Similarly, out of 109 deaths, 73% are men and 27 are women. The COVID-19 cases nationally hopped in the last 24 hours by 693, and nearly 32 deaths were reported, which shows the progression towards a peaking trend (as of 6 April 2020). The Health Ministry also examined age-wise death trends and identified 63% of all deaths as of people aged 60 and above. Out of 109 deaths, 30% have been reported in people who are 40 to 60 years old, and 7% are people below 40 years. The analysis of the deceased persons show that in 86% of the 109 deaths in the country so far, the patient had comorbid conditions like diabetes, chronic kidney disease, hypertension and cardiac issues. [16], [17]. Data from 6 April discloses that a significantly high portion of men in India tested positive for COVID-19 compared to other countries. However, statistics from seven states that provide a gender-wise split of the infected cases show that the trend still holds good, though the difference has pointed down. In India, as of 6 April, 76% of the patients were male, which is the maximum share among the countries which released gender-wise data. Pakistan too has a similar pattern¹⁸.

^v <https://abcnews.go.com/alerts/obamacare>

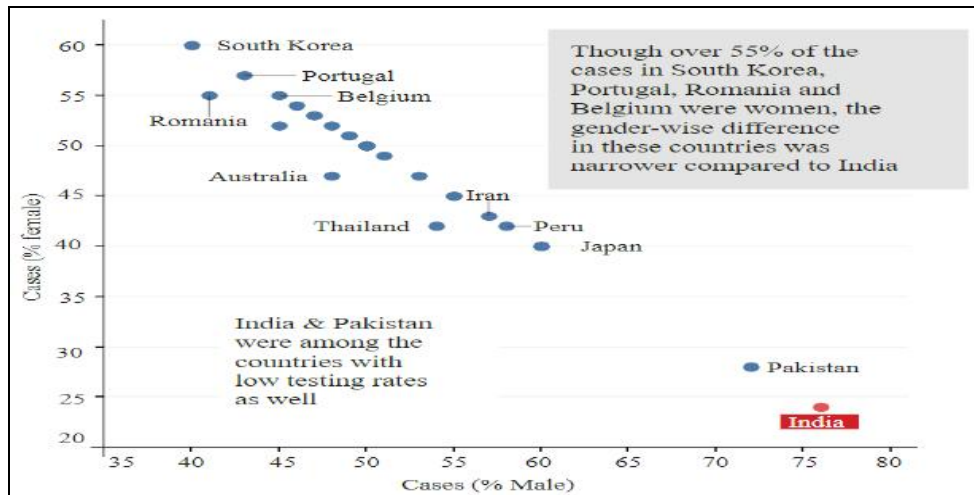


Figure 7. The gender-wise difference in multiple countries (confirmed cases)¹⁴

State	Male %	Female %
Maharashtra	62	38
Telangana	68	32
Tamilnadu	66.5	33.5
Karnataka	64	36
Bihar	58	42
Odisha	64	36
Jharkhand	75	25

Table 2. Gender proportion in various states of India (confirmed cases)¹⁴

Some of the countries have published a full demographic profile of their coronavirus patients since the disease manifested late last year. The available data suggest that men seem to be in the majority of coronavirus deaths worldwide. However, globally, men and women are equal in numbers for confirmed cases. Conclusively, the analysis found that men are 50% to 80% more likely to die due to COVID-19 than women.

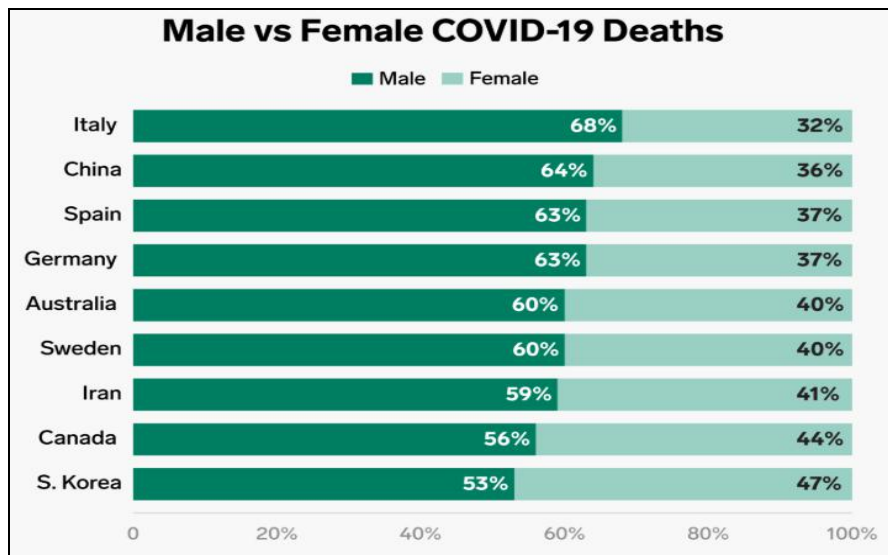


Figure 8. Male vs female deaths¹⁹

As per the data in Figure 6, Italy has reported the differences between male and female deaths, with men contributing 68% of the country's confirmed cases. Two other nations, Greece and Peru, not listed on the chart, have seen a higher proportion of male deaths, i.e. 72%. We observe a similar pattern for countries with smaller epidemics. For instance, Australia has reported around 6,000 cases compared to hundreds of thousands in Spain, Italy and Germany. No country in the analysis indicated a higher portion of women dying from the virus than men. In South Korea, 60% of the confirmed coronavirus cases are women, but more men have died. On average, men smoke cigarettes more than women, which leads to respiratory problems. As per the Chinese Center for Disease Control and Prevention, 50% of Chinese men smoke compared to 3% women. Similarly, in Italy, around seven million men smoke compared to 4.5 million women. According to the Italian National Health Institute, the requirements of intensive care and ventilation for smokers are double that for non-smokers. Biological factors could also play a role to some extent in the difference between male and female deaths due to COVID-19¹⁹.

The novel coronavirus destroys the life of human beings and the economy of multiple countries across the world. COVID-19 is sickening many people and has killed at least 50,000 individuals to date. Day by day, scientists are learning more about it. People aged 60 and above are at a higher risk of dying from coronavirus, based on the data from China, Italy and South Korea. Additionally, men appear to have higher fatality rates. (as of 3 April 2020). 'Researchers have found sex differences in each tissue and organ system in the human body, including the immune system,' says Caroline Criado Perez²⁰.

One crucial lifestyle risk factor for diminishing life due to coronavirus is through travelling. Women's and men's different travel patterns could also explain the reason for the apparent imbalance of coronavirus cases. Research indicates that mobility is experienced differently by women and men. Both genders use different modes of transport for different purposes and in different ways. In addition to their paid labour force participation, women tend to take on a more significant role for unpaid care responsibilities for the family, which leads to multiple trips, could be either shorter or longer distance. According to the Shanghai Women's Federation, 90% of nurses and more than half of doctors are women, battling coronavirus in Hubei. This replicates the global share of high female employment in the health and social sectors. WHO has analysed and estimated that 67% of the health workforce in 104 countries are female. As every individual, government and health organisation prepare to contain the novel coronavirus, it is essential to understand the potential gender dimension of the risk for a possible infection. Here, women's leadership in emergency response teams may play a key role²¹.

As the global death numbers from the novel coronavirus increases rapidly, the evidence is proving that more men than women are becoming extremely ill and dying from the virus. On 29 April, a study published in *Frontiers in Public Health*^{vi} reviewed data on 37 COVID-19 patients who died early in the outbreak in Wuhan. In that group, men were 2.4 times more likely to die than women. 'While men and women had the same vulnerability, men were more likely to dying', as mentioned by the authors. In the New York state, as of 5 May, about 60% of the total deaths reported (more than 19,600) are men.

Scientists are yet to understand the cause of this pattern. Marcia Stefanick, professor of medicine at Stanford University, told the *Wall Street Journal*,^{vii} 'There are deep sex differences in immune systems, and this epidemic is revealing them.' But, she noted, 'What is biology versus what are our social norms and gender behaviours confounds our ability to understand what's going on?'

Finding answers could help develop more effective treatment protocols and prevention measures, as well as lead to a more successful vaccine. Researchers^{viii} think that women are more resistant to diseases because most women have two X chromosomes, which help them have a more robust immune system. Hormones might also help provide women with a more effective defence. Immune cells have oestrogen receptors and an oestrogen supplement has been shown^{ix} to increase general immune responses in mice. One of the factors could be the

^{vi} <https://covid19tracker.health.ny.gov/views/NYS-COVID19-Tracker/NYSDOHCOVID-19Tracker-Fatalities?%3Aembed=yes&%3Atoolbar=no&%3Atabs=n>

^{vii} <https://www.wsj.com/articles/coronavirus-seems-to-be-infecting-and-killing-more-men-than-women-11585819801>

^{viii} https://www.researchgate.net/publication/276067139_Sex_differences_in_immune_responses_to_infectious_diseases

^{ix} <https://www.ncbi.nlm.nih.gov/pubmed/16237062>

smoking rates. On 17 March, A review of existing research^x concluded that ‘smoking is most likely associated with the negative progression and adverse outcomes of COVID-19’. Smokers are more likely to have lung disease, which is an established risk factor for a severe infection. In South Korea, according to a paper in *Clinical Infectious Diseases*,^{xi} just 38% of the patients were male. However, according to that analysis, men were about twice as likely to die from the disease (1.19% for men versus 0.52% for women).

In Spain, the country’s Health Ministry reported^{xii} that men and women comprise about an equal number of COVID-19 cases, as of 3 April 2020. But men were more likely to die, about two-thirds of the deaths. A study about the hard-hit region of Lombardy^{xiii}, Italy, found that 82% of the patients admitted to the ICU were men. Around 70% of the people who have died due to coronavirus are men. A study conducted by *JAMA* on 5,700 hospitalised COVID-19 patients in the New York City found that about 60% them were men. Also, 66.5% of those admitted to the ICU were men. It is also found that every age group over 20, men died at a higher rate than women²².

Currently, in the pandemic, we are unable to provide a precise answer to the question which gender is experiencing more issues with COVID-19. However, experience and evidence so far convey that both sex and habit are essential drivers of risk and response to infection and disease. To understand the role gender is playing in the COVID-19 outbreak, countries must begin both collecting and publicly reporting sex-disaggregated data. In partnership with CNN, Global Health 50/50 started collating publicly available sex-disaggregated data reported by various countries to date and is exploring how gender may feature in the higher reported deaths in men among the confirmed cases so far. Until now, based on the data, there is no scientifically proven pattern in terms of which gender is more likely to become infected with COVID-19. However, the available data shows that among the confirmed cases, men are continually dying at a higher rate across countries. When we analyse the reason for men to be dying at a higher rate from COVID-19 than women, it looks like biology is playing a vital role. Differences in both innate and adaptive immune responses help women to tackle this novel virus more effectively. However, the virus also appears to be taking advantage of this and increasing the gender-driven health inequalities. For example, there is some evidence that the presence of previous medical conditions such as cardio and lung sicknesses may increase the risk of death from COVID-19. Worldwide rates of heart and lung disease are higher in men. Much of this illness is influenced by gender as in

general men smoke tobacco and drink alcohol more than women²³.

Tackling COVID-19 needs detailed and gender-disaggregated data that highlights any variation in the distribution of infection and clinical outcomes across the population. Understanding why we see a variance between the genders will add more value to the research and help address both the underlying biological differences and social conditions that are likely leading to higher percentage of severe illness and death in men. Only such data can help in better decision making and evidence can be utilised in public health policy. Understanding gender-related factors concerning global health should not be seen as elective but to be considered as a core element to ensure effective and adequate health systems that work for everyone. National governments and global health organisations must look into this immediately²³.

^x <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7083240/pdf/TID-18-20.pdf>

^{xi} <https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa354/5813861>

^{xii} <https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/Documents/INFORMES/Informes COVID-19/Informe n%C2%BA 20. Situaci%C3%B3n de COVID-19 en Espa%C3%B1a a 3 de abril de 2020.pdf>

^{xiii} https://jamanetwork.com/journals/jama/fullarticle/2764365?guestAccessKey=30d46ccf-ea21-4205-89b7-30e89cdb7b53&utm_source=twitter&utm_medium=social_jama&utm_term=3251819456&utm_campaign=article_alert&li nkId=85926589

Country	Sex-disaggregated?	Date	Cases	Cases (% male)	Cases (% female)	Deaths	deaths (% male)	deaths (% female)	Deaths in confirmed cases (Male:female ratio)
Thailand	Yes	16.05.20	3,025	54	46	56	77	23	2.8
Dominican Republic	Yes	17.05.20	12,725	54	46	434	72	28	2.2
Greece	Yes	19.05.20	2,832	55	45	166	72	28	2.1
The Netherlands	Yes	19.05.20	44,196	37	63	5,715	55	45	2.1
Belgium	Yes	18.05.20	55,664	37	63	6,475	51	49	1.8
Denmark	Yes	19.05.20	11,044	42	58	551	57	43	1.8
Italy	Yes	14.05.20	2,21,895	46	54	29,692	60	40	1.8
Romania	Yes	17.05.20	16,911	45	55	1,107	60	40	1.8
Spain	Yes	18.05.20	2,38,892	43	57	19,186	57	43	1.8
South Africa	Yes	18.05.20	16,244	42	58	286	56	44	1.8
Bosnia and Herzegovina	Yes	13.05.20	994	45	55	37	59	41	1.8
China	Yes	28.02.20	55,924	51	49	2,114	64	36	1.7
Sweden	Yes	19.05.20	30,799	42	58	3,743	55	45	1.7
Peru	Yes	18.05.20	94,933	60	40	2,789	71	29	1.7
Northern Ireland	Yes	19.05.20	4,415	39	61	488	52	48	1.7
England	Yes	12.05.20	1,37,090	46	54	29,654	59	41	1.7
Ecuador	Yes	19.05.20	25,195	56	44	2,839	66	34	1.6
South Korea	Yes	19.05.20	11,078	41	59	263	52	48	1.6
Switzerland	Yes	19.05.20	30,590	46	54	1,614	58	42	1.6
Mexico	Yes	18.05.20	51,633	58	42	5,332	66	32	1.6

Table 3. Confirmed as well as death cases: men and women global³².

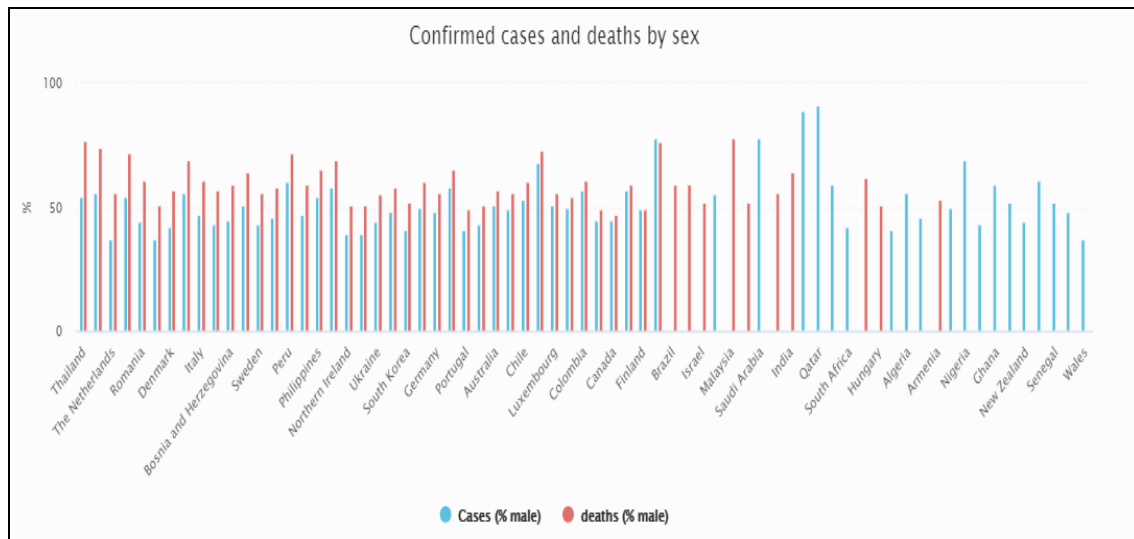


Figure 9. Confirmed as well as death cases: men and women globally³².

The spread of COVID-19 in Italy has infected females somewhat more than men. As per Figure 8, 54% of individuals infected with the virus were female and 46% male. The first case was detected

at the end of January and COVID-19 has been spreading fast. As of 19 May 2020, the authorities reported 226,000 cases in the country²⁴.

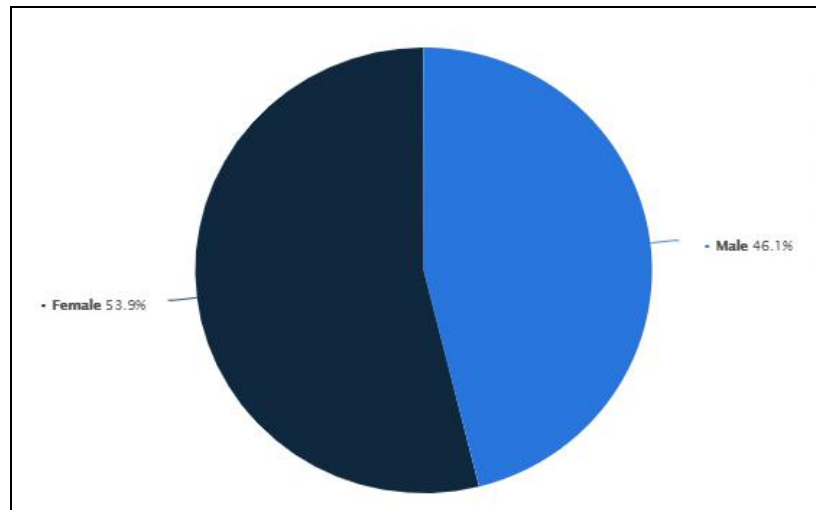


Figure 10. The female and male proportion for COVID-19 infection in Italy³³.

MEDD (Medical Education and Drugs Department) published a report with the trends of daily COVID-19 cases in India. Presently, positive cases in India have reached 4,442 and the death toll has reached 109 (as of 6 April 2020). In Maharashtra, out of 490 cases, 63% (308) patients were male and 37% (182) patients were female²⁵.

Women have a more exceptional ability to fight against infections and diseases than men. Another reason behind more men dying is possibly due to COVID-19 could be smoking habits; 31.6 crores of people smoke in China while only 2.8 crores of Chinese women smoke. As per the publication by the *Annals of Internal Medicine*, other diseases such as SARS in 2003 and MERS in 2012 also killed more men than women. Research on mice also indicates that males are more vulnerable to infection than females²⁶.

On 6 April 2020, the health ministry said that 76% of the coronavirus patients in India are men and 24% are women. During a press meet on COVID-19, The Health Ministry Joint Secretary Lav Agarwal also said that 73% of the COVID-19 deaths had been reported in men while 27% in women²⁷.

The updated data received for Australia does not give any clue whether men are affected more or women (Figures 11 and 12). Both in confirmed and death cases, for multiple age groups, the infection is scattered. In some groups, the women are more affected, which is contrary to the data for India and a few other nations where the men count are high in both confirmed and death cases²⁸.

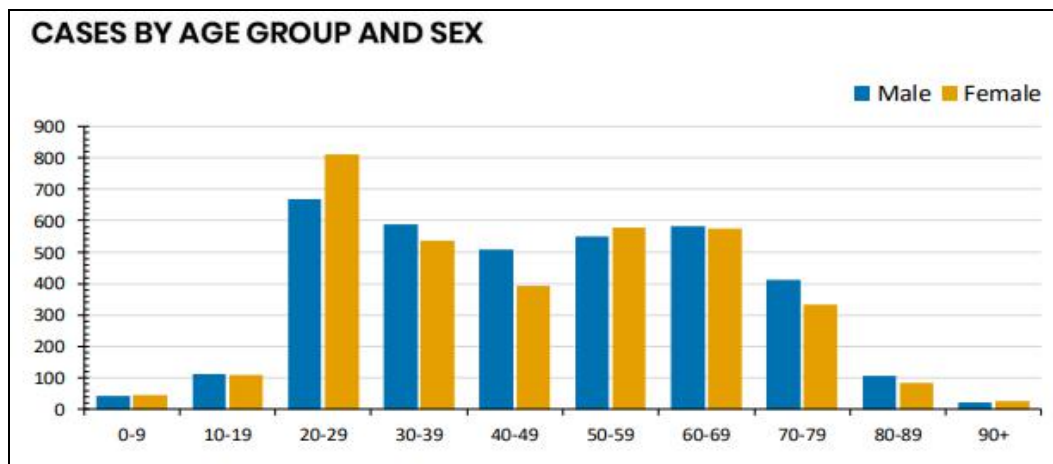


Figure 11. Confirmed cases by age group and sex²⁸

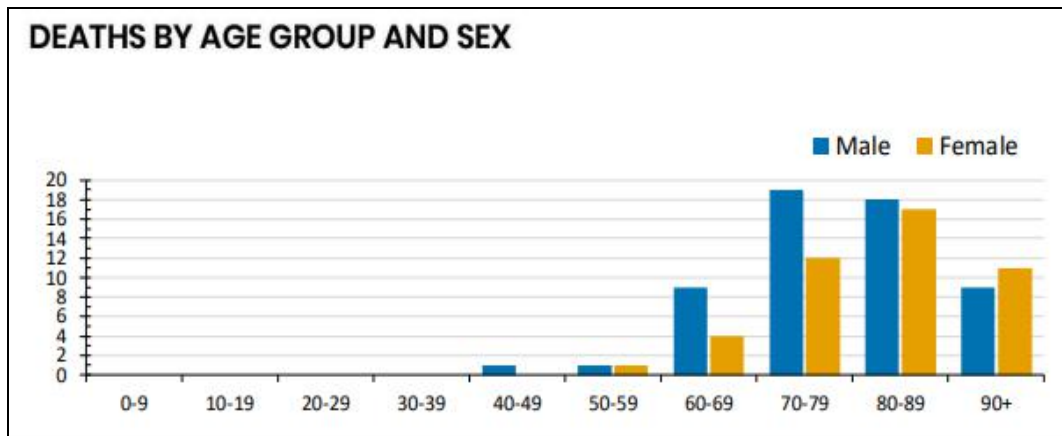


Figure 12. Deaths by age group and sex²⁸

Discussion and interpretation

According to India's Health Ministry report, 76% of the coronavirus patients are men, and 24% are women (figure 3). 73% of the COVID-19 deaths are men, while 27% are women. The men vs female ratio are around 3:1 in both infected and death cases. A similar pattern is observed in Italy and Spain too and the male death rate is 71% and 65% respectively (figure 4). Also, as per the data from CCDC, infected men and women are almost equal in numbers, but the death rate of men is 2.8% as compared with 1.7% for women. In Greece, 55% of the affected are male, while in Italy, 53% are male (reference 14). In South Korea, more women (60% of the cases) have been confirmed positive than men. In Germany, the ratio is 50:50. Most of the countries are not sharing gender-based data publicly. However, from the available sources, gender-split in all countries is roughly 50–50, with two exceptions, India and Pakistan. As of 26 May 2020, in Tamilnadu, 11,217 men and 6,506 women are affected, which is 64% and 36% respectively.

The medical professionals have the opinion that men are more vulnerable to viruses. Women are likely to have a more robust immune system; however, this is still open for discussion. It is also the fact that more than 80% of all autoimmune diseases are attributed to women. As per scientists, there could be multiple reasons for such men and women proportions, including biological and lifestyle factors (reference 11,12 and 13). Another critical point to note here is that most of the front-line warriors are female in the health sector. Blood sample collection, testing, scanning, receptionist, nursing and interacting with the public for medical examination and data collection is mostly done by women. To be precise, 90% of the nurses and 50% of the doctors are women in Hubei. As per WHO, around 70% workforce is women in the health sector, based on the data from 104 countries. As per the advisory from an epidemiologist, international travel may be the reason for the spread of the infection, which could be the cause for equal ratio in men and women in Western countries. But in India, women are less involved in international travel, and this is because the number of employed women in India is comparatively less. Multiple medical experts mentioned that X chromosome is necessary for survival and contain essential genes related to the brain. Females have two X chromosomes, whereas the Y chromosome found only in males is not crucial for survival. Males have one X and one Y chromosome; hence men are biologically more vulnerable than women. Along with double XX chromosome and oestrogen, women are stronger and fight against diseases (reference 15). From the resources, 85% of the people who are reaching the age of 100 years are women and almost 95% of the people who are entering the age of 110 years are women, which indicates better survival of the women due to their more robust immune system. Men have testosterone, which reduces immunity and hence they are biologically fragile. Men are more likely to suffer from conditions such as cardio disease, stroke and hypertension, which put them further into the risk. Worldwide, the rate of heart and lung disease is higher in men. Much of this illness is influenced by gender as generally men tend to both smoke and drink more than women do (reference 23)

It is understood that there are various reasons for men getting more affected by coronavirus than women. The y chromosome, smoking and alcohol and the associated diseases, travelling exposure, more employment opportunity and extended social gathering may be the causes for men getting more affected. Two X chromosomes, presence of oestrogen, less smoking, less social gathering, comparatively less travelling

exposure, lower employment opportunity and strong mental ability are the reasons for women being more resistant to the coronavirus. Due to these reasons, though the number of confirmed cases is equal or in some countries even more in women, the death rate is less than that of males. It is crucial to understand why India is different from other nations due to its 3:1 ratio in confirmed and death cases.

Majority of the Indian population is from the rural areas and the majority of women are in agricultural where they need to work hard daily. This helps maintain good health by default so that they can fight better against any diseases, including coronavirus. Since the majority of women are in rural areas, professional and industrial employment opportunity for them is not as bright as men. Although there are well-educated females in the cities, only some of them are professionally working. Comparatively, the number of working women is less when we consider the population in India as a whole. Due to this, the exposure to interact with others and also international travel is less for Indian women.

Another critical factor is exposure to smoking and alcohol consumption. Indian women are comparatively less exposed to smoking and drinking than women from foreign nations. This lifestyle has kept them away from cardio, lung, hypertension and other diseases. The Indian food style is also different from that of other nations. Maybe in some of the developed cities of India, the food pattern could be somewhat similar to that of the foreign countries, in the rural areas, the majority is following the traditional food habits, which helps them maintain a better immune system. Junk food is not easily available and known to most women from rural areas. Also, they are engaged in hard work, which may also help them to maintain their health at a reasonable level. While social distancing is requested by governments and health organisations to avoid the spread of COVID-19, Indian female is already well maintaining the social distancing following the Indian culture. This could be another significant reason for less infection to women.

So, conclusively, we assume that there are multiple influencers for women getting less infected by COVID-19. There are biological reasons such as chromosomes and oestrogen; lifestyle reasons such as smoking and drinking habits, and controlled food habits; social causes such as working hard in rural areas, less exposure to the crowd and minimal international travelling opportunities; cultural reasons such as less social gathering, default social distancing system and also there is an assumption that Indian women are culturally more disciplined.

Conclusion

Every epidemic has a different pattern and affects people differently. WHO had announced COVID-19 as a pandemic. Irrespective of age, social status, financial status and sex, it affects the people globally. From this study, it is understandable that women can resist better to the diseases due to various biological, social, cultural and lifestyle reasons. Though men are biologically weak, they can also withstand the diseases better if they avoid smoking and drinking. By doing this, they can add more immunity to their biological system. COVID-19 is a potentially serious infectious viral disease for which there is no vaccination to prevent and presently or therapeutic medicines to cure the affected patients. Doctors and health organisations are attempting to treat the patients with different combinations of the available drugs as a trial and error method as advised by ICMR and WHO. It helps to some extent only and not completely to handle all cases. Due to this, we have lost the lives of valuable human beings. It is a fact that there is a difference in confirmed and death cases based on the gender and the associated factors are also investigated. However, it is vital to understand gender-based differences in the human immune systems and how it affects the spread of the virus. Knowing the steps and precautionary measures can help us to prevent the spread of coronavirus. Prevention is always better than cure. It is easier to stop something from happening in the first place than to rectify the damage after it has happened. By following the advisories from WHO and other nation's health organisation, making a collaborative effort, we all should be able to manage better.

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