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# Dynamics of Viral Rhinitis Incidences in the COVID-19 Pandemic Era Following Adopted Preventive and Control Measures to Coronavirus in Tanzania: A Lesson to Learn

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## ABSTRACT

**Background:** Coronavirus disease 19 (COVID-19) is a highly contagious disease caused by a virus belonging to a large family of viruses called coronaviruses, namely severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which emerged in December 2019 in Wuhan, China. The disease has resulted in millions of human deaths worldwide to date. Different countries in the world have implemented various preventive measures against COVID-19, like social distancing, lockdown and mask wearing. These measures, apart from COVID-19, can cross prevent person-to-person transmission of other upper-respiratory conditions, including viral rhinitis (Common cold). This study aimed to assess the impact of COVID-19 preventive measures in the control of viral rhinitis and its potential consequences.

**Methods:** The study was conducted at Muhimbili University of Health and Allied Sciences in Dar es Salaam, involving 384 university students and healthcare workers purposively selected from two Higher Learning Institutions, the Muhimbili University of Health and Allied Sciences (MUHAS) and St. Joseph University in Tanzania (SJUIT). In addition, two referral hospitals, namely, Mwananyamala Regional Referral Hospital (MRRH) and Temeke Regional Referral Hospital (TRRH) to gather information from healthcare workers. The data was collected using closed and open-ended questionnaires, entered, cleaned and analysed using a IBM SPSS Statistics for Windows version 24.0 (IBM Corp, Armonk, NY, USA).

**Results:** The annual incidences of viral rhinitis during the COVID-19 pandemic were found to be lower than those before the pandemic during which a total of 163 (47.4%) respondents reported to have suffered more than two episodes of viral rhinitis. About 216 (56%) respondents reported having practised social distancing, while 43 (11%) reported not to have adhered to hand hygiene practice while less than one third, 103 (26%) of the respondents reported practising steaming, while 78 (20%) used traditional medicines. None of the preventive measures showed statistically significant relationship with viral rhinitis $p<0.05$.

**Conclusion:** While the use of preventive measures against COVID-19 might be unique, and considering their similarity with those of the common cold (viral rhinitis) prevention, the study has shown that if they are observed, particularly the face masks, they may reduce person-to-person transmission of airborne conditions. Therefore, we recommend instituting the use of masks and all hygienic measures in situations where upper respiratory infection of any source is suspected, to limit spread to others from acquiring the infection, particularly in large gatherings.

## BACKGROUND

Viral rhinitis (common cold) is an inflammatory condition of the nasal mucosa linings caused by various viruses, including human rhinovirus, influenza, parainfluenza, and adenovirus. The condition may be acute or chronic, with symptoms during the acute phase comprising a runny nose, watery eyes, postnasal drip, sneezing and nasal itching.[1] The main symptom in chronic viral rhinitis is nasal congestion of thick mucoid plaques lasting 5 to 10 days. The chances of one contracting the disease within a given period or a specified period (incidence) differ between individuals. On average, the incidence of viral rhinitis in adults ranges from 2 to 5 episodes a year and 7 to 10 episodes in children a year.[2,3] On the other hand, COVID-19 is an infectious respiratory condition, similar to viral rhinitis, caused by the SARS-COV-2 virus, with most infected individuals experiencing mild to moderate respiratory illness and recovering without need for treatment. However, depending on the strength of the immune status of an individual, COVID-19 may strike with serious illness necessitating medical attention. With this disease, contrary to viral rhinitis, older people and people with underlying medical conditions like cardiovascular disease, diabetes, chronic respiratory disease, or cancer may most likely experience serious illness. Experience shows that anyone contracting the disease may easily become seriously ill or die irrespective of age, although, unlike common cold, more adults and old individuals than children

and younger age groups are affected. Kwiyolecha et al.,[4] reported patterns of viral pathogens causing upper respiratory tract infections (URTI) among symptomatic children in Mwanza, Tanzania in which viruses were the commonest diagnosed cause of Rhinitis.

Viral rhinitis and Coronavirus infections are both conditions that affect the upper respiratory tract, causing various discomforts. While viral rhinitis is said to be caused by a variety of upper respiratory tract viruses and relatively older infection, coronavirus disease is caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). It is with no doubt that the infection by SARS-Cov-2 has caused a serious global pandemic in the face of COVID-19 with varying symptoms from asymptomatic, mild, severe to very severe and consequently several deaths worldwide. Several approaches have been sought as emergence measure to alleviate the COVID-19 pandemic.

Human rhinovirus is responsible for up to half of the cases of viral rhinitis.[5,6] Other viruses such as coronaviruses, adenoviruses, respiratory syncytial virus (RSV), influenza viruses and parainfluenza viruses account for a relatively minor proportion of viral rhinitis. These viral agents infect the nasal respiratory epithelium and also other components of the upper/lower respiratory tract after inoculation through respiratory droplets of an infected person through coughing or sneezing. These two routes of inoculation of the virus to uninfected remain the major ones despite oral inoculation playing an alternative source of viral transfer at relatively low risk.[7] Symptoms of viral rhinitis include runny nose, sneezing and congestion. Risk of experiencing viral rhinitis in a single year is much more probable for children than adults, pending differences in immune response and exposure between these two groups.[2,3,8]

COVID-19, being a contagious disease, is transmitted mainly via respiratory route, when people inhale droplets and particles that infected people release as they breathe, talk, cough, sneeze or sing. The closer people interact, and the longer they interact the more likely they are to transmit COVID-19, but infection can occur over long distances, particularly indoors.[9] The symptoms of COVID-19 include respiratory distress associated with fever, cough, and fatigue, shortness of breath, vomiting, and loss of taste or smell. An individual infected with COVID-19, can recover if timely attended depending on extent of damage the virus cause in the lungs particularly the coagulopathies that is believed to be imposed to the cardiovascular system. Some infected individuals may remain asymptomatic.[10]

Regarding the pathogenesis of viral rhinitis, the etiological viruses infect the nasal epithelial cells, damage tight junctions, as well as disrupting membranes and inducing cell death.[11] The epithelial infection process begins with viral entry into the nasal cell via receptors. The identified receptors for rhinoviruses are intercellular adhesion molecule-1 and Toll like receptors 3.[6] Viral endocytosis is the next step after receptor binding and is followed by expression and duplication of viral genetic materials within a couple of hours after initial viral and human cell interaction. After invasion, the virus begins to dominate host cell metabolism in order to replicate itself and this usually results in host cell destruction.[2,3,8] Viral inflammation triggered by the infected cells and augmented by host immune system is composed of an activated cascade of numerous biological pathways and results in elimination of the offending agent. In the initial stage there occurs a transient vasoconstriction followed by vasodilatation that results into oedema and secretions. This inflammation is also the source of various clinical symptom experienced during the course of acute viral rhinitis.[7]

Pathogenesis of COVID-19 virus once inside the body, binds to host receptors and enters host cells through endocytosis or membrane fusion. Angiotensin converting enzyme 2 (ACE-2) is the functional receptor for SARS-CoV-19 and is highly expressed on the pulmonary epithelial cells. The S-protein, otherwise known as the spike protein, is the viral component that attaches to the host receptor via the ACE-2 receptors. The effect of the virus on ACE-2 cell surfaces leads to leukocytic infiltration, increased blood vessel infiltration, increased blood vessel permeability, as well as decreased secretion of lung surfactants.[12] These effects cause the majority of the respiratory symptoms. However, the aggravation of local inflammation causes a cytokine storm, eventually leading to a systemic inflammatory response syndrome.[13]

Although SARS-CoV-2 has a tropism for ACE-2 expressing epithelial cells of respiratory tract, people with severe COVID-19 have symptoms of systemic hyperinflammation. The adaptive immune response is activated following viral uptake and antigen processing by a range of antigen-presenting cells (APCs) that include dendritic cells and macrophage which presents viral antigen to B cells which then differentiate into antibody producing plasma cells.[14] The neutralizing antibodies then bind to key viral proteins and neutralize their activity. Other antibody mediated antiviral functions include antibody dependent cellular cytotoxicity, antibody dependent cellular phagocytosis and antibody dependent complement activation.[13] Cytotoxic CD8 T cells kill virally infected cells via the production of granzymes and perforin and the expression of Fas ligand, all of which mediate cellular apoptosis. A series of CD4 T-cell populations are involved in the adaptive cellular immune response to SARS-Cov-2. Follicular helper T cells and CD8+ T cells both provide help for B cell antibody production. CD4+ T cells have been implicated to play a role in inflammatory response and viral killing. CD4+ regulatory T-cells have been implicated with an immunoregulatory role in SARS-Cov-2 infection via the production of anti-inflammatory cytokines and contact mediated cellular suppression.[15]

Following viral infection, viral rhinitis starts with cytokines, which are triggered to promote initiation and persistence of inflammation by their direct cellular effects by their role in inducing or releasing other inflammatory chemicals in a cascaded fashion. A common pathway in viral rhinitis infection as is for other viral infections may be the early release of nonspecific host alert cytokines including TNF and IL-1.[7,16,17] These cytokines upregulate intergrin and selectin expression thereby mediating the local recruitment of inflammatory cells, which in turn promotes the release or synthesis of histamines, bradykinin, eicosanoids and cytokines which initiate neurogenic inflammation and increased vascular

permeability which consequently, cause rhinorrhea, sneezing and nasal congestion.[6]

Rhinovirus is responsible for the most common cold in half of the cases in adults annually. As highlighted in previous sections, the average adult experiences two to three cold episodes per year, while the children average 8 to 12 colds per year.[2,3,8,18] Children are major reservoir for rhinovirus. In some cases, it can bring about complication like sinusitis, otitis media, apnea palatal abnormalities and Eustachian tube dysfunction, though in many cases the condition is self-limiting resolving in within three to five days post infection.[19,20]

Since the emergence of COVID-19 pandemic in December 2019, Wuhan, China, there are more than 180 million confirmed cases and 3.6 million confirmed deaths worldwide to date.[21,22] At least a third of people who are infected remain asymptomatic. Of those who develop noticeable symptoms enough to be classified as patients, 81% develop mild to moderate symptoms (up to mild pneumonia), while 14% develop severe symptoms (dyspnea, hypoxia, or 50% lung involvement on imaging) and 5% suffer critical symptoms (respiratory failure, shock or multiorgan dysfunction).[23] Older people are at higher risk of developing severe symptoms. Some people continue to experience a range of effects for months after recovery and damage to organs has been observed. COVID-19 have led to an economic crisis in many countries due to lockdown and increased budget in the health sector.

Various control strategies have been adopted during the COVID-19 pandemic and proved useful during the time period. These include daily symptom-based screening of all individuals in the shelter involving temperature and symptoms survey but also the use of molecular-based technique, the Polymerase Chain Reaction (PCR) testing among high-risk groups. The latter is an amplification technique for cloning the specific or targeted parts of a DNA sequence to generate thousands to millions of copies of DNA of interest. PCR tests are used to directly screen for the presence of viral RNA, which will be detectable in the body before antibodies form or symptoms of the disease are present. The average sensitivity of PCR is 73%, and the average specificity is 99%.[14] The PCR test is the gold standard test for diagnosing COVID-19 because it is the most accurate and reliable test.[24] A study done in UK on the effect of routine PCR testing for COVID-19 in high-risk health environments to reduce outbreaks revealed 61.4% reduction of transmission rate observed when healthcare workers were tested after every 3 days, 37% reduction was observed when healthcare workers were tested weekly and 9% reduction was observed when healthcare worker were tested monthly.[25] Routine PCR testing among high-risk groups have been proven to be effective in reducing the outbreak. Despite all of the above benefits, PCR testing is costly than antibody test and lateral flow test. In Tanzania it cost USD 100 per person in Aga Khan Hospital, Dar es Salaam.[26] In our limited settings this is the most expensive diagnostic test, so it is going to be cumbersome to conduct it routinely to all healthcare workers necessitating people to invest on preventive measure to cut down these preventable costs of advanced tests for screening.

Universal mask wearing is another potentially effective strategy that has been used to limit infections as well as transmission across individuals. There are three main types of masks used during COVID-19 pandemic which are medical, N95 and cloth masks. N95 mask offers more protection than medical and cloth masks because it filters out both large and small particles when the wearer inhales but they have been costly with short supply hence they are reserved for healthcare providers. Medical masks protect the wearer from contact with droplets and sprays that may contain germs. Medical masks are cheaper and more available than N95.[27] Hence medical mask are recommended in our settings. Mandatory mask wearing indoors introduced in Canada in 2020 observed an estimated weekly 25%-40% decline in new diagnoses also a mandatory mask wearing in public introduced in 16 US states in 2020 observed an estimated overall initial daily decline in new diagnosis by 2%.[28] This means that mask wearing have much impact in transmission of COVID-19. Many developed countries have more implementation of universal mask wearing than developing countries. Poor leadership, poor knowledge and poor economy are among the contributing factors for lack of implementation of universal mask wearing.[29] The implementation of these universal mask wearing and other preventive measure could be useful in preventing other aerosol conditions like common cold (viral rhinitis).

Practices adopted to combat COVID-19 includes staying at home, quarantine, wearing a mask in public, avoiding crowded places, observing social distance from others, ventilating indoor spaces, keeping proper hygiene by washing hands with soap and water often and for at least twenty seconds, practicing good respiratory hygiene and avoiding touching the nose, eye, mouth with unwashed hands. Use of sanitizers where affordable has greatly been an upgrade of hand hygiene especially in public offices.

There is potential that the emergency of COVID-19 pandemic has triggered opportunity for use of various simple and affordable measures to control or limit other respiratory conditions. If deployed, these measures may help reduce the incidence of other respiratory conditions such as common cold that, although not fatal, it causes annoyance and greatly reduce efficiency in normal working rates of individuals. If adopted and accepted by users, the measures might be very useful to prevent person to person transmission and risk not only for COVID-19 but also for other upper respiratory conditions with similar transmission route. The findings from the study are expected to provide clues to policy makers of change in behavior that might have impact not only on the target disease but also on other similar conditions.

This scholarly study therefore, intended to explore the various measures that have been deployed in control of COVID-19 and impact on control of respiratory conditions in the face of common cold (viral rhinitis). The study focused mainly on the application of face masks, social distancing, steaming, hand hygiene, use of traditional remedies and frequency and their impact on other observable and perceivable respiratory conditions with more emphasis on viral rhinitis. The choice of the respiratory condition based on the fact that, despite their difference in fatality rates, they have similar modes of transmission from infected to naïve individuals. It is not

known whether the approaches in an attempt to prevent coronavirus transmission from infected to healthy individuals have an impact on other simple respiratory conditions like the famous common cold. Thus, we hypothesised that in the face of COVID-19 pandemic, preventive measures for the disease may have impact on other respiratory viral conditions (particularly viral rhinitis) thus influencing prevention for such conditions.

## MATERIALS AND METHODS

### Study Design

This was a cross-sectional study conducted between January and June 2022 to assess the change in viral rhinitis incidences in the COVID-19 pandemic era, following the adoption of preventive and control measures to coronavirus. The study was conducted at two Higher Learning Institution; Muhimbili University of Health and Allied Sciences (MUHAS) and St. Joseph University in Tanzania (SJUIT) where subjects were purposively recruited in the study and questionnaires administered. Two government-owned referral hospitals, namely, Mwananyamala Regional Referral Hospital (MRRH) and Temeke Regional Referral Hospital (TRRH) were also conveniently selected from which subjects were also administered with questionnaires to gather information from healthcare workers side. Mwananyamala Regional Referral Hospital serves a population of more than 2,200,000 people (average of 1654 patients per day) residing in Dar es Salaam, Kinondoni, and Ubungo municipals and the surrounding areas with a bed capacity of 254. On the other hand, the Temeke Regional Referral Hospital, with 304 bed capacity in the Temeke District, Dar es Salaam, serves 1,800 to 2,000 patients daily.[30] The questionnaires were administered to SC who is also the author to this article in Kiswahili, the Tanzania national language to ensure full capture of any relevant information. Prior to study questionnaires were evaluated through base line pre-testing to ensure that they capture the relevant information needed. This was done by SC to some volunteering students and staff at the study site under the supervision of EVM. All of the study sites are located in Dar es Salaam, where the COVID-19 pandemic was mostly experienced and therefore, the preventive measures were highly adopted

### Sampling Procedures

### Sample Size Calculations

The study involved healthcare workers from the two regional referral hospitals and students from the two institutions, respectively. The sample size estimates were based on Cochran's formula by Cochran[31] where the 95% confidence interval (95% CI) was set with level of significance of 5%. With the prevalence set to 50%, the sample size was estimated to be 384 subjects to be recruited and provide reliable findings. Calculation for the sample size is shown below:

$$n = \frac{Z^2 pq}{e^2}$$

Where,
N = sample size population.
Z = Level of confidence (1.96 for 95% confidence level)
P (Prevalence) = 50% (since there was no study like this in our settings
q = 100-p (50%)
e = Margin error (assumed to be 5%)
$n = (1.96^2 \times 0.5 \times 0.5) \div 0.05^2$
n = 384

From the Annual assessment report of external hospital performance assessment for regional referral hospitals 2018, TRRH had a total of 513 staffs and MRRH had 342 staff [32] and from MUHAS annual report of 2018, 2129 students were enrolled for undergraduate degree[33] and from Higher Education Students Admission, enrollment and Graduation Statistics Report by The Tanzania Commission for Universities (TCU), SJUIT enrolled approximately 430 undergraduate students.[34] Then from these data, the total number of the study population was 3,414. The contribution of subjects per study site was therefore 62.3% (MUHAS), 12.6% (SJUIT), 15% (TRRH) and 10% (MRRH). As such, the 384 as a minimum sample size consisted of 239 as our minimum sample size from MUHAS undergraduate students, 49 as our minimum sample size from SJUIT undergraduate students, 58 as our minimum sample size from TRRH staffs and 38 as our minimum sample from MRRH. A total of 384 was therefore a minimum samples size to provide sufficient data for analysis and representation of the studied populations.

### Sampling Strategy

The sampling strategy involved stratified sampling,[35] where students and healthcare workers were selected based on the inclusion and exclusion criteria. This ensured that every subgroup within a population is adequately represented. Thus, we divided the population into two homogeneous subpopulations (strata) of students and healthcare workers. Then, subjects were further grouped based on gender identity and location with each member of the population slotted to exactly one stratum.

### Data Collection

The data were collected through structured questionnaires with closed ended questions administered to study subjects. The questionnaire was targeted to assess the change in incidences of viral rhinitis before and during the COVID-19 pandemic, as well as adherence of respondents to preventive measures against COVID-19. The questionnaires were prepared in English and Swahili languages to taking into account respondents' language preference and comfort level

### Inclusion and Exclusion Criteria

To be included in the study, student status as Medical Doctor students (MD), Doctor of Dental Surgery (DDS), Bachelor of Science in Nursing (BScN), Bachelor of Science in Radiation Therapy Technology (BSc. RTT) students and employment status as healthcare workers willing to take part in the study was necessary. In our study, the age of 18 and above defined eligibility to participate. One exclusion criterion was students or healthcare workers who did not consent to participate in the study.

### Data Management

This involved data collection, data organisation, cleaning and coding, analysis and data storage for security and

back up. Data collection was done through designed questionnaires, the filled questionnaires was kept in closed opaque envelopes, which were then taken to recording center. Data organization involved creating folders and naming of all files accordingly. Data storage was done using IBM SPSS Statistics for Windows version 24.0 (IBM Corp, Armonk, NY, USA) on one personal computer and external storage devices like flash disks and hard disks. Data security involved physical security, which means that only one individual had access to the storage devices. In computer system, passwords were used and virus protection update for antiviruses installed in these devices. Data backups were in place, and involved making copies of the original data to take care of data loss or damage or computer crushing or loss.

### Data Analysis

The data were entered, cleaned and analysed using IBM SPSS Statistics for Windows version 24.0 (IBM Corp, Armonk, NY, USA). The data were scrutinized according to each specific objective. Frequency of viral rhinitis before and after the emergence of COVID-19 was computed, including the frequent use of various COVID-19 preventive measures in the population. From these proportions, Chi-square was used for comparison at a p-value of 0.05 as the level of significance to assess the impact of COVID-19 preventive measures in the control of viral rhinitis. This was measured by developing a categorized scoring code with the levels (high, moderate, low) on the frequency of use of various COVID-19 preventive measures and the degree of change of frequency of viral rhinitis per year during pre-COVID-19 and during the COVID-19 period.

### Ethical Consideration

Ethical approval was sought from MUHAS Ethical Review sub-committee (Ethical Clearance Certificate No. EC/MUHAS/IRB/2017-04-10320/01). The participants were informed about the purpose of the study and their consent was obtained before data collection and participation was voluntary. Consent was obtained through reading, understanding and signing of the consent form by the participant. Confidentiality and privacy were observed and participants' identification, such as names, were not included in the questionnaire to ensure confidentiality.

## RESULTS

### Social Demographic Characteristics

These findings came from 386 participants from four sites in Dar es Salam region of Tanzania. In this study, a proportion of 235 (60.9%) were males and 151 (39.1%) were females, with the rate for consent and willing to participate to the study in males being about twice that of females. About 304 (78.8%) participants were aged between 18-30 years old, while 80 participants were aged 31-50 years old. Two (2) participants were aged 51-70 years. None of the participants had the age above 70 years. A total of 237 (61.4%) participants were subjects who stayed in hostels, and 149 (38.6%) stayed at home when these data were collected. Of the 149 participants who stayed home when data was collected, 102 (68.4%) were healthcare workers and 47 (31.6%) were students. About 284 (73.6%) were university students, and 102 (23.4%) were healthcare workers. Third-year students made up 92 (23.8%) of all university students that participated in this study, followed by fourth-year students who made up 69 (17.9%) of all university students involved in this study. A total of 41 (10.6%) participants reported having chronic illness with diabetes mellitus and hypertension, making about 37 (92.5%) of the prevalence among those with chronic illness. About 385 (99.7%) participants reported to be non-smokers and 62 (16%) reported having familial history of allergy (Table 1).

**TABLE 1: Distribution of Respondents' Socio-Demographic Characteristics (N=386)**

| Variable | Frequency | Proportion (%) |
|---|---|---|
| Sex | | |
| Male | 235 | 60.9 |
| female | 151 | 39.1 |
| Age | | |
| 18-30 | 304 | 78.8 |
| 31-50 | 80 | 20.7 |
| 51-70 | 2 | 5 |
| >70 | 0 | 0 |
| Place of residence | | |
| hostel | 237 | 61.4 |
| home | 149 | 38.6 |
| Occupational | | |
| University student | 284 | 73.6 |
| Health care worker | 102 | 23.4 |
| Year of study | | |
| 1 | 11 | 2.8 |
| 2 | 62 | 6.1 |
| 3 | 92 | 23.8 |
| 4 | 69 | 17.9 |
| 5 | 50 | 13 |
| Chronic illness | | |
| Yes | 41 | 10.6 |
| No | 345 | 89.4 |
| Smoking | | |
| yes | 1 | 0.3 |
| no | 385 | 99.7 |
| Familial history of allergy | | |
| yes | 62 | 16.1 |
| no | 236 | 66.1 |
| I don't know | 88 | 22.8 |

### Frequency of Viral Rhinitis in the Study Population Before and After the Emergency of COVID-19

Before emergency of COVID-19 pandemic incidences of viral rhinitis per person seemed to be higher than after emergency of COVID-19 pandemic. Before pandemic 163 (47.4%) respondents reported to have had more than two incidences of viral rhinitis annually while during pandemic only 58 (15%) respondents reported to have more than two incidences of viral rhinitis. About 42 (10.9%) respondents reported to have no incidence of viral rhinitis during pandemic while none of the respondents reported to have no incidence of viral rhinitis in a year before COVID-19 pandemic. A total of 204 (52.8%) respondents had many incidences of viral rhinitis annually before pandemic than during pandemic and 182 (47.2%) respondents had the same number of viral rhinitis annually before and during COVID-19

pandemic (Table 4).

### Assessment of the Frequent use of Various COVID-19 Preventive Measures in the Population

This study found increasing level of practices of COVID-19 preventive measures during COVID -19 pandemic. On assessing whether people adhered to general prevention measures to COVID-19, the findings showed that 99 (25.6%) respondents rarely wore facemasks, 132 (34.2%) respondents frequently wore facemasks, 131 (33.9%) respondents wore facemask precautionary depending on the situation and 24 (6.2%) respondents did not wear facemasks at all. About 216 (56%) respondents avoided crowded places and applied social distancing measures while 170 (44%) respondents did not apply social distancing measures. Further assessment on health/safety practices showed that a total of 192 (49.7%) participants applied hand hygiene practices, 43 (11.1%) respondents did not apply hand hygiene practices and 151 (39.1%) respondents applied hand hygiene practices irregularly. Results also showed that 295 (76.4%) respondents covered their nose and mouth during sneezing or coughing, and the rest did not cover their mouth and nose during coughing or sneezing. As regards traditional approaches, 103 (26.7%) respondents practised steaming and 78 (20.2%) respondents had at least used traditional medicines in fighting against COVID-19 (Table 5).

**TABLE 2: Number of Incidences Before Covid-19 Pandemic**

| Number of encounters | Frequency | Percentage |
|---|---|---|
| Once | 60 | 15.5 |
| Twice | 143 | 36.8 |
| More than twice | 163 | 47.4 |

**TABLE 3: Frequencies of Viral Rhinitis During Covid-19 Pandemic**

| Number of encounters | Frequency | Percentage |
|---|---|---|
| None | 42 | 10.9 |
| Once | 129 | 33.4 |
| Twice | 157 | 40.7 |
| More than twice | 58 | 15.0 |

### Assessment of the Impact of the Covid-19 Preventive Measures in the Control of Viral Rhinitis and Its Potential Consequences

The results showed that 185 (48%) participants who wore facemasks had reduced incidence of viral rhinitis. On the other hand, 166 (43%) participants wore facemasks but reported to have no reduction in annual incidence of viral rhinitis. About 19 (4.9%) participants did not wear facemasks and had reduced annual incidences of viral rhinitis. Our study results show that facemask wearing reduce the incidences of viral rhinitis but the reduction was not statistically significant ($p$=.858). About 112 (29%) of respondents who practiced social distancing reported to have reduced number of viral rhinitis encounters during COVID-19 although the annual decrease in incidences of viral rhinitis was not statistically significant ($p$=.658). Again, 99 (25.6%) of respondents who practiced hand hygiene reported to have reduced number of viral rhinitis encounters during COVID-19 with the annual decrease in incidences being statistically not significant ($p$=.737). As regards social distancing, 212 (55%) of respondents who do not shake hands during greetings reported to have reduced number of viral rhinitis incidence during COVID-19 although the practice showed no statistical association with annual viral rhinitis encounters ($p$=.603). Covering the nose during coughing and sneezing had no statistically significant impact ($p$ =.239). Results also showed that 56 (14.5%) of respondents who practice steaming reported to have reduced incidences of viral rhinitis despite the practice having no statistically significant effect ($p$=0.718). The use of traditional medicines was found to have no statistically significant effect on viral rhinitis incidences (0.270).

**TABLE 4: Individual Perception on the Difference in Encounters of Viral Rhinitis Between the Pre-COVID-19 Period and During the COVID-19 Pandemic**

| Differences in encounters per person | Frequency | Percentage |
|---|---|---|
| Different | 204 | 52.8 |
| No difference | 180 | 47.2 |

**TABLE 5: Frequency of Use of Various COVID-19 Preventive Measures**

| Practice | Students | | Health worker | |
|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage |
| Frequency of wearing face mask in a month | | | | |
| Very rare | 69 | 17.8 | 30 | 7.7 |
| Frequently | 100 | 26 | 33 | 8.5 |
| Precautionary depending on situation | 102 | 26.4 | 29 | 7.5 |
| Not at all | 13 | 3.3 | 9 | 2.3 |
| Social distancing | | | | |
| yes | 165 | 42.7 | 51 | 13.2 |
| No | 119 | 30.8 | 51 | 13.2 |
| Hand hygiene practice | | | | |
| Yes | 137 | 35.5 | 55 | 14.2 |
| No | 34 | 8.8 | 9 | 2.3 |
| Sometimes | 113 | 29.2 | 38 | 9.8 |
| Covering nose and mouth during sneezing | | | | |
| Yes | 222 | 57.5 | 73 | 18.9 |
| No | 62 | 16 | 29 | 7.5 |
| Steaming | | | | |
| Yes | 70 | 18.3 | 33 | 8.5 |
| No | 214 | 55.4 | 69 | 17.8 |
| Traditional medicine | | | | |
| Yes | 58 | 15 | 20 | 5.2 |
| No | 225 | 58 | 82 | 21 |

**TABLE 6: Impact of COVID-19 Preventive Measure on Incidence of Viral Rhinitis**

| Variables | Incidences during COVID-19 | Fewer encounter during COVID-19 than before | *p*-value |
|---|---|---|---|
| Facemask wearing practices | | | |
| yes | 166(43%) | 185(48%) | .858 |
| no | 16(4%) | 19(4.9%) | |
| Frequency of wearing face mask in a month | | | |
| Very rare | 46(12%) | 53(13.7%) | 0.422 |
| Frequently | 57(14.7%) | 76(19.6) | |
| Precautionary depending on situation | 66(17%) | 65(17%) | |
| Not at all | 13(3.3%) | 9(2.3%) | |
| Social distancing practice | | | |
| yes | 104(26.9%) | 112(29%) | 0.658 |
| no | 78(20%) | 92(23.8%) | |
| Hand hygiene practice | | | |
| yes | 93(24.1%) | 99(25.6%) | 0.737 |
| no | 18(4.6%) | 25(6.47%) | |
| sometimes | 71(18.4%) | 80(20.7%) | |
| Greeting practice | | | |
| yes | 96(24.8%) | 113(29.3%) | 0.603 |
| no | 86(22.2%) | 91(23.57%) | |
| Covering the nose | | | |
| yes | 144(37.3%) | 151(39%) | 0.239 |
| no | 38(10%) | 53(13.7%) | |
| Steaming practice | | | |
| yes | 47(12%) | 56(14.5%) | 0.718 |
| no | 135(35%) | 148(38.3%) | |
| Traditional medicine uses | | | |
| yes | 41(10.6%) | 37(9.5%) | 0.27 |
| no | 140(36.2%) | 167(43.2%) | |

## DISCUSSION

The main objective of this study was to assess the impact of COVID-19 preventive measures in the control of viral rhinitis and other upper respiratory conditions. Our study found that 351 (91.4%) of study respondents wore a facemask. This suggests that most of people adhered to preventive measures against COVID-19. The high numbers is in line with hypothesis that healthcare workers and students in Health University adhere to preventive measures than general population due to high level of knowledge and awareness. Studies in Ethiopia,[36] and Saudi Arabia,[37] reported 72.5% and 81% of the population respectively, to adhere to COVID-19 preventive measures. The reported proportions however, are relatively lower than that reported in our study. The higher proportion of participants adhering to facemask wearing relative to other two sites can be explained by the functional status of the current study participants. Our study was conducted on population who hypothetically are expected to adhere to COVID-19 preventive measures due their role compared to the general population. In our study, about 192 (50%) of respondents practiced handwashing with soap (Table 6) which was not very far from a similar study in Ghana (31.7%)[28] and Ethiopia (45.9%).[36] Our study found that 216 (56.2%) of respondents practice social distancing and 295 (76.8%) of respondents cover their mouth during sneezing or coughing which is higher than that of Ghana (42%),[28] and Ethiopia (62.6%).[36] This is promising as it shows how preventive measures were positively accepted during the COVID-19 pandemic. The reason for inconsistency in response to the use of preventive measures among different populations could be due to differences in level of respondent's awareness and belief towards protective effect of COVID-19 preventive measures, time of studies and shortage of infrastructure. It could also be due to political influence during COVID-19 where people had contrasting views during the pandemic with bias to one of the two arms. Studies in Sub-Saharan Africa,[38] have recommended the increase in COVID-19 vaccination rates and compliance with preventive measures to help decrease the long-term impact and ease the health and economic burden of COVID-19 in the region. A study by Ngarka et al,[39] calls for adherence to non-pharmaceutical measures over time to be key in reducing risk of persistence of COVID-19 in sub-Saharan Africa emphasizing on changing younger individuals and those with low education towards these measures. Similar philosophy could be applied to other respiratory conditions like Viral rhinitis to limit spread from one individual the other.

With regard to second specific objective of assessment of change of frequency of viral rhinitis during COVID-19 and before COVID-19, our study found that 204 (52.85%) of the respondents reported to have less viral rhinitis encounters annually during COVID-19 than before COVID-19 pandemic and 180 (47.2%) of study respondents reported to have high frequency of viral rhinitis incidences annually during COVID-19 pandemic than before pandemic (Table 4). These results suggest that there is reduction in incidence of viral rhinitis annually during COIVID-19 which is in line with the hypothesis that COVID-19 and viral rhinitis share common preventive measures. The findings that there were more than two annual incidences of viral rhinitis before COVID-19 pandemic 163 (47.4% of respondents) and less during pandemic (about 60 (15.5%) of respondents) is an indicator that preventive measures against COVID-19 can play role in limiting other airborne infections if instituted and included in health policies.

Our study results agree with the results of the 2020 India study,[40] and that in China,[41] which reported similar findings. The explanation for the reported increase in viral rhinitis during COVID-19 (a total of 180 (47.2%) participants) could solely rely on the view that viral rhinitis and COVID-19 incidences were perceived as additive. Our study results show that facemask use had no statistically significant impact on reducing the incidence of viral rhinitis ($P$=.858), which is contrary to the hypothesis that facemasks reduce the spread of saliva and respiratory droplets from infected individuals and hence reduce the incidence of viral rhinitis.[27] Our study found that facemasks reduced viral rhinitis incidence in 185 (48%) respondents who wore facemasks but it could not be detected by a statistical test for significance ($p$=.858) (Table 6). This discrepancy can be explained by poor knowledge on right way of using a facemask and limited resource, which reinforce one mask to be repeated four times and eventually lose its quality and protection role. Our study findings are different from a study in New York ($p$=.02),[42] due to resource rich setting that make regular use of facemasks not interfering with personal income. But our study findings were similar to study in Japan ($p$=.321),[43] which reported a low quality of facemasks used and worn by a small number of participants. This explanation holds true even in our settings whereby we had no tendency of checking the quality of facemask regularly and the negative attitude of majority towards facemask wearing. It is important to note that 19 (4.9%) participants did not wear facemasks yet had reduced annual incidences of viral rhinitis. This could be due to the reason that those who adopted the wearing of masks reduced chances of person-to-person spread of infection rather than what was perceived as not effective by that minority group.

Our study results suggest that social distancing does not significantly impact the incidence of viral rhinitis ($p$=.658) which is contrary to the hypothesis that Viral rhinitis is transmitted in similar manner to COVID-19 and preventive methods like social distancing against COVID-19 are similar to those against viral rhinitis.[44] This inconsistency can be explained by lack of specific definition of social distancing as interpreted by study participants (in real practice). The findings of our study are different from those of study of North Korea ($p$=.01),[45] but similar to findings in the Ethiopian study ($p$=.456).[36] In both our and the Ethiopian studies, social distancing was defined by practice of not attending crowded places which was not specific and not sensitive, unlike the strict definition of social distancing in North Korea study which brought up different results whereby social distancing was defined by 2-meter distance separation from one another.

Germs from unwashed hands can be transferred to other objects, like handrails, table tops and then transferred to another person's hand. Therefore, removing germs through handwashing prevents viral rhinitis and COVID-19.[46] Despite this hypothesis, our study found

handwashing to have no statistically significant effect on viral rhinitis ($p$=.737). Our study found 179 (46.6% of respondents who practices handwashing to have had reduced incidence of viral rhinitis but it was statistically not significant. The findings can be explained by lack of proper way of handwashing and low frequency of handwashing in our study population. Findings of our study were different from that in Sweden ($p$=.02),[46] and California ($p$=.03).[19] The discordance can be explained by the difference in study area, study population and level of development between low-income and high-income countries. Level of the economy of Sweden and California is higher than that of Tanzania which makes sanitizing stations to be available widely in Sweden and California, unlike in Tanzania.[47]

Our study results suggest that steaming does not significantly affect the incidence of viral rhinitis ($p$=0.718), which is contrary to the hypothesis that steam may help congested mucus drain better and that heat may destroy the common cold virus as it does *in vitro*, and hence contribute to the reduction in viral rhinitis incidence.[48] Fifty-six (14.5%) of respondents who practised steaming reported reduced incidences of viral rhinitis, though not statistically significant. The limited information concerning steaming, including technique and frequency of steaming, can explain this inconsistency. Our study findings are different from those reported in Thailand ($p$=.02),[48] whereby differences in the study types, dissimilar populations and study location are most likely to have contributed to the observed inconsistency. There is limited number of studies on the impact of steaming on viral rhinitis incidences. It should be noted that, although information on the use of more than one measures of prevention was not assessed in this study, most people during COVID-19 tried a variety of methods to contain the disease. Thus, there is every possibility that participants used more than one measure in an attempt to protect themselves from the infection. Accordingly, a combination of such methods might be imparting relief from other respiratory tract conditions.

Our study found that traditional medicine use had no significant impact on incidence of viral rhinitis ($p$=0.27) which is in line with the fact that there is no scientific hypothesis behind the impact of traditional medicine on viral rhinitis.[6] Our findings are consistent with the findings of a study done in 2014 in China ($p$=.123).[49] There is a limited number of studies on traditional medicine and viral rhinitis and general preventive impact to upper respiratory infections.

### Limitations of the Study

There are a few important limitations to consider when interpreting the findings of this study. In general, the whole study has regarded every rhinitis encountered as infectious rhinitis, though there are non-infectious rhinitis and allergic rhinitis, which cannot be not contained by all the preventive measures stated. This calls for caution in the interpretation of the findings. Furthermore, participants' inability to recall all the number of times they contracted any form of rhinitis per year before the COVID-19 pandemic may have introduced a recall bias on key findings from this study.

### Strength of the study

The use of healthcare staff in addition to students is likely to have captured a diversity of views, including those with an element of health professional understanding of the symptoms of the tracer disease, thereby increasing the validity of the results. The study provides an avenue for innovative means to be adopted for the prevention of other upper respiratory infections from aerosol spread, exploiting the lessons learnt from the COVID-19 pandemic.

## CONCLUSION AND RECOMMENDATIONS

The level of practice of COVID-19 preventive measures is high among healthcare workers and university students. Despite lack of statistically significant impact of preventive measures against COVID-19 on incidence of viral rhinitis there is reliable information that can be useful. For example, there is observable reported decline in incidence of viral rhinitis per person during COVID-19 pandemic due to high level of practice of COVID-19 preventive measures which passively protects people against viral rhinitis. Lack of statistical significance on impact of COVID-19 preventive measures on viral rhinitis incidences changes could be associated with lack of knowledge on proper way of applying those practices. It can be recommended from this study that much emphasis should be put on the education of the community on the proper way of practicing COVID-19 preventive measures for other airborne infections. While the use of preventive measures against COVID-19 might be overlooked considering common cold (viral rhinitis), the study has shown that if they are observed, particularly face masks, they may reduce person-to-person transmission of airborne conditions than non-use. Therefore, we recommend instituting the use of facemasks and all hygienic measures when one knows that he/she has an infection to protect others from acquiring the condition, particularly in large gatherings and public transport. Policy makers are urged to recommend this to the National Disease Control Programmes even on interim basis for monitoring and further evaluation of its goodness of fit. The significance of this study is to provide a base for adopting cross-cutting preventive measures learnt from the COVID-19 pandemic that apply to other upper respiratory conditions with reference to common cold. This is the easiest way whereby the population can limit the spread of aerosol conditions without necessarily visiting health facilities or in preparation to visit health service providers.

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