Knowledge, Attitude and Practice (KAP) study on COVID-19 Vaccination in Bangladesh

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A thesis submitted to the Department of Mathematics and Natural Sciences in partial fulfillment of the requirements for the degree of

B.Sc. in Biotechnology

Department of Mathematics and Natural Sciences

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December 2021

Declaration

It is hereby declared that

1. The thesis submitted is our own original work while completing a degree at Brac University.

2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.

3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.

4. We have acknowledged all main sources of help.

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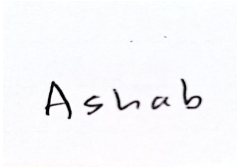

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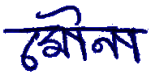

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Acknowledgement

We would first like to express our undying gratitude to the Almighty for keeping us in good health, despite the circumstances, and allowing us to conduct our research without any major obstacles.

Our profound thesis advisor Prof. Dr. Naser of the Biotechnology, School of Data and Sciences at BRAC University. The door to Prof. Naser's office was always open whenever we ran into trouble or had a question about our research or writing. He helped us shape the paper by steering us in the right direction whenever we seeked.

Additionally, we would like to thank the research assistant who collected responses for our survey. Without their passionate participation and input, the validation survey could not have been successfully conducted.

We would also like to acknowledge his profound help in aiding us to mold this paper from nothing into something meaningful, Md. Abdullah Al Kamran Khan of the Biotechnology Department at BRAC University. As well as gracefully being the second reader of this thesis, we are gratefully indebted to him for his very valuable comments on this paper.

Finally, we would like to say that none of us would be here without the constant support of our parents and their encouragement throughout the entire process. For pushing us and making us recognise our abilities and not letting us give up when everything seemed hopeless. Thank you.

Abstract

Coronavirus Disease 2019 (COVID-19), an infectious respiratory disease caused by the viral strain, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has become a distinct cause of the global burden and a rising concern to global public health. Despite earliest cases dating back to mid november of 2019, COVID-19 cases were first confirmed on the 8th of march in Bangladesh. While initial treatments followed generalized drug use based on treating symptoms or antibody-based therapies, the need for vaccines remained to be of significant importance. With the need for vaccines to get the world back on track, scientists through their extensive study and research developed vaccines at the earliest i.e. within a year (2020). Similarly, Bangladesh adapted and began immediate administration of COVID-19 vaccines on 27 January 2021, while mass vaccination started on 7 February 2021. However, the fast production and distribution of vaccines has raised questions and possible suspicions. This along with several other factors such as knowledge, attitude and practice (KAP) of the Bangladeshi population had contributed to an overall decreased rate of vaccinations. Therefore, in our study, we evaluate these correlating factors of KAP with COVID-19 Vaccination to understand how knowledge, attitude and practice, may have possibly contributed to this reduced rate and consequently, in the spike or as a trigger for the second wave.

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List of Acronyms

COVID-19 Coronavirus Disease 2019

SARS-CoV-2 Severe Acute Respiratory Syndrome Coronavirus 2

KAP Knowledge, Attitude and Practice

HCoV Human Coronavirus

MERS-CoV Middle East Respiratory Syndrome

SARS-CoV Severe Acute Respiratory Syndrome

alpha-CoVs *Alphacoronaviruses*

beta-CoVs *Betacoronavirus*

PHEIC Public Health Emergency of International Concern

ACE2 Angiotensin-Converting Enzyme 2

RBD Receptor-Binding Domain

N protein Nucleocapsid Protein

M protein Membrane Protein

E protein Envelope Protein

S protein Spike Glycoprotein

WHO World Health Organization

IEDCR Institute of Epidemiology, Disease Control and Research

rt-PCR reverse transcription–polymerase chain reaction

BRAC Bangladesh Rural Advancement Committee

BUX Brac University Online Learning Platform

COVAX COVID-19 Vaccines

RMG Ready-Made Garment

IL-6 Interleukin-6

TNF-α Tumour Necrosis Factor alpha

HIV Human Immunodeficiency Virus

RNA Ribonucleic acid

RBD Receptor Binding Domain

FDA Food and Drug Administration

ARDS Acute respiratory distress syndrome

PPE Personal Protective Equipment

EUA Emergency Use Authorization

modRNA modified mRNA

mRNA Messenger ribonucleic acid

VAERS Vaccine Adverse Event Reporting System

J & J vaccine Johnson & Johnson vaccine

CNBG China National Biotec Group

SPO_2 Oxygen saturation

1. Introduction

The existence of the now infamously known human coronaviruses (HCoV) date back to the 1960s with representations of mild respiratory infections, despite first cases being reported in the 1930s in domestic and laboratory animals. Inclusive of several pathogenic agents which infect mammals or birds, coronaviruses belong to the Coronaviridae family and are responsible for an array of human illnesses. Such illnesses may range from trivial and common colds to severe diseases and even death, caused by Middle East Respiratory Syndrome (MERS-CoV), Severe Acute Respiratory Syndrome (SARS-CoV) and Severe Acute Respiratory Syndrome 2 (SARS-CoV-2) [1, 2]. The family, *Coronaviridae*, is divided into two subfamilies, *Letovirinae and Orthocoronavirinae*. *Orthocoronavirinae* again includes four different genera including *Alphacoronavirus, Betacoronavirus, Gammacoronavirus*, and *Deltacoronavirus*; A*lphacoronaviruses* (alpha-CoVs) and *Betacoronavuruses* (beta-CoVs) mostly causing the human diseases. Moreover, an overall of seven human coronaviruses have been reported and identified till this date, which include - alpha-CoVs such as HCoVs-NL63 and HCoVs-229E, and beta-CoVs such as HCoVs-HKU1, HCoVs-OC43, SARS-CoV, MERS-CoV and SARS-CoV-2 [3, 4]. Among these, SARS-CoV, MERS-CoV and SARS-CoV-2 have been known for their deadly consequences worldwide; SARS-CoV-2 being the current strain of infection, leading to the highest number of deaths in this current pandemic. SARS-CoV-2 is the viral strain responsible for the infectious respiratory disease, now infamously termed as Coronavirus Disease 2019 (COVID-19) and since its emergence, the virus has mutated and evolved, giving rise to its

multiple variants. The scenario has led to global emergencies owing to its transmission pattern, and a rising global health concern, while scientists provided their unparalleled efforts in the development of effective vaccines. However, similar to SARS-CoV and MERS-CoV, SARS-CoV-2 cases were initially seen to adapt to symptomatic and supportive treatments with no effective antiviral therapies or vaccines present. Additionally, while vaccine developments for MERS-CoV were reported to show some progress, there was a lack of representative immunity to viral infections [5,6]. In the case of COVID-19 however, rigorous efforts by scientists and their extensive research had led them to the production of vaccines within a span of one year, in 2020. Similarly, Bangladesh had adapted and began immediate administration of COVID-19 vaccines on 27 January 2021, while mass vaccination started on 7 February 2021. However, several factors alongside the quick production of vaccines had raised concerns in terms of safety and the need for its administration. While a possible solution to contain the virus had existed, individuals with differing perspectives regarding vaccines, made it harder for the world to get back to normal. To assess such variations in terms of knowledge, attitude and practice (KAP) of the Bangladeshi population and to evaluate how these variables interlink, leading to a decreased vaccination rate and a trigger for the second wave.

2. Coronavirus Disease: historical significance and 2019 emergence

The early traces of coronaviruses date back to the 1960s, causing mild upper respiratory tract infections, when the initial viral strains known as HCoV-229E and HCoV-OC43 were isolated. SARS-CoV, responsible for one of the major outbreaks then, had emerged during 2003 and following this, HCoV-NL63 and HKU1 were isolated and identified in the Netherlands and in

Hong Kong, respectively [7]. Over the years, new strains had emerged, leading to catastrophic outbreaks. The strains responsible for such large-scale and life-threatening outbreaks included SARS-CoV in 2003, MERS-CoV in 2012, and the ongoing SARS-CoV-2 in 2019 [8 - 14]. The 2003 SARS-CoV emerged from the Guangdong province of southern China in November 2002 and it's rapid transmission led to 29 countries being infected and a total of 8096 confirmed cases with 774 deaths by August 2003 [15 - 17]. However, human cases for SARS-CoV were not reported any time after May 2004 and in 2012, MERS-CoV had emerged from Saudi Arabia and rapidly claimed lives following its outbreak. As per WHO data, 2574 cases were confirmed with 885 confirmed deaths from April 2012 till March 2021 [18]. While MERS remains to be present in a toned down manner till this date, the largest and current outbreak involving SARS-CoV-2 had emerged amidst the year of 2019. SARS-CoV-2, being the causative agent spread much faster all over the world leading to the now, global pandemic. The virus, known for its transmission through close contact, via aerosols and respiratory droplets exhaled during talking, breathing, coughing or sneezing [19, 20], include pathways such as direct, indirect or close contact, droplet, airborne, fomite, fecal-oral, bloodborne, mother-to-child, and animal-to-human. [21]. Subsequently, symptoms may range within the non-specific range being asymptomatic or lead to severe pneumonia and death. The milder and common COVID-19 representations include fever, cough, myalgia or fatigue; and atypical symptoms include sputum, headache, hemoptysis, and diarrhoea [22]. COVID-19 affects individuals from all present age ranges however, it is far more prevalent and life-threatening among people of ages 70 and higher, and in those with present underlying comorbidities [23, 24]. While this December 2019 emerged disease in Wuhan, China had been pronounced a public health emergency of international concern (PHEIC)

by the World Health Organization (WHO) on 30 January 2020 and a pandemic on 11 March 2020 [25 - 27], countries all over the world struggled to prepare and outweigh its drawbacks. Simultaneously, countries towards their initial steps for preparation, adapted to symptomatic treatment approaches while waiting for the production and arrival of vaccines. With extended and preogressive research, scientists had sequenced the first SARS-CoV-2 genome and published it on 10th January 2020 [28]. Consequently, this approach led to the development in the vaccine area, and phase trials and number of vaccine candidates moved at an unprecedented speed, leading to the now available vaccines [29].

3. SARS-COV-2 Genomic Constitution and Pathomechanism

SARS-CoV-2 is reportedly known to be a single-stranded, enveloped, positive-sense RNA virus of about 30 kb in size [30] and a predominantly inherited spherical structure, with solar-crown imitating proteins protruding from its surface [31]. Similar to conventional betacoronaviruses, they also constitute a 5′ methylated cap and a 3′ polyadenylated tails [32, 33]; the 5′ methylated cap includes a non-structural protein coding region (having non- structural proteins, nsp1-16) comprising significant genes, which are termed crucial for viral replication [33, 34] and the 3′-terminal region encodes the 4 structural proteins - spike protein, envelope protein, membrane protein, and nucleocapsid protein, which are absolutely necessary for the life cycle of a virus. The spike protein, also known as the S glycoprotein, is a transmembrane protein located on the virus surface and appears to include homotrimers on the surface as well. These S proteins facilitate the binding of viral particles to the host through the angiotensin-converting enzyme 2

(ACE2) receptors, which are present in abundance in the lower respiratory tract region [35]. Attachment leads to the cleaving of the S glycoprotein by the furin-like protease of the host cell, into an N-terminal S1 subunit consisting of a ACE2-specific receptor-binding domain (RBD), and a viral fusion-facilitating (in transmitting host cells) membrane-bound C-terminal S2 region [36 - 39]. The nucleocapsid protein or N protein is situated at the endoplasmic reticulum-Golgi region, attached to the viral nucleic acid material. Consequently, the N protein is known to be associated with processes implicating the genome of the virus, its cycle of replicating and the host cell response towards the viral infection [40]. Moreover, while the Membrane protein or M protein influences the shape of the viral envelope and the binding to other structural proteins, the envelope or E protein governs the viral multiplication as well as maturation [41]. The 16 non-structural proteins also contribute to the regulation of the viral infection mechanism. Owing to these very proteins and their contributory roles, pathogenesis appears to be greatly aided.

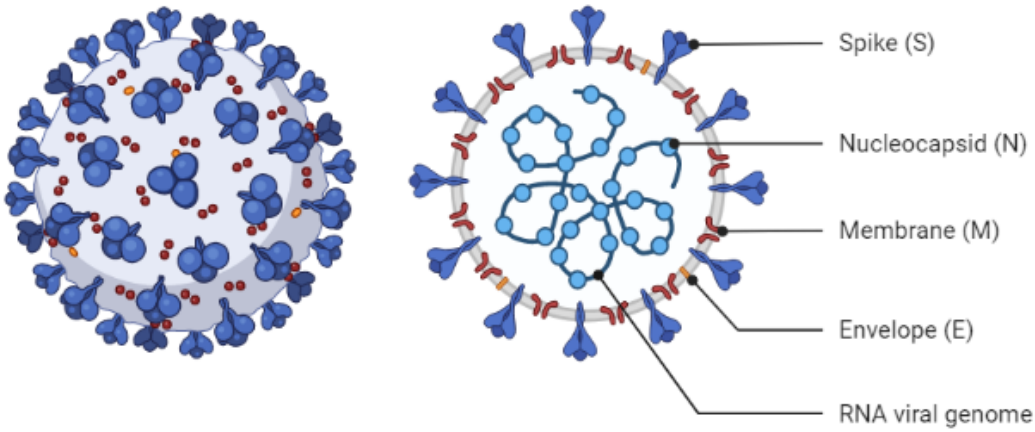

Figure 1: Structural Composition of SARS-CoV-2. A representation of Spike (S), Nucleocapsid (N), Membrane (M), Envelope (E) and RNA viral genome.

Upon transmission, the virus travels to the host airways, and then attaches and enters the host cell with the help of the aforementioned spike glycoprotein. In order to progress through the viral infection, the initial step includes the binding of the virus' S1 subunit's RBD to the host cell's ACE2 peptidase domain. The virus attaches to the ACE2 receptor in sync with transmembrane serine protease 2 of the host, which are present in the airway epithelial cells and vascular endothelial cells [42]. Consequently, this leads to membrane fusion, transferring the viral genome into the cytoplasm of the host cell followed by replication, assembly, maturation and release of the virus. However, the starting mechanism implicating genome entry included the translation process of the virus and after the viral polymerase protein translation, RNA replication followed by sub genomic transcription takes place. The structural proteins are also translated and formed, meaning that they will undergo combination with nucleocapsid. Conclusively, through an exocytosis approach, the viral particles mature and are released to infect more and more host cells [43].

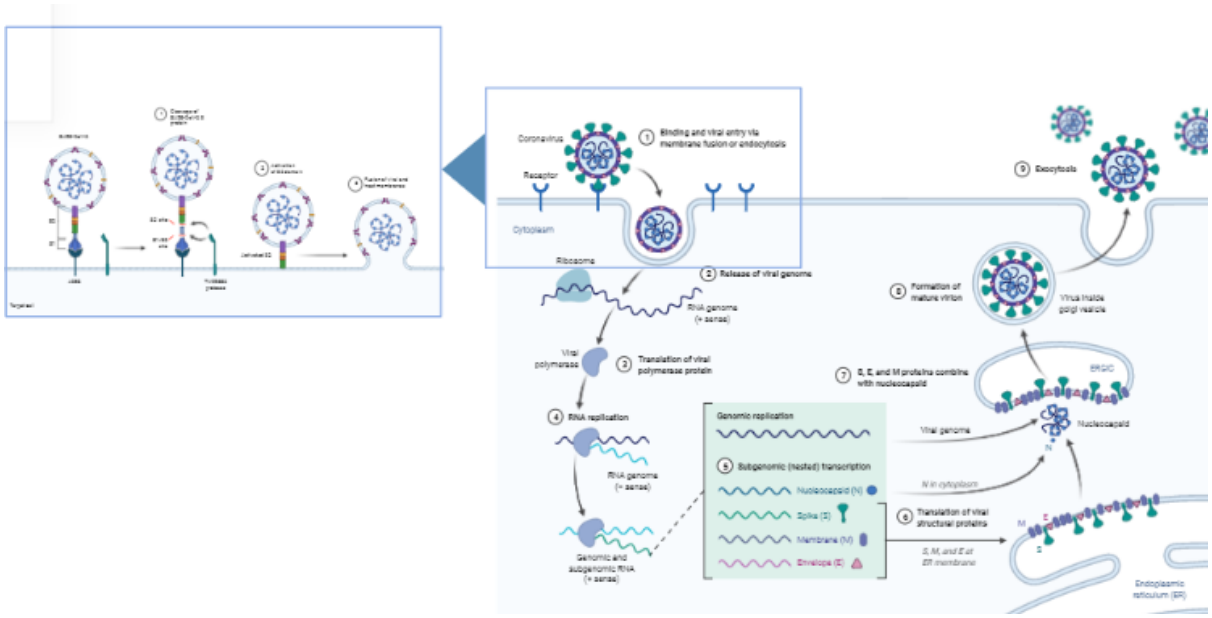

Figure 2: Pathomechanism of COVID-19. Viral entry and pathogenesis.

4. Epidemiology of COVID-19

In December, 2019, the Hubei province of China, Wuhan, reported a rise in the cases of pneumonia of unknown causes. Although the reason behind this outbreak was not yet known, it was reported to be related to the Huanan seafood wholesale market where selling live and aquatic animals was a norm [44]. The novel beta coronavirus from the lower respiratory tract of patients was sequenced utilizing unbiased next generation sequencing and was named 2019–novel Coronavirus (2019–nCoV). The virus was isolated from human epithelial cells and using an electron microscope, the characteristics of the Coronoviridae family were observed [45]. Phylogenetic similarities were found between the novel coronavirus and two other coronavirus strains derived from bats, SARS and MERS [46]. Based on the phylogeny and

taxonomy of the virus, the Coronaviridae study group of the International Committee on Taxonomy of Viruses named it as SARS–CoV2 [47]. After COVID-19 was declared as a pandemic on 11 March, 2020 by WHO, several different variants of COVID-19 began to surface [48]. The disease was reported to be spreading rapidly and the number of cases increased exponentially, and on January 11, 2020, the first coronavirus case outside mainland China was reported in Thailand [49]. Soon after, the first cases of coronavirus were reported in Japan on 15th January, the United States on 20th January and India on 30th January [50]. According to Worldometers, as of November 4, 2021, there have been 249,039,842 confirmed COVID-19 cases and 5,040,968 deaths around the world [51].

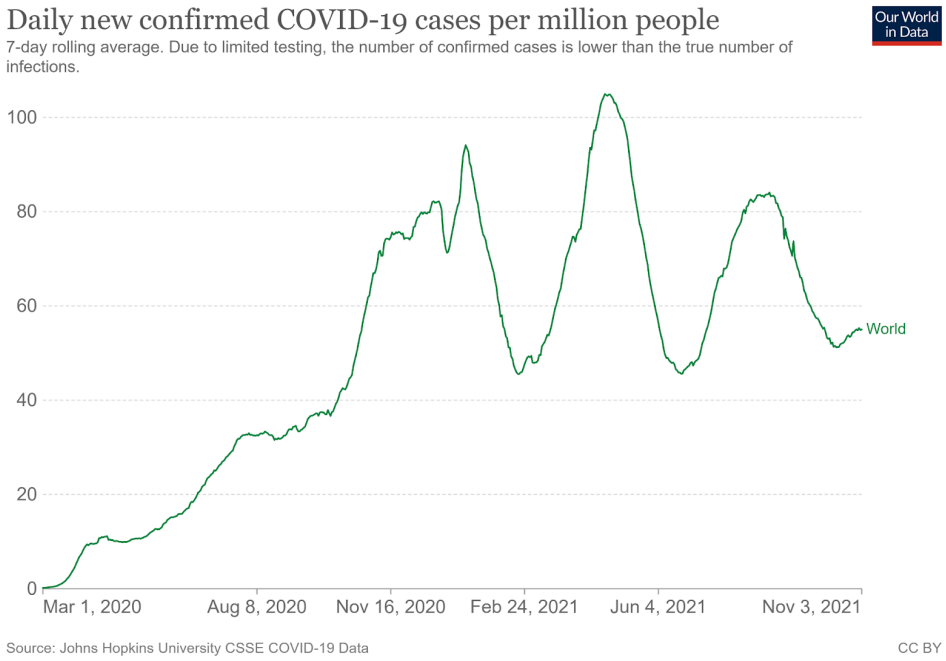

Figure 3 The new confirmed COVID-19 cases per million people, daily, around the globe. The graph shows the data from March 1, 2020 to November 3, 2021 [52]

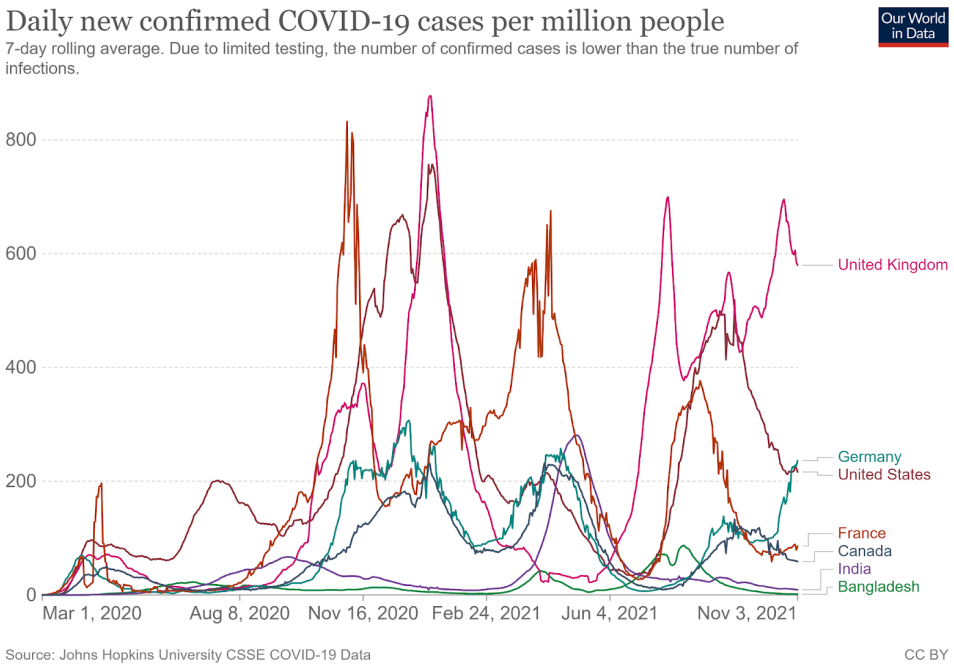

Figure 4 The daily new confirmed COVID-19 cases per million people in some countries. The graph shows the data from March 1, 2020 to November 3, 2021 [52]

The Institute of Epidemiology, Disease Control and Research (IEDCR) was considered the sole institute for conducting public health surveillance and curating a response to the outbreak in Bangladesh. The first case of coronavirus in Bangladesh was detected on March 8, 2020 and by August 10, 2020, there were 260,507 COVID-19 cases confirmed by rt-PCR while the number of deaths stood at 3438, according to IEDCR [53]. On March 16, 2020, one week after the first case of COVID-19 was found in Bangladesh, IEDCR reported that the outbreak had spread locally, indicating that children had been infected by the virus as well [53]. As of November 7, 2021, Bangladesh has reported 1,571,013+143 COVID-19 cases and 27,895+4 deaths according to John Hopkins University and Our World Data.

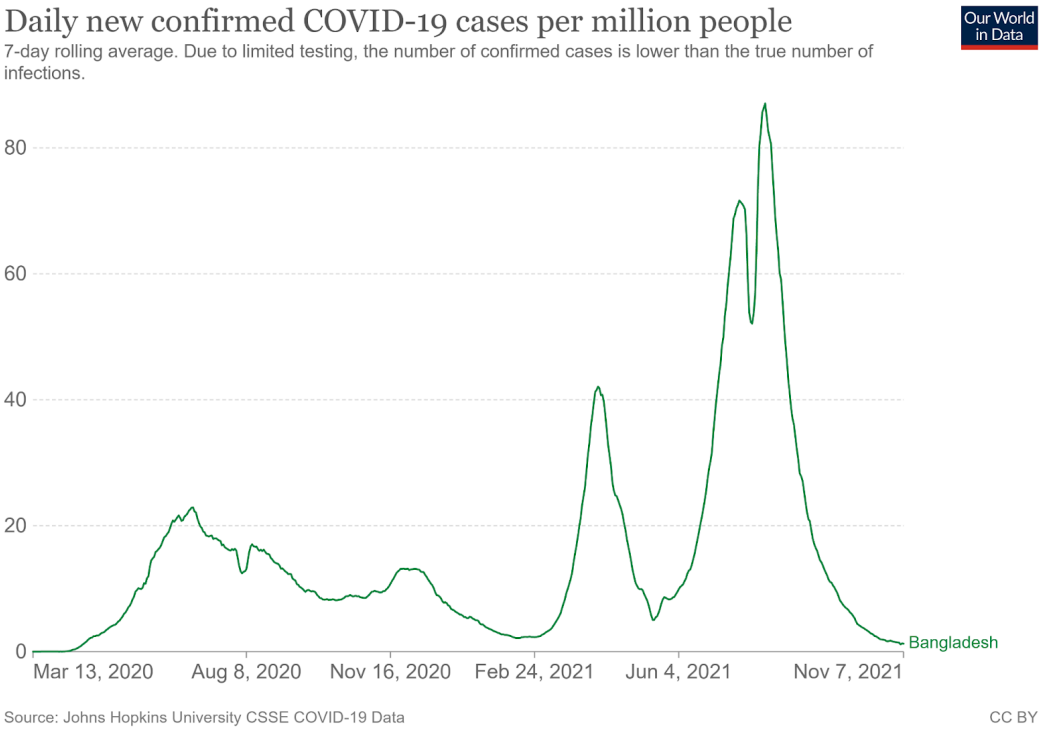

Figure 5 Daily new confirmed COVID-19 cases per million people in Bangladesh as of November 7, 2021 [52]

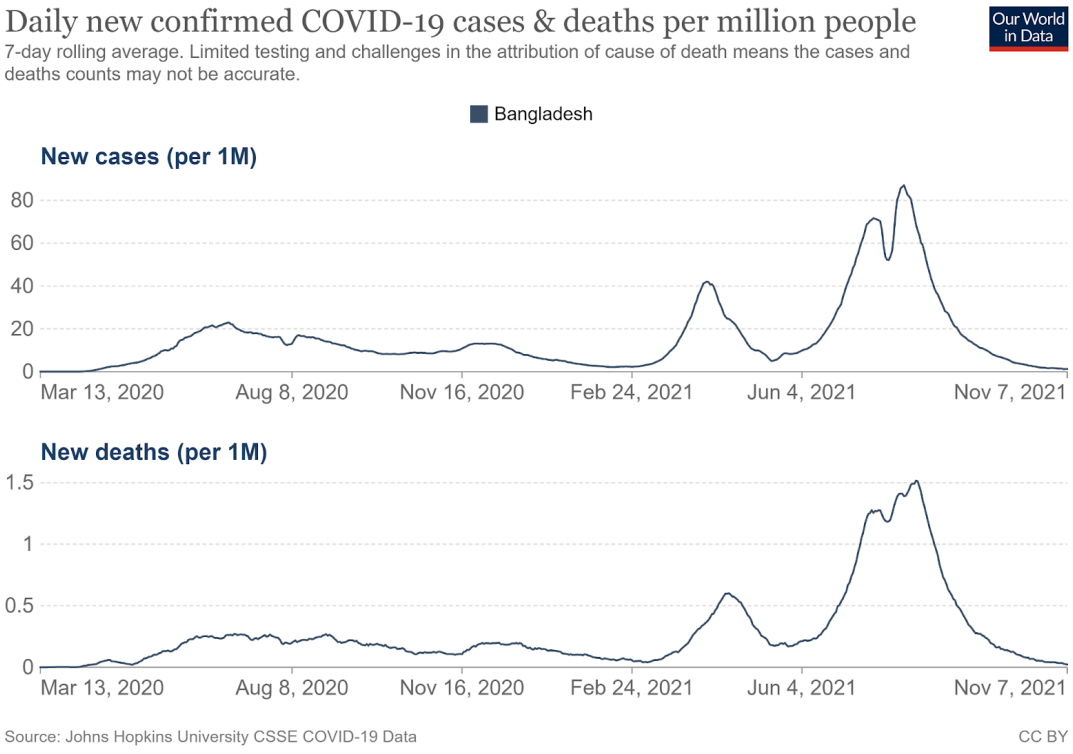

Figure 6 Daily new confirmed COVID-19 cases & deaths per million people in Bangladesh as of November 7, 2021 [52]

5. Bangladesh and COVID-19

Despite earliest cases dating back to mid november of 2019 [56], COVID-19 cases were first confirmed on the 8th of march [57]. Due to the lack of strong regulatory measures and scarcity of testing kits, the cases went unnoticed [58]. One of the major reasons Bangladesh fell into the grasp of this plague was due to continuous inbound flights bringing in citizens from COVID affected countries. It could have been avoided if quarantine was maintained, but the consequences of the insouciant ways of the travelers [59] is one of the reasons for what we see today. In addition to the frivolous travelers, the fear of spending a significant amount of money

on hotel rooms for 14 days led to the unrest and reluctance to comply. Furthermore, the possible influx of money handed in by the tourists forced the decision makers to reduce the scientifically advised quarantine period [60] of 14 days to 3 days only [61], in hopes to strengthen our damaged economy. In hopes of containment, the Government decided to impose a strict lockdown from 18th March 2020 onwards. Despite strenuous efforts, positive cases doubled after the month of April [62]. This could have been due to the RMG sector and services related to exports, government official work etc had started operating soon after March [63] was over and thus even after following COVID safety measures, the cases kept on skyrocketing. The first wave, besides the rise in case, was in very low numbers when compared to countries such as Italy. Thus the lockdown was gradually lifted by June 2020, however, educational institutions were kept at a halt until further notice. Universities continued classes but online, BRAC University being the first in launching an online learning platform, buX, in order to make it easier for students with electricity/internet scarcity to learn from recorded lectures [64]. Inorder to ensure the survival of the citizens, various scientists of bangladesh advised the use of repurposed drugs to battle this virus. Certain examples were Ivermectin, HydroxyChloroquine was used, however, Remdesivir was one of the most notable drugs that were even mass produced by Beximco Pharmaceuticals [65], one of the leading pharmaceuticals of Bangladesh. Despite the doctors' waning efforts, these drugs could only alleviate the disease but was not a solution or prevention. Thus, once vaccines were successfully created to tackle SARS-CoV-2, the government left no stone unturned to import these. The first vaccine administered took place on the 27th of January 2021 followed by the mass vaccination from 7th February onwards. Astra-Zeneca was the prescribed emergency vaccine used at that time and anyone aged above 40

were allowed to take the vaccines [66]. Just as everyone was settling into the new normal, the second wave took over Bangladesh with an increase in infection rates by 21-24% as well as higher death tolls starting from the last week of March 2021 [67]. This was reported due to hospital management irregularities, scarcity in testing kits, reluctance towards safety measures such as wearing masks, social distancing and vaccination and lockdown [67] Second wave led to another lockdown as well as a vaccination shortage during April to June. Soon enough, the deadliest variant of COVID-19 had crossed borders and arrived in Bangladesh from India. 98% of the 300 COVIDpositive cases were confirmed to be Delta Variant on June 29th [68]. Death cases spiked up to 14000+ and daily cases rose to above 5000 [69]. Finally, the government imposed the strictest lockdown with police checkposts to control the careless citizens. Thankfully due to the COVAX Initiative, on july 2nd, US donated 6.5 million Pfizer and 5.5 million Moderna, Japan donated over three million AstraZeneca, and China donated 3.4 million Sinopharm vaccines [70]. Things looked better as time passed by as people were more willing to take the vaccines, after seeing the drastic fatalities taking place in the third wave, today (30/10) 13.00% [71] of the total population are completely vaccinated and it doesn't seem like it will stop anytime soon as educational institutes are steadily reopening.

To explain the first vaccine drive hesitancy, we searched previously conducted surveys and found that the majority of the participants did not believe they needed the vaccines because they were healthy regardless while another significant portion did not have faith in the vaccine due to its abrupt and hasty production [63]. These responses were, however, from before the mass vaccination took place (24th Jan to 6th Feb 2021), in order to validate these results, we

conducted a similar KAP study to find out the attitudes towards COVID-19 vaccines after the majority of the age group had already received their second doses. Our research compares and analyses the knowledge and beliefs of vaccination amongst participants hailing from different socioeconomic backgrounds. We aim to achieve their understanding in COVID-19 precautionary practices, reasons to get or not get vaccinated and if these points have a correlation with their background.

6. Treatment and Management

Coronavirus 2 also known as SARS-CoV-2 causes severe acute respiratory syndrome and has had catastrophic effects resulting in more than 4.14 million deaths worldwide. At the very beginning of the pandemic, limited resources and knowledge about COVID-19 and its therapeutic management led to a global chaos. However, the effort of researchers and scientists worldwide to mitigate the effect of the virus resulted in the development of novel therapeutics and vaccines.

6.1 Antiviral therapies

6.1.1 Hydroxychloroquine and Chloroquine

During the initial phases of the pandemic, hydroxychloroquine and chloroquine were used for treatment. Chloroquine which is also used to treat malaria is found to treat COVID-19 efficiently as well [72]. It tends to interfere with the replication process of the virus by altering the pH and tends to prevent the release of TNF-α and IL-6 [73]. A study by Gautret et al. showed that hydroxychloroquine on infected patients can effectively reduce the viral load [74]. However, according to the data from randomized control trials it was observed that hydroxychloroquine with or without azithromycin in hospitalized patients did not improve the clinical status or overall mortality compared to placebo [75][76].

6.1.2. Remdesivir

Remdesivir, a nucleoside analog, is also a potential drug to treat COVID-19 [77]. It was seen to significantly reduce the viral load in lung tissue infected with MERS-CoV and also improve lung function in animal models [78]. A study conducted by Grein et al. reported that infected patients treated with remdesivir showed remarkable improvements in their health [79]. However, data from randomized, double-blind, placebo-controlled, multicenter trial, a study by Wang et al., concluded that the drug presented no clinical benefits [80].

6.1.3. Lopinavir and Ritonavir

During the initial stage of the pandemic, lopinavir and ritonavir (protease inhibitors used for the treatment of HIV) were used for the treatment of COVID-19. These drugs were hypothesized to inhibit the 3-chymotrypsin-like protease of SARS and MERS and thus were thought as an effective treatment. Immediately after this idea, a discussion on whether the HIV protease inhibitors could also inhibit the 3-chymotrypsin-like and papain-like proteases of SARS-CoV-2 arose. Although a Korean case showed significant reduction in viral loads after the administration of lopinavir/ritonavir [81], it was later seen that it causes no significant benefit to patients infected with severe COVID-19 and thus it is no longer used as a treatment option in hospitals. [82].

6.1.4. Favipiravir

Favipiravir is a RNA-dependent RNA polymerase inhibitor which tends to inhibit the replication of other RNA viruses such as SARS-CoV-2 [82]. Clinical trials reveal flavipiravir being more efficient than lopinavir/ritonavir in terms of antiviral activity. [83].

6.2 Anti-SARS-CoV-2 Neutralizing Antibody Products

6.2.1. Convalescent serum

Recovered individuals contain a high titer of antibodies in their serum and thus neutralizing antibodies can be extracted and transfused into an infected patient to deactivate the virus in order

to treat them[84][85][86]. Passive immunotherapy is one of the most effective strategies to treat patients infected with SARS and MERS viral infections [87] [88]. However it must be noted that neutralizing antibodies are short-lived and thus antibodies extracted from recently recovered patients are effective as treatments [89]. Studies also show that older recovered patients have a higher titer of neutralizing antibodies compared to young recovered patients [90]. Limitations in the administration of convalescent serum exists: causes phagocytosis, antibody-mediated cellular cytotoxicity among infected individuals and shortage of donor.

6.2.2. REGN-COV2 (Casirivimab and Imdevimab)

REGN-COV2, an antibody with two non-competing IgG1 antibodies, casirivimab and imdevimab attacks the receptor binding domain (RBD) on the SARS-CoV-2 spike protein which then tends to lessen the viral replication *in vivo*. A study was conducted on 275 patients where randomized patients received placebo, 2.4 g of REGN-COV2 (casirivimab 1,200 mg and imdevimab 1,200 mg) or 8 g of REGN-COV2 COV2 (casirivimab 2,400 mg and imdevimab 2,400 mg). It was then concluded that patients administered with REGN-COV2 antibody cocktail contained lower viral load compared to placebo [91].

6.2.3. Bamlanivimab and Etesevimab (LY-CoV555 or LY3819253 and LY-CoV016 or LY3832479)

Bamlanivimab which is a neutralizing monoclonal antibody also tends to attack the receptor binding domain (RBD) on the SARS-CoV-2 spike protein and thus reduce viral load in non-human primates [92]. On the contrary, etesevimab binds to a different epitope than bamlanivimab. In BLAZE-1 trial (phase 2), bamlanivimab/etesevimab was shown to reduce SARS-CoV-2 viral load compared to placebo [93].

6.2.4. Sotrovimab(VIR-7831)

In vitro studies show that sotrovimab (VIR-7831), an anti-spike neutralizing monoclonal antibody is effective against all the four variants of concern: Alpha (B.1.1.7), Beta (B.1.351), Gamma(P1), and Delta (B.1.617.2). A research conducted by Gupta *et.al* reported that

administration of one dose of sotrovimab(500 mg) decreases the risk of hospitalization or death among mild to moderate patients by 85% compared with placebo [94].

6.3 Immunomodulatory Agents

6.3.1. Corticosteroids

Corticosteroids have immunosuppressive activity as well as anti-inflammatory activity which tends to detain the development of pneumonia, prevent alveolar damage, reduce systemic inflammation and exudative fluid in the lung tissue thus reducing hypoxemia and further damage to the lungs [95] [96]. A study to determine the efficiency of corticosteroids showed that administration of dexamethasone resulted in improvements in patients who were in intensive care, under oxygen support [97]. Due to its remarkable result, only dexamethasone or combination of dexamethasone and remdesivir is used to treat patients in hospitals who require oxygen support.

6.3.2. Anti-IL-6 receptor Monoclonal Antibodies

Interleukin-6 (IL-6) which is a proinflammatory cytokine can be targeted with IL-6 receptor inhibitor to reduce the progression of inflammation in patients with severe infection [98] [99] [100]. Three different types of IL-6 receptor inhibitors approved by FDA are Tocilizumab, Sarilumab to treat rheumatological conditions and Siltuximab to treat Castleman's syndrome.

Every country has been adopting methods to prevent and mitigate the effects of COVID-19. Bangladesh which is one of the densely populated countries worldwide has been also trying to prevent the spread of the virus from the very beginning of the pandemic with the drugs available. A study was conducted by Bhuyan MAR, et al., with 33 patients who were tested positive for SARS-CoV-2 through PCR testing. While taking medications, 1 out of 33 patients died on the 4th day, after the 2nd and 3rd day, the condition of other 2 patients deteriorated and thus they were referred to tertiary hospital of Dhaka. The remaining patients were given antipyretic drugs to

control fever, pain reliever for extreme pain, oxygen for controlling respiratory issues and saline to restore body hydration. Hydroxychloroquine, 400 mg was given twice daily on the first day, followed by 200 mg, three times daily from day 2 to 10. Azythromycin, 500 mg was given on the first day, followed by 250 mg daily for 4 days. It was reported that the remaining 30 patients recovered within a mean period of 14 days after they were administered with hydroxychloroquine and azithromycin [101]. It was also concluded that early detection and diagnosis can significantly increase the rate of survival among infected individuals.

6.4. Management:

According to the National Guidelines on Clinical Management of Coronavirus Disease 2019 (COVID-19), Version 4.0 released on 30th March 2020, mild and moderate cases which include Influenza like Illness and pneumonia can be treated from home and patients with severe and critical cases (severe pneumonia, sepsis, ARDS, septic shock) must be hospitalized [102].

6.4.1. Case management for mild to moderate patients at home

· Social distancing with family members

· Repeated hand wash for about 20 seconds each time

· Use tissue to cover mouth while coughing or sneezing, elbow can be used but should be immediately followed by handwash

· Must wear medical masks

· Gargle with lukewarm water

· Symptomatic infection should be treated with Tab Paracetamol 500 mg 1+1+1 and Tab antihistamine (Fexofenadin) 0+0+1

· Must seek for medical assistance if condition worsens: respiratory distress, worsening cough with fever, extreme tiredness

6.4.2. Hospital care Principles

· Severe and critical patients suffering from Covid-19 must be hospitalized

· Severe disease need oxygenation support

· Healthcare workers must be in appropriate personal protective equipment (PPE)

· Patient with sepsis with or without shock may require treatment in high dependency unit (HDU) or ICU depending on disease severity

· Oxygen hood can be provided for patients in general ward if they need oxygen

6.4.3. Case management for mild to moderate patients

· Immediate supplemental oxygen must be provided to patients with SPO_2 < 93%, respiratory rate≥ 30 breaths/ minute with shock

· Face mask with reservoir bag (at 10–15 L/min) must be used in critical condition

· Severe pneumonia or sepsis must be treated carefully with intravenous fluids. Aggressive fluid can worsen oxygenation.

· Empiric antimicrobials must be administered to treat all pathogens leading to severe pneumonia

· The patients must be closely monitored. Respiratory failure and septic shock must be rapidly responded

6.5. Vaccines

In order to end the Covid-19 pandemic, access to effective and safe vaccines is a must. Scientists refer to vaccines as being a game changer in today's world but it should not be the end of taking precautions to protect oneself from the virus. The vaccines which are being administered are still

undergoing extensive research and we are still unaware of possible outcomes it may have in future.

6.5.1. Pfizer–BioNTech COVID-19 vaccine

Pfizer–BioNTech COVID-19 vaccine was developed cooperatively by an American pharmaceutical company named Pfizer and a German biotechnology company called BioNTech [103][104][105]. It is a mrna based vaccine which is not yet licensed by the U.S. Food and Drug Administration (FDA), but has been approved by FDA under an Emergency Use Authorization (EUA) in order to prevent Coronavirus Disease 2019 (COVID-19). The vaccine is used to provide protection to individuals aged 12 years and above or 16 years and above (depending on the country's jurisdictions) who are infected with SARS CoV-2[106]. The vaccine consists of nucleoside modified mRNA (modRNA) which encodes for the mutated spike protein of the virus [107]. The vaccine started clinical trials in April 2020 and after second dosage, it was shown to be effective on individuals who exhibited symptomatic infection with an efficiency of 91.3% [108]. The vaccine requires two doses which should be 21 days apart [109]. Side effects of the vaccine appear after 1-2 days after injection which includes pain, redness and swelling on the site of injection, tiredness, headache, muscle pain, chills, fever and nausea. According to a study, the Pfizer vaccine shows an efficacy of 52% after the first dose and 95% after second [110]. Another recent study published in The New England Journal of Medicine showed the Pfizer vaccine to be 88% effective at preventing symptomatic disease from the Delta variant of the virus and 93.7% effective against the Alpha variant [111].

6.5.2. Moderna COVID-19 vaccine

Moderna COVID-19 vaccine**,** mRNA-1273 is manufactured by ModernaTX, Inc [112]. It is a mrna vaccine which consists of nucleoside-modified mRNA (modRNA) encoding a spike protein of SARS-CoV-2 [113]. It was approved by the U.S. Food and Drug Administration. A total of two shots should be administered, 28 days apart in order to obtain immunity against SARS-CoV-2. Side effects of the vaccine include pain, redness and swelling on the site of injection, tiredness, headache, muscle pain, chills, fever and nausea. The vaccine is approved for

people aged 18 years and older [114]. The Moderna vaccine entered clinical trial phase I on 15 March 2021 [115]. According to a study published in The New England Journal of Medicine, the mRNA-1273 vaccine was shown to prevent severe infection with COVID-19 with an efficacy of 94.1% [116].

6.5.3. Oxford–AstraZeneca COVID-19 vaccine

Oxford–AstraZeneca COVID-19 vaccine, AZD1222 is a viral vector vaccine which has been developed jointly by Oxford University and AstraZeneca. A virus from the adenovirus family is modified so that it can carry the gene which encodes for the protein of SARS-CoV-2 [117]. After the gene is introduced into the body, the protein is formed within and the immune cells of the body recognize the protein as foreign thus generating an immune response. Cascade of events takes place and finally memory cells are produced which remain in the body as safeguards. They are ready to attack if the SARS-CoV-2 virus enters the body. The AstraZeneca vaccine itself does not cause COVID-19. It provides protection to individuals aged 18 years and above. Two doses of the vaccine must be taken where the second dose should be taken between 4 and 12 weeks after the first dose. Side effects of the vaccine include injection-site pain, headache and nausea [118]. Unusual blood clots and low blood platelet count can be the other severe side effects but EMA's safety committee (PRAC) deduced this one to be very rare, however individuals who develop such symptoms must seek for medical assistance [119]. A study in 2020 conferred the efficacy of the vaccine to be 76.0% after 22 days of administration of the first shot and 81.3% after the second shot [120]. A recent article which studies the effectiveness of the vaccines against the delta variant, B.1.617.2 suggests that 2 complete doses of Oxford–AstraZeneca vaccine is 60% effective against the B.1.617.2 variant and 66% effective against the alpha variant B.1.1.7. [121].

6.5.4. Sputnik V COVID-19 vaccine

Sputnik V also known as Gam-COVID-Vac by the Gamaleya Research Institute of Epidemiology and Microbiology in Russia was the first registered COVID-19 vaccine to be administered to individuals. However, this vaccine has been facing controversies from the very beginning since it

lacked well-grounded scientific research confirming its safety and efficacy [122]. Sputnik V is an adenovirus vaccine. Although it is similar to the Oxford–AstraZeneca vaccine and Johnson & Johnson vaccine, differences exist in the adenoviruses used in the first and second dose of the Sputnik V vaccine. Two different adenoviruses, rAd26 and rAd5 are used for the first and second shots, respectively. According to a biotechnology researcher at the Skolkovo Institute of Science and Technology in Moscow, Dmitry Kulish, using two differently engineered adenoviruses to deliver the genetic material could increase the efficacy of the vaccine [123]. According to study published in The Lancet: Safety and efficacy of a rAd26 and rAd5 vector-based heterologous prime-boost COVID-19 vaccine, an interim analysis of a randomized controlled phase 3 trial in Russia, phase 3 trial of Gam-COVID-Vac demonstrated 91·6% efficacy against COVID-19 and was well tolerated in a large cohort [124].

6.5.5. Johnson & Johnson COVID-19 vaccine

Johnson & Johnson vaccine or Janssen COVID-19 vaccine was produced by Janssen Vaccines in Leiden, Netherlands and its Belgian parent company Janssen Pharmaceuticals [125]. It is a viral vector vaccine which consists of a modified adenovirus vector carrying the gene encoding for the SARS-CoV-2 virus spike protein. This vaccine only requires one shot. It is recommended for people aged 18 years and above [126]. Side effects of the vaccine include injection-site pain, headache and nausea, muscle pain, fever and chills. About 653 fainting incidences among approximately 8 million doses of the administered J & J vaccine in the US have been reported by the Vaccine Adverse Event Reporting System (VAERS). The US Food and Drug Administration warns about the possible rare side effect of the vaccine, a neurological intricacy known as Guillain-Barré syndrome (GBS). About 100 reports of this rare disorder among approximately 12.8 million doses of the administered J & J vaccine in the US have been reported by the VAERS [127]. Many researches are being carried out to determine whether this vaccine is effective against the delta variant of the SARS-CoV-2 virus. According to a study carried out by Tada, T et.al. The J & J vaccine was found to be less effective against the Delta and Lambda variants [128].

6.5.6. Sinopharm COVID-19 vaccine

The Sinopharm vaccine also known as BIBP vaccine or BBIBP-CorV was developed by Beijing Bio-Institute of Biological Products Co Ltd, subsidiary of China National Biotec Group (CNBG) [129]. It is an inactivated vaccine which means killed viral particles being introduced into the body and this initiates the immune response. It is recommended to be administered on individuals aged 18 years and above. Unlike other vaccines which require deep freezing for storage, Sinopharm can be stored at 2-8 degrees Celsius which is the temperature of a standard refrigerator and thus it can be an advantage for the developing countries who tend to store large amounts of the shots [130]. A peer-reviewed study published in JAMA conferred the vaccine to be 74% effective against asymptomatic and symptomatic infections and 78% effective against symptomatic cases [131]. Studies conducted by Sri Jayewardenepura University, Sri Lanka suggests the Sinopharm vaccine to be effective against the delta variant which is the presiding one at this moment [132].

7. Material and Methods

7.1. Study outline and questionnaire

The study involved a cross-sectional assessment to understand and evaluate the pre-existing knowledge inherent to the population of Bangladesh, as well as its correlating influence on attitude and practice towards the COVID-19 vaccines. The constructive outline has been designed and based on the overall perception, challenges, and acceptance of the vaccines. The study is inclusive of the Bangladeshi population aged from 18 years and above, with all three categories - no vaccines taken, the first dose taken only, and second or all doses taken. The questionnaire included a total of 53 questions, both quantitative and qualitative. The questions addressed all the potential data as well as misconceptions associated with the COVID-19 vaccines that may influence the administration of vaccines. The initial questionnaire draft included 65 questions that underwent preliminary evaluations with 32 respondents. The overall number of questions was reduced to 53 and only after additional adjustments for better understanding and sorted analysis, the final questionnaire was completed and finalized. The 53 questions were divided into 7 sections (i) the complete information regarding the study (ii) general information (iii) knowledge (iv) attitude (v) practice (vi) individuals not taking the vaccine (vii) individuals taking the vaccine. The collection involved online surveys and face-to-face interviews, and all questions included a Bengali meaning in brackets to ensure easier communication and completion of the survey.

7.2. Data collection and analysis

In this study, we recruited and trained a group of research assistants in order to help us collect data. We targeted subjects from different socioeconomic backgrounds and arranged interviews, either in person or online and conducted the interviews while recording the data on Google forms. Respondents who were deemed to have a sufficient education level and und technologically adept were asked to fill out the form on their own. Finally, the results from the Google form were curated after generating an excel sheet directly from the questionnaire made on Google form. The curated data was fed into IBM® SPSS® Statistics in order to generate graphs, tables and to compare and correlate the data.

8. Results

8.1 Sociodemographic Characteristics

A total of 1390 people participated in the survey and 100% of them were Bangladeshi. The mean age of the respondents was 38.15 years (standard deviation). 50.4% of the respondents were female while 49.6% were male. The highest number of respondents were from Dhaka (72.4%) while the lowest were from Rajshahi (1.4%). 79.5% of the participants were city dwellers and 4.2% were living in a slum. Most respondents were graduates (66.9%) and 58.8% were employed. The number of respondents had a household income of over 1 lakh (26.3%) while the lowest had a household income of less than ten thousand taka (12.4%). The respondents were asked to select the health issues they were facing and 25.3% of them claimed to have a high blood pressure, 17.8% had diabetes, 7.4% had allergies, 8.5% had asthma, 6.8% suffered from a heart disease, 5.4% said they have a skin disease, 3.8% had kidney diseases, 1.7% faced problems with their liver, and finally, 0.1% said they were affected by AIDS.

Demographic Characteristics	**Variables**	**Number**	**Percentage (%)**
Gender	Male	690	49.6
	Female	700	50.4
Division of	Barisal	21	1.5

residence	Chattogram	141	10.1
	Dhaka	1007	72.4
	Khulna	100	7.2
	Mymensingh	33	2.4
	Rajshahi	20	1.4
	Rangpur	35	2.5
	Sylhet	33	2.4
Area of residence	City	1105	79.5
	Slum	58	4.2
	Village	227	16.3
Level of Education	No education received	68	4.9
	Class 5	36	2.6
	Class 8	47	3.4
	SSC/O Levels	93	6.7
	HSC/A Levels	216	15.5
	Graduates and above	930	66.9

Occupation	Unemployed	251	18.1
	Student	497	35.8
	Self employed	199	14.3
	Employed	818	58.8
	Retired	48	3.5
	Other	1	1
Diseases	Allergy	103	7.4
	Asthma	118	8.5
	High blood pressure	352	25.3
	Diabetes	248	17.8
	Kidney disease	53	3.8
	Liver disease	24	1.7
	Heart disease	95	6.8
	AIDS	1	1
	Skin disease	75	5.4
Monthly	Less than 10,000	173	12.4

household income	10,000 to less than 25,000	200	14.4
	25,000 to less than 50,000	269	19.4
	50,000 to less than 75,000	224	16.1
	75,000 to less than 1 Lakh	159	11.4
	1 Lakh and above	365	26.3

Table 1: Sociodemographic Characteristics of participants

8.2 Knowledge of COVID-19 Disease and Vaccine

Following a question regarding the symptoms of COVID-19, the total of 1390 respondents selected a multitude of characteristic signs and symptoms securing a total of 1364 for fever (98.1%), 1265 for coughing (91%), 1165 for difficulty in breathing (83.8%), 1053 for sore throat (75.8%), 947 for headache (68.1%), 910 for body ache (65.5%), 681 for Diarrhea (49%), 121 for constipation (8.7%) and 73 for acidity (5.3%).

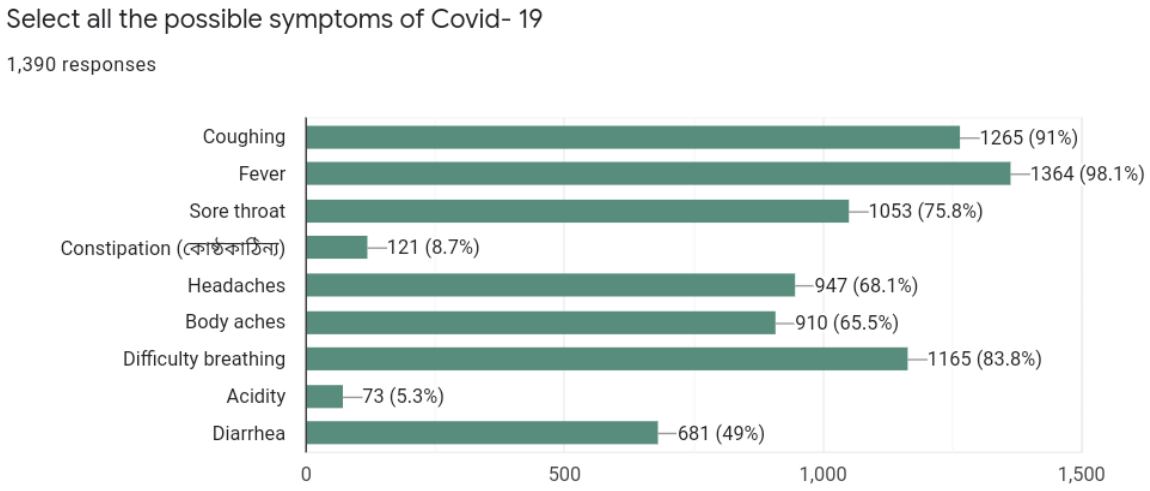

Figure 7: Potential symptoms of COVID-19.

Moreover, when asked to select true statements from a total of six options, the respondents agreed to the virus spreading from an infected person through talking, breathing or coughing making up about 1207 (86.8%), older people and people with heart disease, lung disease, diabetes being at high risk from covid-19 making about 1190 (85.6%), the virus taking 0-14 days to show signs after being infected which made up 1147 (82.5%), an apparently healthy person still spreading the disease making about 1073 (77.2%). However, a number of participants also selected antibiotics as a cure and homeopathy as a valid treatment for COVID-19, making about 256 (18.4%) and 96 (6.9%), respectively.

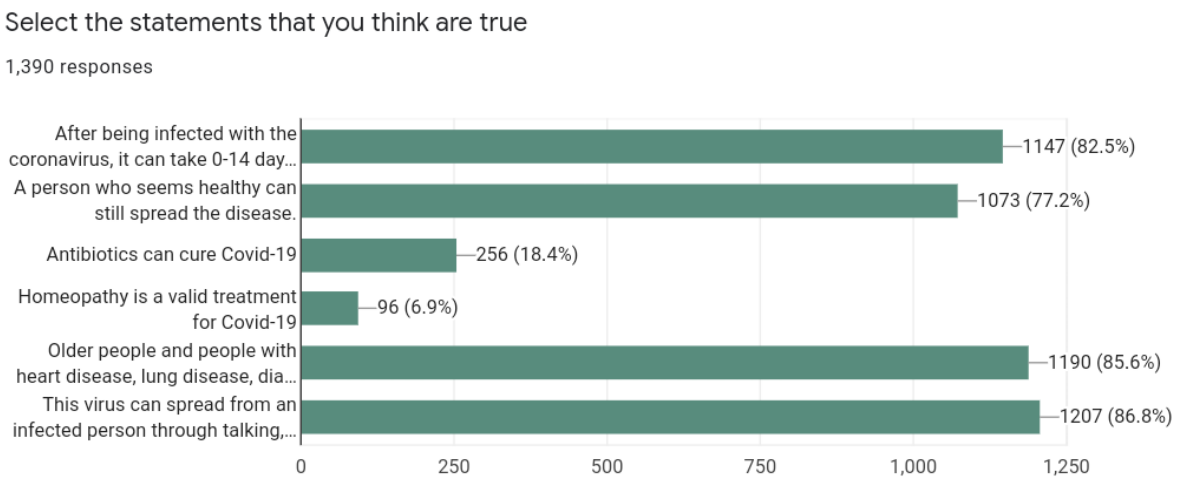

Figure 8: Statements concerning COVID-19

Enquiries concerning the varying after effects of COVID-19 vaccination represented 1075 participants choosing fever (77.3%), 1025 choosing muscle pain or body pain (73.7%), 816 choosing pain at the site of injection (58.7%), 618 choosing headache (44.5%), 535 choosing fatigue (38.5%), 141 choosing no after effects/reaction (10.1%) and 140 choosing diarrhea (10.1%).

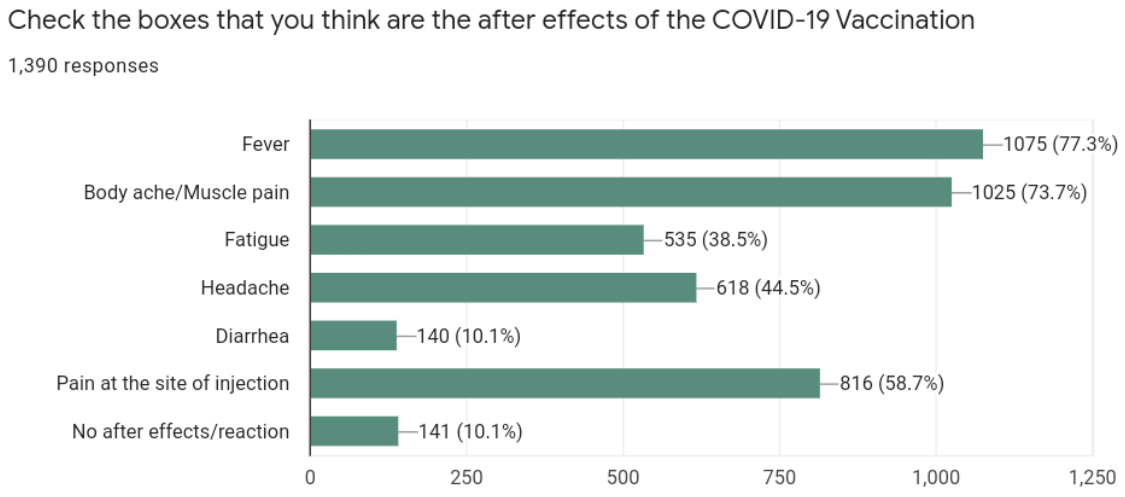

Figure 9: Evaluation of after effects of COVID-19 Vaccination

Additionally, when asked if they knew about the availability of COVID-19 vaccines on spot and without prior registration, 32.6% said yes and a greater proportion making up the remaining 67.4% said no.

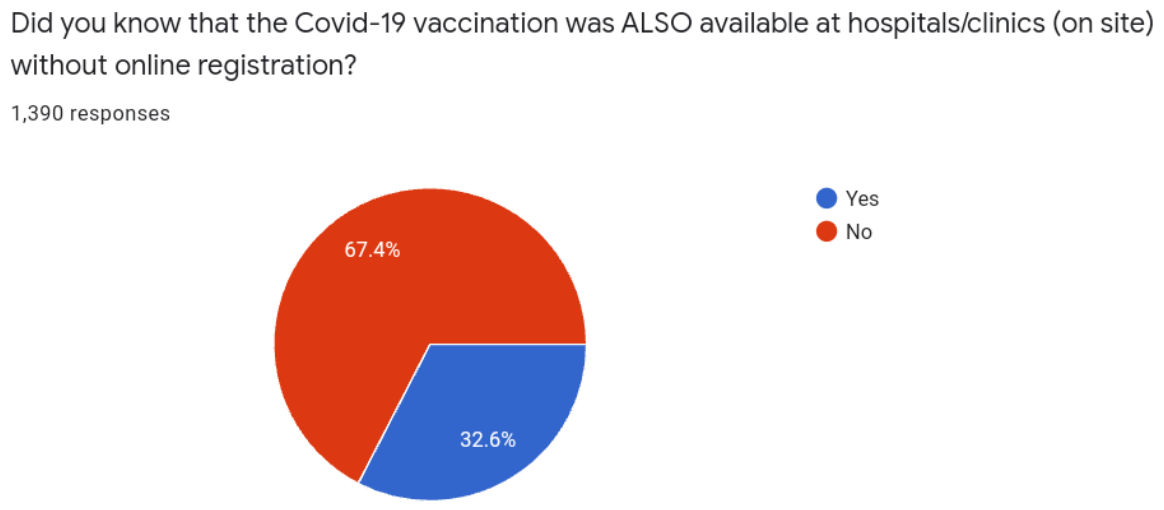

Figure 10: Availability of COVID-19 Vaccines

Lastly, an evaluation through generalized statements showed 1285 (92.4%) responses for knowing that the participants are required to register online through a website, 447 (32.2%) for acknowledging that they can register through cyber cafes, printing shops for a small service fee, and 382 (27.5%) for understanding that the number of shots needed depends on the vaccine. However, additional statements as an evaluation of knowledge demonstrated that 312 (22.4%) respondents agreed to readily stand in a line in the hospital to register for the vaccine and 76 (5.5%) of the overall participants believed that they would have to pay to get the vaccine.

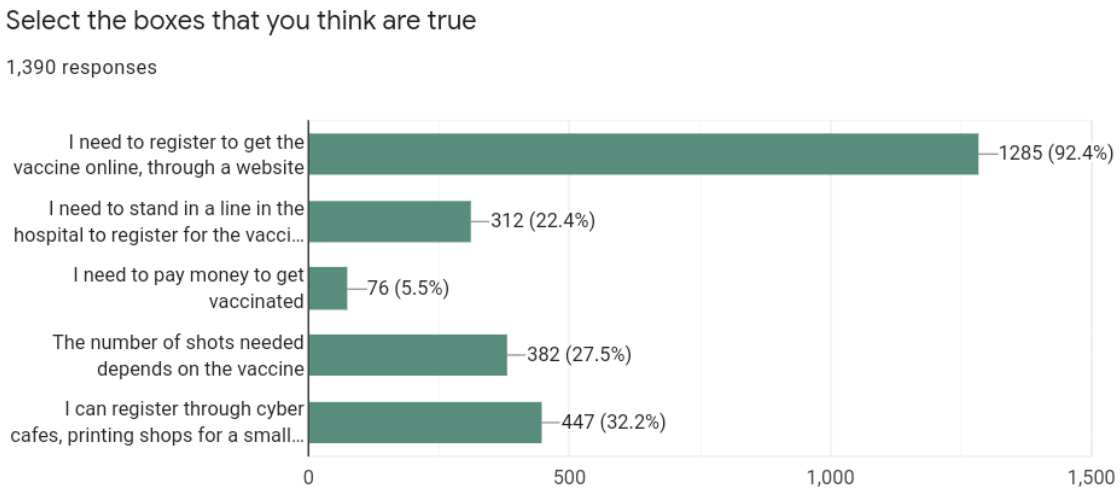

Figure 11: Statements regarding COVID-19 Vaccination

8.3 Attitude towards COVID-19 Disease and Vaccines

After testing out the participants' perception towards certain aspects of COVID-19 and its vaccinations. It consisted of straight forward questions that the participants could answer only using the following options: Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree.

	COVID-19 can be fully controlled	Covid 19 Is a natural calamity	COVID-19 is a hoax	COVID-19 can put my life at risk
Strongly Disagree	80	116	827	27
Disagree	371	357	432	37
Neutral	341	246	99	37
Agree	445	439	19	479
Strongly Agree	153	232	13	810

	I feel like vaccination is unsafe	I think vaccine is fake/placebo	Vaccines will disrupt pregnancy, or lead to mental disorders of the baby	Vaccine may affect fertility
Strongly Disagree	356	407	231	247
Disagree	608	659	424	480
Neutral	320	273	558	543
Agree	92	42	151	104
Strongly Agree	14	9	26	16

	Any vaccine is effective against all variants of coronavirus	The government should reopen schools and universities	The vaccine got released too early, I don't trust the makers of the vaccine	I don't need to take precautions after vaccination
Strongly Disagree	118	240	207	722
Disagree	442	389	643	492
Neutral	474	259	430	74
Agree	301	303	84	54
Strongly Agree	55	199	26	48

	My religion stops me from getting vaccinated
Strongly Disagree	923
Disagree	405
Neutral	47
Agree	8
Strongly Agree	7

Figure 12: Evaluation of Attitudes concerning COVID-19 and COVID-19 Vaccines

From the tables above we can see that 43% of the respondents believed that the COVID-19 curve can be flattened and total control was possible, however, a significant number disagreed (32.4%) while the remaining 24.5% refused to weigh in.

There seems to be debate amongst the participants as they seem torn between the origin of COVID-19. While 48.3% of them believe it is a natural calamity, 34% disagree. This result can be backed up by the following question, “COVID-19 is a hoax”, as 91% deny it being fake and

acknowledge its existence. The same percentage of people (92%) also agree that this virus is a threat to their lives while 8% believe they might be completely immune to it.

When it comes to the authenticity of the vaccines, there were very few people (7.6%) who felt the vaccines were unsafe for them and a similar percentage of people (3.7%) agreed that vaccines were placebos. Additionally, only 7.91% of the participants had trust issues on the manufacturing of the vaccines. Therefore, by comparing the data it can be concluded that the majority of the participants believe in the effectiveness of the vaccine.

According to the question asking about the necessity of precautionary steps post vaccination revealed that the majority (87.3%) of the participants are aware that even after vaccination, they need to maintain distancing, masks etc.

We wanted to tackle certain misconceptions and thus asked questions linking vaccines to fertility and its possible side effects on unborn children. Majority of the participants, 39%, were neutral while few agreed and a big portion disagreed. Same results were observed when asked if vaccine administration went against their religious beliefs. 95% were against this notion while the rest agreed it is against their faith to take vaccines.

Finally, we asked if the lockdown should be removed and educational institutes should be operating physically. 36% were for this notion, 18% had no opinions and the rest 46% were skeptical of full fledged running of schools.

8.4 Practice

8.4.1 Pre vaccination

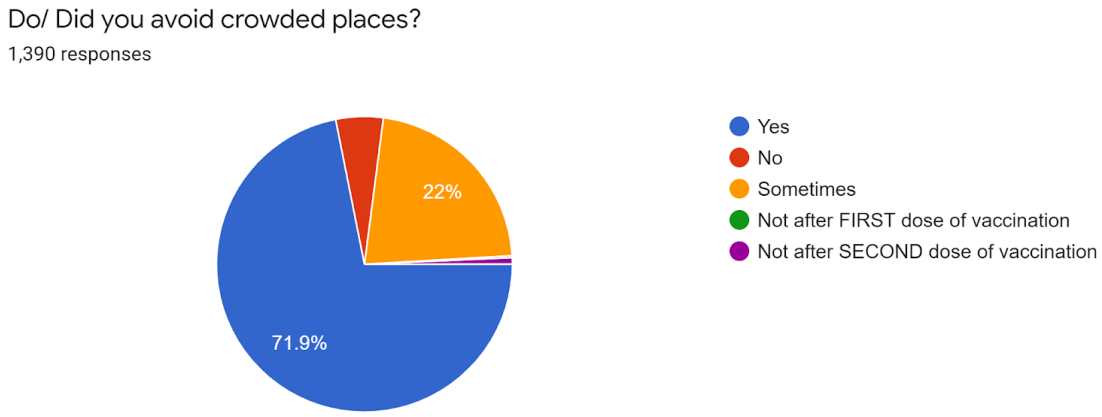

Figure 13: Avoiding Crowded Places before vaccination

71.9% of the respondents avoided crowded places before getting vaccinated while 5.2% said they did not. 22% of respondents sometimes avoided crowds and 0.2% said they did not avoid crowds after their second dose of vaccine.

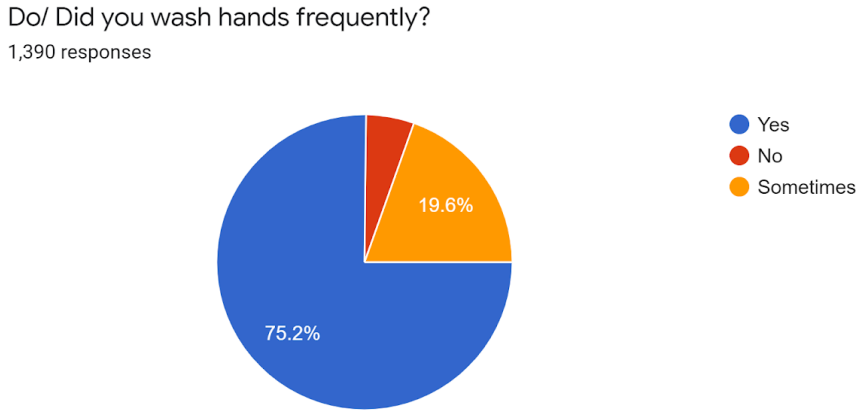

Figure 14: Washing hands frequently

75.2% of respondents washed their hands frequently while 5.3% said they did not and 19.6% sometimes washed their hands.

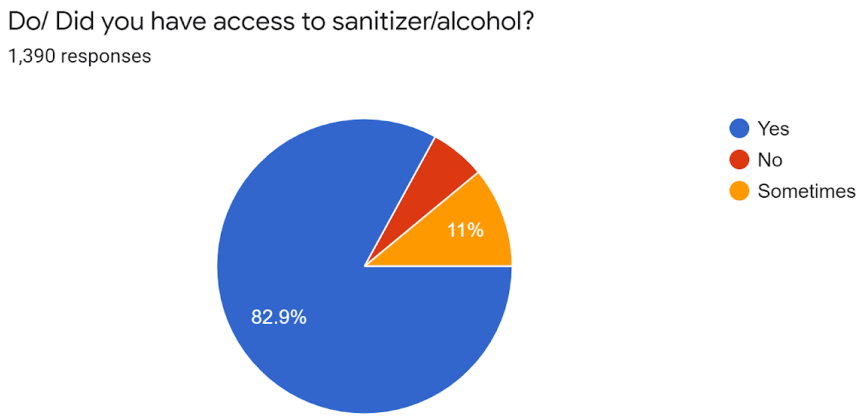

Figure 15: Access to sanitizer

Majority of respondents had access to hand sanitizers/alcohol (82.9%) while 6% did not have access and 11% sometimes had access.

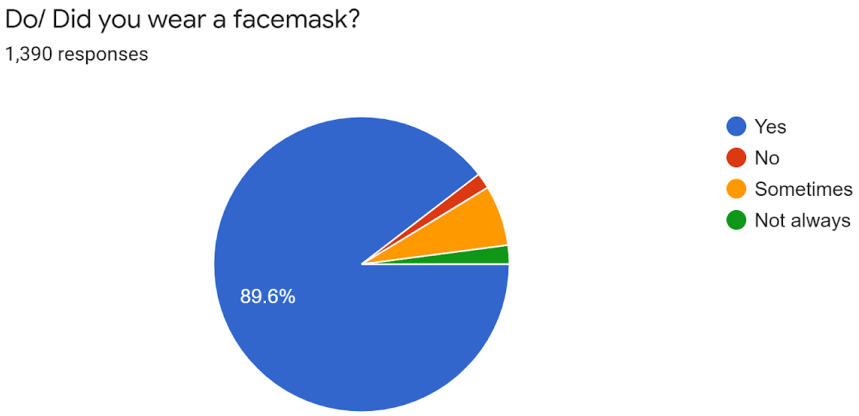

Figure 16: Wearing Facemasks

89.6% of respondents wore a facemask before getting vaccinated while 1.7% said no. 6.6% of people wore a mask sometimes.

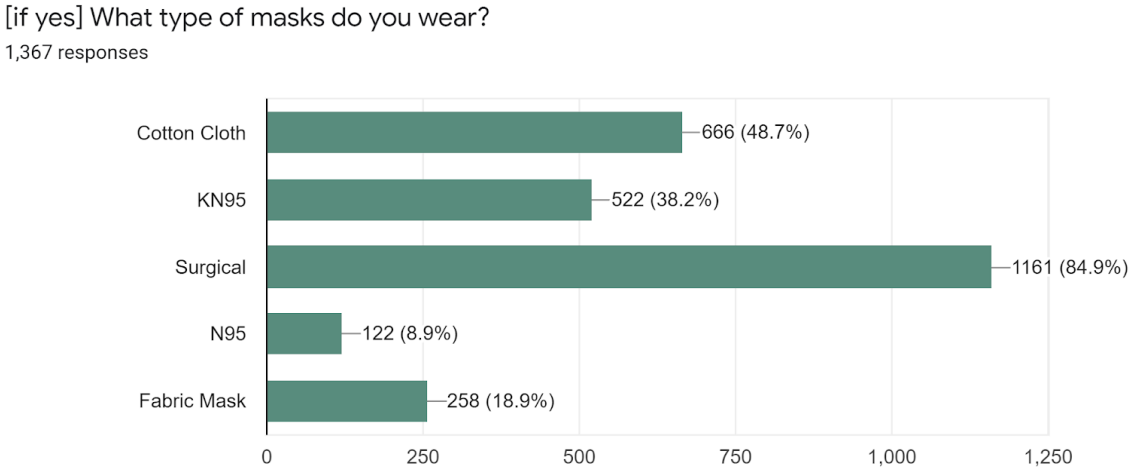

Figure 17: Type of masks

Majority of the respondents wore a surgical mask (84.9%) while N95 masks were preferred the least (8.9%). 48.7% wore cotton cloth masks and 38.2% of respondents wore a KN95 mask.

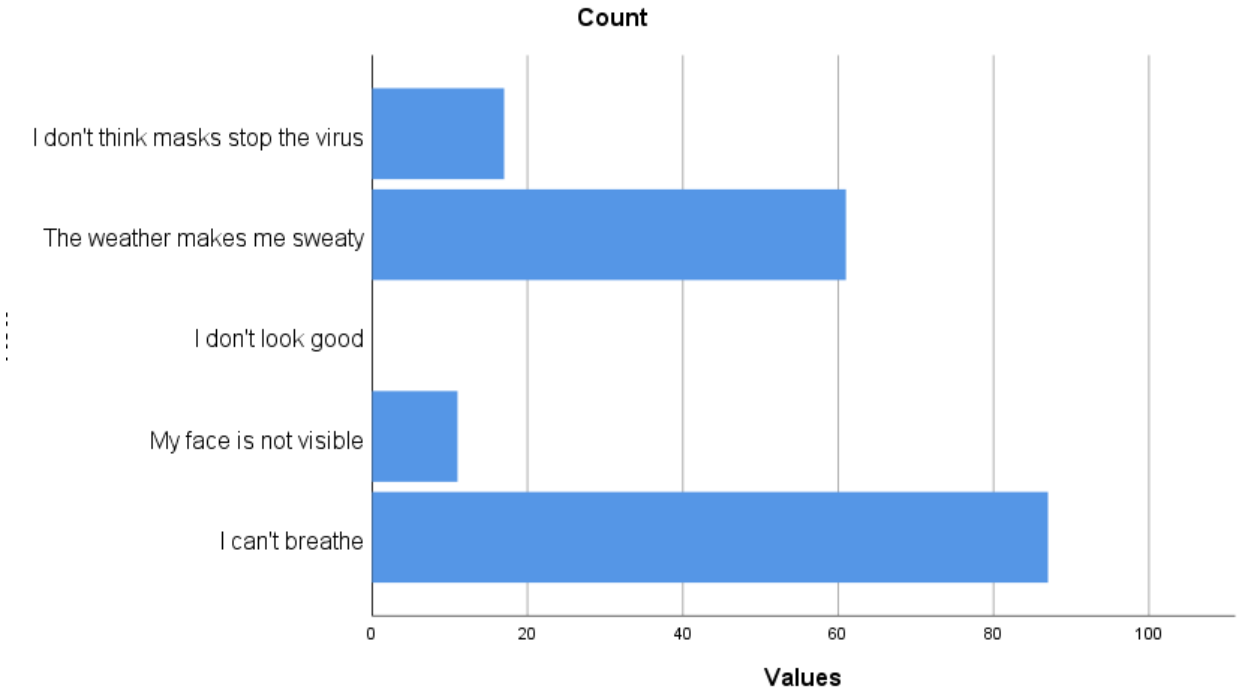

Figure 18: If you don't wear masks, then why?

54.4% of respondents do not wear a mask because they cannot breathe and 38.1% did not because the weather makes them sweat. 7.5% said they do not wear masks as they have pimples or acne while others had different reasons that are to be discussed in the discussion.

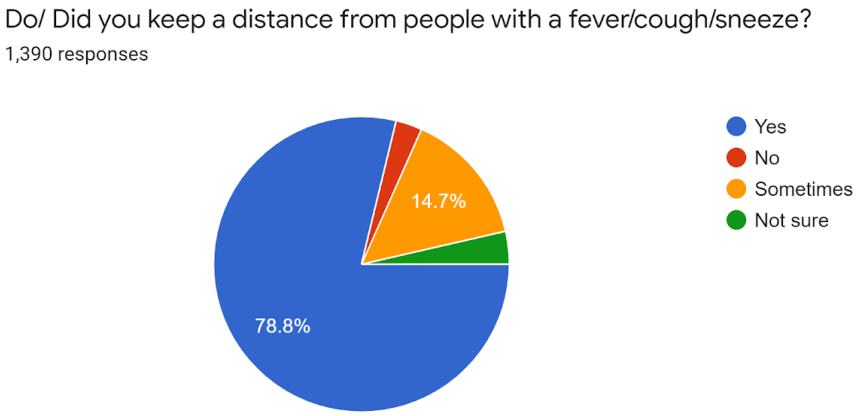

Figure 19: Keeping a distance from people with a fever/cough/sneeze

78.8% of the participants kept their distance from people with a fever/cough/sneeze while 2.9% did not. 14.7% of people sometimes kept their distance.

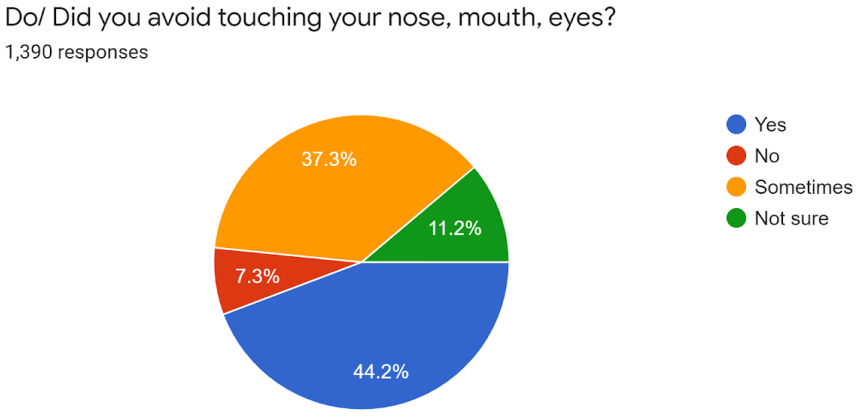

Figure 20: Avoid touching nose, mouth or eyes

44.2% of people avoided touching their nose, mouth and eyes while 7.3% did not. 37.3% respondents sometimes did while 11.2% were not sure.

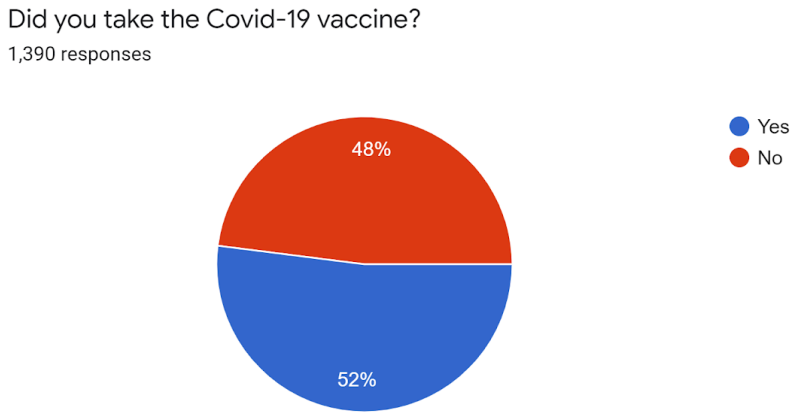

Figure 21: Taking the COVID-19 Vaccine

52% of the respondents got their covid-19 vaccination while 48% of them did not.

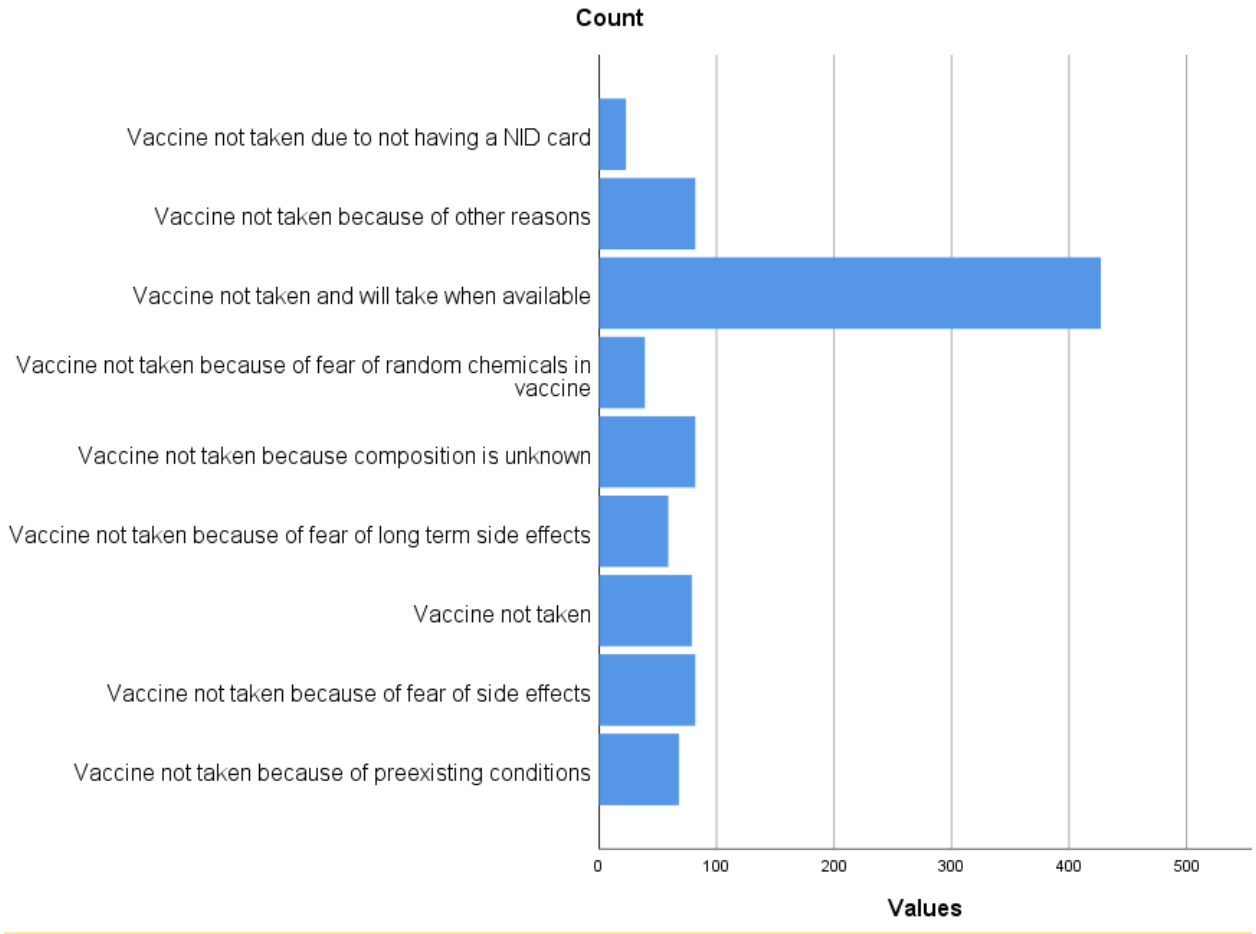

Figure 22: If not taken the vaccine, then why?

63.9% of the respondents said they will get vaccinated when it is made available to them and 12.4% were afraid of the after effects. A large number of the respondents said they could not get vaccinated as they did not have their National ID Card.

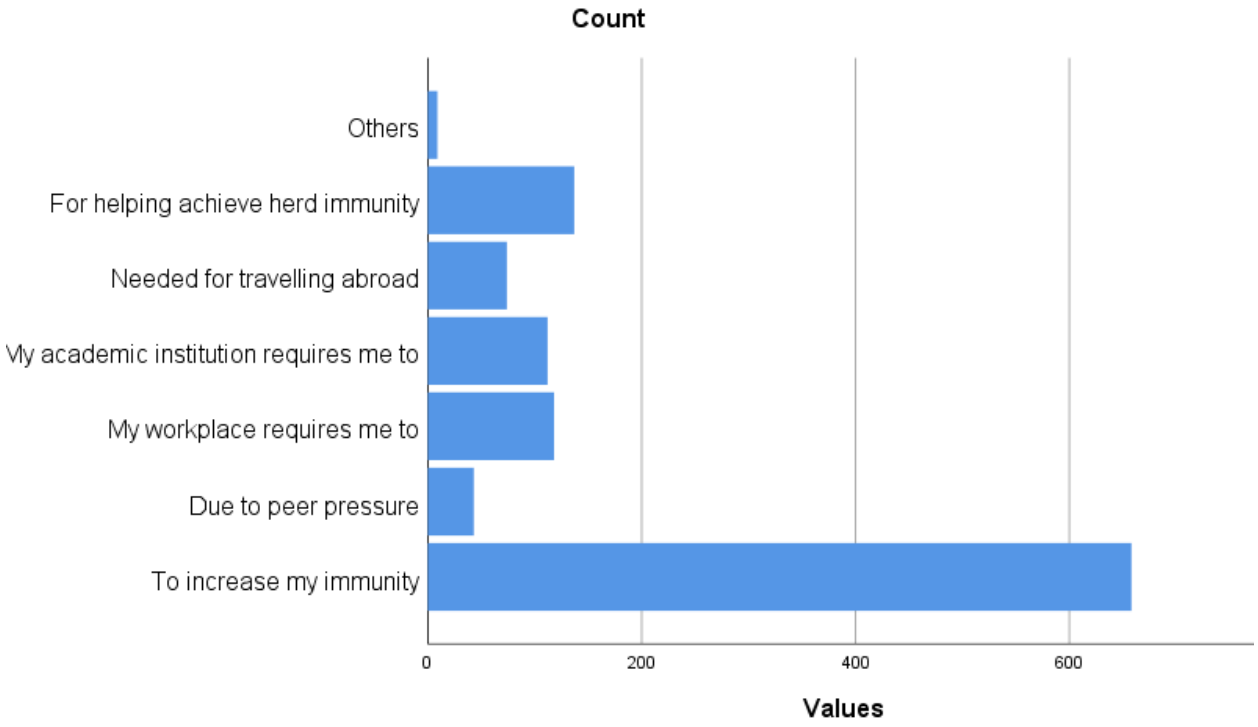

Figure 23: If you have taken the vaccine, then why?

91% of the respondents got vaccinated to increase their immunity while 18.9% wanted to achieve herd immunity. 16.3% and 15.5% said their workplace and academic institution (respectively) requires them to.

8.4.2 Post vaccination

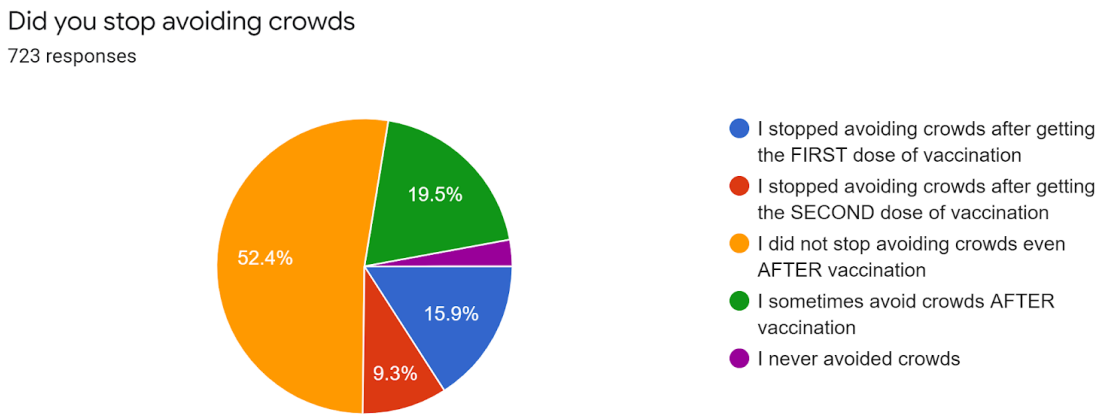

Figure 24: Avoiding crowds after vaccination

52.4% of the respondents did not stop avoiding crowds even after getting vaccinated. 19.5% sometimes avoided crowds after getting vaccinated. 15.9% stopped avoiding crowds after the first dose of their vaccination while 9.3% stopped after their second dose.2.9% never avoided crowds. [discussion: many people did not get their second dose]

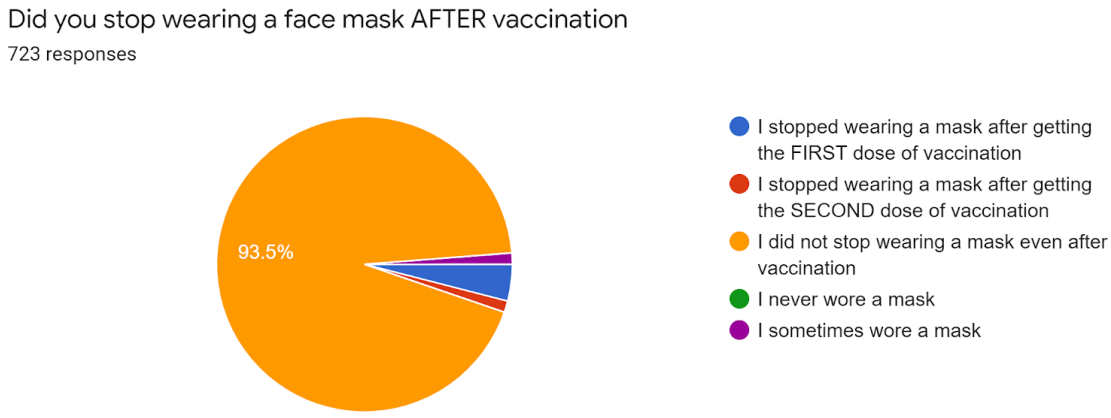

Figure 25: Wearing a facemask after vaccination

93.5% of the respondents did not stop wearing a mask even after their vaccination. 4% of them stopped wearing a mask after getting their first dose of vaccine, 1.2% stopped wearing a mask after their second dose while 1.2% never wore a mask.

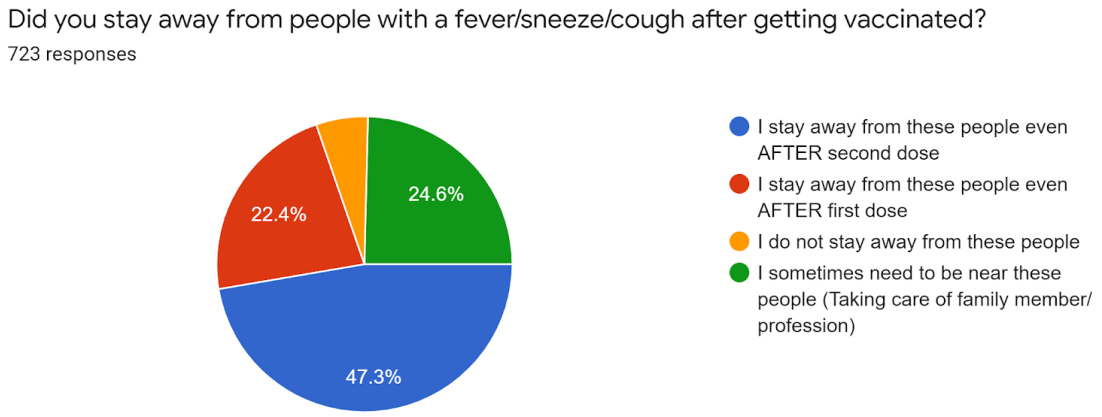

Figure 26: Staying away from people with a fever/sneeze/cough after vaccination

47.3% of the participants kept their distance from people with a fever/cough/sneeze even after their second dose while 22.4% maintained their distance after the first dose. 24.6% of people sometimes need to be near these people in order to take care of them. 5.7% of people do not stay away from them.

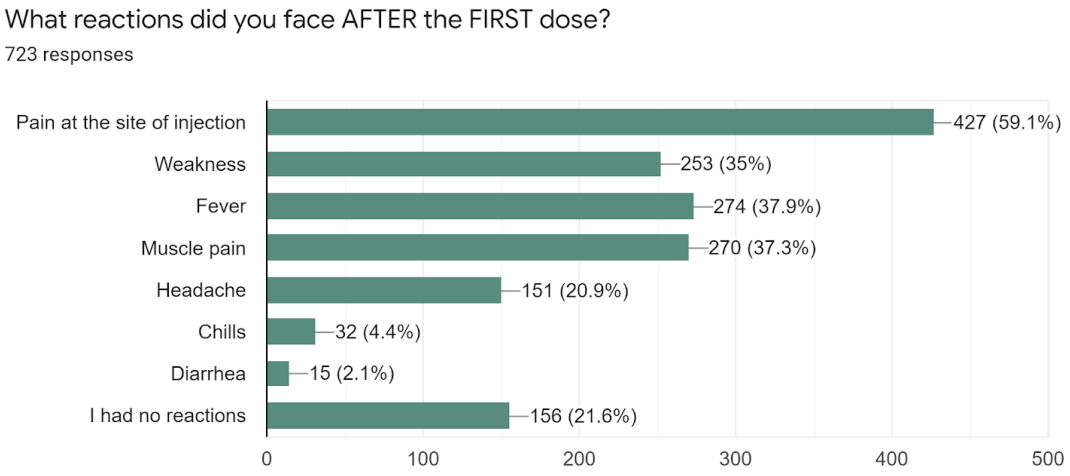

Figure 27: Reactions after the first vaccine dose

59.1% of the participants experienced pain at the site of injection while 35% experienced weakness. 37.9% had a fever and 37.3% had muscle pain. 2.1% had diarrhea.

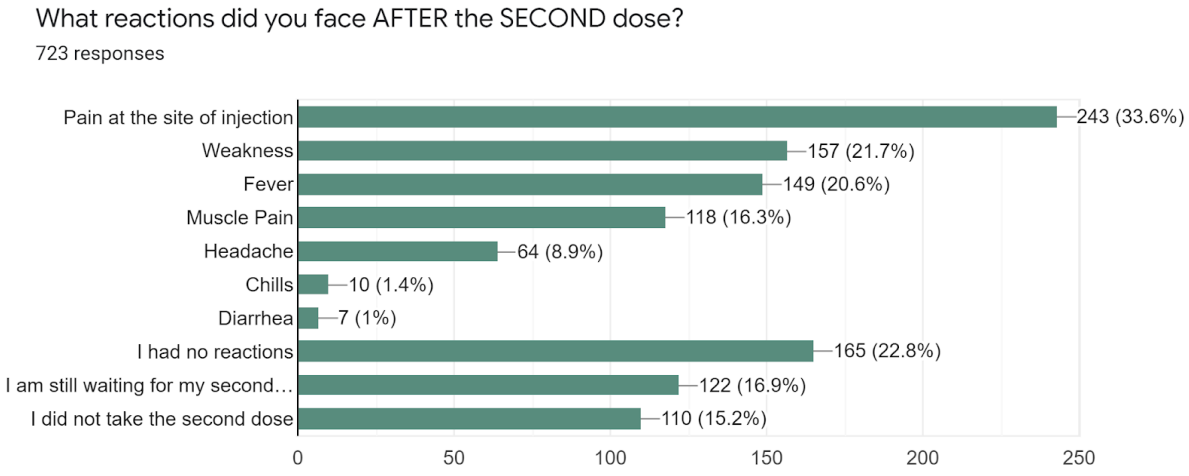

Figure 28: Reactions after the second vaccine dose

33.6% of the participants experienced pain at the site of injection while 21.7% experienced weakness. 20.6% had a fever and 16.3% had muscle pain. 1% had diarrhea.

9. Discussion

COVID-19 brought catastrophic effects on each and every sector of Bangladesh. From the farmers in the field to the school going students, the impact was severe with transmission and death tolls being the burning issues of the present world. In order to cease the rapid transmission rate among the people, vaccination seemed to be the classic solution. However the rapid mutation in the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) genome was encountered as one of the greatest challenges while designing the vaccine. Alterations in their functional properties led to differences in infectivity, disease severity and interactions with host immunity. Contributions by the scientists have resulted in the development of vaccines against SARS-CoV-2. Yet, this was not enough. Before making the vaccine available for the public, it went through clinical trials, U.S. Food and Drug Administration (FDA) approval, manufacturing, and distribution. COVID-19 vaccinations have already been launched in Bangladesh. Although there are several vaccination services offered to the public, the complete new idea of the Covid-19 vaccine resulted in confusions which made distribution and acceptance of vaccines a crucial factor among the public. Our study presents findings from the assessment involving knowledge, attitudes and practices towards COVID-19 vaccinations in Bangladesh. This study targeted

different groups of people varying in terms of age, gender, district, education level and income among a multitude of other variables and evaluated their responses in the context of their intelligence or understanding, behavioural approach and implementation. A total of 1390 individuals were evaluated following an interview-based questionnaire consisting of 53 questions, which were further analyzed and correlated using SPSS.

While studying the knowledge of respondents, we observed that a great number of people believed that antibiotics could cure COVID-19 and that homeopathy is a valid treatment for the disease as well. A group of the respondents also believed that they would have to stand in a line in order to receive the vaccine as well as pay for it. During the analysis of the attitude of the respondents, we further saw that people believed that COVID-19 could be fully controlled. A significant portion of them also believed that the vaccine is either fake or plaecbo and would disrupt pregnancy or lead to a miscarriage or deformation of the child. A number of people also believed that the vaccine may lead to infertility. There was also a group of people who did not trust the vaccine as it was released too soon. A significant proportion of people believed these although our data was positively skewed towards people who were educated and have degrees.

It was observed that, before getting vaccinated, more than 50% of the participants avoided crowded places whereas the percentage dropped drastically after getting vaccinated. A similar scenario was noted in case of the percentage of individuals staying away from people who showed symptoms such as fever/ cough/ sneeze. Before getting the vaccine, a significant proportion of the participants avoided getting in contact with the people who showed the

symptoms whereas after getting vaccinated, the ratio dropped to less than 50%. The probable reason for such results may be due to the misconception that getting vaccinated would protect them from any further COVID-19 infection and that taking precautions after getting vaccinated is absolutely unnecessary. Owing to these differences in knowledge, attitude and practices, we further evaluated the correlations to find specified variations or interlinks among the variables.

9.1 Correlation

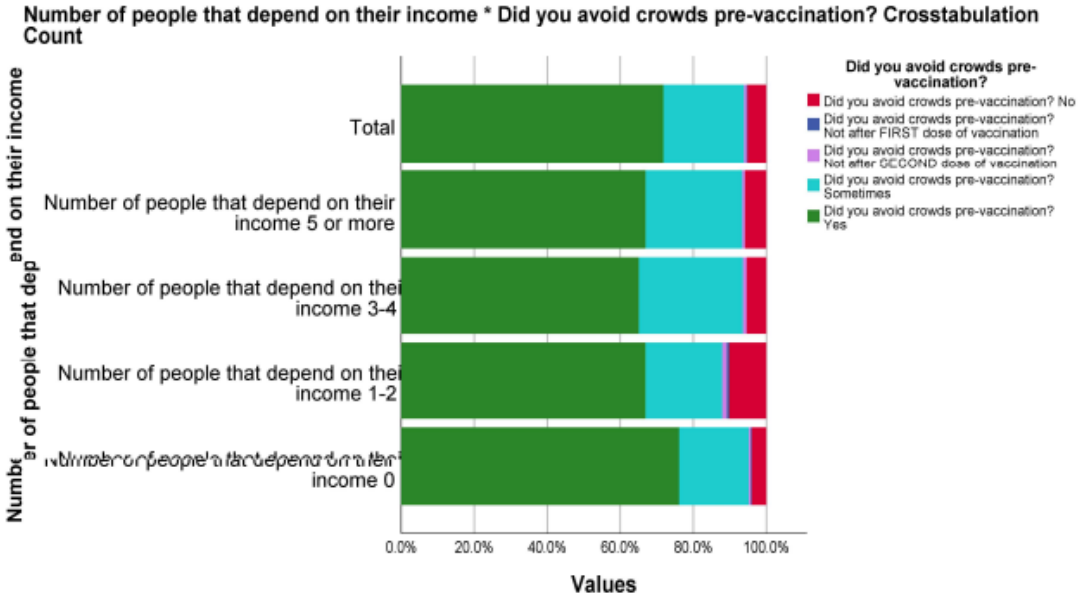

Figure 29: Number of dependents of an individual vs frequency of individuals avoiding the crowd before the vaccination

It is seen that a greater number of people avoided the crowd as the number of dependents on them decreased.

Our study depicts a correlation between the number of dependents of an individual and their stand on avoiding the crowd before getting vaccinated. Individuals with no dependents were found to make up the highest fraction of those who avoided the crowd before vaccination. On the other hand, it was observed that as the number of dependents of an individual increased, the frequency of them avoiding the crowd declined thus adding up to the idea that since more people are dependent on a person, he/she must take the responsibility to earn and feed the other members.

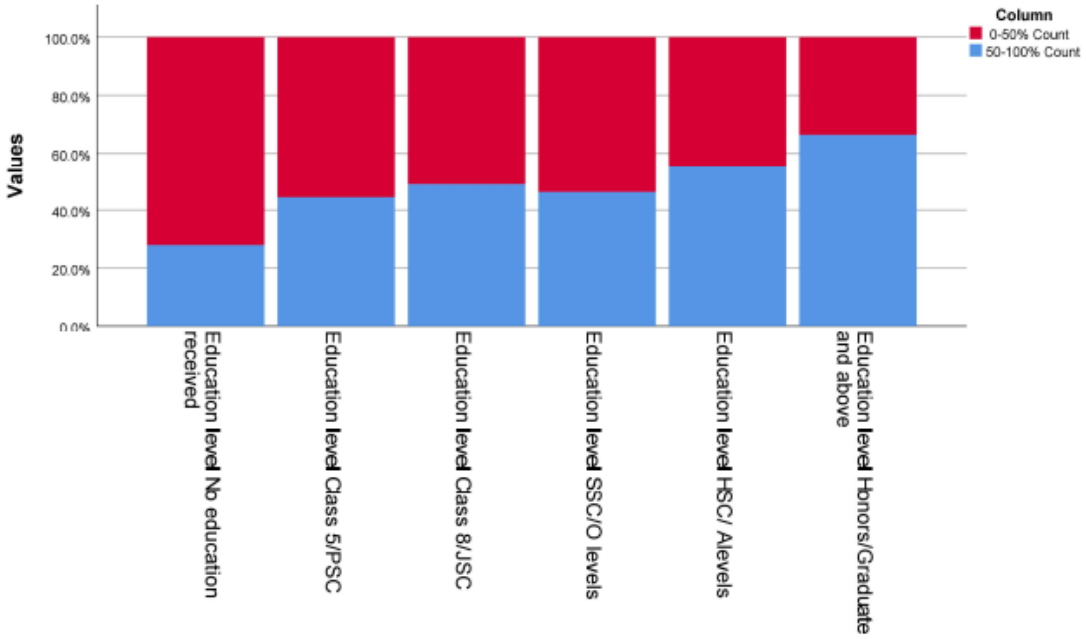

Figure 30: Level of education received vs Knowledge on Covid-19 vaccinations

According to our study, a significant association was observed between the level of education received and their knowledge on Covid-19 vaccination. The study revealed that the participants who received a higher level of education were found to have greater knowledge on Covid-19 vaccination. This outcome is backed up by previous KAP studies conducted in Bangladesh in which people who acquired higher levels of education were more knowledgeable compared to the individuals with no education at all. This can be due to the fact that people who are more educated are conscious about their health as well as their surroundings. They know the fatal impact the virus can cause and thus in order to keep themselves as well as their family members safe, they remain updated with all the information being circulated on different news portals, such as of COVID-19 vaccinations.

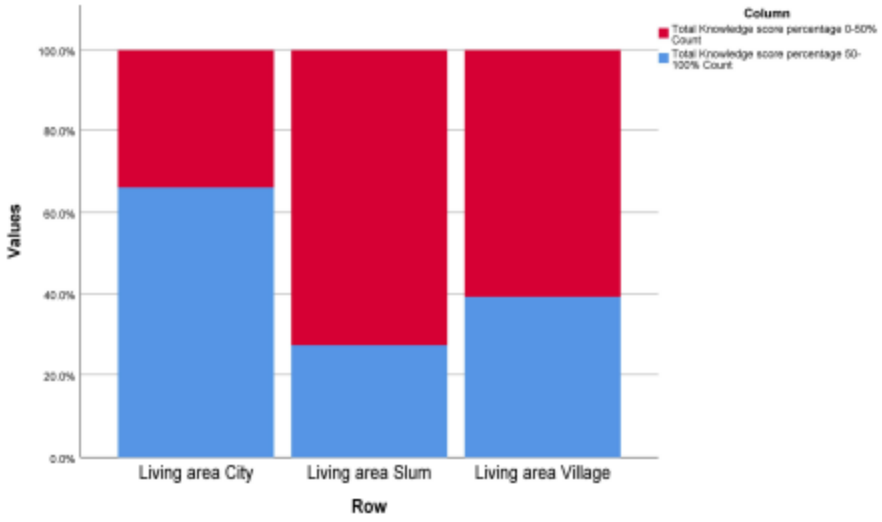

Figure 31: Knowledge score vs Living Area

It is observed that slum dwellers had the least knowledge score while city dwellers had the highest scores. People living in slums have both the lowest incomes and the lowest education levels, which could mean they have less access to information and a lower capacity to understand them.

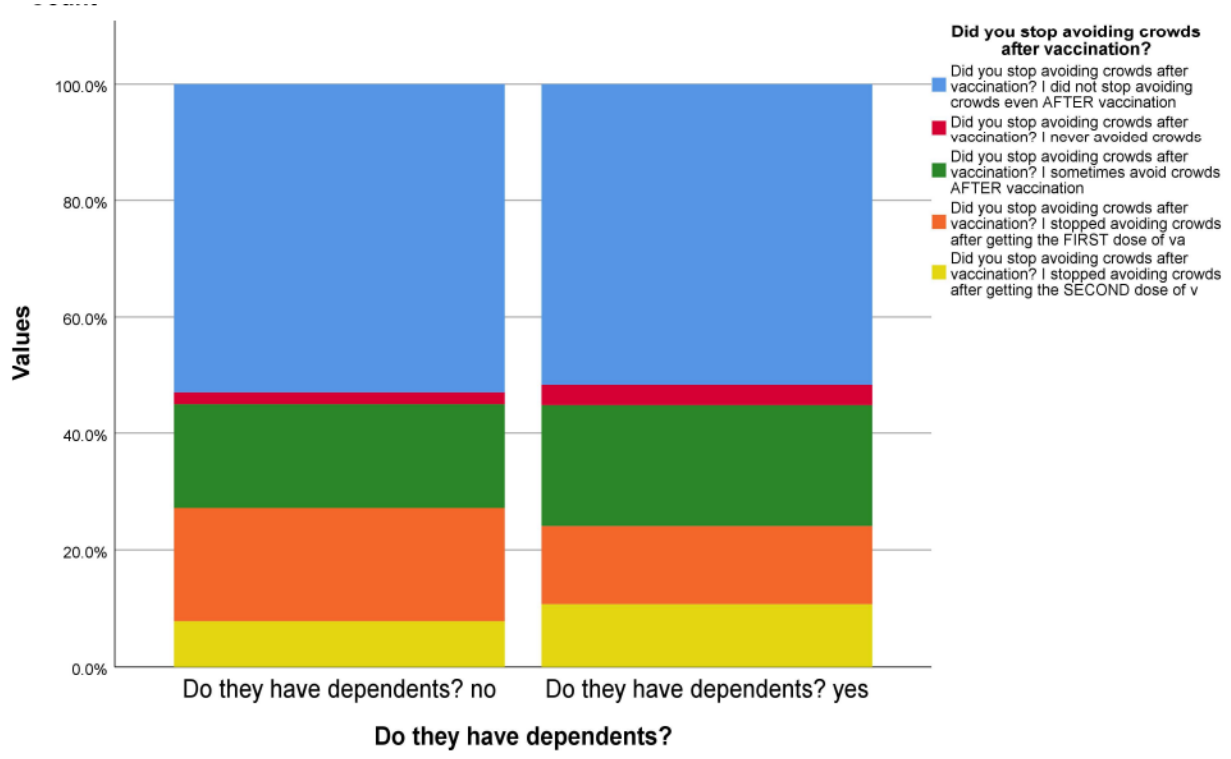

Figure 32: Avoiding crowds vs Having dependents

There was no strong correlation between people having dependents and avoiding crowds.

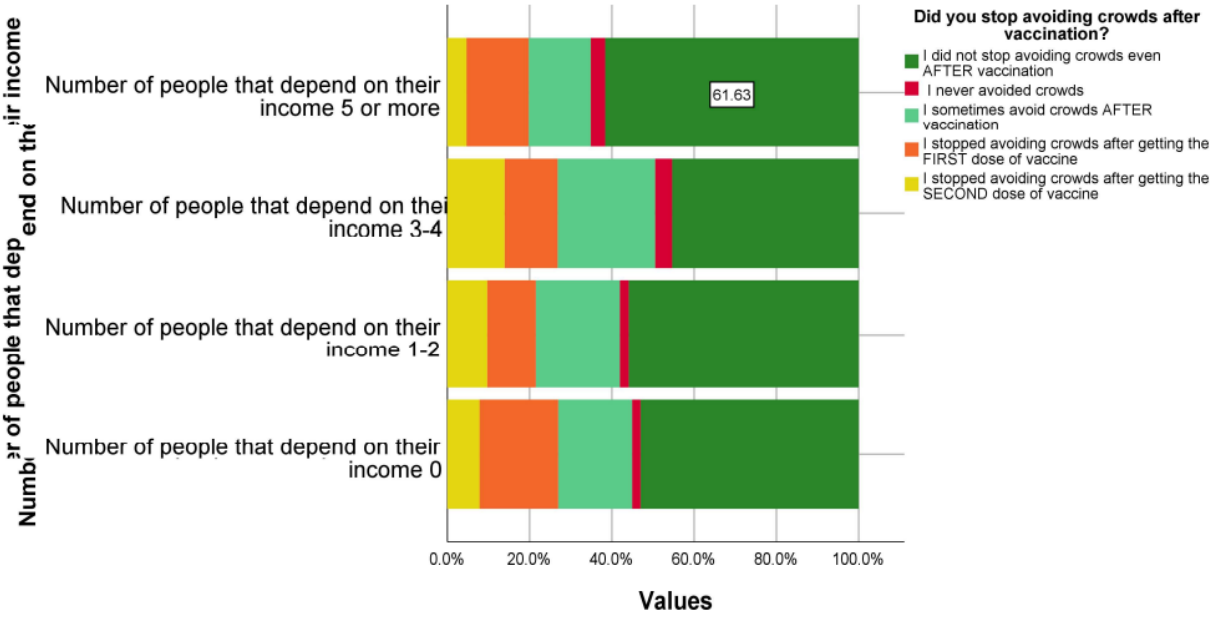

Figure 33: Avoiding crowds vs Number of dependents.

There was no consistent and clear correlation between avoiding crowds and the number of dependents the respondents had.

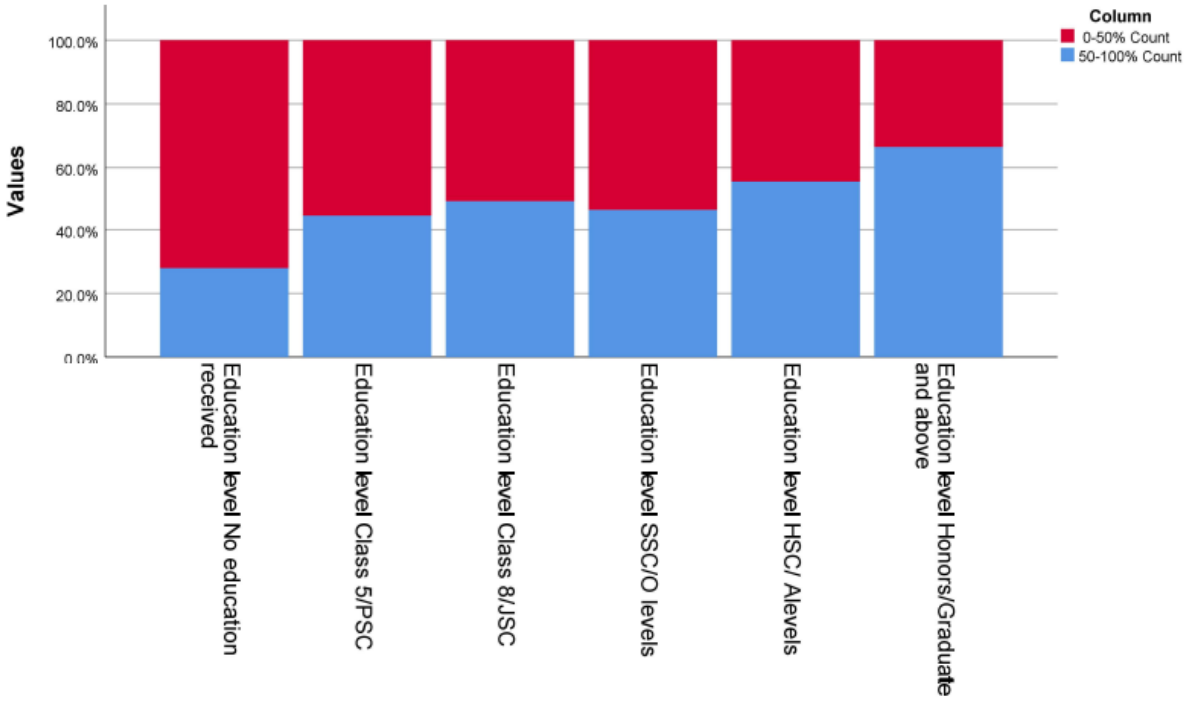

Figure 34: Mean knowledge score vs education level

As education level increases the mean knowledge also increases consistently, except in the case of SSC/O levels. This could be due to the fact we started letting people fill out the survey on their own if they had at least a SSC/O level education. There is a possibility of misinterpretation of some of the questions resulting in a lower score than class8/PSC level education score.

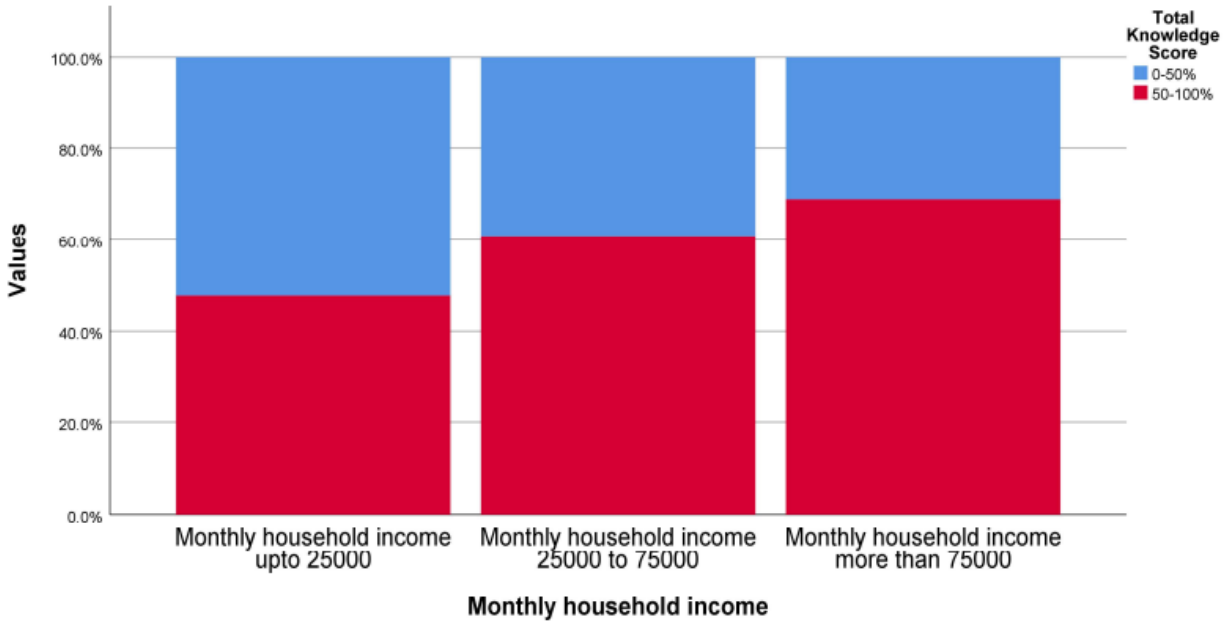

Figure 35: Monthly income vs knowledge score

Knowledge score obtained in the survey is proportional to the monthly household income. Households with more income can afford a better education and have access to televisions and the internet which exposes them to more information about the covid-19 situation.

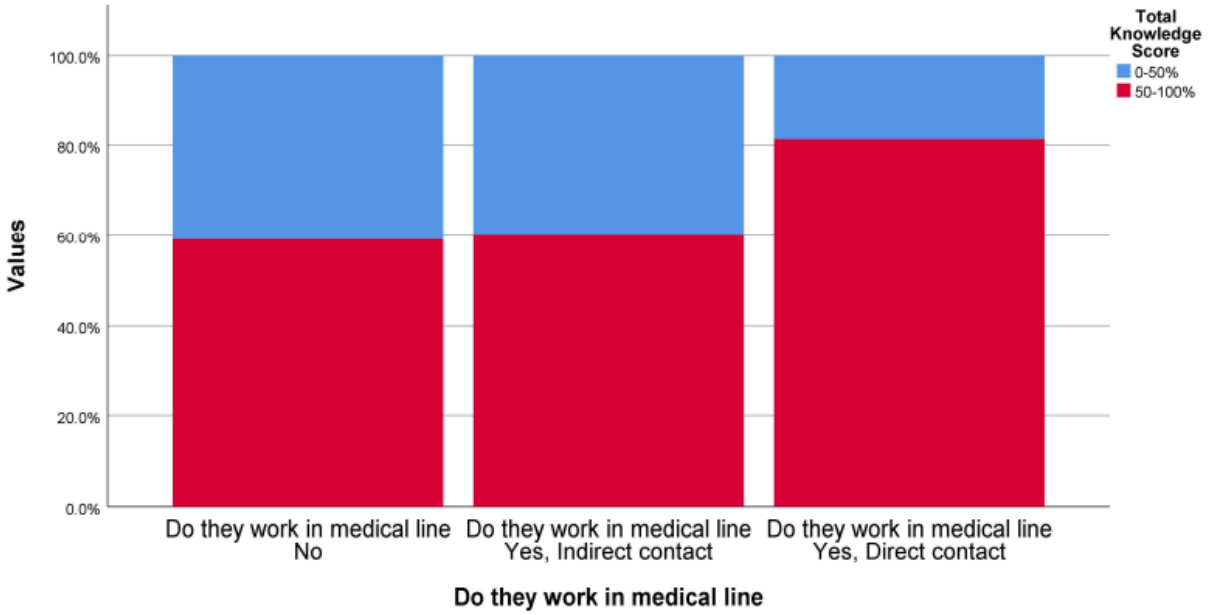

Figure 36: Knowledge vs Involvement in medical field

People who have careers needing direct contact with COVID-19 patients have significantly higher knowledge than people who are not as involved. This is because people having direct contact are nurses and doctors who need to be well informed as part of their job, or cleaners and ward boys who need to be well instructed to be kept safe from getting infected.

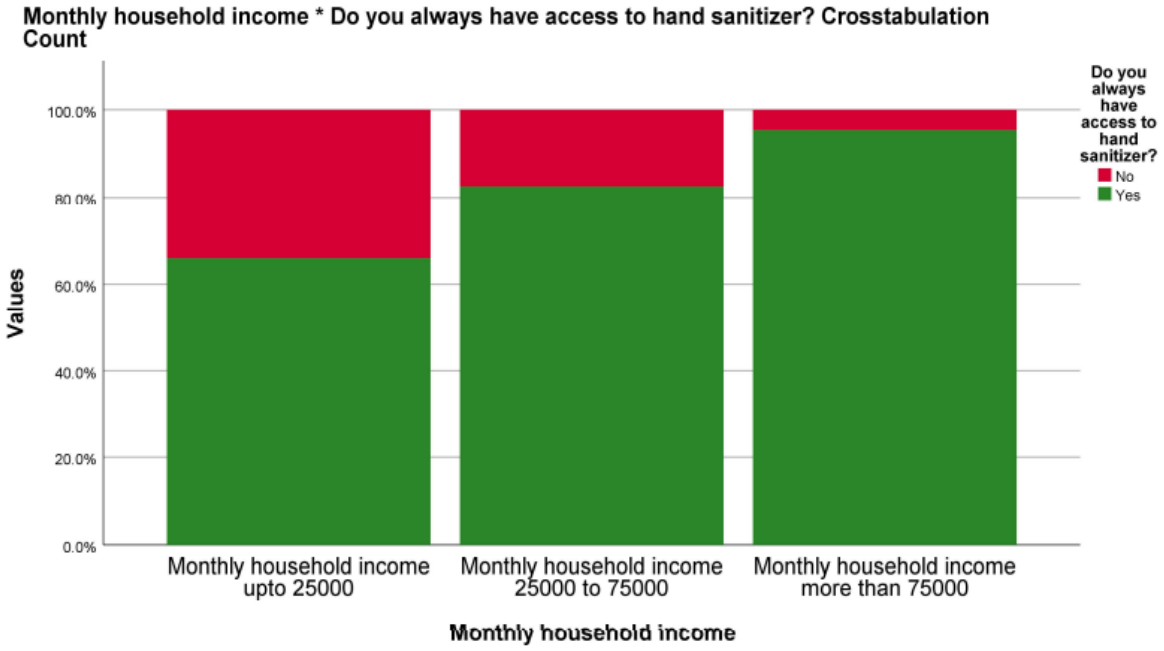

Figure 37: Access to hand sanitizer vs Monthly household income

People with a greater monthly household income had significantly higher access to hand sanitizers. This could be because more poor people are simply unable to afford the expenditure or they are unaware of the benefit. Also, people with lower household incomes may prefer cheaper alternatives. People also have access to sanitizers though their place of work.

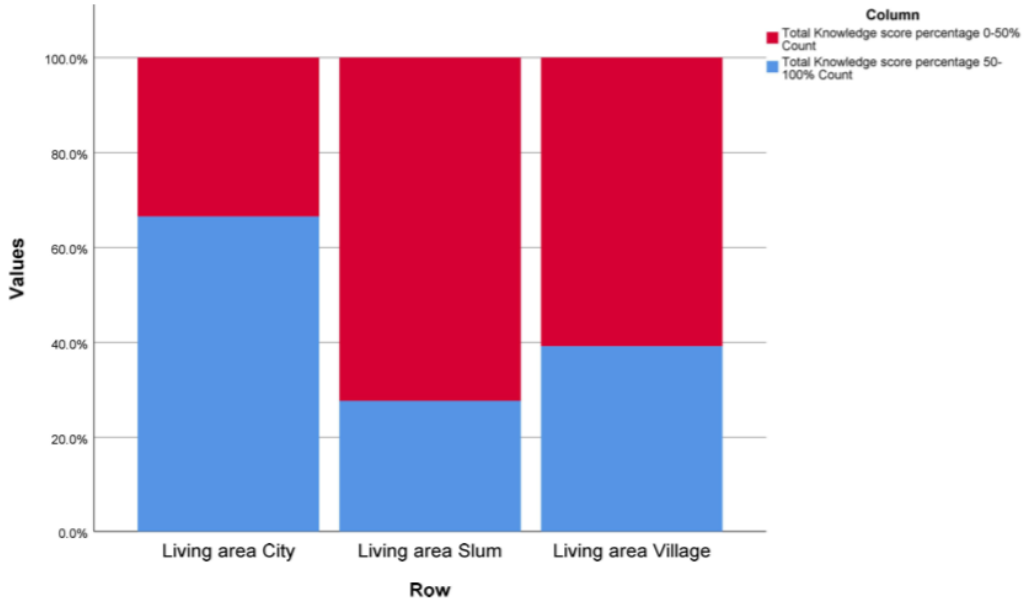

Figure 38: Knowledge about COVID19 vs Living Area

The purpose of this study was also to see the correlation between knowledge and the standards of living amongst the citizens of Bangladesh. We believed that people living in poverty or far from the city will have limited knowledge. As we can see from the graph in figure 37, participants living in the heart of the country scored higher, proving to be more aware of COVID-19 as opposed to those living in the slums and villages. 65% of the participants living in the city answered accurately. Whereas, only approximately 25% and 38% of the slum inhabitants and villagers, respectively, were well educated regarding the coronavirus. This was most likely because those living in the city are exposed to various platforms from which they can easily learn about COVID-19, be it online, from blogs, awareness campaigns or even from their surrounding people. City people have more access to data unlike their counterparts and thus, as the graph is clearly portraying, knowledge regarding the virus is rich in the capital.

10. Conclusion

As COVID-19 spread all over the world, Bangladesh prepared to tackle the effects of the pandemic as well. Once vaccination had begun in Bangladesh, it was expected that the number of cases would decrease and the pandemic would cease to exist. The following weeks witnessed an even larger wave of COVID-19, known as the second wave. The rate of infections and death toll increased from March 19, 2021 to April 19, 2021. As this was not consistent with the expectations due to the vaccination program being started, we aimed to discover the reason behind this anomaly. Our hypothesis aimed to test the change in behaviour of the people in Bangladesh and their knowledge and attitudes towards COVID-19 and COVID-19 vaccines. We hypothesized that the change in attitudes and practices of people after the initiation of covid-19 vaccinations is what brought about the second wave of COVID-19 in Bangladesh. Our study showed changes in attitude and practices of people before and after vaccines along with differences among people with different socio demographic backgrounds, income levels, education levels, dependants and more. Our limitations included not being able to meet people in different districts and slums. Additionally, it is possible that people may have not been true to their statements over call interviews and google doc interviews. In conclusion, there was a slight change in attitude and practices of the people in Bangladesh once the vaccination program had begun and this may have triggered the second wave of COVID-19 in 2021.

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Appendix

General Information

1. **Name:**
2. **Gender:**
   ☐ **Male** ☐ **Female** ☐ **Other**
3. **Age:**
   ☐ **40 - 50** ☐ **51 - 60** ☐ **61 - 70** ☐ **71 -80** ☐ **80+**
4. **District of residence (Dhaka, Sylhet, etc):**
5. **Where do you live:**
   ☐ **City** ☐ **Village** ☐ **Slum**
6. **Education level (Ongoing/Highest level of education received in case of discontinuation):**
   ☐ **no education received,** ☐ **Class 5/PSC** ☐ **Class 8/JSC** ☐ **SSC/O levels** ☐ **HSC/ A levels** ☐ **honors/graduate and above**
7. **Occupation (check the boxes that apply to you):**

☐ **Unemployed** ☐ **Student** ☐ **Self-employed** ☐ **Employed** ☐ **Retired** ☐ **Other**

8. **Do you work in the medical line (clinic/hospital)?**

   ☐ **Yes (Direct contact with patient- Doctor, Nurse, Attendant, Cleaner, Ward boy etc.)**

   ☐ **Yes (Indirect contact with patients - Admin, Manager, Supervisor, Accountant, etc.)**

   ☐ **No**

9. **How many people depend on your income?**
10. **Which people depend on your income?**

    ☐ **No one depends on my income** ☐ **Parents** ☐ **Husband/wife**

    ☐ **My Kids** ☐ **Others**

11. **Monthly household Income:**

    ☐ **Less than 10,000** ☐ **10,000 to less than 25,000** ☐ **25,000 to less than 50,000**

    ☐ **50,000 to less than 75,000** ☐ **75,000 to less than 1 Lakh** ☐ **1 Lakh and above**

12. **Comorbidities/Pre existing health issues (Check the boxes that apply to you):**

    ☐ **None** ☐ **Asthma** ☐ **High Blood Pressure** ☐ **Diabetes** ☐ **Kidney Problem**

    ☐ **Liver Problem** ☐ **Heart Problem** ☐ **AIDS** ☐ **Skin disease**

    ☐ **Allergies** ☐ **Others**

13. **How frequently do you visit a doctor?**

    ☐ **Every 3 months** ☐ **Every 6 months** ☐ **Every year** ☐ **Every 2 years**

    ☐ **Only when I am sick** ☐ **Only when absolutely necessary**

14. **How health conscious are you?**

    ☐ **I go for checkups frequently** ☐ **I exercise frequently** ☐ **I frequently eat healthy food**

    ☐ **I am not health conscious** ☐ **I try to be health conscious but don't always succeed**

15. **What is your source of knowledge on the COVID-19 situation?**

    ☐ **Newspaper** ☐ **Word of mouth (friends/family)** ☐ **Television** ☐ **Social Media**

    ☐ **Other**

16. **What is the source of your knowledge on COVID-19 Vaccine?**

    ☐ **Newspaper** ☐ **Word of mouth (friends/family)** ☐ **Television** ☐ **Social Media**

    ☐ **Other**

KNOWLEDGE

17. **Select all the possible symptoms of Covid- 19**

    ☐ **Coughing** ☐ **Fever** ☐ **Sore throat** ☐ **Constipation** ☐ **Headaches**

    ☐ **Body aches** ☐ **Difficulty breathing** ☐ **Acidity** ☐ **Diarrhea**

18. **Select the statements that you think are true**

- ☐ **After being infected with the coronavirus, it can take 0-14 days to show signs**
- ☐ **A person who seems healthy can still spread the disease.**
- ☐ **Antibiotics can cure Covid-19**
- ☐ **Homeopathy is a valid treatment for Covid-19**
- ☐ **Older people and people with heart disease, lung disease, diabetes are at high risk from covid-19**
- ☐ **This virus can spread from an infected person through talking, breathing or coughing**

19. **Check the boxes that you think are the after effects of the COVID-19 Vaccination**

☐ **Fever** ☐ **Body ache/Muscle pain** ☐ **Fatigue** ☐ **Headache** ☐ **Diarrhea**

☐ **Pain at the site of injection** ☐ **No after effects/reaction**

20. **Which vaccine would you prefer most to get vaccinated with?**

- ☐ **USA vaccine (Moderna)**
- ☐ **UK vaccine (Oxford Uni - AstraZeneca)**
- ☐ **Germany and USA vaccine (Pfizer - BioNTech)**
- ☐ **Russia vaccine (Sputnik)**
- ☐ **Netherlands and Belgium vaccine (Johnson & Johnson /Jansen Vaccine)**
- ☐ **Chinese vaccine (Sinovac vaccine)**
- ☐ **I don't have a preference**
- ☐ **I am not aware of any difference**

21. **Did you know that the Covid-19 vaccination was ALSO available at hospitals/clinics (on site) without online registration?**

- ☐ **Yes**
- ☐ **No**

22. **Select the boxes that you think are true**

- ☐ **I need to register to get the vaccine online, through a website**
- ☐ **I need to stand in a line in the hospital to register for the vaccine**
- ☐ **I need to pay money to get vaccinated**
- ☐ **The number of shots needed depends on the vaccine**
- ☐ **I can register through cyber cafes, printing shops for a small service fee**

Attitude

23. **COVID-19 can be fully controlled?**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

24. **COVID-19 is a natural calamity**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

25. **COVID-19 is a hoax**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

26. **COVID-19 can put my life at risk**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

27. **I feel like vaccination is unsafe**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

28. **I think the vaccine is fake/placebo**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

29. **Vaccines will disrupt pregnancy, or lead to mental disorders of the baby**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

30. **Vaccine may affect fertility**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

31. **Vaccines contain microchip that will track me**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

32. **Any vaccine is effective against all variants of coronavirus (Indian variant, African variant, Delta variant etc).**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

33. **The government should reopen schools and universities**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

34. **The vaccine got released too early, I don't trust the makers of the vaccine**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

35. **I don't need to take precautions (mask, social distancing etc) after vaccination**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

36. **My religion stops me from getting vaccinated**

☐ **Strongly Agree** ☐ **Agree** ☐ **Neutral** ☐ **Disagree** ☐ **Strongly Disagree**

PRACTICE QUESTIONS

Pre vaccination

37. **Do/Did you avoid crowded places?**

Yes **No** **Sometimes**

Not after FIRST dose of vaccination **Not after SECOND dose of vaccination**

38. **Do/Did you wash hands frequently?**

Yes **No** **Sometimes**

39. **Do/Did you have access to sanitizer/alcohol?**

Yes **No** **Sometimes**

40. **Do/Did you wear a facemask?**

Yes **No** **Sometimes**

41. **[if yes] What type of masks do you wear?**

Cotton Cloth **KN95** **Surgical** **N95** **Fabric Mask**

42. **[if no] It's because of**

I can't breathe **My face isn't visible** **Mask acne/pimples**

I don't look good **the weather makes me sweat a lot**

I don't think masks stop viruses **Other**

43. **Do/Did you keep a distance from people with a fever/cough/sneeze?**

Yes **No** **Sometimes** **Not sure**

44. **How can you protect yourself from covid?**

By wearing masks **Social distancing** **Hand Washing**

45. **Do/Did you avoid touching your nose, mouth, eyes?**

Yes **No** **Sometimes** **Not sure**

If you did not take the vaccine…

46. **If you have not taken the vaccine, then why?**

I have pre-existing health issues so I am afraid

I am afraid of the after effects

I am afraid of the long term side effect

I believe my immune system is strong

I don't know what it is made of

I do not want random chemicals inside my body

I will take the vaccine when it is made available to me

Other

If Yes….

47. If yes, then why?

- ☐ **To increase my immunity**
- ☐ **Due to peer pressure**
- ☐ **My workplace requires me to**
- ☐ **My academic institution requires me to**
- ☐ **Needed it for traveling abroad**
- ☐ **Herd immunity**
- ☐ **Other**

Post Vaccination

48. Did you stop wearing a face mask AFTER vaccination

- ☐ **I stopped wearing a mask after getting the FIRST dose of vaccination**
- ☐ **I stopped wearing a mask after getting the SECOND dose of vaccination**
- ☐ **I did not stop wearing a mask even after vaccination**
- ☐ **I never wore a mask**
- ☐ **I sometimes wore a mask**

49. Did you stop avoiding crowds

- ☐ **I stopped avoiding crowds after getting the FIRST dose of vaccination**
- ☐ **I stopped avoiding crowds after getting the SECOND dose of vaccination**
- ☐ **I did not stop avoiding crowds even AFTER vaccination**
- ☐ **I sometimes avoid crowds AFTER vaccination**
- ☐ **I never avoided crowds**

50. Did you stay away from people with a fever/sneeze/cough after getting vaccinated?

- ☐ **I stay away from these people even AFTER second dose**
- ☐ **I stay away from these people even AFTER first dose**
- ☐ **I do not stay away from these people**
- ☐ **I sometimes need to be near these people (Taking care of family member/profession)**

51. What reactions did you face AFTER the FIRST dose?

- ☐ **Pain at the site of injection**
- ☐ **Weakness**
- ☐ **Fever**

- [ ] **Muscle pain**
- [ ] **Headache**
- [ ] **Chills**
- [ ] **Diarrhea**
- [ ] **I had no reactions**

52. What reactions did you face AFTER the SECOND dose?

- [ ] **Pain at the site of injection**
- [ ] **Weakness**
- [ ] **Fever**
- [ ] **Muscle pain**
- [ ] **Headache**
- [ ] **Chills**
- [ ] **Diarrhea**
- [ ] **I had no reactions**
- [ ] **I am still waiting for my second dose**
- [ ] **I did not take the second dose**

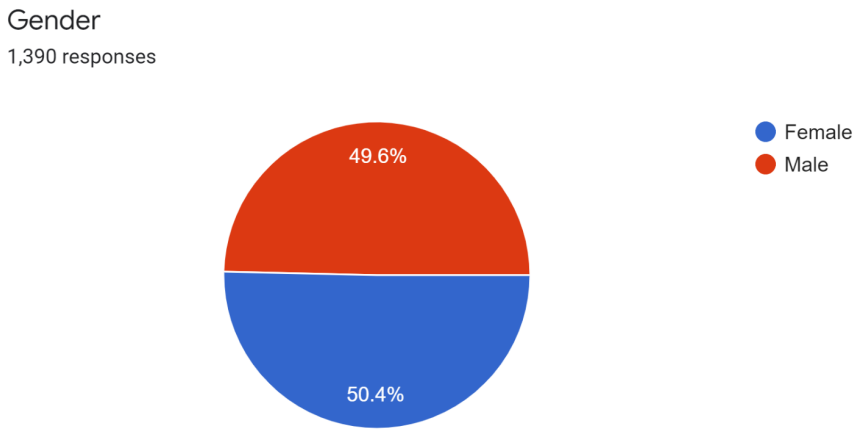


Figure 1 Percentage of gender of respondents

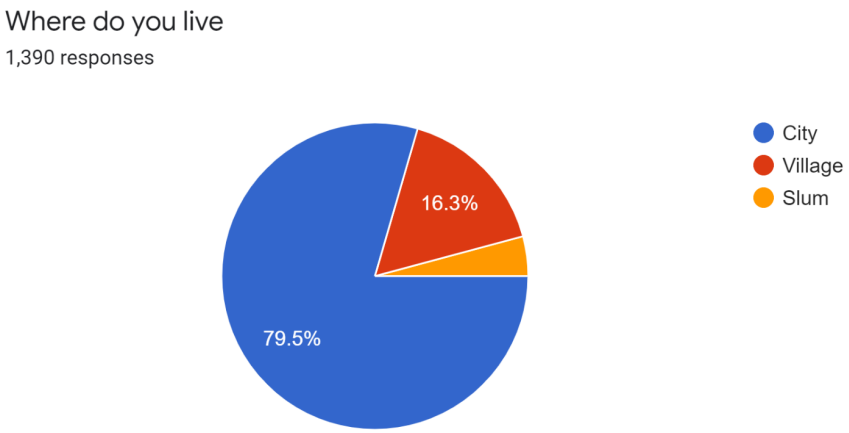


Figure 2 Area of residence of the respondents

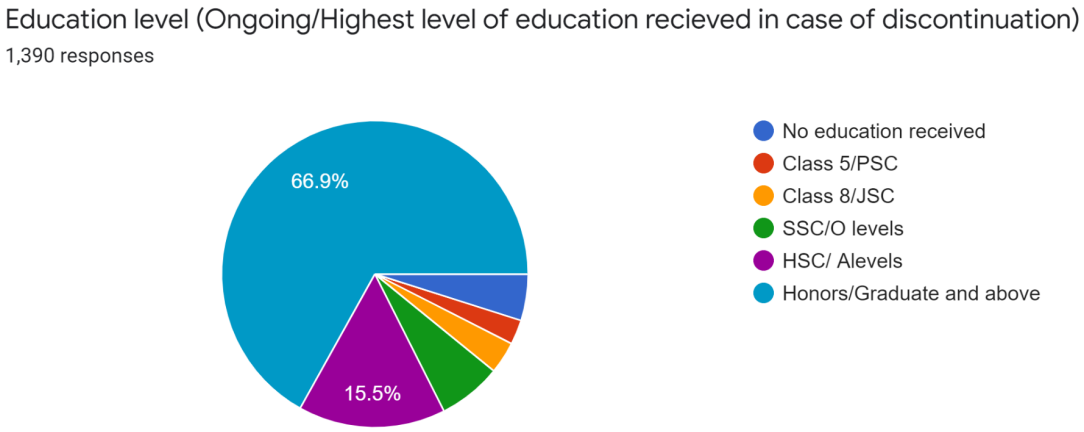


Figure 3 Level of education

Figure 4 Occupation of respondents

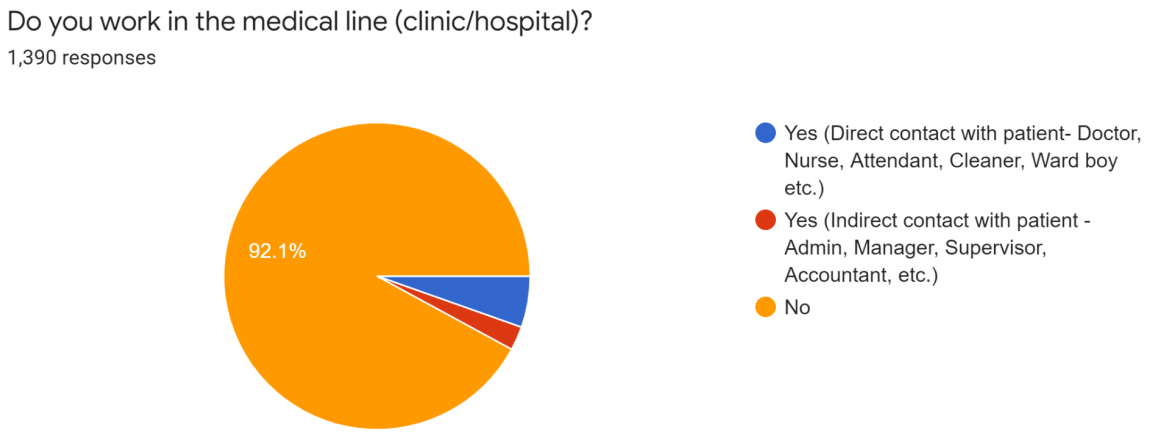


Figure 5 Percentage of people working in the medical sector

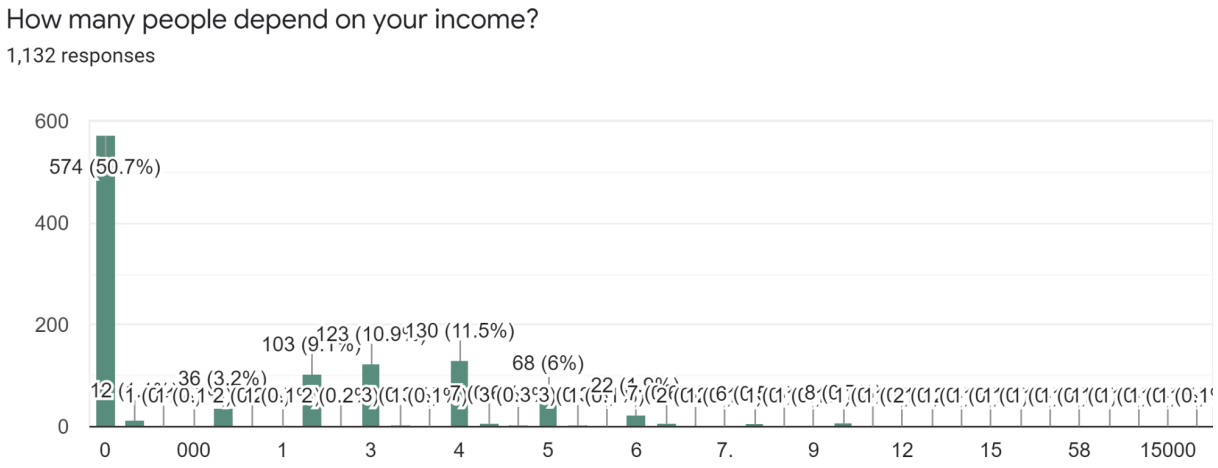


Figure 6 Number of people depending on the income of each respondent

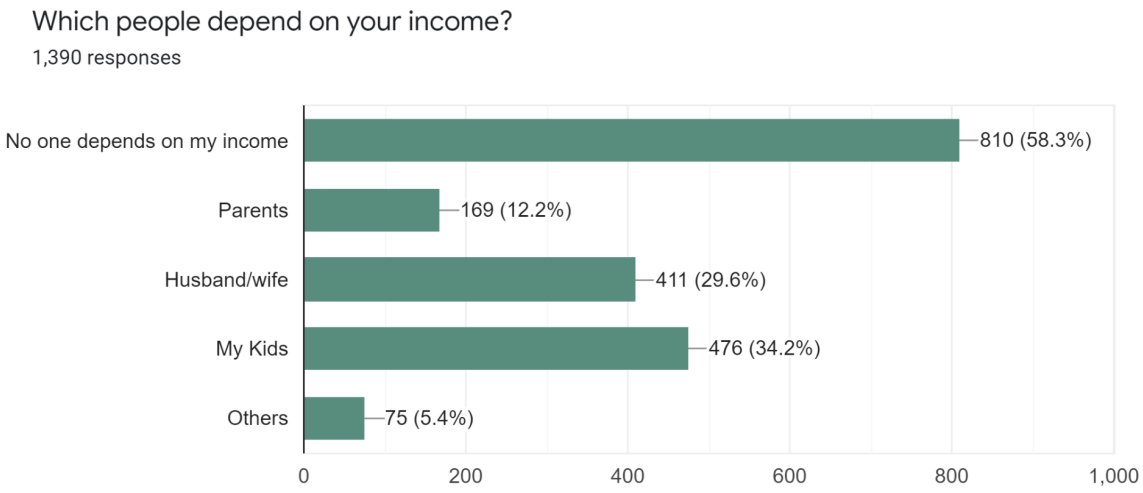


Figure 7 Which people depend on their income

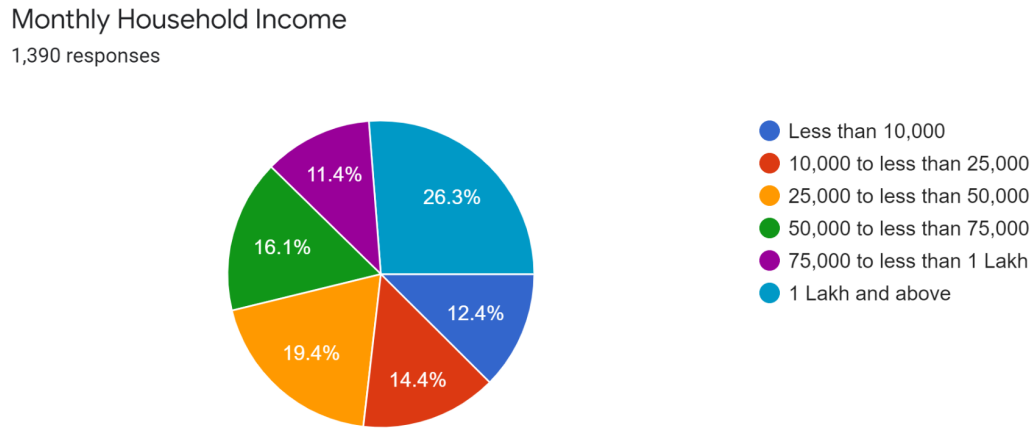


Figure 8 Monthly household income

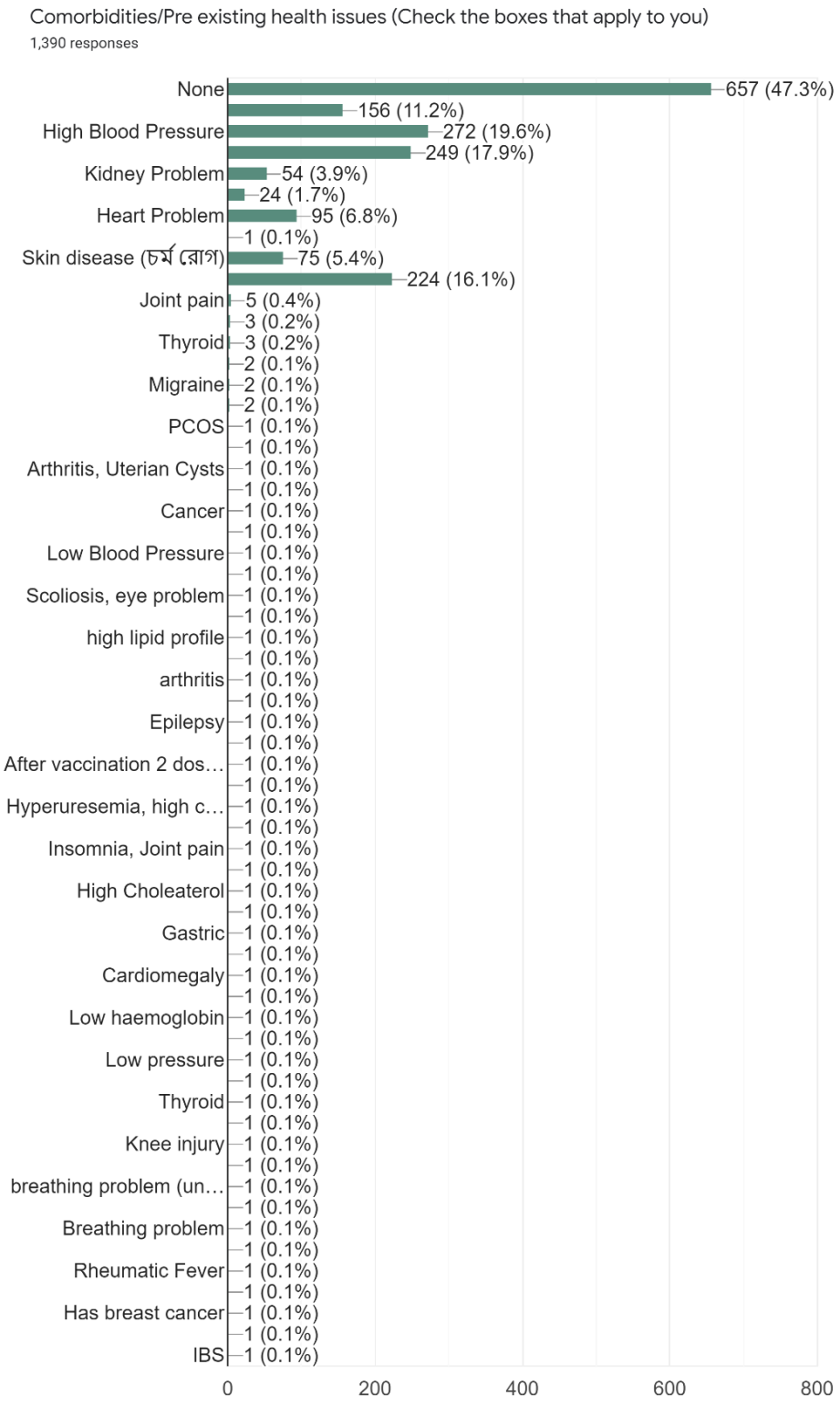


Figure 9 Comorbidities of respondents

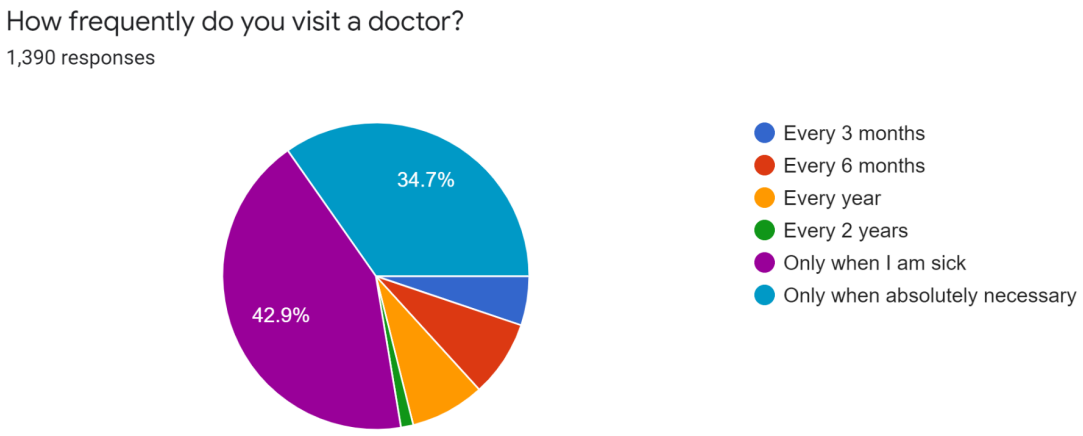


Figure 10 Frequency of visiting a doctor

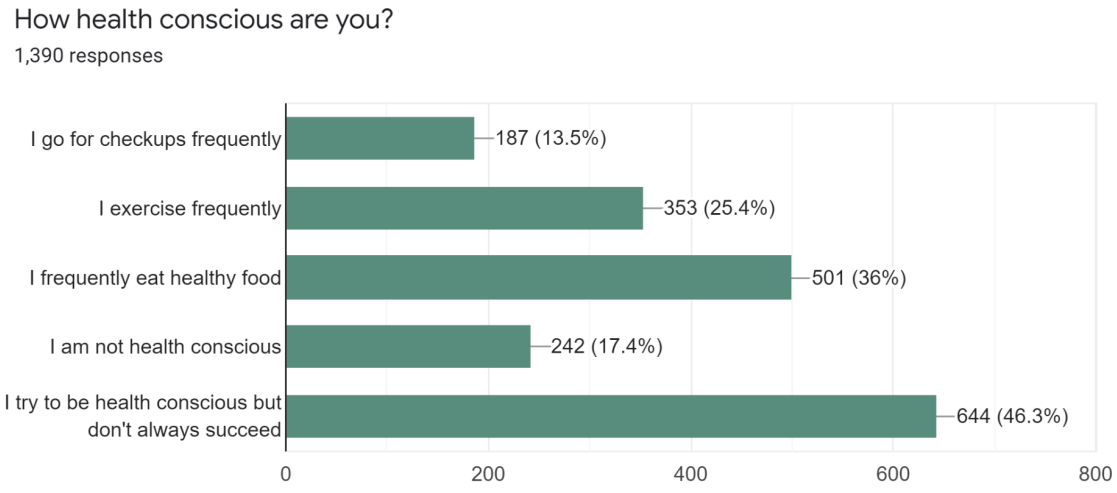


Figure 11 How health conscious are you

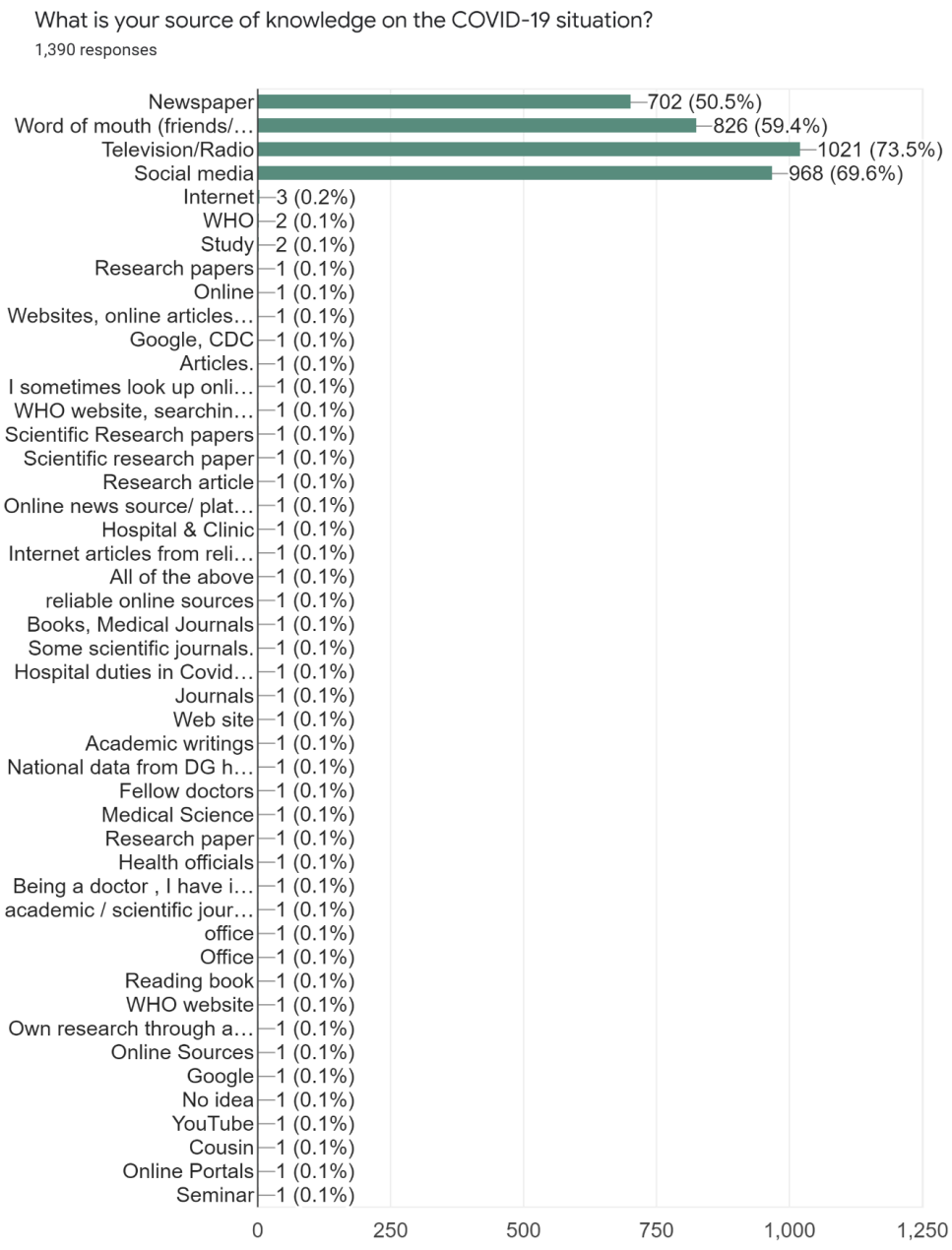


Figure 12 Source of knowledge on COVID-19

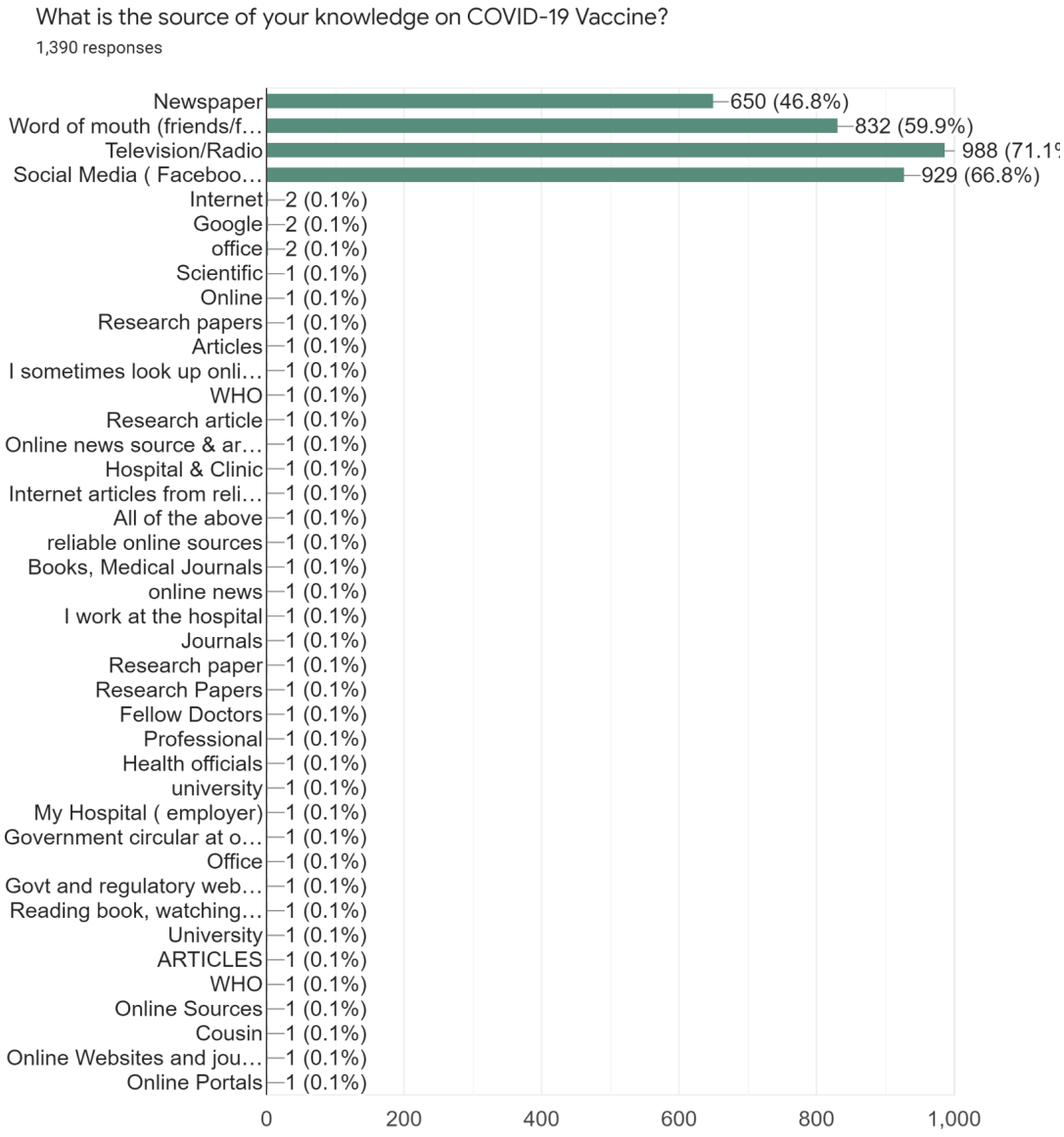


Figure 13 Source of knowledge on COVID-19 vaccines

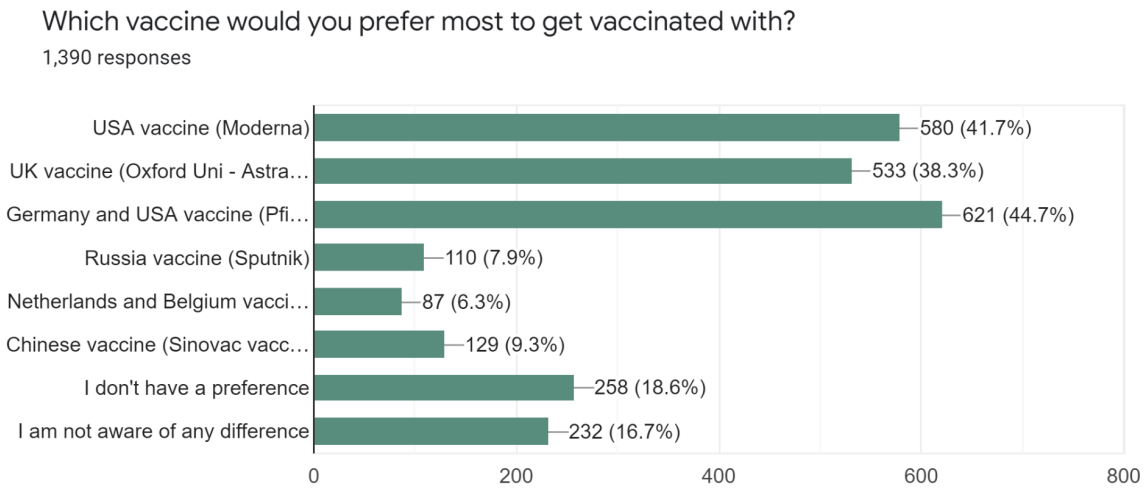


Figure 14 Which vaccine would you prefer to get vaccinated with

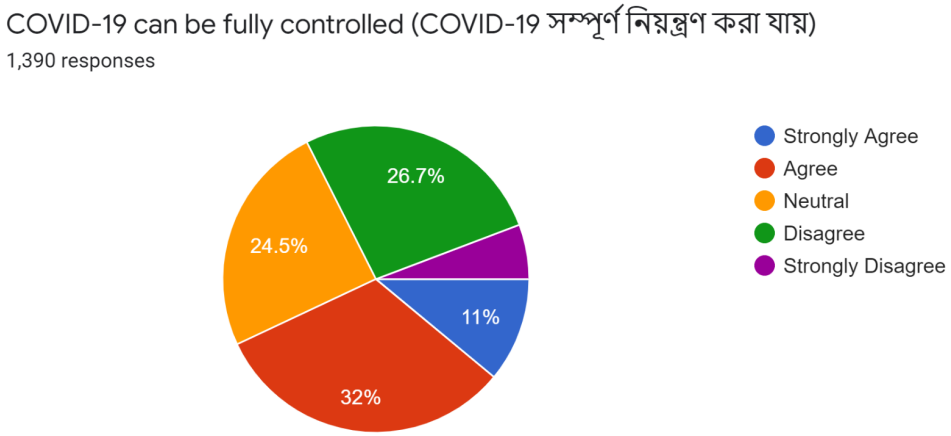


Figure 15 Can COVID-19 be fully controlled

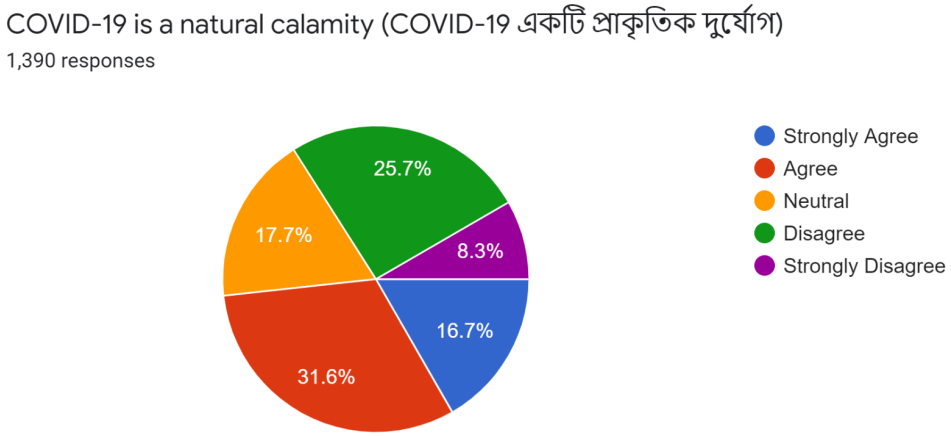


Figure 16 COVID-19 is a natural calamity

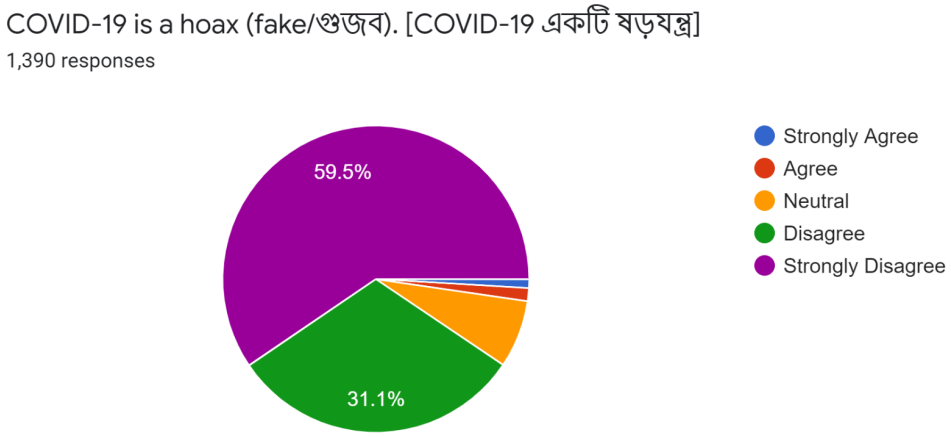


Figure 17 COVID-19 is a hoax

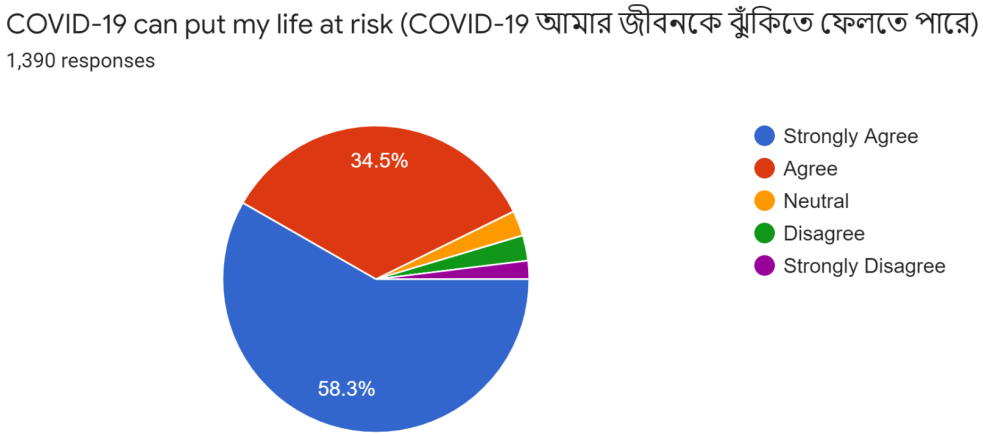


Figure 18 COVID-19 can put my life at risk

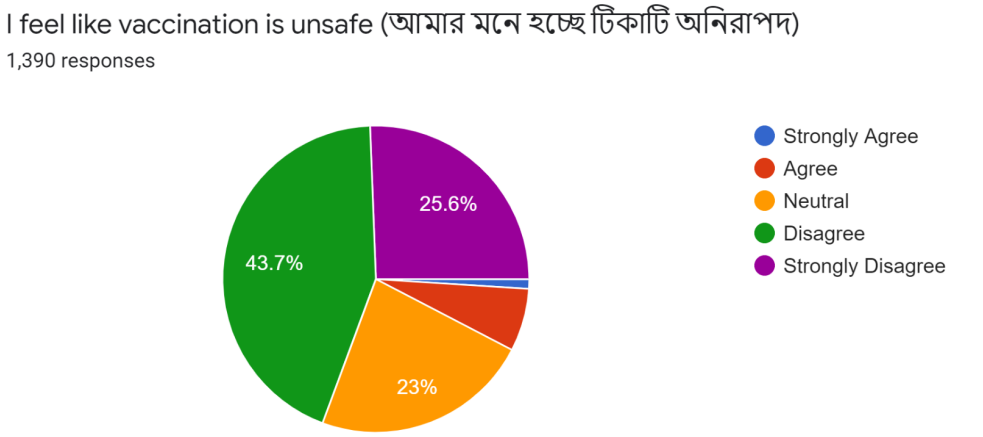


Figure 19 I feel like the vaccination is unsafe

I think vaccine is fake/placebo (saline) [আমার মনে হয় ভ্যাকসিনটি নকল / প্লেসবো (স্যালাইন)]

1,390 responses

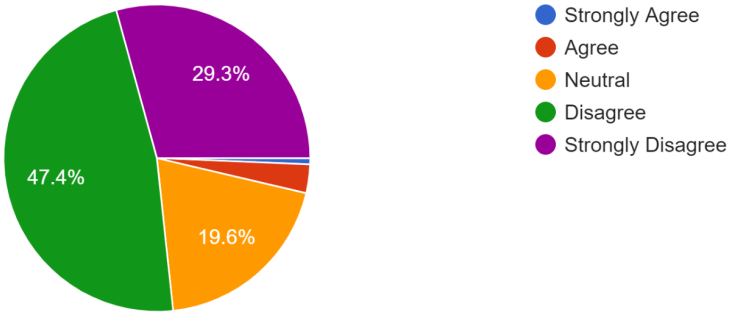


Figure 20 I think the vaccine is fake/placebo

Vaccines will disrupt pregnancy, or lead to mental disorders of the baby (ভ্যাকসিন গর্ভাবস্থা ব্যাহত করবে বা শিশুর মানসিক ব্যাধি ঘটাবে)

1,390 responses

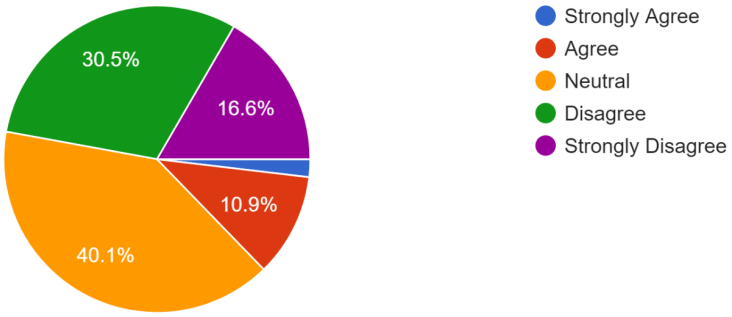


Figure 21 Vaccines will disrupt pregnancy, or lead to mental disorders of the baby

Vaccine may affect fertility (ভ্যাকসিন উর্বরতা প্রভাবিত করতে পারে)

1,390 responses

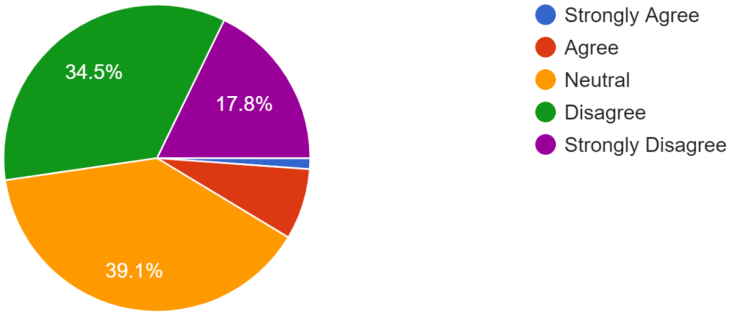


Figure 22 Vaccines may affect fertility

Vaccines contain a microchip that will track me (ভ্যাকসিনগুলিতে একটি মাইক্রোচিপ রয়েছে যা আমাকে ট্র্যাক করবে)

1,390 responses

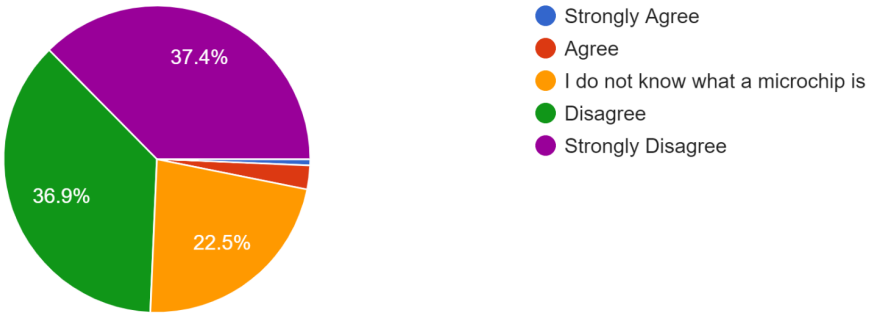
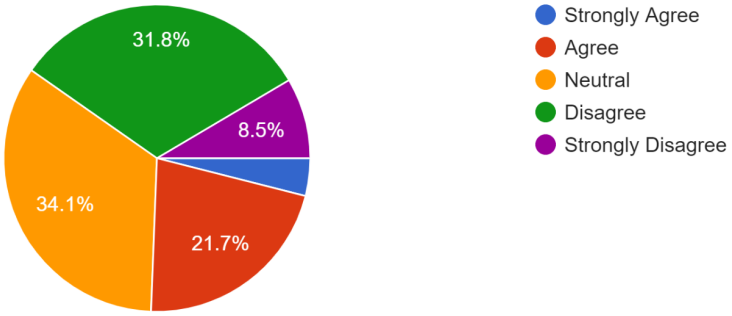


Figure 23 Vaccines contain microchip that will track me

Any vaccine is effective against all variants of coronavirus (Indian variant, African variant, Delta variant etc) [যে কোনও ভ্যাকসিন CORONAVIRUS এর সমস...iant, আফ্রিকান Variant, Delta Variant ইত্যাদি)]

1,390 responses



Figures 24 Any vaccine is effective against all variants of coronavirus

The government should reopen schools and universities (সরকারের উচিত স্কুল ও বিশ্ববিদ্যালয় পুনরায় চালু করা উচিত)

1,390 responses

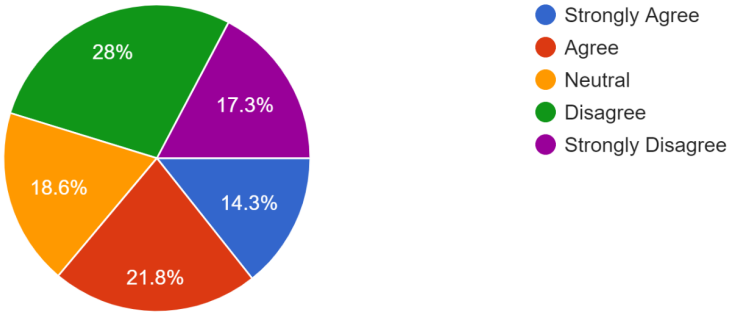


Figure 25 The government should reopen schools and universities

The vaccine got released too early, I don't trust the makers of the vaccine (ভ্যাকসিনটি খুব তাড়াতাড়ি তৈরি হয়েছিল, আমি ভ্যাকসিন প্রস্তুতকারীদের বিশ্বাস করি না)

1,390 responses

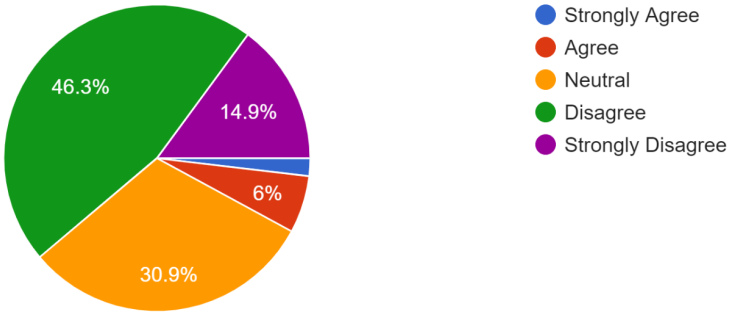


Figure 26 The vaccine got released too early, I don't trust the makers of the vaccine

I don't need to take precautions (mask, social distancing etc) after vaccination (টিকা দেওয়ার পরে আমাকে সাবধানতা অবলম্বন করার প্রয়োজন নেই (মাস্ক, সামাজিক দূরত্ব ইত্যাদি))

1,390 responses

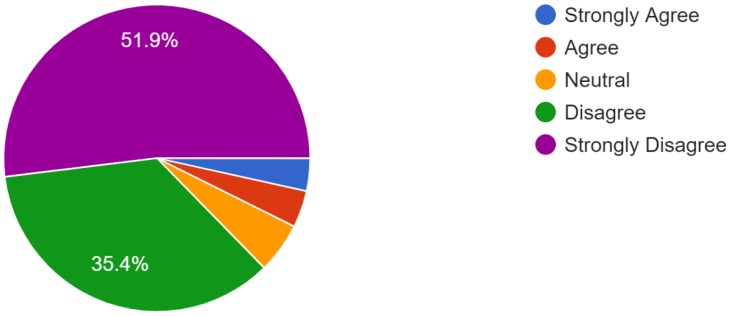


Figure 27 I don't need to take precautions (mask, social distancing etc) after vaccination

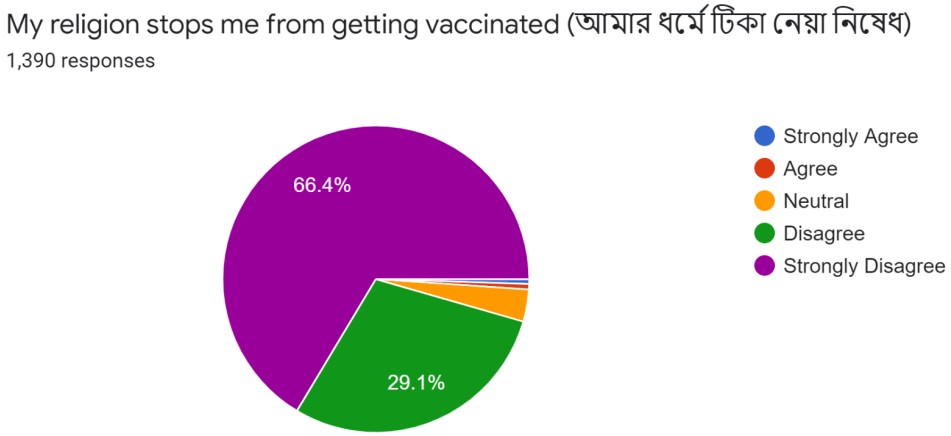


Figure 28 My religion stops me from getting vaccinated

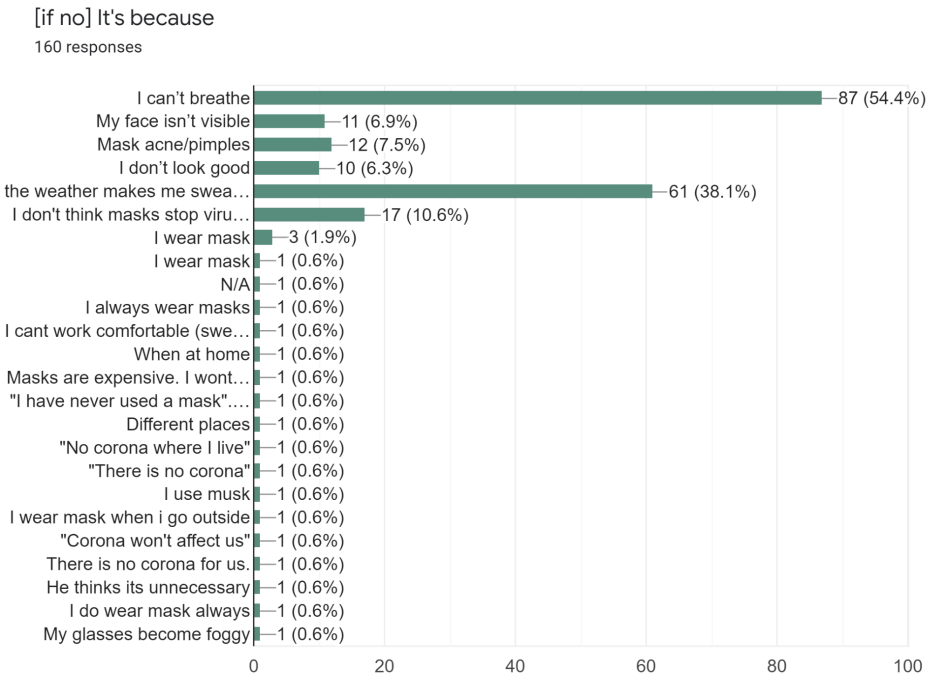


Figure 29 Why do you not wear masks

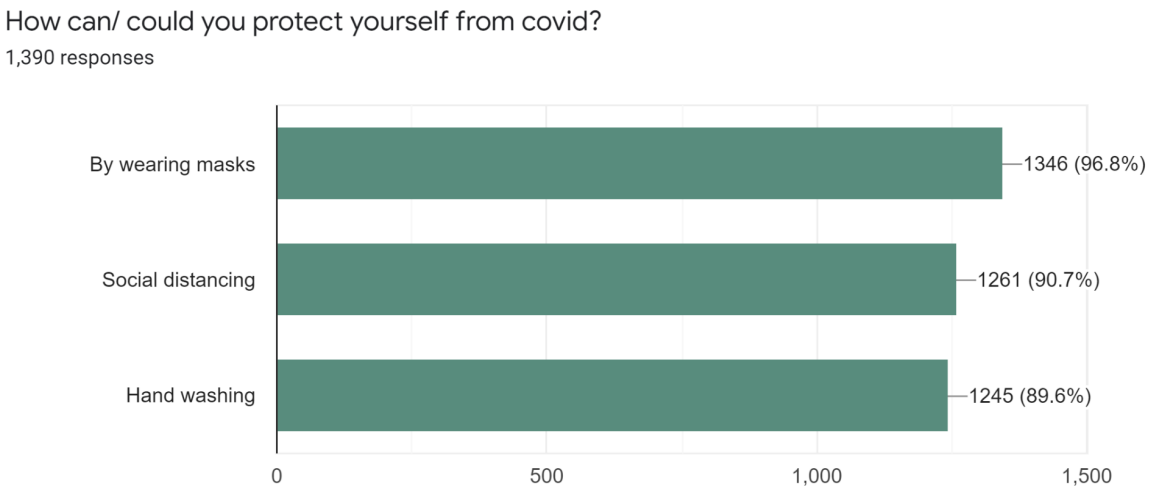


Figure 30 How can you protect yourself from COVID-19


If you have not taken the vaccine, then why?
667 responses
I will take the vaccin…
426 (63.9%)
I believe my immun…
83 (12.4%)
I am afraid of the lo…
59 (8.8%)
I do not want rando…
52 (7.8%)
No NID
43 (6.4%)
I need NID
37 (5.5%)
Will register soon
24 (3.6%)
I was not eligible then
2 (0.3%)
I didn't get the date…
2 (0.3%)
Waiting for the date
2 (0.3%)
I don't have NID he…
1 (0.1%)
I am unable to regis…
1 (0.1%)
Because of age limi…
1 (0.1%)
Didn't get my slot yet
1 (0.1%)
NID is on process
1 (0.1%)
too young
1 (0.1%)
I haven't got access…
1 (0.1%)
Im underage
1 (0.1%)
I am not eligible
1 (0.1%)
Because I don't hav…
1 (0.1%)
I am currently covid…
1 (0.1%)
Lazy
1 (0.1%)
I couldn't register d…
1 (0.1%)
No nid to register
1 (0.1%)
I don't have NID card
1 (0.1%)
My NID card is still…
1 (0.1%)
not received NID yet
1 (0.1%)
Will have my vaccin…
1 (0.1%)
Now i am affected…
1 (0.1%)
"I will die when it's ti…
1 (0.1%)
"I am quite old and…
1 (0.1%)
"Our immunity is str…
1 (0.1%)
I am very afraid to g…
1 (0.1%)
I have already regis…
1 (0.1%)
There is no option f…
1 (0.1%)
I have registered, I…
1 (0.1%)
"I dont think vaccine…
1 (0.1%)
I already registered…
1 (0.1%)
I dont have NID, but…
1 (0.1%)
The vaccine was m…
1 (0.1%)
I will not take Chine…
1 (0.1%)
I am too old. I am s…
1 (0.1%)
I have tested positiv…
1 (0.1%)
I am done with my r…
1 (0.1%)
Because i am lactati…
1 (0.1%)
Waiting for my date
1 (0.1%)
I want to get Vaccin…
1 (0.1%)
I don't have my NID…
1 (0.1%)
I will be taking vacci…
1 (0.1%)
Age Limitation
1 (0.1%)
Other
21 (3.1%)
0
100
200
300
400
500

Figure 31 Why did you not get vaccinated?

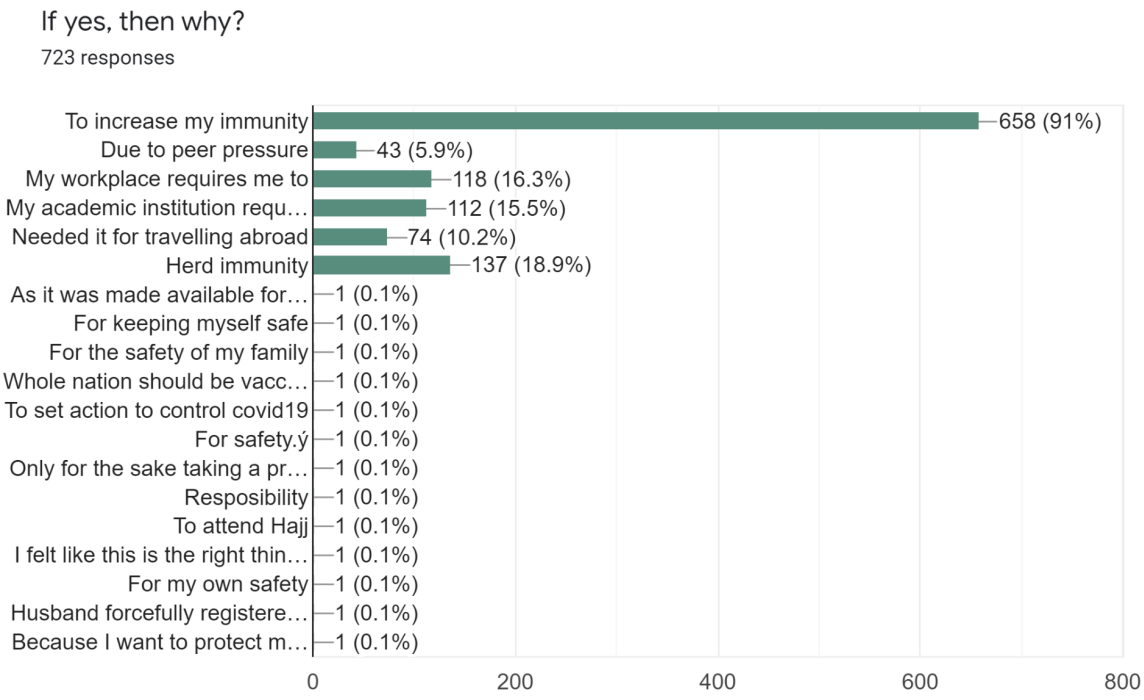


Figure 32 Why did you get vaccinated?

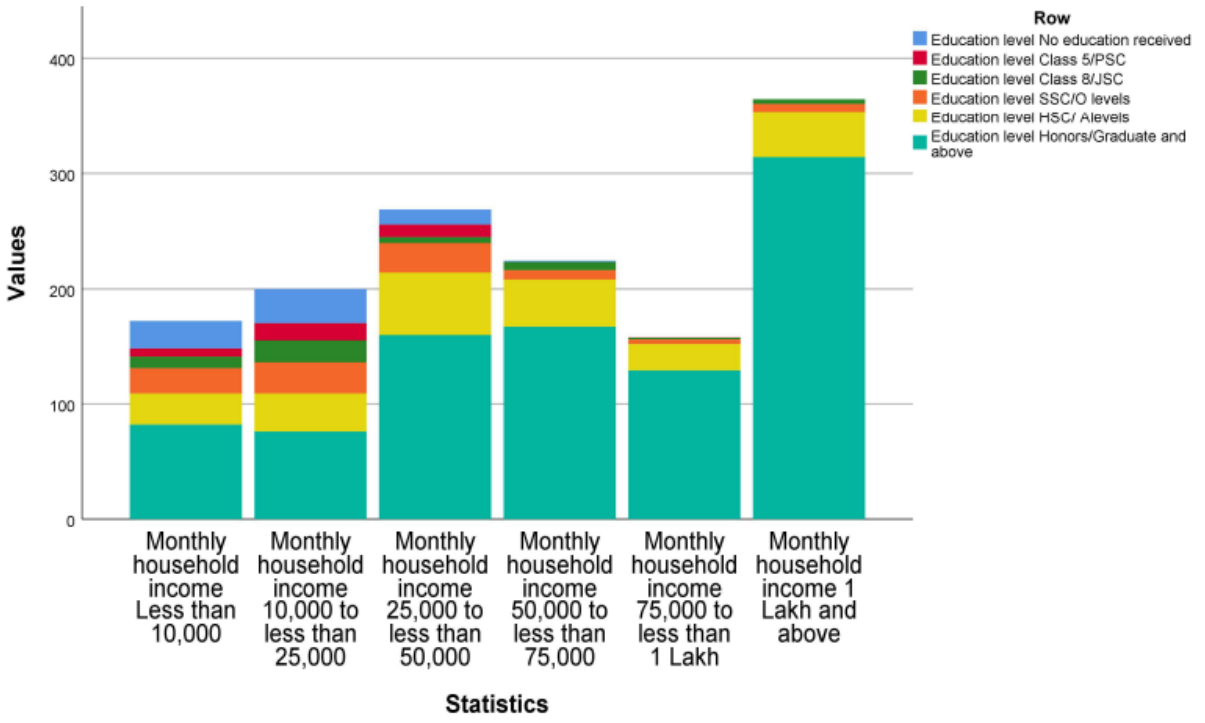


Figure 33 Correlation between the monthly household income and the education received

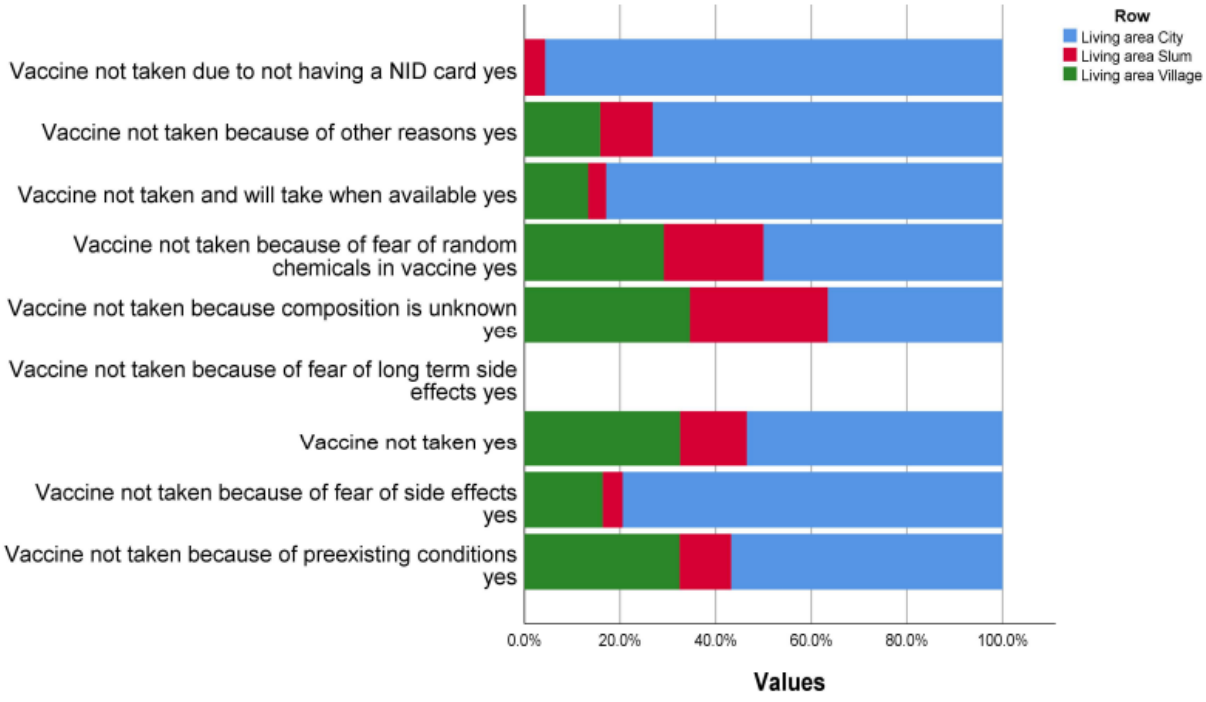


Figure 34 Correlation between level of education received and reason for not getting vaccinated

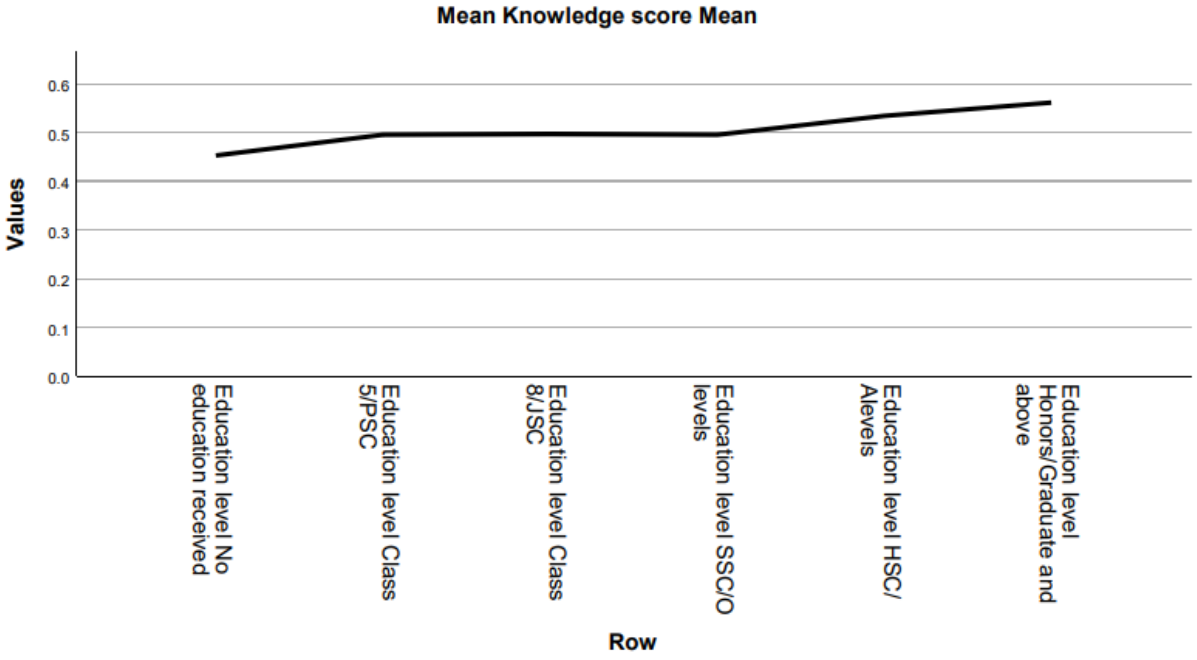


Figure 35 Mean knowledge score based on level of education of respondents