THE EFFECTS OF FASTING ON VARIOUS ACOUSTIC AND PERCEPTUAL PARAMETERS OF VOICE

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CERTIFICATE

This is to certify that this dissertation entitled ***"THE EFFECTS OF FASTING ON VARIOUS ACOUSTIC AND PERCEPTUAL PARAMETERS OF VOICE"*** is a bonafide work submitted in part fulfillment for the degree of Master of Science (Speech Language Pathology) of the student Registration No.: 12SLP030. This has been carried out the under guidance of a faculty of this institute and has not been submitted earlier to any other university for the award of any diploma or degree.

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DECLARATION

This is to certify that this master's dissertation entitled **"THE EFFECTS OF FASTING ON VARIOUS ACOUSTIC AND PERCEPTUAL PARAMETERS OF VOICE"** is the result of my own study under the guidance of **Dr. Y.V. Geetha,** Lecturer in Speech Sciences, Department of Speech Language Sciences, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier to any other university for the award of any diploma or degree.

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Dedicated to....

Achan, Amma, Chettan & Liji mol

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CHAPTER I

INTRODUCTION

Larynx is considered as the primary source of voice production. Larynx serves 3 different functions; biological function, emotional function and the linguistic function.

Biological function

The primary biological function is to retain liquids and foods entry into the airway thus preventing aspiration. When the larynx plays a sphincteric role of airway closure in order to permit the posterior passage of food or liquid the entire laryngeal body rises. Besides the elevating capability of larynx airway closure is aided by 3 laryngeal muscle valve, the aryepiglottic fold, ventricular fold and the thyroarytenoid muscle.

Under vigorous valving conditions like severe cough the most vertical valve pair the aryepiglottic fold begin to adduct. Below the aryepiglottic fold is the ventricular folds, they also adduct during vigorous adductory activities. The lowest and the medial of 3 laryngeal valves are the thyroarytenoid muscle. During swallowing they always adduct to prevent aspiration. During breathing all the 3 valves automatically opens. The vocal fold separates further on inspiration, allowing a greater volume of air to pass through quickly, on expiration they move slightly towards each other. Voice is produced when there is a slight adduction of the vocal folds together, letting the air to pass between them leading to vibration. The vibration produces voice. This phonation is then resonated through various sites of vocal tract. The resonance of voice begins with vibratory sound in the larynx, travelling up

through the pharynx, oral and nasal cavities. The voice is produced by a combination of respiratory activation, amplifying resonance and phonation.

Emotional Function

Infant's makes laryngeal sounds to express emotions. Caregivers are able to detect these changes in emotional status by infant's vocalizations. Emotional status plays a role in control of respiration. Once mood status can be heard in his/her voice, this can be threatening to professional singers or harmful to sales for the sales person. So, emotional status can be clearly conveyed through our voice.

Linguistic function

As the child begins to learn and use language he incorporates supra segmental vocalization in all aspects of spoken communication. Vocal stress is added in order to augment what is being expressed. The actual word spoken is only a part of communication, how it is said is conveyed through vocal strategies like changing intensity, grouping words together on one breath group, changing frequency, resonance and quality etc. Thus voice carries most of the message. The same word spoken or written may convey different message depending on the stress patterns given on the word by the speaker.

Vocal cords

Housed within the larynx are the vocal cords which constitute the vibrating element for voice production. Vocal folds are elastic structures which are mainly responsible for voice production. It consists of 4 different layers. The different layers comprise of epithelium, the basement membrane, the lamina propria and the vocalis muscle (Gray, Hirano & Sato, 1992). All these layers work in coordination for the

proper functioning of vocal fold vibration. The coordinated action of these structures will result in normal voice production.

Normal voice is characterized by five aspects and they are as follows: 1) the voice must be loud enough to be heard, this refers to adequate carrying power which means that voice can be heard and speech can be understood over the noise of most every day environmental sounds. 2) Voice must be produced in a manner that is hygiene and safe, i.e., without any vocal trauma or laryngeal lesions. 3) Voice must be of a pleasing quality, i.e., it should not be distracting. 4) Normal voice should be flexible enough to accurately express emotions. 5) Voice should represent the speaker well in terms of age and gender.

Vocal fold consist of a thin mucosal layer that acts as a lubricant, thereby serving efficient vocal fold vibrations. It also protects vocal folds from injuries. Water provides the raw material for producing this layer of mucous. Inadequate hydration to the vocal folds results in the mucous being thick and viscous and vocal fold tissues being dry. Sticky, thick secretions can rise the vocal fold mucosa's viscosity, thereby making vocal folds bulky, impeding smooth vibratory pattern along with cultivating throat clearing and habitual coughing, which may perhaps provoke irritation .Dry mucosa hinders the natural vibratory pattern of the vocal folds by increasing the subglottic pressure requirement for voice production (Verdolini-Marston et al., 1990). It also increases the risk of phonotrauma. For effortless voice production tissue hydration seems to be a contributing factor.

Voice disorders

Voice disorders stem from different pathologies. These disorders not only occur due to pathologies of vocal mechanics, but several precipitating factors can lead

to voice disorders. Systematic hydration helps in preventing several voice disorders. Hydration is an essential factor for the performance of entire laryngeal system. For efficient and effortless voice production tissue hydration seems to be a contributing factor. The fluid intake recommended for adults is 1 ml per kilocalorie of spent energy (Stookey, 1999).

Dehydration due to fasting

Fasting is a condition which results in excessive dehydration. Fasting is an act of abstinence of food and drinks for a period of time. An absolute fast refers to complete abstinence of food and liquid for a definite period i.e., a single day (24 hours), or several days. Fasting can be done in several modes. Some kind of fasting is only partially restrictive, in such a way limiting only some particular food items. Fasting can also be intermittent in nature. Humans undergo fasting as a part of their religious beliefs. It can alter the metabolic status of body which will result in dehydration, headache, nausea, vomiting, weight loss, sleep disturbances, drowsiness, alertness, gastric reflux etc. Absolute fasting from dawn to dusk can result in substantial increases in serum protein, urea, creatinine, uric acid and electrolyte imbalance (Awada, & Al Jumah 1999).

Dehydration is one of the major changes that occur in the body during fasting, Energy loss is one of the early symptoms of dehydration. Acid reflux is another symptom resulting from dehydration. Food is digested by the action of sufficient stomach acid, but dehydration can result in reducing the amount of stomach acid, thus when the stomach does not have enough acid for digestion it can result in reflux; which can in turn impair the digestive system. Another bodily change which occurs due to dehydration is constipation. The intestinal tract requires sufficient amount of

water for breaking down the food and absorbing the nutrients, and as a result of dehydration the passage of waste through lower intestine becomes difficult.

Grandjean, Reimers, Bannick and Haven (2000), well-defined systemic dehydration as a state in which the body fluid output exceeds fluid intake. This definition reflects on all possible sources of fluid consumption, such as through beverages and food, in addition to sources of fluid losses via body waste e.g., sweat, urine etc.

Dehydration has several negative consequences on the entire body physiology, and hence the phonation subsystem involving the vocal folds also can get affected.

Excessively dry vocal folds are irritated by repeated impact more easily than are folds with normal lubrication. Thick and sticky secretions may increase the mass of a fold, impeding smooth vibratory patterns and predisposing the speaker to habituate to coughing and throat clearing, which may aggravate irritation (Andrews, 1999). Fasting, which is a contributing factor for dehydration, can also result in voice changes.

The research in the area of fasting and its effect on voice has not been extensively focused. Hamdan, Sibai and Rameh, (2007) studied the effect of fasting on voice in women involving abstinence from food and water intake between 14 and 18 hours. Vocal fatigue was the most common self-reported complaint (53.6%) followed by deepening of the voice (21.4%) and harshness (10.2%). Out of the 28 subjects, 23 had an increase in their phonatory effort. Vocal acoustic parameters did not change markedly except for the Maximum Phonation Duration (MPD), which decreased significantly. Laryngeal videoendo-stroboscopy did not reveal any significant changes during fasting.

Hamdan, Ashkar and Sibai (2011) studied the effect of fasting on voice in males and reported significant increase in phonatory effort during fasting. The incidence of vocal fatigue was not significantly higher while fasting compared to non-fasting. A significant decrease was seen in the parameters like habitual pitch, as well as voice turbulence index, and noise-to-harmonic ratio. No laryngeal video stroboscopic changes were reported.

India, being a country rich in heritage and religious rituals, many Indians do fasting on many occasions. Due to limited literature pertaining to the vocal consequences of fasting, especially in the Indian context, present study looks forward to enhance the knowledge of the vocal parameters affected if any as a result of systemic dehydration brought about by fasting. This would provide empirical evidence to emphasize the role of hydration on the vocal mechanics.

Aim

The present study aims at investigating the effect of fasting on voice in adult males and females.

Objectives

i. To study the variations in acoustic parameters, if any, in normal subjects, with and without fasting
ii. To study the perceptual parameters of voice across the conditions of with and without fasting
iii. To determine the variability of voice parameters with duration of fasting
iv. To study the gender differences, if any, in voice parameters with and without fasting conditions

CHAPTER II

REVIEW OF LITERATURE

Structure and function of Larynx

Larynx is an intricate structure formed by interlinked cartilages, membranes and ligaments, muscles and soft tissue. Larynx is mainly composed of intrinsic muscles, extrinsic muscles and mucosa. The thin, upper respiratory epithelium enclosing the vocal folds forms the contact area between the vibrating vocal cords. Abduction, adduction and tension of the vocal folds are accomplished by intrinsic muscles. The position of the larynx in the neck is maintained by extrinsic laryngeal muscles.

Larynx serves different functions. One of the striking features of larynx is airway protection during swallowing. It also helps protecting the airway by means of coughing. Coughing is a reflex intended to expel any foreign object from air way. Larynx is also concerned with emotional expression by means of reflexive vocalization such as crying and laughing. It also serves a major function like phonation wherein the exhaled air is converted into sound by means of vibration of the vocal folds.

Vocal folds and its layers

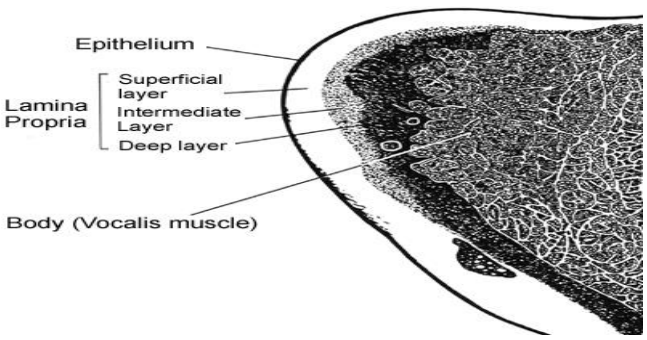

Figure 1: Layers of vocal folds

Vocal fold is an elastic structure which is mainly responsible for voice production. It consists of 4 different layers. The different layers comprise of epithelium, the basement membrane, the lamina propria and the vocalis muscle (Gray, Hirano & Sato1992). The lamina propria consists of 3 layers; the superficial layer, intermediate layer and deep layer which are made of collagenous and elastic tissue. The epithelium and superficial layer form the mucosa and the intermediate and deep layers form the ligament. The epithelial layer is composed of squamous cells, which are specific cells having micro ridges that helps with cell to cell adhesion at the surface. The basement membrane is a thin layer between epithelium and lamina propria, which plays a larger role in the function of voice. Its function is to hold the epithelium to the lamina propria's superficial layer. Lamina propria is the space between the basement membrane and the vocalis muscle. It is greatly important for elasticity and osmotic regulation. The lamina propria consists of extracellular matrix. The matrix substance mainly comprises of glycosamingoglycans, proteoglycans and the fibrous protein collagen and elastin (Hirano, 1981). Hyaluronic acid is one of the important glycosamingoglycans in the lamina propria. Glycosamingoglycans are hydrophilic molecules. They are relatively inflexible; they provide space filling characteristics through gel formation. The glycosamingoglycans are also osmotically active. They are osmotically active due to their negative charge, this negative charge attract ions and water. The extra cellular matrix uses this osmotic activity to resist compressive force (Albert et al, 1994). Capillaries, nerves and macrophages are also seen in lamina propria. Elastin plays a major role in vocal fold vibration. It is found in three distinct forms in the lamina propria: Oxytalan, which is composed of microfibrills, elaunin, which is composed of microfibrills and an elastic amorphous components and mature elastic fibres which are characterized by a large amorphous

component surrounded by small microfibrills. All these layers work in coordination for the proper functioning of vocal fold vibration. The coordinated action of these structures will result in a normal voice production.

Normal Voice and its characteristics

Normal voice is a multidimensional entity that encompasses many different physical, perceptual and lifestyle aspects. Normal voice includes factors concerning the vocal output such as pitch, loudness, and quality; physical aspects of voice production such as effort, pain, discomfort strain and fatigue and lifestyle considerations like degree and purpose of voice use.

A good voice should exhibit pleasing voice quality, proper oral and nasal resonance, an appropriate pitch or frequency level suitable for age and gender, and appropriate loudness (Wilson 1972). When any of the above aspects of voice production is compromised, it can result in voice disorder.

Abnormal voice and its classification

Abnormal voice results from deviation in quality, pitch, loudness, or flexibility which may signify illness or interferes with communication. The Diagnostic Classification System for Voice Disorders (DCSVD) classifies voice disorders as an 'Organic' or 'Non-organic' or functional voice disorder, where the sub-group 'Functional Voice Disorders' is split into 'muscle tension voice disorder' and 'psychogenic voice disorder'(Baker, 2008). Many of the disorders that occur in human vocal folds are benign lesions such as nodule and polyp. They are little growth of unwanted materials. One reason for such a growth is because of the disturbance in balance of lamina propria.

Voice disorders and its consequences

As a consequence of voice disorders an individual faces phonation difficulties, vocal fatigue, altered voice quality, altered pitch, altered resonance, altered breath control for sustaining loudness, hyper and hypotension in musculature, and pain/discomfort when vocalizing. The person may also exhibit a reduction in the ability to communicate effectively, and may exhibit an inability to participate fully in educational curriculum.

Disruption of career in professional voice users like teachers, call center workers and aerobics instructors are also seen as a result of voice disorders.

Adverse effects on job performance, attendance, and future career choices, social isolation, limited participation, and loss of autonomy, avoidance of situations, frustration, anxiety, mood, self-esteem, and depression, repression of emotions, stress, and impact on peer/adult perception are some of the negative impact of voice disorders on individuals' life.

Causes of Voice Disorders

There are many factors which can result in voice disorders. These include vocal abuse, vocal misuse, and illness such as cold or upper respiratory tract infection, allergies, trauma, alcohol consumption, smoking, cancer, gastric reflux, endocrine related problems, psychological stress, professional voice users' work environment, aging and dehydration.

Systemic Hydration

Body hydration is vital for maintaining life (Schrier, 1994). Appropriate body functions need ingestion of adequate amount of water (Miller & Keane, 1997). The process of systemic hydration occurs when fluids ingested are transported throughout the body by the vascular system and after being engrossed by intestinal cells and transferred to the capillary network (Titze & Verdolini). Clinical guidelines recommend total daily fluid intake of 35 ml per kilogram of body weight per day (Howard, 1998; Mudge & Weiner, 1990). On the basis of standard conditions, the optional fluid intake for adults is 1 ml per kilocalorie of energy used (Stookey, 1999).

Hydration effect on vocal folds

The vocal folds are responsible for phonation during which the vocal folds vibrate and there is contact between the covering layers of the two vocal folds. The structure of the vocal fold lining and a layer of thin mucus protect the vocal folds from trauma. The mucus acts like a lubricant for the vibrating vocal folds. The presence of surface liquid is also vital to maintain optimal bio-mechanical characteristics of vocal fold mucosa, increase efficiency of vocal fold oscillation, and improve voice quality.

Hydration and vocal function

1. **Researches on animal cadavers**

Jiang, Jennie and Hanson (1998) conducted a study on effects of rehydration on phonation in excised canine larynges. They had studied the restoration of vocal efficiency in dehydrated larynges. The 13 canine larynges were obtained from postmortem of animals. Dehydration of the larynges was enabled by directing of dry and warm airflow through the approximated vocal folds. This was done not entrain the folds to produce phonation. Recordings were obtained for Phonation Threshold

Pressure, magnitude of airflow at PTP, and maximum acoustic intensity before and after dehydration. After surface dehydration larynges were immersed in saline for 30 minutes. The rehydrated larynges were then remounted on the bench apparatus that permitted phonation with a constant humidified airflow, and measurements were made for phonation threshold pressure, glottal airflow, and amplitude. The results indicated that after rehydration, PTP, average airflow levels at PTP were significantly decreased. A significant improvement in the glottal airflow and glottal efficiency was seen with increasing hydration Hydration resulted in considerably better efficiency and reduction in phonation threshold pressure. Thus, it could be concluded that hydration is critical in the physiology of normal phonation.

Hanson, Yu Zhang, and Jiang (2011) documented the recoverability of canine vocal fold (VF) lamina propria (LP),the vocal fold lamina propria were rehydrated from varying levels of dehydration. The vocal fold lamina propria of 10 canine larynges was extirpated and tissue samples were obtained. The original volume of each sample was measured. Among the 20 samples ten samples were dried to 30% and the other 10 samples to 70% by mass. Once dehydration has been completed each sample was rehydrated in 0.9% saline until the mass was stabilized. The liquid mass and volume fractions liquid: solid mass and volume ratios, and the fractions of the original tissue masses and volumes were calculated. All calculated parameters were considerably different between 30% and 70% dehydration recovery. Samples subjected to 30% dehydration fully recovered to their original volumes, whereas only one of the 10 samples subjected to 70% dehydration fully recovered its volume. These results suggest that the concentration of the saline solution absorbed by the tissue samples on rehydration was less than the concentration of the liquid initially present in the tissue.

2. **Hydration Treatment**

Two techniques in the prevention and treatment of voice disorders are water intake and steam inhalation. This improves tissue function and makes phonation less effortful (Franca & Simpson 2009). Hydration techniques are also used to reduce salivary gland malfunction. Systematic and surface hydration is important elements in ensuring treatment techniques concerning vocal hygiene.

3. Harmful effects of hydration

Consumption of large quantities of water can result in an increase in the probability of reflux or cause hyponatremia (Harris & Rubin, 2003). Hyponatremia has been inferred as water intoxication. It presents with clinical features like agitation, apathy, anorexia, confusion, fatigue, difficulty concentrating, headache, muscle cramps, nausea, lethargy seizures, hypoantremic encephalopathy, coma and death. So, caution should be taken when using hydration as a therapeutic treatment.

4. Systemic Dehydration

Systemic dehydration is a condition in which the body fluid output exceeds fluid intake. This takes into consideration all possible sources of fluid intake, such as through food and beverages, and fluid losses via body waste e.g., sweat, urine etc.(Grandjean, Reimers, Bannick & Haven (2000).

5. Dehydration and its negative effects on body

Dehydration can result in increased headaches, fatigue, discoloration in the urine, frequent constipation, bloating, dryness of skin and lips, lack of tears, skin refusing to spring back after being pinched, problems focusing, vomiting, problems

with feet and hands warming up, lack of urine production, vertigo, irritability, confusion, flushed face coma and even death etc.

Dehydration has an adverse effect on body performance in the following ways. It can result in reduction in blood volume, decreased blood flow, decreased sweat rate, decreased heat dissipation, increased core temperature, increased rate of muscle glycogen use, a reduced maximal cardiac output etc.

6. Dehydration and its effect on voice

Drying of the vocal fold surface can occur due to many reasons including environmental and behavioral challenges associated with mouth breathing, exercising, and inhaling poorly conditioned air. Vocal fold dehydration can also occur resulting from reduced systemic hydration, emotional factors, and the normal aging process. Dehydration has several negative consequences on the entire body physiology, and thus the phonation subsystem involving the vocal folds can also get affected. During dehydration the layer of mucous becomes too thick, increasing its viscosity and reducing mucosal mobility, thus making the voice very stressful. Increased viscocity of layers of mucosa results in swelling which makes the vocal folds even more vulnerable to infectious pathogens, strain and damage. Excessively dry vocal folds are irritated by frequent impact more easily than are folds with normal lubrication (Verdolini-Marston, Titze, & Druker, 1990). This can also have some negative consequences on the voice quality, like increased vocal effort and decreased vocal efficiency.

7. Signs of vocal fold dehydration

The few indicators of vocal dehydration are feeling of dry/scratchy throat, frequent throat clearing, effortful voice use and feeling thirsty.

8. Researches on hydration in human subjects

Verdolini, Titze, and Druker (1990) conducted a pilot study in order to investigate the relationship between phonation threshold pressure and hydration level in human subjects. Six adult subjects participated in the study. They were instructed to produce consonant-vowel-consonant strings as quietly as possible at low, medium, and high pitches in no-treatment, hydrated, and slightly dehydrated conditions. To estimate PTP the average oral pressures for these trials were used. The results indicated that the lowest pressures were gained in the hydrated condition, and reduction in baseline pressures was highest for high pitches in hydrated condition. The maximum pressures were found for the dry condition, and the greatest increase in pressure relative to the baseline was found at low pitches for dehydrated condition. The threshold pressures for intermediate (speaking) pitches were not affected by hydration condition. The results indicated that dehydration increased PTP while the placebo and hydration conditions did not, signifying that drying challenges have negative effects on vocal function.

Verdolini, Titze, and Fennell (1994) sought to assess the relation between hydration level and phonatory effort. Twelve adults participated in the study. Subject were untrained voice users with normal voices, subjects received a 4-hour hydration treatment, a 4-hour dehydration treatment, and a 4-hour placebo (control) treatment. Following each treatment, phonatory effort was measured using a physiological measure, PTP), wherein the subjects had to produce /pae/ at low, mid and high pitches. A psychological measure, direct magnitude estimation was also used in order to check perceived phonatory effort (DMEPPE). The results revealed that when all the

three pitches were considered, average PTPs were highest following the dehydration condition, and lowest following the hydration condition. Across all hydration levels, PTPs were greatest for the high pitch. The results for perceived phonatory effort (PPE) measures showed that effort measures were greatest subsequent to dehydration condition and were lower subsequent to control and wet conditions. Results indicate an inverse relationship between phonation threshold pressure and level of hydration.

Sivasankar, Erickson, Schneider and Hawes (2008) evaluated negative phonatory effects of short-term oral breathing at low, moderate, and high humidity in individuals complaining a history of vocal fatigue and control participants. The female participants reporting a history of vocal fatigue (N = 8) and matched controls (N = 8) participated in the study over 3 different days. The PTP and PPE were collected at baseline and after 15 minutes of oral breathing and 15 minutes of nasal breathing. On each day the participants were initially trained on the PTP task at comfortable pitch. In order to obtain measures of PPE, the participants were instructed to sing "Happy Birthday" in a soft voice starting at the 50^{th} percent of their pitch range. The result revealed that oral breathing at low and moderate humidity increased phonation threshold pressure (PTP) to a greater degree in individuals reporting a history of vocal fatigue as compared to controls. On the other hand, PTP did not increase in either participant group after oral breathing in a humid environment. The perceived phonatory effort (PPE) ratings were poorly correlated with PTP. The differences in PTP at low and moderate but not high ambient humidity demonstrates that drying challenges might be harmful to voice production in individuals with a history of vocal fatigue.

The studies reviewed above mostly used systemic way to induce dehydration. Nonetheless, reducing surface fluid alone may also have undesirable effects on vocal function.

Inhaling poorly-humidified air for 15 minutes through the mouth elevated PTP in healthy subjects. Tanner, Roy, Merrill and Elstad (2007) documented the effects of nebulized hypertonic saline, isotonic saline (IS), and sterile (hypotonic) water on phonation threshold pressure (PTP) and self-perceived phonatory effort (PPE) following a surface laryngeal dehydration challenge. 60 vocally healthy women (n = 15 per group) underwent a laryngeal dehydration challenge which involved oral breathing for 15 minutes using medical-grade dry air (RH <1%). Three of the four groups then received nebulized isotonic saline (0.9% NaCl), hypertonic saline (7% NaCl), or sterile (hypotonic) water, respectively. The 4th group served as a non-treatment control. The PTP and PPE were estimated for high-pitched productions at baseline, immediately post dehydration, and at 5, 20, 35, and 50 minutes post nebulization. The results revealed that the PTP increased significantly for all groups following the dehydration challenge. The PTP values were 0.5 cm H_2O greater immediately post dehydration versus baseline. While the PTP values did not change significantly following the administration of nebulized treatments, PPE ratings decreased considerably after the dehydration challenge. PPE ratings were poorly correlated with PTP measures. The authors came to the conclusion that a laryngeal dehydration challenge significantly increases the PTP.

Significance of hydration in prevention and management of voice problems

Records on the adverse vocal effects of dehydration have encouraged research on the possible role of hydration in the prevention and treatment of voice problems.

Verdolini, Sandage, and Titze (1992) assessed the effectiveness of hydration treatments in the clinical management of selected voice disorders. Six adult female patients who had laryngeal nodules and polyps participated in the study. Each subject received 5 consecutive days of hydration treatment and 5 consecutive days of placebo/control treatment. A series of voice and laryngeal measures were made immediately prior to the beginning of the protocol, and 1 day following the termination of each treatment. These included measures of phonatory effort, PTP, laryngeal status, auditory-perceptual status, and acoustic status of voice. The results indicated improvements in voice and in laryngeal appearance following both placebo/control and hydration treatments as compared with baseline. The maximum improvements were obtained following the hydration treatment. This study provides preliminary evidence of a therapeutic benefit from hydration treatments in patients with nodules or polyps. The study also supports the theoretical notion that hydration effects may be related to reductions in the viscosity of vocal fold tissue.

Yiu, and Chan (2002) demonstrated that untrained singers who received both systemic hydration and vocal rest during karaoke performance were able to sing for longer durations. Authors carried out a study in amateur karaoke singers. The aim was to find out the amount of singing which would lead to the perception of vocal fatigue. Another aim was to find out whether regular hydration and brief voice rest would minimize the changes in voice quality during singing. The participants involved 10 male and female adults in the age range of 20 - 25 years. Each of the participants was made to sing. A series of phonatory function tasks like MPD, a pitch at comfortable pitch and loudness were also recorded along with singing. 10 of the participants were randomly selected and were given hydration and voice rest at regular intervals during singing and when the phonatory function tasks were carried out. Acoustic and

perceptual analyses were carried out and vocal function was measured using phonetogram. The results indicated that perceptual, acoustic and vocal function measures did not show any significant variation during singing in participants who were given water and rest at regular intervals during singing, whereas in participants who sang without any rest and without drinking water showed significant changes in measures like jitter, and pitch. The results support the notion that hydration and voice rest are useful strategies to conserve voice quality and function during singing.

Franca and Simpson (2012) examined effect of systemic hydration on vocal acoustics. Aim of the study was to find out whether dehydration will result in an increase in acoustic parameters like jitter and shimmer, and whether rehydration will result in decrease in jitter and shimmer. 38 female subjects in the age range of 18-35 years participated in the study. The participants had to produce 3 sustained productions of 5 vowels during pre-test and posttest conditions. Each of the target vowels was captured using the MDVP and Relative Amplitude Perturbation (RAP) and Shimmer values were measured. The results indicated a decreased shimmer value at posttest compared to pre-test; an average decrease in RAP was also noted in the rehydration condition. The results of the study revealed that hydration improved vocal fold function. The study also supports the hypothesis concluding that hydration has a positive effect on acoustic parameters. The positive effects of hydration also pointed out that it can be used as a treatment technique in some of the vocal fold pathologies.

Data from animal and human subjects have revealed that systemic and superficial

dehydrations are detrimental to vocal fold physiology.

Fasting

Fasting is a condition which results in excessive dehydration. Fasting is an act of abstinence of food and drinks for a period of time. An absolute fast refers to complete abstinence of food and liquid for a definite period i.e., a single day (24 hours), or several days.

Fasting overnight can result in fluid deficit. Dehydration, electrolyte imbalance, malnutrition, and general malaise are some of the negative effects of fasting. Hypoglycemia and raised serum concentrations of uric acid, sodium, chloride, and proteins during the initial stages of fasting highlight the status of dehydration. Fasting without fluid intake also results in a hyper-lipid level.

Evidence of hemo-concentration and dehydration has been found during Ramadan (El-Hazmi, Al-Faleh, & Al-Mofleh, 1987). Restricted fluid intake leads to disturbance in the fluid balance. The initial stage of dehydration is characterized by clinical signs like tachycardia, tiredness and malaise, headaches and nausea. Middle-aged or more elderly persons are usually more prone to the effects of dehydration (Schmahl & Metzler, 1999). Dehydration is indicated by an increase in serum level (El-Hazmi & Al-Faleh, 1987).

Effect of fasting on vocal characteristics

Hmdan, Sibai and Rameh (2007) documented the effect of fasting on voice in females. The participants were in the age range of 21-45 years. 28 females participated in the study. They were tested in non- fasting, during fasting and after the first week of intermittent fasting. Initially the subjects were asked about their vocal symptoms and ease of phonation. The participants were evaluated using VISI Pitch & Video endostroboscopy. The results indicated that vocal fatigue was the most commonly reported complaint, followed by deepening of voice and harshness. When

the acoustic parameters were considered, a significant change was observed only in Maximum Phonation Duration (MPD). Increased phonatory effort was seen in 23 subjects during the fasting conditions. Stroboscopy revealed similar stroboscopic parameters in both with and without fasting conditions. The authors commented that the dehydration during fasting is responsible for increased phonatory effort. The decrease in the MPD occurred as a result of decrease in the breath support and control, which is frequently seen in cases of vocal fatigue.

Hamdan, Ashkar, Sibai, Oubari and Husseini (2011) conducted a study on the effect of fasting on voice in males. 26 participants in the age range of 22 - 50 years were considered. They were tested in non-fasting, during fasting and after the first week of intermittent fasting. Initially the subjects were asked about their vocal symptoms and ease of phonation. The participants were evaluated on VISI Pitch & Video endostroboscopy. The results indicated that the vocal fatigue was not higher while fasting compared to no fasting. Most of the participants indicated an increased phonatory effort. A significant reduction in the habitual pitch, voice turbulence index, and noise-to-harmonic ratio was noted and there were no laryngeal videostroboscopic changes. The results revealed that fasting in males lead to an increased phonatory effort. The phonatory changes may be resultant of dehydration as well as overall neuro-muscular fatigability.

The above reviews suggest that dehydration is one among the major consequences of fasting. The changes in vocal characteristics noticed as a result of fasting were fatigue, reduced maximum phonation duration, increased phonatory effort. The study suggested that these symptoms are resultant of dehydration effect and had a negative consequence on vocal efficiency.

Most significantly of all, there is a lack of clarity in consequences of systemic dehydration brought about by fasting. Since there seemed to be fewer controversies throughout the literature, and due to the dearth of evidences in negative consequences of voice as a result of fasting this study would be directed towards enhancing knowledge about changes brought about if any in the acoustic, perceptual and aerodynamic parameters of voice. Also, there have been dearth of literature pertaining to the vocal consequences of fasting, especially in the Indian context. Hence, the present study looks ahead to boost the knowledge of the vocal parameters affected, if any, as a result of systemic dehydration brought about by fasting.

CHAPTER III

METHOD

The present study was undertaken to investigate the effect of systemic dehydration brought about by fasting on the vocal characteristics in normal adult individuals.

Participants

Twenty four participants, comprising twelve males and twelve females between twenty to thirty years of age were considered as the participants of the study. Participants undergoing absolute fasting (complete abstinence of food and liquid intake for a period of 12 – 13 hours) were considered for the study. The following subject selection criteria were used in order to select the participants.

Inclusion criteria:

- Participants (both males and females) fasting for a minimum of 12-13 hours
- No history of vocal abnormalities
- No history of speech, language or auditory pathology
- No history of respiratory disorders like asthma, bronchitis, pneumonia or allergic diseases
- No history of receiving any formal vocal or athletic training
- No history of any surgery or prolonged intake of medication
- No history of alcohol intake, smoking, exposure to chemical fumes or tobacco use
- Female subjects not having menstrual cycle during one week around the recording

Instruments/Materials:

- Digital voice recorder (Olympus Digital Voice Recorder WS-100) to record the voice samples.
- Multi-dimensional Voice Profile (MDVP) from Computer Speech Lab (CSL, 4500) to analyze the selected acoustic and aerodynamic parameters for phonation samples
- Maximum Phonation Duration (MPD) was obtained using a stop timer.
- CAPE-V scale for perceptual evaluation of the recordings

A questionnaire was prepared to select subjects based on the subject selection criteria, to gain information regarding voice usage, self-reported changes in with and without fasting conditions (See Appendix A)

Procedure

A written informed consent was obtained from each participants of the study. Questionnaire was administered on all participants individually and those fulfilling the criteria were selected for the study.

The samples of phonation, spontaneous speech and reading and MPD were recorded in 3 conditions namely, no fast condition, at 5-6 hours of fasting, and before they break fasting (12-13 hours of fasting) from all the participants.

The participants were made to sit in a comfortable position and the recording of samples was carried out using Olympus digital recorder placed at a distance of ten centimeters from the participant's mouth. The spontaneous speech and reading samples of 30 seconds duration each was recorded using the same digital recorder.

The MPD for vowel /a/ was obtained using a stop watch. The participants were instructed to sit comfortably and take a deep breath and then to sustain the vowel sound /a/ for as long as possible at a comfortable pitch and loudness on a single exhalation, without strain. The samples for MPD were recorded in 3 trials and the average of these 3 trials was considered for analysis.

The recorded samples in all the conditions were analyzed in terms of acoustical and perceptual parameters of voice. The acoustical analysis of phonation sample was done for selected acoustic parameters from MDVP such as average fundamental frequency (F0), jitter percent (Jitt), absolute jitter (Jita), variation of fundamental frequency (vF0), shimmer percent (shim), shimmer in dB (ShdB), amplitude and pitch perturbation quotients (APQ & PPQ), noise to harmonics ratio (NHR), and voice turbulence index (VTI). The perceptual evaluation was carried out using CAPE-V scale. Perceptual evaluation was done for phonation, speaking and reading samples The samples recorded were given for perceptual evaluation to 3 post graduate SLPs. 10% of the participants underwent repeated measures of the above for reliability assessment.

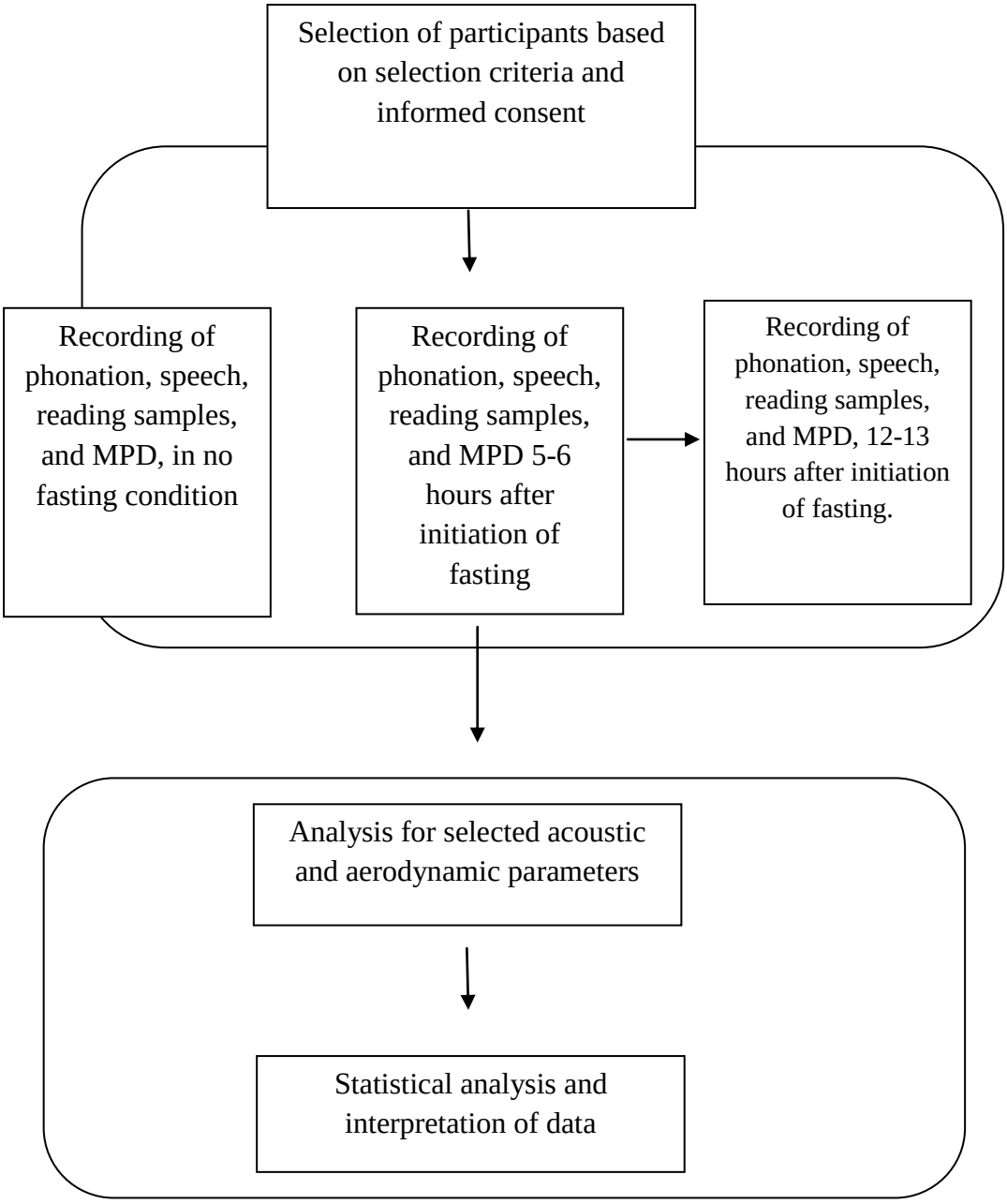

Figure 2- *Flow chart depicting the procedure involved in the current study*

Analyses

The measured acoustic aerodynamic parameters were analyzed and compared between the two conditions (with fast vs. without fast) across two durations namely, 5-6hr and 12-13 hr and between gender (male and female) for any differences.

Statistical analysis

- Descriptive statistical analysis was used to compute the mean and standard deviation of the acoustic and aerodynamic measures at with and without fasting condition in males and females across two different durations.
- Mixed ANOVA was used to examine the main effect and interaction effect among the variables- fasting, no fasting, duration and gender.
- MANOVA was used to determine the gender differences in the obtained parameters in both conditions across durations.
- Paired sample t test was estimated to make an independent comparison of the estimated parameters between fasting and no fasting condition across two different durations.
- Wilcoxon sign rank test was used to see the effect of change in duration in fasting condition.
- Kappa coefficient was computed to check the inter and intra judge reliability and Cronbach's Alpha was used to check the test –retest reliability.

CHAPTER IV

RESULTS & DISCUSSION

The present study investigated the effect of fasting on acoustic, perceptual and aerodynamic parameters of voice. A total of 24 participants (12 males and 12 females) within the age range of twenty to thirty served as the participants. The data obtained was subjected to statistical analysis using SPSS version 16.

The results of the present study are discussed under the following 3 headings:

1. Acoustic parameters: Acoustic parameters measured from /a/ phonation will be average fundamental frequency (f0), jitter percent (Jitt), absolute jitter (Jita), variation of fundamental frequency (vf0), shimmer percent (shim), shimmer in dB (ShdB), amplitude and pitch perturbation quotients (APQ & PPQ), noise to harmonics ratio (NHR), and voice turbulence index (VTI).
2. Aerodynamic parameters: The aerodynamic parameter, Maximum Phonation Duration (MPD) was analyzed.
3. Perceptual parameters: Perceptual evaluation was carried for phonation, speaking and reading sample using CAPE-V scale.

1. Acoustic parameters

1.1. Average Fundamental Frequency

It is the frequency at which maximum mode of vocal fold vibrations happens.

1.1.1. Comparison of average fundamental frequency (f0) between with and without fasting conditions in males and females across 2 durations

Table 1 shows the mean and SD of average fundamental frequencies values in with and without fasting in males and females across 2 durations.

Table 1*: Mean and SD of average f0 in males and females between two conditions*

Timings	Males				Females			
	With fast		Without fast		With fast		Without fast	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
After 5-6 hours	140.00	21.56	140.44	21.25	212.52	16.31	211.34	15.37
After 12-13 hours	130.68	19.08	140.19	21.13	211.55	15.93	210.59	15.27

SD: Standard Deviation

On comparing the average fundamental frequencies values between with and without fasting across different durations (5-6 hours and 12-13 hours), it was found that the average fundamental frequencies were reduced at 12-13 hours with fasting condition for males as compared to after 5 hours of fasting and without fasting condition.

Table 2 shows the Mixed ANOVA results of average fundamental frequency values for with and without fasting across 2 different durations in males and females.

Table 2*: Mixed ANOVA results of average f0 in males and females between two conditions*

Source	df	F	Sig
Condition	1	4.451	.046*
Condition X gender	1	10.666	.004*
Duration	1	8.631	.008
Duration X gender	1	4.181	.053
Condition X duration	1	5.263	.032
Condition X gender X duration	1	4.782	.040*

(* indicates statistical significance at 0.05 level)

Results of Mixed ANOVA showed a significant difference (main effect) for condition [$F(1, 22) = 4.451$, $p<0.05$], duration [$F(1, 22) = 8.631$, $p<0.05$]. Also, the test revealed an interaction effect for condition X gender [$F(1, 22) = 10.666$, $p<0.05$], condition X duration [$F(1, 22) = 5.263$, $p<0.05$] and condition X duration X gender [$F(1, 22) = 4.782$, $p<0.05$]. No interaction was seen for other variables.

The present study found that the average fundamental frequency was reduced in 12-13 hours of fasting condition, and it was noticed in males. The study interestingly found that there is a decrease in the average fundamental frequency with duration of fasting. The results of the present study add on a new finding to study by Hamdan et al (2007, 2011) study. The result point out that average fundamental frequency was reduced in 12 -13 hours fasting condition. From this result it could be inferred that dehydration for a prolonged period may be the factor for reduction in f0. During normal voice production the vocal folds vibrate smoothly, and these smooth movements are noticed when the vocal folds are in well lubricated condition. During this period the irregularities in the average f0

will be less. When there is inadequate lubrication of the vocal folds, it can result in an increase in mass of the vocal folds thus resulting in reduced vibratory pattern (Verdolini-Marston et al., 1990) and lowering of the fundamental frequencies. So from the results it could be inferred that the increased viscocity of vocal folds during the dehydrated condition (fasting) is responsible for such a finding.

1.1.2. Gender difference for average f0 in with and without fasting condition across different durations

Table 3 shows the MANOVA results of average fundamental frequency values for with and without fasting conditions across two different durations.

Results of MANOVA indicated a significant difference for average fundamental frequency measures between males and females in both with and without fasting conditions.

A difference exists for average fundamental frequency values at the durations, after 5-6hrs [F (1, 22) = 30165.185, $p < 0.05$] and 12-13hrs of [F (1, 22) = 29736.816, $p < .05$] in without fasting condition, and at 5-6hrs fasting [F (1, 22) = 31551.929, $p < 0.05$], 12 -13 hours [F (1, 22) = 29736.819, $p< 0.05$] in fasting condition

Table 3*: MANOVA results of Average Fundamental Frequency*

Source	Dependent Variable	df	F	Sig.

Gender	With fasting at 5-6 hrs	1	31551.92	.000*
	With fasting at 12-13 hrs	1	39239.82	.000*
	Without fasting at 5-6 hrs	1	30165.18	.000*
	Without fasting at 12-13 hrs	1	29736.81	.000*

(* indicates statistical significance at 0.05 level)

The present study showed significant difference in f0 between males and females in both conditions. From the results it could be inferred that in both the conditions, there is a significant gender difference. This may be attributed to the anatomical difference in the laryngeal makeup between the genders (Titze, 1988).

1.1.3. Comparison of average fundamental frequency measures for with fasting conditions across different duration in males and females

Tables 4 shows the repeated measures ANOVA results of average fundamental frequency for males and females respectively, across different durations in fasting conditions.

Table 4: *Repeated measures ANOVA results of average f0 for males and females in with fasting condition*

	Males	Females

Source	df	F	Sig.	df	F	Sig.
Condition	1	10.389	.008*	1	.140	.715
Condition X Gender	0			0		

(* indicates statistical significance at 0.05 level)

Repeated measures ANOVA results revealed that a significant difference exists in the average f0 values of males [F (1, 11) = 10.389, $p < 0.05$] across different duration in fasting condition.

1.1.4. Comparison of average f0 measures for without fasting condition across different duration in males and females

The repeated measures ANOVA results of average f0 for males and females respectively, across different duration in without fasting conditions revealed that no significant difference exists in the average f0 values of males and females across different duration in without fasting conditions.ie, [$p > .05$].

The results of the study suggest that a significant change in the average f0 was noticed in males during fasting condition. The results of the current study suggest that in the fasting condition, i.e., after 12-13 hours of fasting the average f0 was reduced in males. The reason attributed could be that the prolonged duration of reduced water intake can result in decreasing vibratory pattern adding viscosity to the vocal folds (Verdolini-Marston et al.,1990), thus resulting in a reduction in the average f0 in males.

1.1.5. Comparison of average f0 measures with and without fasting conditions at different timings using paired sample t test

Table 5: Results of Paired t-test for comparison of average f0

		Males			Females		
	Conditions	t	df	Sig	t	Df	Sig
Pair 1	f0 5-6 hrs fast – f0 12-13 hr fast	3.22	11	.008	.375	11	.715
Pair 2	f0 5-6 hrs without fast –f0 at 12-13 hr without fast	. 379	11	.712	1.887	11	.086
Pair 3	f0 at 5-6 hour fast – f0 at 5-6 hour without fast	-.726	11	.483	1.067	11	.309
Pair 4	f0 at 12-13 hour fast - average f0 at 12-13 hour without fast	-3.447	11	.005*	.397	11	.699

(* indicates statistical significance at 0.05 level)

Paired sample t test revealed a significant difference in the average f0 value of 12-13 hrs duration [$t = -3.447$, $p < 0.05$] between with and without fasting conditions. A significant difference was also noticed in the average f0 values between 5-6 hrs and 12-13 hrs durations in both conditions.

1.2. Variation in Fundamental Frequency

It is the relative long term standard deviation of f0 and reflects long term variation in f0.

1.2.1. Comparison of variation in f0 with and without fasting conditions in males and females across 2 timings

Table 6: Mean and SD of variation f0 in males and females between two conditions

Timings	Males				Females			
	With fast		Without fast		With fast		Without fast	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
After 5-6 hours	1.99	1.05	1.11	.04	1.69	1.14	1.14	.00
After 12-13 hours	2.35	1.22	1.13	.01	2.00	1.22	1.14	.00

SD: SD-Standard Deviation

Table 6 shows the mean and standard deviation of variation in f0 values in with and without fasting conditions in males and females across 2 durations.

On comparing the variation in f0 values with and without fasting across different durations, it was found that all the values were increasing in fasting conditions at 12- 13 hours, in both males and females as compared to 5-6 hours of fasting condition and without fasting conditions.

Table 7 shows the Mixed ANOVA results of variation in f0 for with and without fasting across 2 different timings in males and females.

Table 7: Mixed ANOVA results of variation in f0 in males and females between two conditions

Source	df	F	Sig.
Condition	1	14.349	.001*
Condition X gender	1	.536	.472
Duration	1	9.868	005*
Duration X gender	1	.073	.789
Condition X duration	1	8.829	.007*
Condition X duration X gender	1	.021	.887

(* indicates statistical significance at 0.05 level)

Results of mixed ANOVA indicated that there was a significant difference obtained for condition [$F(1, 22) = 14.349$, $p<0.05$], duration [$F(1, 22) = 9.868$, $p<0.05$], and an interaction effect noticed for condition and duration [$F(1, 22) = 8.829$, $p<0.05$], and no interaction was seen for other variables. The variations are noted across conditions, and with duration of fasting. This variation shows irregularities in vocal fold vibration. Drying of the vocal fold surface can be one of the reasons for these irregularities, which can occur due to many reasons including environmental and behavioural challenges associated with mouth breathing, exercising, and inhaling poorly conditioned air. The reason attributed for this is that because of the prolonged duration of reduced

water intake irregularities in the vibratory pattern of vocal cords may happen thus resulting in variations in the fundamental frequencies.

1.2.2. Gender difference for variation in f0 in with and without fasting condition across different timings

Results of MANOVA indicated that no significant difference exists for vf0 between males and females in both the conditions.

1.2.3. Comparison of variation in f0 variation measures for with fasting conditions across different duration in males and females

Tables 8 show the repeated measures ANOVA results of variation in f0 for males and females respectively, across different timings in fasting condition.

Table 8: Repeated measures ANOVA results of variation in f0 for males and females in with fasting condition

	Males			Females		
Source	df	F	Sig.	df	F	Sig.
Condition	1	8.258	.015*	1	3.006	.111
Condition X Gender	0			0		

(* indicates statistical significance at 0.05 level)

Repeated Measures ANOVA results revealed that a significant difference exists in the variation in f0 values of males across different timings in fasting conditions [$F(1, 11) = 8.258$, $P < 0.05$]. The results of the study suggest significant difference in variation of f0 in fasting condition in

males. So the results support the claim that dehydration/drying of vocal folds during fasting may be contributing to the variation in f0.

1.2.4. Comparison of average f0 for without fasting condition across different duration in males and females

Repeated measures ANOVA results revealed that there was no significant difference in the variation in f0 values of males and females across different durations in without fasting conditions.

1.2.5. Comparison of variation in f0 measures with and without fasting conditions at different duration using paired sample t test

Results of paired-t test revealed no significant differences ($p > .05$) among the pairs in with and without fasting conditions in both the gender groups.

1.3. Absolute Jitter

It is the measure of very short term irregularities of the pitch period in the voice sample.

1.3.1. Comparison of absolute jitter with and without fasting conditions in males and females across 2 timings

Table 9 shows the mean and standard deviation of absolute jitter values with and without fasting conditions in males and females across 2 timings.

Table 9: *Mean and SD of absolute jitter in males and females between two conditions*

Duration of fasting	Males				Females			
	With fast		Without fast		With fast		Without fast	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
After 5-6 hours	80.88	1.18	48.83	30.04	81.25	1.21	22.74	6.68
After 12-13 hours	115.81	15.42	81.44	.98	81.62	1.06	48.12	52.86

SD: Standard Deviation

The absolute jitter values were relatively less in without fasting conditions as compared to fasting conditions. In fasting condition (i.e., during 12-13 hours of fasting) an increase in the absolute jitter was noticed for males.

Table 10 shows the mixed ANOVA results of absolute jitter values with and without fasting across 2 different duration in males and females.

Results of mixed ANOVA indicates that there was a significant difference obtained for condition [$F(1, 22) = 4.481$, $p<0.05$], duration [$F(1, 22) = 8.236$, $p<0.05$] and interaction effect was noticed for condition X gender [$F(1, 22)= 4.959$, $p<0.05$], and condition X duration

[$F(1, 22) = 7.952$, $p<0.05$] and no interaction was seen for other variables.

The results found that the absolute jitter was increased in fasting condition, and it was significantly more with the increased duration of fasting and noticeably observed in males compared to females. The results of the study find agreement in the acoustic parameters studied by Yiu and Chan (2002). In their study they had found no significant change in any of the acoustic parameters for singers who were given voice rest and water during the singing tasks, but in the subjects who were not given voice rest

and water, a significant increase was noted in jitter. Yiu and Chan attributed it to the increased vocal fatigue. The current study supports Yiu and Chan findings, in such a way giving a positive result that in the hydrated condition (i.e., without fasting) the absolute jitter values were relatively less.

Table 10*: Mixed ANOVA results of absolute jitter in males and females between two conditions*

Source	df	F	Sig.
Condition	1	4.481	.046*
Condition X gender	1	4.956	.037*
Duration	1	8.236	.009*
Duration X gender	1	1.653	.212
Condition X duration	1	7.952	.010*
Condition X duration X gender	1	1.632	.215

(* indicates statistical significance at 0.05 level)

1.3.2. Gender difference for absolute jitter in with and without fasting condition across different timings.

Table 11 shows the MANOVA results of absolute jitter values for with and without fasting condition across two different timings.

Table 11: MANOVA results of absolute jitter

Gender	With fasting at 5-6hrs	1	8.620	.008*
	With fasting at 12-13hrs	1	3.411	.078
	Without fasting at 5-6 hrs	1	.563	.461
	Without fasting at 12-13hrs	1	.189	.668

(*indicates statistical significance at 0.05 level)

Results of MANOVA indicated that a significant difference exists for absolute jitter measures between males and females in 5-6 hours of fasting [F (1, 22) = 8.620, P < 0.05].

From this result it could be inferred that a significant difference in absolute jitter value was noticed during with fasting condition. The results suggests that even minimal amount of dehydration can cause irregularities in the pitch period. The results support the findings of Franca and Simpson (2009), whose results suggest that jitter values decreased significantly following rehydration. Hence, in without fasting condition sufficient hydration is taking place leading to lesser changes in the absolute jitter values. A significant change was also noticed in males as compared to females. This may be attributed to the anatomic differences in the laryngeal mechanism (Titze, 1988).

1.3.3. Comparison of absolute jitter measures for fasting conditions across different duration in males and females

Tables 12 show the repeated measures ANOVA results of absolute jitter for males and females respectively, across different timings in fasting conditions.

Table 12: *Repeated measures ANOVA results of absolute jitter for males and females in fasting conditions*

Source	Males			Females		
	df	F	Sig.	df	F	Sig.
Condition	1	5.394	.040*	1	2.900	.117*
Condition X Gender	0			0		

(*indicates statistical significance at 0.05 level)

Repeated measures ANOVA results revealed that a significant difference exists in the absolute jitter values of males and females across different duration in fasting conditions [F (1, 11) = 5.394,P < 0.05] for males and [F (1, 11) = 2.900, P < 0.05] females. This difference can be attributed to the increased vocal fatigue caused due to dehydration in the fasting period (Yiu & Chan, 2002). This resulted in changes in the absolute jitter.

1.3.4. Comparison of absolute jitter measures for without fasting condition across different duration in males and females

Repeated measures ANOVA results revealed that there was no significant difference in the absolute jitter values of males and females across different timings in without fasting conditions

1.3.5. Comparison of absolute jitter measures with and without fasting conditions at different timings using paired sample t test

Paired sample t-test results revealed a significant difference in the absolute jitter values between 5-6 hrs fast and 12-13 hrs fast [t=-2.332, P < 0.05], and between 12-13 hour fast and without fast [t=-2.218, P < 0.05], in females

Table 13: *Results of Paired t-test for comparison of absolute jitter measures between different conditions*

	Conditions	Males			Females		
		t	df	Sig	t	df	Sig
Pair 1	Abs jitt 5-6 hrs fast – abs jitt 12-13 hr fast	-2.332	11	.040*	-1.703	11	.117
Pair 2	Abs jitt 5-6 hrs without fast –abs jitt at 12-13 hr without fast	-2.226	11	.058	-3.019	11	.052
Pair 3	Abs jitt at 5-6 hour fast– abs jitt at 5-6 hour without fast	-3.668	11	.058	-3.019	11	.053
Pair 4	Abs jitt at 12-13 hour fast- abs jitt at 12-13 hour without fast	1.029	11	.325	-2.218	11	.049

(* indicates statistical significance at 0.05 level)

1.4. Jitter Percent

It measures very short term cycle to cycle irregularities in the pitch period of voice.

1.4.1. Comparison of jitter percent with and without fasting conditions in males and females across 2 durations

Table 14: Mean and SD of jitter percent in males and females between two conditions

Timings	Males				Females			
	With fast		Without fast		With fast		Without fast	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
After 5-6 hours	2.10	1.73	.90	.43	1.63	1.52	.83	.26
After 12-13 hours	3.12	1.44	.93	.41	2.42	1.39	.92	.54

SD: Standard Deviation

Table 14 shows the mean and SD of jitter percent values in with and without fasting conditions in males and females across 2 durations.

On comparing the jitter percent values in with and without fasting across different durations, it was found that the jitter percent values were within normal range, but the values were comparatively increased in fasting conditions as compared to without fasting condition in both males and females.

Table 15 shows the Mixed ANOVA results of jitter percent for with and without fasting across 2 different duration in males and females.

Results of mixed ANOVA indicates that there was a significant difference obtained for condition [$F(1, 22) = 26.303$, $p<0.05$], duration [$F(1, 22) = 16.796$, $p<0.05$], and an interaction effect for condition and duration [$F(1, 22) = 15.627$, $p<0.05$], and no interaction was seen for other variables.

Table 15*: Mixed ANOVA results of jitter percent in males and females between two conditions.*

Source	df	F	Sig.
Condition	1	26.303	.000*
Condition X gender	1	.960	.338
Duration	1	16.796	.000*
Duration X gender	1	.116	.736
Condition X duration	1	15.627	.001*
Condition X duration X gender	1	.473	.499

(* indicates statistical significance at 0.05 level)

From these results it could be inferred that a significant difference in jitter value is noticed during the fasting conditions. The values of jitter were more in 12- 13 hours fasting compared to 5-6 hours of fast and without fasting conditions. The results of the present study are consistent with Hamdan et al (2007) study findings wherein they found an increase in RAP measures during the fasting conditions but the values were not significant. In this study the jitter percent values were significant in the fasting condition. The results support the findings of Franca and Simpson (2009), who suggested that jitter value decreased significantly following rehydration. Hence, it could be concluded that in without fasting condition sufficient hydration is taking place leading to lesser changes in the jitter percent values.

1.4.2. Gender difference for jitter percent with and without fasting conditions across different timings

Results of MANOVA indicated no significant difference ($p > .05$) for jitter % measures between males and females in both without fasting and fasting conditions.

1.4.3. Comparison of jitter percent measures for fasting conditions across different duration in males and females

Tables 16 shows the repeated measures ANOVA results of jitter percent for males and females respectively, across different duration in fasting conditions

Table 16*: Repeated measures ANOVA results of jitter percent for males in with fasting conditions*

Source	Males			Females		
	df	F	Sig.	df	F	Sig.
Condition	1	6.900	.024*	1	13.992	.003*
Condition X Gender	0			0		

(* indicates statistical significance at 0.05 level)

Repeated measures ANOVA results revealed that a significant difference exists in the jitter values of both males and females across different durations in fasting conditions [$F(1, 11) = 6.900$, $P < 0.05$] and [$F(1, 11) = 13.922$, $P < 0.05$].

1.4.4. Comparison of jitter percent measures for without fasting condition across different timings in males and females

Repeated measures ANOVA results revealed that there was no significant difference in the absolute jitter values of males and females across different durations in without fasting conditions.

From the results it could be inferred that a significant change was noted in gender and the results also suggests that significant changes were noticed in the fasting conditions. The present study shows similar findings to that of Yiu and Chan (2002) study**,** in which when the subjects did not receive voice rest and water, a significant increase was noted in jitter. So, from their study and from the result of the present study it could be inferred that inadequate hydration results in an increase in the jitter value.

1.4.5. Comparison of jitter percent measures with and without fasting conditions at different timings using paired sample t test

Paired sample t-test results revealed a significant difference in the jitter %values between 5-6 hrs fast and 12-13 hours of fast in males [t = -2.627, $P < 0.05$], and females [t=-3.741, $P < 0.05$].

Table 17: *Results of Paired t-test for comparison of jitter percent measures between different fast conditions*

Conditions		Males			Females		
		t	df	Sig	T	df	Sig
Pair 1	Jitt% 5-6 hrs fast –	-2.627	11	.024	-3.741	11	.003*

	jitt% 12-13 hr fast						
Pair 2	Jitt% 5-6 hrs without fast – jitt% 12-13 hr without fast	-2.208	11	.059	-1.112	11	.099

* indicates statistical significance at 0.05 level)

1.5. Shimmer Percent

It is the measure of very short term variation of peak to peak amplitude within the analyzed voice sample.

1.5.1. Comparison of shimmer percent with and without fasting conditions in males and females across 2 timings

Table 18 shows the mean and SD of shimmer percent values with and without fasting conditions in males and females across 2 timings

On comparing the shimmer percent values with and without fasting across different timings, it was found that all the values were increasing in fasting conditions in the two duration in both males and females as compared to the without fasting conditions. The shimmer percent values were also high in 12-13 hours of fasting as compared to 5-6 hours of fasting.

Table 18 shows the Mixed ANOVA results of shimmer percent for with and without fasting across 2 different timings in males and females.

Table 18*: Mean and SD of shimmer percent in males and females between two conditions*

	Males	Females

Timings	With fast		Without fast		With fast		Without fast	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
After 5-6 hours	5.48	2.33	1.37	1.21	3.44	.81	1.30	.84
After 12-13 hours	7.74	3.72	1.69	1.12	4.18	1.54	1.84	.79

SD: SSSD: Standard Deviation

Table 19: Mixed ANOVA results of shimmer percent in males and females between two conditions

Source	df	F	Sig.
Condition	1	71.86	.000*
Condition X gender	1	10.814	.003*
Duration	1	11.020	.003*
Duration X gender	1	1.244	.277
Condition X duration	1	3.103	.092
Condition X duration X gender	1	2.036	.168

(* indicates statistical significance at 0.05 level)

Results of mixed ANOVA indicates that there was a significant difference obtained for condition [F (1, 22) = 71.86, $p<0.05$], duration [F (1, 22) = 11.020, $p<0.05$], and interaction effect was seen for condition and gender [F (1, 22) = 10.814, $p<0.05$], and no interaction was seen for other variables. The results of the present study revealed an increase in shimmer percent during fasting condition and with increasing duration in both

males and females. The findings of the present study are consistent with the results of the study by Rebecca et al (1988). They found out that shimmer percent values were increased in the dehydrated condition and it was decreased in the rehydrated condition. The results of the present study suggest that the increase in the shimmer percent values may be attributed to the decreased hydration level. The results of the present study also support findings by Franca et al (2012), who also found an increased shimmer during dehydration and decrease in shimmer percent following rehydration condition. In the rehydration condition it was assumed that restoration of fluid occurs resulting in vocal fold tissue moisturization. This will reduce the variability in vocal fold vibration thus resulting in a reduction in shimmer percent.

1.5.2. Gender difference for shimmer percent with and without fasting condition across different timings

Table 20 shows the MANOVA results of shimmer percent values with and without fasting conditions across two different timings.

Table 20: *MANOVA results of shimmer percent*

Source	Dependent Variable	df	F	Sig.
Gender	With 5-6 hrs fasting	1	8.136	.009*
	With 12-13 hrs fasting	1	9.334	.006*
	Without fasting at 5-6 hrs	1	.25	.0877
	Without fasting at 12-13 hrs	1	.147	.705

(*indicates statistical significance at 0.05 level)

Results of MANOVA indicated that there was significant difference for shimmer % measures between males and females in fasting condition [F (1, 22) = 8.136, p<0.05], [F (1, 22) = 9.334, p<0.05] compared to without fasting condition. The results were consistent with the findings of Franca et al (2012) and Rebecca et al (1998). The gender difference noticed may be as a result of the variability in laryngeal structures in males and females (Titze, 1988).

1.5.3. Comparison of variation in shimmer percent measures for with fasting conditions across different duration in males and females

Repeated measures ANOVA results revealed that there was no significant difference i.e., p > .05 in the variation in shimmer percent values of males and females across different duration in with fasting conditions.

1.54. Comparison of shimmer percent for without fasting condition across different timings in males and females

Repeated measures ANOVA results revealed that there was no significant difference in the shimmer percent values i.e., p >.05 of males and females across different duration in without fasting conditions.

1.5.5. Comparison of shimmer percent measures at with and without fasting conditions at different duration using paired sample t test

Table 21*: Results of Paired t-test for comparison of shimmer percent measures between different conditions*

Pairs	Conditions	Males			Females		
		t	df	Sig	T	df	Sig
Pair 1	Sh% 5-6 hrs fast – sh% 12-13 hr fast	-2.09	11	.060	-1.618	11	.134
Pair 2	Sh% 5-6 hrs without fast – sh% 12-13 hr without fast	-2.134	11	.056	-3.477	11	.006
Pair 3	Sh% 5-6hour fast – sh% 5-6 hour without fast	5.729	11	.000*	7.344	11	.000*
Pair 4	Sh% 12-13 hour fast - sh% 12-13hour without fast	5.062	11	.000*	5.176	11	.000*

(*indicates statistical significance at 0.05 level)

Paired sample t-test results revealed a significant difference in the shimmer percent values between 5-6 hours of fast and 5-6 hours of without fast [t = 5.729, P < 0.05], in males, and females [t = 7.344, P < 0.05], and between 12-13 hour fast and without fast [t = 5.062, P < 0.05] in males and[t= 5.716, P < 0.05] in females.

1.6. Shimmer in dB

It is the short term variability of peak to peak amplitude within the analysed sample.

1.6.1. Comparison of shimmer in dB with and without fasting conditions in males and females across 2 duration

Table 22 shows the mean and standard deviation of shimmer in dB values at with and without fasting conditions in males and females across 2 duration.

Table 22: Mean and SD of shimmer in dB in males and females between two conditions

Timings	Males				Females			
	With fast		Without fast		With fast		Without fast	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
After 5-6 hours	.59	.25	.17	.18	.46	.39	.30	.12
After 12-13 hours	.70	.38	.22	.20	.5	.40	.30	.15

SD: Standard Deviation

The results of the present study revealed an increase in shimmer in dB during fasting conditions and with increasing duration of fasting in both males and females. The findings of the present study are consistent with the results of Rebecca et al (1998). They found the shimmer values were increased in the dehydrated condition and decreased in the rehydrated condition. The results of the present study suggest that the increase in the shimmer values may be attributed to the decreased hydration level. The results of the present study also support Franca et al (2012), who also found out an increased shimmer during dehydration and decrease in shimmer following rehydration condition. In the rehydration condition it was assumed that restoration of fluid occurs thus resulting in vocal fold tissue moisturization. This will reduce the increased variability in vocal fold vibration thus resulting in a reduction in shimmer percent.

Table 23 shows the Mixed ANOVA results of shimmer in dB for with and without fasting across2 different duration in males and females.

Table 23: Mixed ANOVA results of shimmer in dB in males and females between two conditions

Source	df	F	Sig.
Condition	1	21.630	.000*
Condition X gender	1	3.604	.071
Duration	1	4.324	.049*
Duration X gender	1	.788	.384
Condition X duration	1	.030	.157
Condition X duration X gender	1	.010	.923

(* indicates statistical significance at 0.05 level)

Results of mixed ANOVA indicates that there was a significant difference obtained for condition [F (1, 22) = 21.630, $p<0.05$], and duration [F (1, 22) = 4.324, $p<0.05$], and no interaction was seen for other variables. Results suggest that during fasting and with changing timings, a significant change was noticed in the shimmer values. The difference was noticed across gender which may be attributed to the changes in the laryngeal structures of both male and females (Titze, 1998).

1.6.2. Gender difference for shimmer in dB in with and without fasting condition across different duration

Results of MANOVA indicated that there was no significant difference p> .05 for shimmer in dB between males and females in both with and without fasting.

1.6.3. Comparison of shimmer in dB measures for with fasting conditions across different duration in males and females

Repeated measures ANOVA results revealed that there was no significant difference (p > .05), in the shimmer in dB measures of males and females across different timings in with fasting conditions.

1.6.4. Comparison of shimmer in dB for without fasting condition across different timings in males and females

Repeated measures ANOVA results revealed that there was no significant difference (p > .05), in the shimmer in dB of males and females across different durations in without fasting conditions.

1.6.5. Comparison of shimmer in dB measures at with and without fasting conditions at different durations using paired sample t test

Table 24: *Results of Paired t-test for comparison of shimmer in db measures between different conditions*

Conditions	Males	Females

		t	df	Sig	t	Df	Sig
Pair 1	Sh dB 5-6 hrs fast – Sh dB 12-13 hr fast	-1.894	11	.085	-1.833	11	.068
Pair 2	Sh dB 5-6 hrs without fast – sh dB 12-13 hr without fast	-8.56	11	.810	.088	11	.093
Pair 3	Sh dB 5-6 hour fast – sh dB 5-6 hour without fast	4.277	11	.001*	1.488	11	.165
Pair 4	ShdB 12-13 hour fast - sh dB 12-13hour without fast	4.788	11	.001*	2.068	11	.063

(* indicates level of significance)

Paired sample t-test results revealed a significant difference in the shimmer in dB values between 5 hours fast and 5 hours of without fast

[$t = 4.277$, $P < 0.05$], in males and 12 hours of fast and without fast in males [$t = 4.788$, $P < 0.05$].

1.7. Amplitude Perturbation Quotient (APQ)

It is the relative evaluation of period to period variation of peak to peak amplitude within the analyzed sample with a smoothing of 11 periods

1.7.1. Comparison of APQ with and without fasting conditions in males and females across 2 durations

Table 25 shows the mean and SD of APQ values with and without fasting conditions in males and females across 2 durations.

Table 25: *Mean and SD of APQ in males and females between two conditions*

	Males	Females

Timings	With fast		Without fast		With fast		Without fast	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
After 5-6 hours	5.14	1.69	2.64	.83	3.28	.79	2.84	.61
After 12-13 hours	6.31	2.82	2.79	.83	3.45	.99	2.69	.72

SD: Standard Deviation

On comparing the APQ values with and without fasting across different timings, it was found that all the values were increasing in fasting conditions at the two durations in both males and females as compared to the without fasting conditions. The APQ values were also high in 12-13 hours of fasting as compared to 5-6 hours of fasting.

Table 26 shows the mixed ANOVA results of APQ for with and without fasting across2 different timings in males and females.

Table 26: Mixed ANOVA results of APQ in males and females between two conditions

Source	df	F	Sig.
Condition	1	27.469	.000*
Condition X gender	1	12.243	.002*
Duration	1	3.807	.064
Duration X gender	1	3.557	.073
Condition X duration	1	3.505	.075
Condition X duration X gender	1	1.018	.324

(* indicates statistical significance at 0.05 level)

Results of Mixed ANOVA indicates that there was a significant difference obtained for condition [F (1, 22) =27.469, p<0.05], an interaction was seen for condition X gender [F (1, 22) =12.243, p<0.05], and no interaction was seen for other variables. The results of the present study suggests that there is a change in APQ in with fasting and without fasting conditions, these changes may be as a result of the dehydration caused during the time of fasting, in without fasting condition the APQ values are within normal range, thus it could be concluded that dehydration during fasting may be one among the reasons for this change in APQ measures.

1.7.2. Gender difference for APQ in with and without fasting condition across different duration

Table 27 shows the MANOVA results of APQ for with and without fasting condition across two different timings.

Table 27: MANOVA results for APQ

Source	Dependent Variable	df	F	Sig.
Gender	With fasting at 5-6 hrs	1	11.768	.002*
	With fasting at 12-13 hrs	1	10.972	.003*
	Without fasting at 5-6 hrs	1	.444	.512
	Without fasting at 12-13 hrs	1	.086	.773

(* indicates level of significance)

Results of MANOVA indicated that there was a significant difference between males and females in both fasting conditions [F(1,22)=11.768, p<0.05],[F(1,22)=10.972, p<0.05]. The differences in males and females

can be attributed to the anatomical differences seen between genders (Titze, 1998).The changes in APQ measures are most evident in fasting condition, so the changes in APQ measures may be attributed to dehydration caused during the time of fasting, thus it could be concluded that dehydration during fasting may be one among the reasons for this change in APQ measures.

1.7.3. Comparison of APQ measures for with fasting conditions across different duration in males and females.

Repeated Measures ANOVA results revealed that there was no significant difference in the APQ measures of males and females across different duration in with fasting conditions.

1.7.4. Comparison of APQ for without fasting condition across different duration in males and females

Repeated Measures ANOVA results revealed that there was no significant difference in the APQ values of males and females across different duration in without fasting conditions.

1.7.5. Comparison of APQ measures at with and without fasting conditions at different timings using paired sample t test

Table 28: Results of Paired t-test for comparison of APQ measures between different conditions

Conditions		Males			Females		
		t	df	Sig	t	df	Sig
Pair 1	APQ5-6 hrs fast – APQ 12-	-1.789	11	.101	-8.46	11	.415

	13 hr fast						
Pair 2	APQ 5-6 hrs without fast – APQ at 12-13 hr without fast	-2.872	11	.055	1.020	11	.330
Pair 3	APQ at 5-6 hour fast – APQ 5-6 hour without fast	4.937	11	.000*	1.578	11	.143
Pair 4	APQ at 12-13 hour fast- APQ at 12-13 hour without fast	4.173	11	.002*	1.931	11	.080

(* indicates statistically significant at .005 level)

Paired sample t-test results revealed a significant difference in the APQ between 5 hours fast and5hours of without fast [t = 4.937, P < 0.05], in males and 12hours of fast and without fast in males [t= 4.173, P < 0.05].

1.8. Pitch Perturbation Quotient (PPQ)

It is the relative evaluation of the period to period variability of pitch within the analyzed voice sample with a smoothing factor of 5 period. Normal value is .84%

1.8.1. Comparison of PPQ between with and without fasting conditions in males and females across 2 durations

Table 29 shows the mean and standard deviation of PPQ values at with and without fasting conditions in males and females across 2 durations.

Table 29*: Mean and SD of PPQ in males and females between two conditions*

	Males				Females			
Timings	With fast		Without fast		With fast		Without fast	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
After 5-6 hours	.38	.24	.64	.59	.28	.08	.38	.23
After 12-13 hours	.90	.90	1.1	.74	.60	.67	.84	.93

SD: Standard Deviation

On comparing the PPQ values with and without fasting across different durations, it was found that all the values were within normal limits with not much variations seen in fasting condition at the two durations in both males and females as compared to the without fasting conditions.

Table 30 shows mixed ANOVA results of PPQ with and without fasting across 2 different durations in males and females.

Table 30: Mixed ANOVA results of PPQ in males and females between two conditions

Source	df	F	Sig.
Condition	1	2.802	.165
Condition X gender	1	.095	.760
Duration	1	16.364	.001*
Duration X gender	1	.317	.579
Condition X duration	1	.118	.734
Condition X duration X gender	1	.152	.700

(* indicates statistical significance at 0.05 level)

Results of mixed ANOVA indicates a significant difference for duration

[$F(1, 22) = 16.364$, $p<0.05$], and no interaction was seen for other variables. The results suggest that with the duration of fasting there could be changes in the PPQ measures. This change may be because of inadequate amount of hydration during the fasting period. So, it could be concluded that the difference in PPQ measures with duration of fasting may be because of dehydration effect.

1.8.2. Gender difference for PPQ with and without fasting condition across different duration

Table 30 shows the MANOVA results of PPQ for with and without fasting conditions across two different timings.

Table 31: MANOVA results for PPQ

Source	Dependent Variable	df	F	Sig.
Gender	With 5-6 hrs fasting	1	1.757	.199
	With 12-13 hrs fasting	1	.820	.375
	5-6 hrs without fasting	1	2.005	.171
	12-13 hrs without fasting	1	.842	.369

(*indicates statistical significance at 0.05 level)

Results of MANOVA indicated that there was no significant difference for PPQ measures between males and females, in both fasting and without fasting.

1.8.3. Comparison of PPQ measures for fasting conditions across different durations in males and females

Table 32 shows the results of repeated measures ANOVA PPQ for males and females respectively, across different durations of fasting conditions.

Repeated measures ANOVA results revealed that there was a significant difference in the PPQ measures [$F(1, 11) = 5.598$, $p<0.05$], of males across different durations in fasting conditions.

Table 32: Repeated measures ANOVA results of PPQ for males in with fasting condition

Source	Males			Females		
	Df	F	Sig.	df	F	Sig.
Condition	1	5.598	.037*	1	2.983	.112
Condition X Gender	0			0		

(* indicates statistical significance at 0.05 level)

The results revealed that with the duration of fasting there could be changes in the PPQ measures. This change may be because of inadequate amount of hydration during the fasting period. So, it could be concluded that the difference in PPQ measures with duration of fasting is because of dehydration effect.

1.8.4. Comparison of PPQ for without fasting condition across different durations in males and females

Repeated measures ANOVA results revealed that there was no significant difference in the PPQ values of males and females across different durations in without fasting conditions.

1.8.5. Comparison of PPQ measures with and without fasting conditions at different durations using paired sample t test

Paired sample t-test results revealed no significant difference in any of the PPQ between durations in both males and females.

Table 33: *Results of Paired t-test for comparison of PPQ measures between different conditions*

	Conditions	Males			Females		
		t	df	Sig	T	Df	Sig
Pair 1	PPQ 5-6 hrs fast – PPQ 12-13 hr fast	-2.366	11	.067	-8.46	11	.415
Pair 2	PPQ 5-6 hrs without fast – PPQ 12-13 hr without fast	-3.005	11	.012	1.020	11	.330
Pair 3	PPQ 5-6 hour fast – PPQ 5-6 hour without fast	-1.365	11	.202	1478	11	.163
Pair 4	PPQ 12-13 hour fast - PPQ 12-13 hour without fast	-.791	11	.446	1.431	11	.070

1.9. Noise to Harmonic Ratio

It is the average ratio of inharmonic energy to harmonic energy.

1.9.1. Comparison of NHR with and without fasting conditions in males and females across 2 durations

Table 34 shows the mean and SD of NHR values for with and without fasting conditions in males and females across 2 durations.

Table 34: Mean and SD of NHR in males and females between two conditions

Timings	Males				Females			
	With fast		Without fast		With fast		Without fast	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
After 5-6 hours	.18	.077	.11	.057	.12	.016	.16	.02
After 12-13 hours	.21	.060	.13	.052	.13	.02	.16	.02

SD: Standard Deviation

On comparing the Noise to Harmonic Ratio values with and without fasting across different durations, it is found that the NHR values were

increased at 12-13 hours in fasting condition for males as compared to 5 hours after fasting and without fasting conditions.

Table 35 shows the mixed ANOVA results of NHR for with and without fasting across 2 different durations in males and females.

Table 35: Mixed ANOVA results of NHR in males and females between two conditions

Source	df	F	Sig.
Condition	1	3.022	.096
Condition X gender	1	17.901	.000*
Duration	1	10.925	.003*
Duration X gender	1	.054	.818
Condition X duration	1	.118	.734
Condition X duration X gender	1	.046	.832

(* indicates statistical significance at 0.05 level

Results of mixed ANOVA indicates that there was an interaction effect obtained for condition and gender [F (1, 22) = 17.901, $p<0.05$], and significant difference was noticed for duration [F(1, 22) = 10.925, $p<0.05$], no interaction was seen for other variables. The results of the present study revealed that significant difference in NHR values were noted with increased duration of fasting. The differences in NHR values were also seen in study by Hamdan et al (2011), but it was not significant. In this study a significant increase in NHR values were obtained in the fasting condition, suggesting dehydration during the fasting may be the cause of such a change. The results also confirm with Rebecca et al (1998) study, wherein the results found a decrease in NHR values following rehydration.

1.9.2. Gender difference for NHR with and without fasting conditions across different durations

Table 36 shows the MANOVA results of NHR for with and without fasting conditions across two different durations.

Table 36: MANOVA results for NHR

Source	Dependent Variable	df	F	Sig.
Gender	With 5-6 hrs fasting	1	6.558	.018*
	With 12-13 hrs fasting	1	21.513	.000*
	5-6 hrs without fasting	1	7.264	.013*
	12-13 hrs without fasting	1	2.190	.153

(*indicates statistical significance at 0.05 level)

Results of MANOVA indicated that there was a significant difference for NHR measures between males and females in 5-6 hrs of without fasting

[F (1, 22) = 7.264, $p<0.05$], and at 5- 6 hrs fasting [F (1,22) = 6.558, $p<0.05$], and 12-13 hrs [F(1,22) = 21.513, $p<0.05$] of fasting condition. The differences can be attributed to the anatomical differences in the laryngeal structure (Titze, 1998).

1.9.3. Comparison of NHR measures for with fasting conditions across different timings in males and females.

Tables 37 show the repeated measures ANOVA results of NHR for males and females respectively, across different durations with fasting condition.

Table 37: Repeated measures ANOVA results of NHR for males and females in fasting condition

Source	Males			Females		
	df	F	Sig.	df	F	Sig.
Condition	1	4.860	.050*	1	.183	.677
Condition X Gender	0			0		

(* indicates statistical significance at 0.05 level)

Repeated Measures ANOVA results revealed that there was a significant difference in the NHR measures [F (1,11) = 4.860, $p<0.05$], of males across different durations in with fasting conditions.

1.9.4. Comparison of NHR for without fasting condition across different duration in males and females

Tables 38 show the repeated measures ANOVA results of NHR for males and females respectively, across different durations in without fasting conditions.

Table 38: Repeated measures ANOVA results of NHR for males in without fasting condition

Conditions	Males			Females		
	df	F	Sig.	df	F	Sig.
Condition	1	.718	.021*	1	4.211	.065
Condition X Gender	0			0		

(* indicates statistical significance at 0.05 level)

Repeated measures ANOVA results revealed that there was a significant difference in the NHR values [F (1, 11) = .718, P < 0.05] of males across different duration in without fasting conditions. No significant difference in the NHR values of females across different timings in without fasting conditions.

1.9.5. Comparison of NHR measures with and without fasting conditions at different durations using paired sample t test

Paired sample t-test results revealed a significant difference in the NHR between 5 hours fast and 5 hours without fast [t = 2.771, P < 0.05], in males.

Table 39: Results of Paired t-test for comparison of NHR measures between different conditions

	Conditions	Males			Females		
		t	df	Sig	t	df	Sig
Pair 1	NHR 5-6 hrs fast – NHR 12-13 hr fast	-2.204	11	.051	-4.28	11	.677
Pair 2	NHR 5-6 hrs without fast – NHR at 12-13 hr without fast	-2.67	11	.061	-2.50	11	.065

Pair 3	NHR 5-6 hour fast– NHR 5-6 hour without fast	2.771	11	.018	3.684	11	.004
Pair 4	NHR 12-13 hour fast- NHR 12-13 hour without fast	3.263	11	.08	-3.307	11	.071

1.10. Voice Turbulence Index

It is the average ratio of spectral harmonic high frequency energy to spectral harmonic low frequency energy.

1.10.1. Comparison of VTI with and without fasting conditions in males and females across 2 durations

Table 40 shows the mean and standard deviation of VTI values in with and without fasting conditions in males and females across 2 timings.

Table 40: Mean and SD of VTI in males and females between two conditions

Timings	Males				Females			
	With fast		Without fast		With fast		Without fast	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
After 5-6 hours	.03	.01	.06	.01	.04	.01	.08	.04
After 12-13 hours	.03	.01	.07	.01	.04	.01	.07	.04

SD: Standard Deviation

On comparing the Voice Turbulence Index values with and without fasting across all different durations, it was found that the VTI values were within normal limits in all the conditions in both males and females.

Table 41 shows the mixed ANOVA results of VTI for with and without fasting across 2 different durations in males and females.

Results of mixed ANOVA indicates a significant difference obtained for condition [F (1, 22) = 30.238, $p<0.05$]. An interaction effect was noticed for condition and duration [F (1, 22) = 5.758, $p<0.05$] and also for condition, duration and gender [F (1, 22) = 5.336, $p<0.05$], and no interaction was seen for other variables.

Table 41: Mixed ANOVA results of VTI in males and females between two conditions

Source	df	F	Sig.
Condition	1	30.238	.000*
Condition X gender	1	.055	.816
Duration	1	1.036	.320

Duration X gender	1	3.506	.075
Condition X duration	1	5.758	.025*
Condition X duration X gender	1	5.336	.031*

(* indicates statistical significance at 0.05 level)

The results suggest changes in VTI measures with and without fasting conditions, and it was noticed between males and females and for different durations. The results of the present study support findings of Hamdan et al (2011) wherein he found out a decrease in VTI measures following fasting. The results can be attributed to the fact that dehydration during the fasting period was resulting in changes in VTI measures. The study also supports Rebecca et al (1998) wherein they found a decrease in VTI measures following rehydration.

1.10.2. Gender difference for VTI in with and without fasting condition across different durations

Table 42 shows the MANOVA results of NHR for with and without fasting condition across two different timings.

Results of MANOVA indicated that there was a no significant difference between males and females for VTI measures in the both fasting conditions and without fasting.

Table 42: MANOVA results for VTI

Source	Dependent Variable	Df	F	Sig.
Gender	With 5-6 hrs fasting	1	2.825	.107

	With 12-13 hrs fasting	1	3.457	.076
	5-6 hrs without fasting	1	2.503	.128
	12-13hrs without fasting	1	.087	.771

1.10.3. Comparison of VTI measures for fasting conditions across different durations in males and females

Repeated measures ANOVA results revealed that there was no significant difference in the VTI measures of males and females across different durations in fasting conditions in both males and females.

1.10.4. Comparison of VTI for without fasting condition across different duration

Repeated measures ANOVA results revealed no significant difference in the VTI values of males and females across different durations in without fasting conditions.

1.10.5. Comparison of VTI measures with and without fasting at different durations using paired sample t test

Paired sample t-test results revealed a significant difference in the VTI values between 5 hours fast and 5 hours of without fast [$t = 4.937$, $P < 0.05$], in males and 12 hours of fast and without fast in males [$t= 4.173$, $P < 0.05$].

Table 43: Results of Paired t-test for comparison of VTI measures between different conditions

Conditions		Males			Females		
		t	Df	Sig	t	Df	Sig
Pair 1	VTI 5-6 hrs fast – VTI 12-13 hr fast	.737	11	.477	-.661	11	.522
Pair 2	VTI 5-6 hrs without fast – VTI 12-13 hr without fast	-2.872	11	.061	.568	11	.582
Pair 3	VTI 5-6 hour fast – VTI 5-6 hour without fast	-5.168	11	.000*	-3.279	11	.007
Pair 4	VTI 12-13 hr fast - VTI 12-13 hour without fast	-6.915	11	.000*	-2.815	11	.080

2. Aerodynamic Measures

2.1 Maximum Phonation Duration

It is the maximum time for which a person can sustain a vowel sound when produced after a deep breath at his comfortable pitch and loudness.

2.1.1. Comparison of MPD with and without fasting in males and females across 2 timings

Table 44 shows the mean and SD of MPD values with and without fasting conditions in males and females across 2 durations.

Table 44: Mean and SD of MPD in males and females between two conditions

Timings	Males		Females	
	With fast	Without fast	With fast	Without fast

	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
After 5-6 hours	12.2	2.09	16.50	2.46	9.58	1.37	13.5	1.62
After 12-13 hours	9.16	1.74	16.3	2.14	8.0	1.12	13.0	1.65

SD: Standard Deviation

On comparing the MPD values with and without fasting across two durations, it was found that the MPD was reduced at 12-13 hours fasting condition for males and females as compared to the after 5 hours of fasting and the without fasting conditions.

Table 45 shows the mixed ANOVA results of MPD with and without fasting across 2 different durations in males and females.

Results of Mixed ANOVA indicates that there was a significant difference obtained for condition [$F(1, 22) = 170.63$, $p<0.05$], duration [$F(1, 22) = 120.47$, $p<0.05$], and a main interaction effect is seen for duration X gender [$F(1,22) = 5.765$, $p<0.05$], condition X duration [$F(1, 22) = 25.809$, $p<0.05$] and also for condition X duration X gender [$F(1,22) = 5.336$, $p<0.05$], and no interaction was seen for other variables.

Table 45: Mixed ANOVA results of MPD in males and females between two conditions

Source	df	F	Sig.
Condition	1	170.63	.000*
Condition X gender	1	2.579	.123
Duration	1	120.471	.000*

Duration X gender	1	5.765	.025*
Condition X duration	1	25.809	.000*
Condition X duration X gender	1	5.422	.029*

(* indicates statistical significance at 0.05 level)

The results of the present study revealed a decrease in MPD with the duration of fasting and it was seen in both the genders. This decrease in MPD could be explained on the basis of decrease in the breath support and breath control noticed in the cases of vocal fatigue. During dehydrated state individual may exhibit fatigue when spoken for a long period which may be the reason for the decreased breath support leading to a decrease in MPD. The findings of the present study support the findings of Hamdan et al (2007).

2.1.2. Gender difference for MPD in with and without fasting condition across different durations

Table 46 shows the MANOVA results of MPD for with and without fasting condition across two different timings.

Results of Mixed A NOVA indicates that there was a significant difference obtained for condition [$F(1,22) = 170.63$, $p<0.05$], duration [$F(1,22) = 120.47$, $p<0.05$], and a main interaction effect is seen for duration X gender [$F(1,22)=5.765$, $p<0.05$], condition X duration [$F(1,22)=25.809$, $p<0.05$] and also for condition X duration X gender [$F(1,22) = 5.336$, $p<0.05$], and no interaction was seen for other variables.

Table 46: Results of MANOVA for MPD

Source	Dependent Variable	df	F	Sig.
Gender	With 5-6 hrs fasting	1	13.571	.001*
	With 12-13 hrs fasting	1	12.375	.002*
	5-6 hrs without fasting	1	3.769	.065
	12-13 hrs without fasting	1	18.182	.000*

(*indicates statistical significance at 0.05 level)

The results of the present study revealed a decrease in MPD with the duration of fasting and it was seen in both the genders. This decrease in MPD could be explained on the basis of decrease in the breath support and breath control. Vocal tasks require sufficient breath support. The effort during breathing increases with increased respiratory (inspiratory and expiratory) muscle loading thus leading to increased effort during breathing. So the effect of fasting on respiration will be transmitted to phonation. The findings of the present study support the findings of Hamdan et al (2007).

2.1.3. Comparison of MPD measures for fasting conditions across different durations **in males and females**

Tables 47 show the repeated measures ANOVA results of MPD for males and females respectively, across different durations in fasting conditions.

Table 47: Repeated measures ANOVA results of MPD for males and females in fasting conditions

Source	Males			Females		
	df	F	Sig.	df	F	Sig.
Condition	1	46.622	.000*	1	37.112	.000
Condition X Gender	0			0		

(* indicates statistical significance at 0.05 level)

Repeated measures ANOVA results revealed that there was a significant difference in the MPD measures [F (1, 11) = 46.622, P < 0.05] of males and [F (1, 11) = 37.112, P < 0.05] females across different durations in fasting conditions.

2.1.4. Comparison of MPD for without fasting condition across different durations in males and females

Repeated measures ANOVA results revealed that there was no significant difference in the MPD values of males and females across different durations in without fasting conditions.

2.4.5. Comparison of MPD measures with and without fasting conditions at different durations using paired sample t test

Table 48: Results of Paired t-test for comparison of MPD measures between different conditions

	Conditions	Males			Females		
		t	df	Sig	t	df	Sig
Pair 1	MPD 5-6 hrs fast – MPD 12-13 hrs fast	-1.789	11	.101	-.846	11	.415
Pair 2	MPD 5-6 hrs without fast – MPD 12-13 hrs without fast	-2.872	11	.055	1.020	11	.330

Pair 3	MPD 5-6 hour fast – MPD 5-6 hour without fast	4.937	11	.000*	1.578	11	.143
Pair 4	MPD at12-13hour fast- MPD 12-13 hour without fast	4.173	11	.002*	1.931	11	.080

(* indicates statistical significance at 0.05 level)

Paired sample t-test results revealed a significant difference in the MPD values between 5 hours fast and 5 hours without fast [$t = 4.937$, $P < 0.05$], in males and 12 hours fast and without fast in males [$t= 4.173$, $P < 0.05$].

3. Perceptual evaluation

The perceptual evaluation was carried out using CAPE-V (ASHA, 2002) which assesses 6 voice parameters namely overall severity, roughness, breathiness, strain, pitch and loudness. It displays each attribute in a 100 millimeter line forming a visual analog scale where the rater can judge the perceived deviance from normal for each parameter. 3 Speech Language Pathologists were considered as judges for the study. The samples were randomized and played through a compact disc and they were asked to rate samples based on CAPE-V rating scale. The analysis sheets were given to judges for perceptual evaluation. The obtained data were tabulated in the SPSS software.

Kappa coefficient was computed to obtain reliability between and within judges. Cronbach's alpha coefficient was computed to obtain the test – retest reliability. The judges had to listen to the phonation, reading and speaking samples and judge each of the 6 parameters.

The perceptual evaluation results revealed that a mild deviance was noticed in the voice parameters like breathiness, pitch and loudness yielding the overall severity to be mild in 5-6 hours of fasting. This was noticed in 70% of the participants. During 12-13 hours of fasting most of the subjects exhibited either a mild or moderate deviance in the voice parameters. 45% of the subjects exhibited (6 of the males and 5 of the females) exhibited a moderate deviance in the voice. Most of them exhibited a breathy quality, strain, and they were less efficient in changing their pitch and loudness during 12-13 hours of fasting. 54% (6 males and 7 females) exhibited a mild deviancy in voice quality. Self-reported complaints were dryness, throat clearing sensation and vocal fatigue. These were more evident in 12- 13 hours of fasting, and were found in both males and females. In no fasting condition the subjects did not show any change in their voice quality and it was perceptually rated as normal voice quality by the 3 judges.

For the intra judge reliability check, the entire samples were rated perceptually for the second time by the judges after a minimum gap of 15 days. The measure of agreement between the 3 judges for intra and inter judge reliability was calculated by using kappa coefficients.

Table 49: *Inter Judge Reliability for fasting*

Parameters	J1 & J2	J2 & J3	J3 & J1	J1 & j2	J2 & J3	J1 & J3
	Kappa (5 hr-6 hr)	Kappa (5 hr-6 hr)	Kappa (5 hr-6 hr)	Kappa (12-13 hr)	Kappa (12-13 hr)	Kappa (12-13 hr)
OS	.903	.798	.710	.750	.750	.664
R	1	1	1	1	1	1
B	.750	1	.750	.750	.750	.822

S	1	.653	1	.913	.833	.746
P	.812	.812	.625	.727	.793	.829
L	1	.882	.882	.750	.714	.700

OS: Overall severity R: Roughness B: Breathiness S:Strain P:Pitch L: Loudness

Table 50: *Inter Judge Reliability for no fast*

Parameters	J1 & J2 Kappa (no fast)	J2 & J3 Kappa (no fast)	J3 & J1 Kappa (no fast)
OS	.76	.78	.81
R	.67	.69	1
B	.77	1	.73
S	.72	.63	1
P	.66	.81	.63
L	.67	.72	.80

(* indicates statistical significance at 0.05 level)

The Kappa coefficient value between 3 judges yielded a values greater than 0.6, $p < 0.05$, which indicated a significant agreement in judgments between the 3 judges on perceptual measures. Thus, positive correlation was found between judge 1 and judge 2 and judge 2 and judge 3 and judge 1 and 3.

Test –retest reliability was also carried out for the perceptual evaluation and the results revealed good test retest reliability. Cronbach's Alpha yielded a score greater than 0.6 ($P > 0.05$) across all parameters which indicated good test retest reliability measures.

It can be concluded from the results of perceptual evaluation that during the fasting conditions major changes are noticed in the voice parameters. The reasons can be attributed to dehydration. The results of the current study are in par with Hamdan et al (2007) and Verdolini et al (1994) study who reported an increased phonatory effort during dehydration condition. The results of the study also support study by Sivasankar (2008) who reported an increased vocal fatigue during the dehydration condition. The results of present study yielded similar findings as reported in previous literature.

Wilcoxon signed rank test was done to check the effect of duration across fasting conditions. The groups considered were overall severity, breathiness, strain, pitch, and loudness in, 5-6 hours and 12-13 hours fast conditions.- The results revealed a significant difference at $p< 0.05$ level of significance. The result suggested that with increased duration of fasting there exists change in perceptual parameters.

CHAPTER V

SUMMARY AND CONCLUSION

Voice is considered as the vehicle of speech, which is produced by the vibration of the vocal cords. It is one of the most important aspects of human communication. Voice conveys wealth of information about the individual (Greene, 1991). Larynx is the biological structure responsible for voice production. Vocal folds are thin elastic structures housed within the larynx, and consists of 4 different layers namely the epithelium, the basement membrane, the lamina propria and the vocalis muscle (Gray, Hirano & Sato, 1992). All these layers work in coordination for the proper functioning of vocal fold vibration.

Vocal fold consists of a thin mucosal layer that acts as a lubricant, thereby serving efficient vocal fold vibrations. The presence of surface liquid is also vital to maintain optimal bio-mechanical characteristics of vocal fold mucosa, thus increasing efficiency of vocal fold oscillations, and improving voice quality.

Dehydration results in airway drying which is harmful for phonation and is considered to exacerbate vocal fatigue (Sivasankar, Erickson, Schneider & Hawes, 2008)

Dehydration has several negative consequences on the entire body physiology, and thus the phonation subsystem involving the vocal folds can also get affected. During dehydration the layer of mucous becomes too thick, increasing its viscosity and reducing mucosal mobility, (Verdolini-Marston et al., 1990), thus making the voice very stressful. Increased viscosity of layers of mucosa results in swelling which

makes the vocal folds even more vulnerable to infectious pathogens, strain and damage.

Fasting is a condition which results in excessive dehydration. Fasting is an act of abstinence of food and drinks for a period of time. An absolute fast refers to complete abstinence of food and liquid for a definite period i.e., a single day (24 hours), or several days. Fasting can alter the metabolic status of body resulting in dehydration, headache, nausea, vomiting, weight loss, sleep disturbances, drowsiness, alertness, gastric reflux etc.

The present study looks forward to enhance the knowledge of the vocal parameters affected if any as a result of systemic dehydration brought about by fasting in adult males and females.

Twenty four participants, comprising twelve males and twelve females between twenty to thirty years of age were considered as the participants of the study. Participants undergoing absolute fasting (complete abstinence of food and liquid intake for a period of 12 – 13 hours) were considered for the study.

Digital voice recorder (Olympus Digital Voice Recorder WS-100) was used to record the voice samples. Multi-dimensional Voice Profile (MDVP) from Computer Speech Lab (CSL, 4500) was used to analyze the selected acoustic and aerodynamic parameters for phonation. Maximum Phonation Duration (MPD) was obtained using a stop timer and CAPE-V scale was used for perceptual evaluation of the recordings.

A questionnaire was prepared for the purpose of the study, which included questions pertaining to the subject selection criteria, questionnaire elicited information regarding the client's voice usage during the day, self-reported changes in with and without fasting conditions. These were administered to all participants.

The samples of phonation, spontaneous speech and reading and MPD were recorded in 3 conditions, namely, no fast condition, at 5-6 hours of fasting, and before they break fasting (12-13 hours of fasting) from all the participants.

The MPD for vowel /a/ was obtained using a stop watch. The samples for MPD were recorded in 3 trials and the average of these 3 trials was considered for analysis.

The recorded samples in all the conditions were analyzed in terms of acoustical and perceptual parameters of voice. The acoustical analysis of phonation sample was done for selected acoustic parameters from MDVP such as average fundamental frequency (F0), jitter percent (Jitt), absolute jitter (Jita), variation of fundamental frequency (vF0), shimmer percent (shim), shimmer in dB (ShdB), amplitude and pitch perturbation quotients (APQ & PPQ), noise to harmonics ratio (NHR), and voice turbulence index (VTI). Perceptual evaluation for phonation, speaking and reading samples was carried out using CAPE-V scale. The samples recorded were given for perceptual evaluation to 3 post graduate SLPs. 10% of the participants underwent repeated measures of the above for reliability assessment.

The data obtained was subjected to statistical analysis using SPSS version 16. To find significant main effect and interaction effect (Mixed ANOVA), to find gender difference (MANOVA), to find difference in estimated parameters across different timings in each fasting and without fasting for both gender separately, Repeated Measure ANOVA, and to find difference in parameters across each timings between with and without out fasting conditions (paired sample t test) were adopted. Wilcoxon sign rank test was used to see the effect with changing duration, Kappa

coefficient for inter and intra rater reliability and Cronbach's Alpha for test- retest reliability.

Results of the present study have found out several findings which supports the existing literature.

- While considering the acoustic parameters changes are noticed in almost all the parameters and most of the changes are noticed with increasing duration of fasting.

- There was no significant change in most of the acoustic parameters in without fasting conditions. During fasting changes in all the acoustic parameters were noticed and these changes were seen with increasing the duration of fasting. This pattern was observed in both males and females, but for most of the parameters males exhibited a significant change.

- The aerodynamic parameter MPD was reduced in both males and females in fasting condition compared to without fasting conditions. Significant changes were noted in both durations of fasting.

- Perceptual evaluation revealed mild to moderate deviance in voice parameters during fasting as compared to without fasting.

- Self-reported complaints during fasting conditions were dryness, throat clearing sensation and vocal fatigue.

- A good inter, intra and test –retest reliability measures were also obtained in with and without fasting conditions.

The general conclusion from the present study is that there is an effect of fasting on acoustic, aerodynamic and perceptual parameters of voice. Henceforth, in clinical practice one has to keep in mind the importance of hydration while doing assessment or management of voice disorders and professional voice users.

Limitations

- This study could not incorporate all the acoustic (included only 10)and aerodynamic parameters.
- In the present study the assessment of various parameters is limited to only to 2 (5-6 hr and 12-13 hr) duration in fasting conditions.
- Sample size was less

Clinical Implications:

With the limitations of the study in mind, the following implications could be drawn based on this study.

- Speech and language professionals can make use the results of this study to encourage systemic hydration as one means by which vocal acoustics can be enhanced.
- The results of this investigation may prove to be a valuable insight for professional voice users, who are interested in maximizing their vocal acoustics and in using proper hydration as a vocal hygiene tip in counseling for voice disorders.
- The results of this study can be applied in prevention, planning and treatment of voice disorders.

Future Directions

More extensive studies with an increased sample size can be carried out incorporating various acoustic and aerodynamic parameters. It can be further studied using various durations to figure out the changes in pattern across different durations.

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APPENDIX A

Questionnaire

Name: Age:

Gender: Education:

Height: Weight:

Date of recording:

Answer the following questions with Yes/No as appropriate: Yes/ No

- Do you have any allergic conditions leading to voice problem :
- Do you have any voice problem? What, how long?
- Do you consume alcohol; how much, how frequently?
- Do you smoke?
- Do you have gastric problem?
- Do you have menstrual cycle within a week?
- How many years since you have been fasting during Ramzan:

  <5 yrs, 5-10 yrs, >5 yrs?
- Do you experience any voice problem during fasting?
- Are you taking any medication for any voice problem?
- At what time do you begin fasting?
- At what time do you end fasting?
- Totally how many hours do you fast every day?
- Do you have a heavy meal before fasting?

- Do you have a heavy meal when you break fasting?
- Do you experience any difficulty in speaking during fasting?
- Do you experience any difficulty in speaking from the beginning of fasting to the end of fasting?
- Do you experience any change in voice towards the end of the day?
- Do you generally speak very less/ more?
- Do you reduce speaking during fasting generally?
- Are you a professional voice user?
- How do you cope with your speaking during fasting? No coping / reduced speaking/any other?