



Original Article

Frequency of Voice Changes during Covid-19 Infections: A Retrospective Study

Janet Shanem¹, Muhammad Sikander Ghayas Khan¹, Muhammad Azzam Khan², Aayeshah Firdous³, Sadaf Hameed³, Arooba Asmat⁴, Shabana Majid⁵, Sabahat Khan⁶ and Tallat Anwar Faridi⁷.

¹Department of Health Professional Technologies, University of Lahore, Pakistan

²Department Rehabilitation Sciences, University of Lahore, Pakistan

³Department of Allied Health Sciences, Rashid Latif Khan University, Lahore, Pakistan

⁴Department of Speech and Language Pathology, Sikandar Medical, Gujranwala, Pakistan

⁵Department of Speech and Language Therapy, Hameed Latif Hospital, Lahore, Pakistan

⁶Rashid Latif Khan University, Lahore, Pakistan

⁷University Institute of Public Health, University of Lahore, Pakistan

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*Corresponding Author:

Janet Shanem

Department of Health Professional Technologies,
University of Lahore. Pakistan

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ABSTRACT

Communication is defined as the phenomenon found specifically in animal species. It was however refined and modified only by the human species. Language and speech are two basic areas that fall under the umbrella of communication. With these processes also comes the impending danger of abnormal speech and language, leading to the development of their disorders. **Objectives:** Reporting the frequency changes in the voice of patients who are positive of covid-19. **Methods:** Application of cross-section study type of retrospective nature was steered. Details were extracted from 2 trust hospitals of Lahore, UOL Teaching Hospital and Arif Memorial Hospital. Convenient based sample accumulation technique was applied for data assembly from subjects. The Voice Handicap Index (VHI), was used for the evaluation of patient perceived voice changes. **Results:** Data of 379 patients of Covid-19 infection was compiled. Shaky and weak voice, unclear voice and change in voice observed at the end of the day were all highlighted as voice changes in subjects. Out of 379, 263 experience shaky and weak voice to some extent which meant 69.4% of the participants experienced this. 241 out of 379 experienced problems with voice clarity and complained about not being able to speak clearly, meaning 63.6% faced this issue. 242 experienced change of voice over the passage of time in entire day, indicating 63.9% experienced this. **Conclusion:** Weak voice or having a shaky voice, having voice that was not clear enough to be understood by others, and feeling a change in voice quality over the day were considered as pointers of voice change. collecting and analyzing the data, the investigation concluded that voice changes were observed in individuals during Covid-19 infection.

INTRODUCTION

Communication is defined as the process in which exchange of information in the terms of thoughts, notions, moods and emotions between living beings takes place. This spectacle is not only classified to humans, animals also use this to interact. Communication in humans has 2 basic components, language and speech. Speech is the neuromuscular process that results in the production of appropriate sounds from the vocal tract. Speech occurs when individuals make meaningful sounds with the help of

the articulators that are set in motion when instructed. The components of speech include, voice, fluency in speaking and articulation of an individual. All these components need to be existing in an individual to achieve decent speech in order to communicate. A problem in any one of the components can lead to abnormalities of the vocal tract and thus disrupt production of proper speech for communication. The properties of these components varies from individual to individual however there is a set

standard even still in order to have appropriate voice, proper articulation and effortless fluency [1,2]. Voice is the sound produced at the level of the vocal cords when they vibrate. It is the raw material for our speech. The process of voice manufacture involves the lungs, bronchi, trachea, larynx and specifically the vocal cord movement. The pulmonary air departing the lungs, comes in contact with the glottis, the opening of the vocal cords in the larynx, leading to the vibration of the vocal cords production of sound. Phonation and thus voice is an important aspect of speech. This sound then acts as a raw material which then passes through the various cavities of the pharynx, mouth and nose to shape and transform into various speech sounds humans produce so effortlessly. Voice can only be produced if the air that exits the lungs and lower respiratory tract and interacts in the glottis region if the timings of the air expulsion or vocal cord opening are altered, this process may not even occur subsequently [3]. Production of voice mechanically involves multifaceted adduction of cords of voice and how it is controlled by the muscles present in larynx. It is significant in a research related to voice to determine a theory that links voice function and structure to how the speaker uses and controls his/her voice for communicating personal details and sense [4,5]. Loudness or vibratory amplitude is characterized as the highest or maximum movement of the vocal cords from resting position while a person phonates. The higher the amplitude of the vocal cord vibration, the louder the sound. Pitch or the frequency of the voice can be defined as the number of cycles of vocal cord vibration per unit time. When the length of the vocal cords is increased the number of cycles of vocal cord vibration decreases, decreasing the pitch of one's voice and vice versa [6,7]. Voice quality inevitably with voice pitch as they both are related with the physics of vocal cords: pitch is estimated by the speed of vibration, type of phonation is judged by the degree of closure and opening of the glottis. The quality of voice can be elucidated as that aspect of voice that makes the voice of every human being sound different from the others. Fluency is defined as one's ability to produce smoothly flowing speech sounds and words while communicating. These include, the rate of speech, the complexity of the words that a person produces in his/her speech and the mean length of utterance. Therefore, problems due to one factor can lead to problems of fluency and thus affect the overall speech of an individual [8,9]. There are 5 normal physiological processes that are contributing to the production of speech. These are, respiration, phonation, resonance, articulation and prosody. Of all these processes, the respiration is of the utmost importance a prerequisite to respiration and its control is appropriate respiration for good production speech; individuals who

have poor control of their respiration are found to have, weak speech. Respiration is one of the most important parts of speech, as it provides the air tides for voice phonation. It supplies the larynx with pulmonic air which is then used to create "phonation" [10,11]. There can be various causes and reasons that the voice is impaired, and due to this the disorders of voice are classified into 3 types on the basis of cause. These types are, structural voice disorders, neurogenic voice disorders. Structural voice disorders are those that occur due to a physical alteration or damage of a structure involved in voice production. The second type of voice disorder is the neurogenic voice disorder. This type of voice disorder occurs as result of nerve damage or impairment of the central nervous system which in turn affects the muscles innervating the larynx for voice production. The third type of voice disorder is the functional voice disorder [12,13]. A study carried out in the USA in 2020 by Ismail and colleagues, hypothesized that COVID-19 signs might be observed through the examination of vocal cord vibration. Results showed that COVID-19 had lead to vocal cord disruption during voice production, and also caused asymmetrical movements of the vocal cords which were then used to spot COVID-19 [14]. As the respiratory system plays an important role in voice and thus speech production, impairment of the system or any of its structure can lead to weakened production of voice. Disorders of the respiratory system affect the voice production. One of such disorders is the pandemic of COVID-19. Which not solely impacted our breathing or respiratory system but it has also led to impact the voice. The voice quality is greatly impacted by the method of human breathing while speaking, by speed and extent of exhalation (in relation with the quantity of words present in the sentences), and by variations and force of being rushed through the larynx. It has been established that COVID-19 impacts the respiratory system and tends to infect the lower respiratory tract. There is a high likelihood that condition may then lead to problems in the upper respiratory tract. Infection of the lower tract can cause the vocal cords and the larynx to work inefficiently leading to an improper voice production for speech tasks. [15-19]. A study was carried out in Germany by Bartl-Pokorny and colleagues in 2020 which also aimed at studying changes in voice using acoustic analysis. The study highlighted that the means of segment length of voice and the frequency of voiced segments produces the most imperative alterations among all the vowels demonstrating gaps and breaks in the airstream pathway during voice production in Covid-19 infected individuals [20]. A study by Pinkas and colleagues was carried out in 2020 The researchers hypothesized that use of an electronic application could be used to diagnose COVID-19 and help identify the presence

of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The patients went through swab testing and were grouped into COVID-19 positive patients, the COVID-19 negative individuals were included in the control group for the study [21]. A study was carried out in 2018, highlighting how an upper respiratory tract infection can lead to a direct impact on the larynx and especially the vocal cords. A person is diagnosed with unilateral and idiopathic vocal cord paralysis if the vocal cord paralysis occurs without any proper cause or reason. The mentioned research was aimed to scrutinize cases of idiopathic vocal cord paralysis that were reported in institutions and also to shed light on whether there is an association between the upper respiratory tract and its infections and the occurrence of idiopathic paralysis of the vocal folds [22].

METHODS

Investigation was carried out from June 2020 to January 2021. A cross-sectional natured design was decided for the study and was used to compile data retrospectively from two private trust hospitals of Lahore. Approval from the Internal Review Board (IRB) of the University of Lahore was first obtained. After this, the specimens were ruled to be accumulated through convenient non-probability selection procedure or sampling method with ages between 20 and 50 years who had tested positive in Covid-19 Polymerase Chain Reaction (PCR) tests. 379 were chosen to participate in the research after the sample sizes of the previous research studies related to voice were studied. Those subjects were included who had the infection a month ago or less. Individuals who had co-morbid breathing or voice problems or hormonal diseases that could influence the results were not included. An informed consent in written manner was attained from the subjects, specimens were collected through the Voice Handicap Index (VHI) questionnaire, used in many researches after proper validation of the tool. The questionnaire consists of 30 questions that help record various voice concerns patients had suffered from and also help to recognize and identify the presence of any voice changes. Demographic related details and information pertaining to gender, occupation, duration of infection, duration of voice problems was amassed from each subject. The speech and language pathologist/therapist entered the data in the questionnaire related to the voice changes, issues and symptoms experienced by the patients. Data were analyzed using SPSS 22.0 to determine the how frequent were voice changes and issues experienced by the diagnosed population. Demographic related variables were designated out by descriptive statistics. Frequencies, percentages and quantities were scrutinized using categorical type of data.

RESULTS

Table 1. Provides general information regarding the 379 participants, age range was divided into 3 categories, gender was divided into 2 categories and occupations of the subjects were divided into 3 categories. The results indicate that most participants fell between 20 to 30 years' age. Data was compiled more from females than males. 64.4 % of the subjects were between ages 20 to 30 years. 55.7% of the population was female in the study. 68.9 % individuals were found to fall in the professional category.

Demographics	Frequency	Percentage	
Age	20-30 years	244	64.4
	31-40 years	39	10.3
	41-50 years	96	25.3
Gender	Male	168	44.3
	Female	211	55.7
Occupation	Student	66	17.4
	Professional	251	68.9
	Unemployed	52	13.7

Table 1: Demographics related to the participants

Table 2 was made to divide the observed voice changes into 3 basic groupings. Weak and shaky voice, unclear voice and voice changes noticed after an entire day of speaking were noted as 3 distinct traits related to voice change. The table provides the evidence that voice changes were found to be present in majority of the subjects involved in this research.

Voice changes observed	Frequency	Percentage	
Shaky and weak sounding voice	Never	64	16.9
	Almost Never	52	13.7
	Sometimes	151	39.8
	Almost Always	67	17.7
	Always	45	11.9
Voice was not clear during speech	Never	83	21.9
	Almost Never	55	14.5
	Sometimes	118	31.1
	Almost Always	61	16.1
	Always	62	16.4

Table 2: Indicating specific voice changes observed and recorded

Voice changed after using it entire day	Frequency	Percentage
Never	90	23.7
Almost Never	47	12.4
Sometimes	118	31.1
Almost Always	94	24.8
Always	30	7.9

Table 3: frequencies

DISCUSSION

This research is meant to help aid Covid-19 diagnosis by the presence of voice changes in infected individuals. The voice changes were noted through the use of a questionnaire. This helped the infected people choose

from a given number of options the option that suited them the most regarding their voice during their quarantine period. Another research that aimed at using sounds to diagnose Covid-19 was carried out by Brown and colleagues. In this research sounds of cough and breathing were compared between the Covid-19 positive. In this investigation, more females participated in data collection whereas in the study by Brown and colleagues, more data was collected by males than females. The age group from which data was mostly collected was 20-30 years, whereas more people from 30-39 age group participated in the other study [25, 26]. An article was published by Almada and Maranhao which highlighted voice symptoms in relation with a Covid-19 infection similar to the essence and theme of my research study. Their study aims to promote more voice-based research in correlation with Covid-19 which was performed in my study. They argue that voice change has been a symptom of infections of the respiratory tract and asthma and that its application in this area may lead to a new approach to the Covid-19 infection which is similar to the objective of the existing study. The current investigation was intended to deliver evidence that voice changes can occur during Covid-19 which has been the notion behind the article written by Almada and Maranhao as well [26]. The study by Asiaee and colleagues used the probability sampling technique for employing healthy individuals and used non-probability sampling technique, convenient sampling for data collection of infected patients. This is similar to present research since it also uses the non-probability type, convenient sampling for data collection. The data in their study was collected from a hospital which matches with this study as data was collected from two hospitals. Some of the infected participants chosen in their study passed away during the data collection procedure due to complications of the Covid-19 infection. The present study collected data from individuals who recovered from Covid-19 and are alive and well [27]. The study carried out by Deshmukh and colleagues was a comparative study between infected and healthy individuals whereas my study was completely on Covid-19 positive individuals. This study was a cross-sectional study, the data was collected during the time the individuals were infected whereas my study was a retrospective study and the data was collected after the recovery of the Covid-19 patients. The results of the study carried out by Deshmukh and colleagues indicated that voice flow changes were observed in infected patients which is similar to the results of my study as well, that showed that voice changes were observed in infected patients most of the time during the infection [28]

CONCLUSION

The presence of a shaky and weak voice also indicates that

participants' voices went through a change and had become relatively weaker and shakier than their normal healthy voice. It was also proved that voice change after its use for the entire day was also commonly noted issue in the subjects involved. The voice sounded unclear to the listeners when the participants talked indicating that due to Covid-19 infection their voices changed and had become difficult to be understood by the listeners on the phone or through a barrier placed between the subjects and the family members for isolation. These voice changes observed in the patients are unavoidable, as Covid-19 infection is a respiratory tract infection. The respiratory tract is important for the production of a normal voice. It is highly unlikely for a compromised respiratory tract to produce a normal healthy voice. The respiratory tract's function becomes restricted and therefore leads to changes in the voice. This study highlighted the presence of voice changes and how they were identified through the experiences of Covid-19 patients.

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