DEVELOPMENT OF VOICE SCREENING PROTOCOL (SELF REPORT AND OBSERVATION) FOR SCHOOL GOING CHILDREN

Nazmin A A

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ALL INDIA INSTITUTE OF SPEECH AND HEARING

MANASAGANGOTHRI

MYSURU- 570 006

May, 2015

CERTIFICATE

This is to certify that this dissertation entitled **"Development of Voice Screening Protocol (Self Report And Observation) For School Going Children"** is a bonafide work submitted in part fulfilment for the degree of Master of Sciences (Speech-Language Pathology) of the student (Registration No: 13SLP016). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru

May, 2015

Dr. S. R. Savithri

Director

All India Institute of Speech and Hearing
Manasagangothri
Mysuru- 570 006

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Mysuru

May, 2015

Dr. Jayakumar T.

(Guide)

Lecturer in Speech Sciences
Department of Speech -Language sciences
All India Institute of Speech and Hearing
Manasagangothri, Mysuru-570 006

DECLARATION

This is to certify that this dissertation entitled **"Development Of Voice Screening Protocol (Self Report And Observation) For School Going Children"** is the result of my own study under the guidance of Dr. Jayakumar T., Lecturer in Speech sciences, Department of Speech Language sciences, All India Institute of Speech and Hearing, Mysuru and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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May, 2015

Registration No: 13SLP016

Dedicated to

Vappy, Ummi

& My Guide Jayakumar Sir

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CHAPTER I

INTRODUCTION

Communication is a media through which human beings interact among themselves and individuals are integrated into societies. Speech is one form of communication and believed to be unique to human beings. Speech is the generation of airflow and creation of air pressure by the displacement (movement) of bodily structures, which taken together, cause the disturbances of air that constitute phonemes, the smallest meaningful units of sound. Speech is subdivided into Voice, articulation, fluency and prosody.

Voice and articulation are the major elements of human speech production. When a disorder related to any of these elements is present, the ability to communicate may be impaired. Voice is the element of speech that provides the speaker with the vibratory signal upon which speech is carried. Today, the production of voice is viewed as both a powerful communication tool and an artistic medium. It serves as a melody of our speech and provides expression, feeling, intent and mood to our daily articulated thoughts. As it is expressed artistically through the many varieties of vocal performance, voice provides great expression and joy for both the listener and the performer. Many are depending on their voice for livelihood purpose they are called professional voice users.

According to Johnson, Brown, Curtis et al. (1965) normal voice is defined as a voice of age and gender appropriate pitch and loudness with a pleasant quality and which has adequate flexibility and sustainability. Any voice that deviates from the above quality can be consider as abnormal voice (or) voice disorder. By definition, an abnormal voice is any voice that calls attention to itself, does not meet the

occupational or social needs of the speaker, or is inappropriate to age, gender, cultural group or situation. Voices that attract unwanted attention are most often due to aberrant voice qualities. (Aronson & Bless, 2009). Abnormal voice qualities are often subsumed under the term hoarseness, most often referring to voices that are noisy, atonal, or possess old resonance patterns.

According to Ramig and Verdolini (1998), voice disorders are generally characterized by an abnormal pitch, loudness, or vocal quality are resulting from a disordered laryngeal, respiratory, or vocal tract functioning. Voice disorders varies from a mild hoarseness to complete loss of voice and it may limit the intelligibility or effectiveness of oral communication. It may be due to habits of vocal misuse and hyperfunction which can include improper use of the larynx, such as excessive clearing of throat, yelling, prolonged talking over loud noise commonly producing physical changes in the vocal folds, other medical/physical conditions which includes trauma, neurological disorders, allergies or psychological factors mainly stress, conversion reactions, personality disorders).

The National institute of deafness and communication disorders, a division of national institutes of health, estimates 7.5 million individuals have disease or disorders of the voice caused by upper respiratory infections, vocal fold lesions, overuse of the vocal folds, laryngeal cancers and other laryngeal pathologies (American Speech Language Hearing Association, 2002).

As per the literature and statistics there is a quite huge number of children with voice disease or disorder which are due to various causes and there are also various background factors contributing to voice problems in children. (Chan, Young & Tirunagari, 2007).

Background factors for voice problems in children

Elastin and collagen stabilizes the vocal folds and gives them their elastic features, and because children have lower levels of elastin in their vocal folds and have not yet developed the stabilizing three-layer structure, their vocal folds vibrate with more force and are at higher risk for injury as a consequence of heavy voice use. (Chan, Young & Tirunagari,2007).

The background of dysphonia is multifactorial and depends on vocal loading factors in the environment, such as background noise, room acoustics, air quality, ergonomics, and psychosocial factors. Individual factors such as gender, vocal endurance, health condition, life habits, personality, and genetics contribute. The way the different factors interact is not fully elucidated. Chronic hoarseness in children is often associated with strenuous speaking, singing, or screaming. If the heavy voice use is persisting, repeated mictrotrauma might lead to the formation of either vocal nodules or can lead to changes in the vocal folds.

In a study by Chan, Young & Tirunagari (2007) where school speech-language pathologists (SLP) were asked to estimate the portion of their voice clients that were dysphonic because of vocal misuse, 44% reported that most of their voice cases were related to vocal misuse and 34% that some were.

The majority of children with voice problems are identified by the school Speech language pathologist. The teacher or family members mainly notices that a child has developed a deviant voice quality and makes the initial contact with the Speech language pathologist. Some referral sources lack training in making proper

perceptual quality judgments, so there is chance to miss more subtle problems that requires professional attention. Depending on the tasks used, teachers may not be accurate in identifying children with voice disorders and most of the parents may assume that the children will outgrow the voice disorder.

The identification and management of voice disorders in children is important for the child's psychosocial and educational development, as well as physical and emotional health. It is important to know the underlying cause of any voice disorder because voice disorders that share the same quality deviations may have vastly different medical, psychosocial and behavioural etiologies So there is a need for voice assessment in school going children. (Stemple et al., 2000).

Perceptual Voice assessments are best performed by speech-language pathologists with specific training in voice disorders. Speech- language pathologists have the skills to screen young patients and discriminate dysphonia from common speech and language disorders such as articulation errors, oral motor dyspraxia, dysfluency abnormal resonance, and higher function language difficulties. It is not uncommon for patients to be referred to the voice laboratory for problems that have been misinterpreted as voice disorders. As such, early screening is recommended to clarify the presenting complaint and provide appropriate and well- directed treatment. Ideally voice assessment is performed perceptually and objectively (if specialized equipment is available). The perceptual assessment is primarily performed by a speech- language pathologist. Perceptual evaluations may be informal and descriptive or in accordance with several standardized testing formats.

Knowledge of paediatric voice is still more limited than for the adult voice. One reason is probably that children are more difficult to examine and they are usually not as cooperative as adults. Also, small children may not comprehend the reason for the examination (McAllister & Sjolander, 2013). Unfortunately, pediatric voice has received very less attention in most of the speech and language screening tools. For example, the Fluharty-2 Preschool Speech and Language Screening Test (Fluharty, 2001) has only one line about clinician response to voice quality ("sounded normal; recheck may be necessary"). Same way, one line for description of the voice is present on the Speech-Ease Screening Inventory (Pigott et al., 1985). These conventional one-line summaries failed to address the voice in children comprehensively; that is, they do not assess the three subsystems like respiration, phonation, and resonance. Since there is a lack of research regarding voice and its related concern in pediatric population, the present study is aimed to develop a screening voice test for school going children. To check for voice disorder we need to screen all the school going children because they are high risk of developing voice disorder. For screening entire school population we also need instrument, more professional manpower and time. In a country like India which has more population, screening through instrument will not be feasible. Hence, screening via checklist and observation by Speech Language pathologist will be the best option. The present study planned to screen the children by self report and observation by speech language pathologist. So in order to validate the screening data, perceptual and objective measures was done.

Objectives of the study

- To develop a screening protocol for school going children
- To validate the screening protocol with perceptual and acoustic measurement.

CHAPTER II

REVIEW OF LITERATURE

Voice is the sound produced by the vibration of true vocal folds, which are situated in the larynx. Voice of an individual tells the listeners about their personality, educational background, social status, health and mental alertness. Any deterioration in the phenomenon of voice production at the anatomical or physiological level leads to voice changes, which can be due to injury and vocal abusive behaviours. Commonly occurring voice changes are associated with voice abuse, which are prominent in children

Organic voice disorders can be divided into congenital or acquired, and may include laryngeal pharyngeal reflux (LPR), granuloma contact ulcers or papilloma.

Congenital conditions mainly include laryngeal anomalies, such as laryngeal malacia, stenosis, laryngoceles, webs, clefts and cysts. Acquired disorders would include postsurgical correction of cardiovascular, esophageal, or cranial anomalies; trauma from birth injury or tumor compression, and infections such as polio, syphilis, whooping cough or tetanus (Gray, Smith, & Schneider, 1996).

Incidence and prevalence

Estimate of voice disorder in total population ranging from 3 to 9% (Ramig and Verdolini,1998), in children ranging from 3 to 24% (Senturia & Wilson,1968; Silverman & Zimmer, 1975; Yairi, Currin, Bulian, 1974). Koufman and Blalock (1991) suggest at least 10% of these are functional in origin, but here, too, the estimates range widely.

Statistics on the incidence of voice disorders in school-age children suggest most children with voice disorders have dysphonia related to vocal abuse, either with or without resultant vocal fold nodules or general inflammation (Cooper,1973; Pannbaacker,1999). Senturia and Wilson's (1968) study of 32,500 school-aged children in St.Louis, Missouri, demonstrated 6% had voice disorders. Yairi, Currin, Bulian, et. al (1974), based on a study of 1500 school-age children, found an incidence of hoarseness in 13%. The highest incidence was reported by Silverman and Zimmer (1975), who found voice disorders in 23.4% of school children.

Laguaite (1972) investigated 428 patients aged 18 to 82 years. The results showed that 7.2 % of the males and 5% of the females had voice disorders. In otolaryngologic practice, Brodnitz (1971), reporting on only "functional" voice disorders, found that in 1851 cases, 25.8% had hyperfunctional (musculoskeletal tension) voice disorders, 19.7% had polyps, 15.3% had vocal nodules, 9.4% had polypoid thickening, 5.3% had contact ulcers, 4.7% had mutational voice disorders, 4.7% had spastic dysphonia,, 4.4% had psychogenic aphonia, and the remaining patients had voice disorders from other causes less common.

In a Swedish study of 205 children, in the age range of 10 years old from different parts of the country, the prevalence of hoarseness was 14% (Sederholm, Mc Allister, Dalkvist, Sundberg 1995).

According to Senturia and Wilson (1968) and Silverman and Zimmer (1975), the occurrence of voice disorders in children ranges from 6% to 23.4%. Powell, Filter, and Williams (1989) screened 847 children, age ranged from 6– 10 years, in the Warren County Public School in Virginia for phonatory disorders three times over 5 years and found that initially 23% of the children (203) had voice disorders and after

5 years, 19 of the 203 children still had a voice disorder, with none of the children receiving any kind of treatment.

School Speech Language pathologists in the United States have reported that children with voice disorders mainly comprises of 2% to 4% of their caseloads (Deal, McClain, & Sudderth, 1976; McNamara & Perry, 1994). A recent survey of one primary care trust in the United Kingdom indicated a prevalence of 2% of voice problems in children (Broomfield & Dodd, 2004). Most authors said that anywhere from 1% to 23.4% of children have a voice disorder (Deal et al., 1976; McNamara & Perry, 1994; Powell et al., 1989; Senturia & Wilson, 1968; Silverman & Zimmer, 1975) and somewhere in between 6% to 9% is the best estimate of prevalence seen (McNamara & Perry, 1994).

In 2002, the National Sample Survey Organization (NSSO) estimated that the incidence rates for males were 77 and 75 per 100,000 respectively in rural and urban India as against 61 and 58 per 100.000 respectively among females in which incidence of 59.7% male and 40.3% females below the age range of 15 years , 62.1% male and 37.9% female between the age range of 15-59 years and 57.0% male and 43.0% female in the age range of >60years had speech disability and among them 11.4% below the age of 15 years, 9.4% between the age of 15-59 years had voice problems .

Duff, Proctor and Yairi (2004) conducted a study to examine the prevalence of voice disorders in Preschoolers of African American and European American population wherein 2445 children out of which 1246 males and 1199 females within

the age range of 2 - 6 years were the participants. These children were enrolled from 49 different preschools in urban, rural, and suburban regions of Illinois. The investigators looked for Presence of a voice disorder which is characterized by hoarseness which was identified using three approaches which included teacher identification, investigators screening and parent identification. In teacher identification Classroom teachers were asked to indicate the name of each child suspected of, or identified as, having any communication problem such as speech, language, stuttering, voice, or hearing. In investigators screening Speech Language Pathologists (SLPs) visited the preschools, and children were observed playing and interacting with other children and adults in the room. The SLPs then engaged each child in play-conversation activities or administered the Fluharty Preschool Speech and Language Screening. Individual interactions with each child ranged from 15 to 20 minutes. When an investigator identified a child as having a voice disorder, a second investigator was asked to listen to the child and make a judgment about his/her speech. A child was only considered to have a voice disorder when both clinicians agreed. In parent identification Each parent or guardian received a survey and was asked to indicate any concerns regarding past or present speech, language, hearing, voice, and fluency development. Based on all the three identifications the results revealed that Of the 2445 preschoolers observed, 95, or 3.9% of the sample, presented with a voice disorder characterized by hoarseness.

Carding, Roulstone, Northstone (2006) conducted a cross-sectional study to examine the prevalence of dysphonia in a large cohort of children (n = 7389) at 8 years of age. The study included parent report using a questionnaire and children were engaged in tasks like phonation of vowel /a/ and spontaneous speech which was

assessed by a speech language pathologist who has clinical experience of 5-17 years in the field of pediatric speech, voice, and language screening programs. Results of the study revealed that of those parents who completed the questionnaire, 39 identified their children (0.5%) as ‘‘always having had a problem with their voice.’’ A further 802 (11%) parents reported that their child‘‘sometimes had a problem.’’ Results also revealed that 841 children (11.6%) who were identified by their parents as having a possible voice problem in which there were similar proportions of boys (49.9%) and girls (50.1%). The speech language pathologist identified 445 (6%) children with atypical voices. A significantly higher proportion of boys (7.4%) were identified compared with girls (4.6%). Identified risk factors for childhood dysphonia are having older siblings, male gender, and spending long days in large groups (Carding et al., 2006; Sederholm et al 1993; Sederholm et al., 1995). After puberty voice disorders are more prevalent in women than in men (Yu, Garrel, Nicollas, Ouaknine, Giovanni 2007). Together, these findings may indicate that it is important to identify and treat not only boys but also girls with a voice disorder.

In the same study, parental reports suggested a link between and asthma and tonsillectomy, whereas common upper respiratory or other otolaryngological conditions were not linked to voice problems (Carding et al, 2006).

Emma, Elisabeth, Sofia, Jenny, and Susanna (2014) conducted a study to estimate prevalence of hoarseness in school- aged children wherein 217 children aged 6:4 to 9:10 years participated in the study. For the study the authors used parent and teacher questionnaire and they also collected voice samples by indulging the children in tasks like phonation of vowel /a/, sentence repetition and narrative speech which was mainly used for perceptual evaluation. The results of this study show an overall

prevalence of hoarseness of 12.0% in children, which is higher than the estimated overall prevalence for adults. Results also showed that the prevalence of hoarseness was 7.8% for girls and 15.8% for boys. The parents of 6% of the children reported that their children had two or more vocal symptoms. The results of this study indicated that teachers are able to rate hoarseness in their pupils in a way that, although the connection was weak, correlated significantly with the ratings by the trained listeners.

Banjara, Mungutwar, Sigh, Anuj (2011) conducted a retrospective study to evaluate hoarseness of voice in Raipur, India on 251 cases age ranged from 11-80 years. All cases were analyzed for detailed case history and underwent pre and post operatively stroboscopic examination. Results revealed that smoking was commonest predisposing factor (44.22%) followed by vocal abuse (30.28%) out of 251 cases, 83.67% cases was organic and 16.33% cases were functional in origin.

Manohar and Jayaram (1973) conducted a study to check the prevalence of speech disorders among school children of Mysore city. 1,454 school children aged 3-16 years were tested in that 707 were boys and 747 were girls. They conducted a screening program on these children for about 2 years to detect speech and hearing problems. Speech evaluation was carried out by graduate and post graduate students under the supervision of speech pathologist. Voice was examined for the possible deviations in the pitch, quality and loudness with respect to the age of the children. Mutational voice changes in children were noted separately. Results revealed 46% of boys, 73.47% girls had dysphonias and higher incidence of dysphonias were found more in girls compared to boys.

Prathibha, Yeshoda (2012) conducted a study to examine the prevalence of voice problems among preschoolers in Yemmingantur town, Andhra Pradesh. In this study 320 children participated wherein subjects were divided onto two age groups i.e 3.5-4.5years and 4.5-5.5 years and in each group consisted of 160 children of 80 boys and 80 girls. All subjects were native speakers of telugu. The investigator administered functional voice indicators of voice problems (FIVP) questionnaire to obtain information regarding voice problems in these children by their parents and teachers. Children were also made to phonate vowel /a/ for 2 seconds and it was subjected to acoustic analyses using Dr. Speech software. The four major parameters mainly Jitter, shimmer, Standard deviation of F0, NNE were extracted from the acoustic analysis. Voice quality was also estimated with respect to hoarseness, harshness and breathiness and quantification was done numerically. Results in general revealed that there was no positive significant association between the domains of FIVP questionnaire and the subject group and also no significant difference was there between voice quality assessment and the gender. Both males and females obtained the same value. Results of the study also revealed that jitter and shimmer values were higher for older children when compared to younger children whereas NNE and SDF0 on the other hand was lower for older children when compared to younger children. Using voice quality estimate periodic prevalence was calculated. In that subjects who scored a total of 5 and above were labelled as deviant voices. The results showed that out of 320 children who participated in the study 71 children had deviant voices among which 51% were males and 49% were females and the periodic prevalence was estimated as 22% in the given population.

The reason for the high prevalence of voice disorders in children are multifactorial mainly including different combinations of developmental, personal and

environmental factors. The lack of the protective three-layered structure of the vocal ligament in the immature vocal folds is the main cause to make children more prone to tissue reactions which is mainly because of heavy voice use (Sedlackova 1960; Casper, Colton & Leonard 2006).

Voice Problems in Children

Ramig and Verdolini (1998) reviewed data on occurrence of different types of voice disorders. The majority of the cases as reported were hyperfunctional voice disorders. The estimated portion of school children voice caseloads were related to vocal abuse or misuse is as follows: most was 44%; some was 34%; and none was 22% (McNamara & Perry, 1994). The prevalence of elementary-age children with symptoms of chronic hoarseness has shown to be as high as 38% (Leeper, 1992). Andrews (1995) and Glaze (1996) also reported that hyperfunction is the most voice disorder seen in children, and Peppard (1996) used the author to use the term functional disorders.

McNamara and Perry (1994) survey showed that most percenatge of voice caseloads in school children were related to vocal abuse or misuse. Vocal nodules are the cause for 45% and 80% of childhood voice disorders (Baynes, 1966; Herrington-Hall, Lee, Stemple, Niemi, & McHone, 1988). St. Louis, Hansen, Buch, and Oliver (1992) found that the majority of students studying in grades 1 to 12 with either moderate or severe voice disorders exhibited hoarseness quality. Hoarseness is one of the mostly reported complaint of hyperfunctional voice disorders, but it can also shown a presence of organic pathology (Glaze, 1996). Functional voice disorders that are likely to occur in adolescence population are mainly functional aphonia and puberphonia (Peppard, 1996). Studies also showed that language disorders,

articulation disorders and mild hearing problems coexist with voice disorders (St. Louis et al., 1992). Allergies and asthma, upper respiratory tract infections, also occur with hoarseness in children (Greene & Mathieson, 2001); it has also been reported that gastroesophageal reflux also is a contributing factor to hoarseness (Koufman, Sataloff, & Touhill, 1996).

Environmental factors influencing vocal behaviour

High background noise levels have been documented in pre-schools and schools, ranging between 72 and 80 dBA during an 8-hour working day (Truchon-Gagnon, Hetu 1988; Shield, Dockrell 2004; Sodersten, Granqvist, Hammarberg, Szabo 2002). Background noise has been found to influence several vocal parameters such as loudness, subglottal pressure, fundamental frequency, voice quality and speech comprehension (Gramming, Sundberg, Ternström, Leanderson, Perkins 1988; Stemple, Stanley, Lee 1995; Rantala, Maatta, Vilkman 1997; Crandell, Smaldino 2000; Sodersten et al 2002; Vilkman, Alku 2002; Sodersten, Ternstrom, Bohman 2005). Also, children seem to be more bothered by background noise than adults. In a study of effects of age on speech perception kindergarten aged children need a better signal-to-noise ratio than adults and their older peers to obtain equal comprehension (i.e, much louder speech level than the level of interfering noise) (Marshall, Brandt, Marston, Ruder 1979).

A field study of three day care centers found that the mean background noise level, using a binaural recording technique, was 82.6 dBA Leq, ranging from 81.5 to 83.6 dBA Leq at the different centers (McAllister, Granqvist, Sjolander, Sundberg 2009). The perceptual evaluation of voice quality from recordings of children attending the day care center with the highest noise levels also revealed higher ratings

of hoarseness, breathiness, and hyperfunction than in centers with lower noise levels. Girls increased their loudness level during the day, but for boys no such change was observed. These results point to the importance of studying vocal behavior in natural everyday life situations (Södersten et al. 2002; Vilkman 2004).

Students with voice problems will face many difficulties that will have an effect on academic and social and emotional aspects of their life. As oral communication is pre requisite to all classroom learning and is one of the major medium of instruction and it helps in effective interaction between students and teachers. Children who experiences change in their voice production or vocal behavior will generally require intervention to compensate their academic difficulties (Andrews, 2002).

Children with voice disorders can be negatively affected which can be in many ways. For example, children may be concerned about their atypical voice or feelings of inferiority about their own voices. This can in turn seriously limit them from their classroom participation, giving them only some opportunities to practice. Andrews (2002) reported that school going children deviant vocal behaviors may interfere with limiting their concentration during academic activities or cause less peer reaction or embarrassment. Social and emotional implications mainly include children becoming withdrawn, or vocally aggressive in many situations where the child is attempting to compensate for his or her vocal difficulties. These problems can become worse as time progresses without any intervention and can seriously affect their learning. In Addition, children who are using limited number of vocal strategies (i.e., crying, whining or talking loudly) as a method to solve interpersonal problems may be at a risk of being evaluated in negative ways by teachers. This may even has an indirect affect of how they are viewed in all aspects of their educational program.

In adolescent population, academic content mainly focus about school-to-career activities. The school-to-career program mainly connects academic learning to practical application of learned behavior. Many of these career-related activities demand high vocal communication skills for interviewing, employment opportunities, internships in order to create a strong relationship between the student and the education provider. The adolescent population with voice complaints may have less opportunities to participate in their educational routines. Adolescents with voice problems may also have difficulty in modifying their maladaptive habits and other compensations later in their life as they start their transition into college and other career related programs.

Ruddy & Sapienza, (2004) described some of the adverse effects of voice impairment on a child's educational performance can include the following:

- Difficulty being heard or communicating in educational environments inside or outside of the classroom setting
- Limited participation in public speaking activities
- Fear of participating in oral reading activities
- Limited participation in classroom discussions with peer groups
- Fear of conversing in interpersonal interactions (i.e., raising hand to request to go to the bathroom)
- Limited participation of children in daily physical education routines which can be due to compromised physiologic aspects of the laryngeal anatomy in them
- Limited participation of children in music education in both vocal and instrumental due to problems in upper airway structures

- Reluctant to participate in different activities, such as school plays, cheerleading, debate, other vocal performances etc.
- Limited participation of children in secondary education coop activities, which requires the children to take only non vocal jobs
- Children are reluctant to participate in interviews, thereby limiting their access to good employment and different educational opportunities
- At times they should also face negative attention from their peers, teachers, and other related school personnel
- The children might be a hindrance for academic goals of other classroom students (i.e., a child's voice quality may be distracting to other classmates who focuses mainly on abnormal voice quality of the child instead of to look for the content of the message).

Overall, as a result of all these negative impacts on school children due to their vocal impairment proper detection and treatment of voice problems are important. Therefore, periodic screenings in schools would be advisable, so that eventual voice disorders have the earliest possible detection and adequate treatment. Unfortunately, voice has received scant attention in most speech and language screening tools. For example, the Fluharty-2 Preschool Speech and Language Screening Test (Fluharty, 2001) has one line for clinician response to voice quality ("sounded normal;"). Similarly, one line for description of the voice is allotted on the Speech-Ease Screening Inventory (Pigott et al., 1985). These conventional one-line summaries fail to address the voice comprehensively; that is, they do not assess the subsystems of respiration, phonation, and resonance. However, there is a lack of validated instruments that are able to provide a reliable

prediction of whether the school children has a voice disorder and that, upon a simple screening, is able to identify those who are at risk of having a problem, even if in its early stages.

As per the Annual Status of Education Report (ASER) 2012, 96.5% of all rural children between the ages of 6-14 were enrolled in school. School going children are more prone to exhibit voice related symptoms because of surrounding noise, dust pollution, vocal abuse, poor acoustics of classrooms, poor aeration, etc in Indian schools. Thereby, it is necessary to develop a screening test to screen the school going children.

Evaluation of voice remains a multifactored process involving expert perceptual judgments, voice signal analyses, airflow measurement, stroboscopic imaging, and patient (or parent proxy) report of the handicapping effects and/or quality-of-life changes associated with dysphonia (Hogikyan N, Sethuraman G ,1999). Of these, perceptual evaluation of voice continues to be an essential component of the comprehensive voice evaluation and ongoing care despite numerous documented concerns regarding its use (Kreiman & Gerratt, 1997) Perceptual evaluation is especially valuable when assessing patients with severe or extreme dysphonia.

It may be that expert listeners develop internally consistent standards that are influenced by poorly controlled external and internal factors. Such factors may be as obvious as environmental considerations (eg, noise, distractions, and time

considerations, such as rushing) or as obtuse as shifts in rater cognitive perceptual processing (rater concentration, attention to detail, physical comfort).

Currently, perceptual instruments used to document dysphonia are typically scaled and categorized as being equal appearing/ordinal (eg, descriptor-based numeric ratings; 0- normal; 5-severe) and visual analog (eg, 100-mm line, with 0- normal and 100- severe dysphonia), indicating the severity levels for the described attributes.

In 2003, the Consensus Auditory Perceptual Evaluation of Voice (CAPE-V) was developed so that clinicians could uniformly describe the severity of the auditory perceptual attributes of voice and have a consistent approach to its evaluation. It is a composite of current perceptual evaluation protocols and uses a 100-mm visual analog design to permit more sensitive assessment of voice change across six vocal parameters: overall severity, breathiness, roughness, strain, pitch, and loudness.

Kelchner et al (2010) conducted a study to look for the Perceptual Evaluation of Severe Pediatric Voice Disorders and Rater Reliability Using the Consensus Auditory Perceptual Evaluation of Voice. In this study, fifty participants which included 32 females and 18 males ranging in age from 4 to 20 years were taken and connected speech voice samples were collected from the participants and only sentence stimuli were taken for CAPE-V analysis. The judges participated in this study for the analysis was three certified speech-language pathologists with 7-17 years of experience in the field of assessment and treatment of voice disorders. Each judge had been using the CAPE-V for 2–3 years for perceptually evaluating the quality of children's voices. The intraclass correlation coefficient (ICC) was

calculated for each vocal attribute to assess rater reliability by comparing the variability of different ratings of the same subject with the total variation across all ratings and all subjects.

Results of the study revealed that The following ICCs, based on three raters, demonstrated a moderately strong association: overall severity (67%), roughness (68%), breathiness (71%), and pitch (68%). The degree of reliability between three raters was fair, or just above chance, for loudness (57%) and poor for strain (35%). It also showed that the mean overall severity of the voice quality ratings reported by our three raters was 56.1/100, indicating that most of the children were judged to have at least a moderate dysphonia.

In summary, it is well understood that there is a high prevalence of voice disorders in children, mainly school going children. This can be due to different factors like vocal abuse, surrounding noise, daily activities of children, dust pollution, poor acoustics of classrooms, poor aeration, etc in schools. Voice disorders in children also, have an impact on their quality of life. The identification and management of voice disorders in school going children is important for the child's educational and psychosocial development, as well as physical and emotional health. But the assessment of voice problems in school children is difficult as school children are huge in number and it requires more manpower and time. So there is a need for developing a voice screening protocol for school going children and which helps in classifying the voice of children as normal or abnormal based on the scores.

CHAPTER III

METHOD

Participants

A total of 112 Malayalam speakers were participated in the study. They were in the age range of 8-13 years. Participants were from 3rd grade to 8th grade from three different schools (Al- Ameen public School, Edappally, Najath Public School, Kalamassery and Al – Ameen public school, Chandiroor). All the school children were from the southern part of Kerala i.e Ernakulam. Written concerned was taken from respective school principals for the study.

Inclusion criteria

- Native Malayalam speakers with no history of any speech, language and hearing disorders.
- No structural or functional deficit on oro-motor examination.
- Not attended any voice therapy for any voice disorders.
- Client who has acute pharyngitis or laryngitis were excluded

Procedure

This study was conducted in two phases. Phase I dealt with the development of voice screening protocol and Phase II dealt with the validation of voice screening protocol.

Phase I: Development of voice screening protocol

Development of voice screening protocol included two major steps. Step 1 is for collecting background information and step 2 involves developing voice screening protocol.

Step 1: Information regarding different vocal condition and vocal habits in school going children were collected from various resources like published voice screening and diagnostic checklist, journal, books, and professional reports. All those information were collected from All India Institute of Speech and Hearing (AIISH) library and Information centre.

Step 2: With all the background information collected from step 1 the voice screening protocol was organized and developed in step 2. The voice screening protocol had demographic data about the child and it has two sections about vocal habits and symptoms respectively.

The two sections mainly include:

Section A: Self- report questionnaire (20 questions)

Section B: Observation by Speech Language Pathologist (3 point rating scale of 20 questions)

Section A: This section has bipolar question regarding the vocal behaviour and vocal symptoms from the children. This part of the questionnaire had 20 questions and the children were made to report either "Yes" or "No" for each question and it was given a score of 1 and 2 for the No and Yes responses respectively. For

elder children this section is a self report and for the younger children the section was filled by speech language pathologist (SLP) by child verbal report.

Section B: This section has 3 point rating scale regarding the vocal behaviour and vocal symptoms. Child was indulged in different tasks like simple conversation of 3-5 sentences or counting from numbers 1 to 10, phonation of vowels /a/,/i/,/u/ and pitch and loudness gliding and this was carried out with proper instructions and modelling for younger children and subjects was made to sit comfortably along with a microphone placed at a distance of 6 cm and slightly to the side of the subject's mouth to minimize breathing noise. The voice samples were recorded using Sony recorder ICD-UX543 in a relatively quiet environment. This section was filled by speech language pathologist by his/her observation in different tasks (phonation, counting, gliding) which were carried out by the child. Breathing pattern and other symptoms related to child voice was also rated in this section. The speech language pathologist also observed non - verbal behaviour related to voice production and if necessary, additional remarks were made for each child.

Each task was carried out in the following manner:-

Task 1: Simple conversation or counting (From 1 to 10)

The children were made to speak about himself/herself in 3-5 sentences and for counting task child was made to take a deep breath and count from 1-10. For younger children modelling was done by the speech language pathologist.

Task 2: phonation of vowels (/a/,/i/,/u/)

The children were instructed to take a deep breath and phonate /a/. Initially it was modelled before the actual recording. Minimum of three phonation samples of /a/

was collected from each child. Best of the 3 for their sustained voice at least for 2 seconds were taken for analysis. Same were carried out for the other vowels /i/ and /u/

Task 3: Vocal range task (pitch and loudness gliding)

In this task child was made to glide from low to high for pitch as well as loudness. Initially it was demonstrated by the Speech Language Pathologist and for loudness range child was also made to say a word loudly as well as softly.

Content Validity:

Once the voice screening protocol was developed it was subjected for content validity. Five Speech language pathologists who have experience of more than 5 years in voice research/pathology evaluated for the content of the screening test and later it was revised according to their suggestions. Initially the protocol was developed in English. Later, only section A was translated to Malayalam.

Phase II: Validation of voice screening protocol

For the purpose of validation the screening protocol was administered to 112 children as explained in the phase I and the developed voice screening protocol was validated using perceptual and objective method of voice assessment using the recorded voice samples of different tasks which was mentioned in section B.

Voice screening protocol [Both A i.e Self report of voice problem by child and B i.e Observation by Speech Language pathologist (SLP)] in English and the translated version of Section A in Malayalam are attached in the appendix.

Data Analysis

The data collected from phase II for both the sections A and B was entered in SPSS 17 software for further analysis

Perceptual Analysis

Perceptual analysis was carried out using Consensus Auditory Perceptual Evaluation of Voice (CAPE-V). For CAPE-V analysis recording of phonation task and simple conversation was utilized. CAPE-V rates the voice based on six parameters (attributes) namely roughness, breathiness, strain, pitch, loudness and overall severity of voice. CAPE-V displays each attribute accompanied by a 100-millimeter line forming a visual analog scale (VAS) were the rater (judge) was asked to rate the degree of perceived deviance from normal for each parameter.

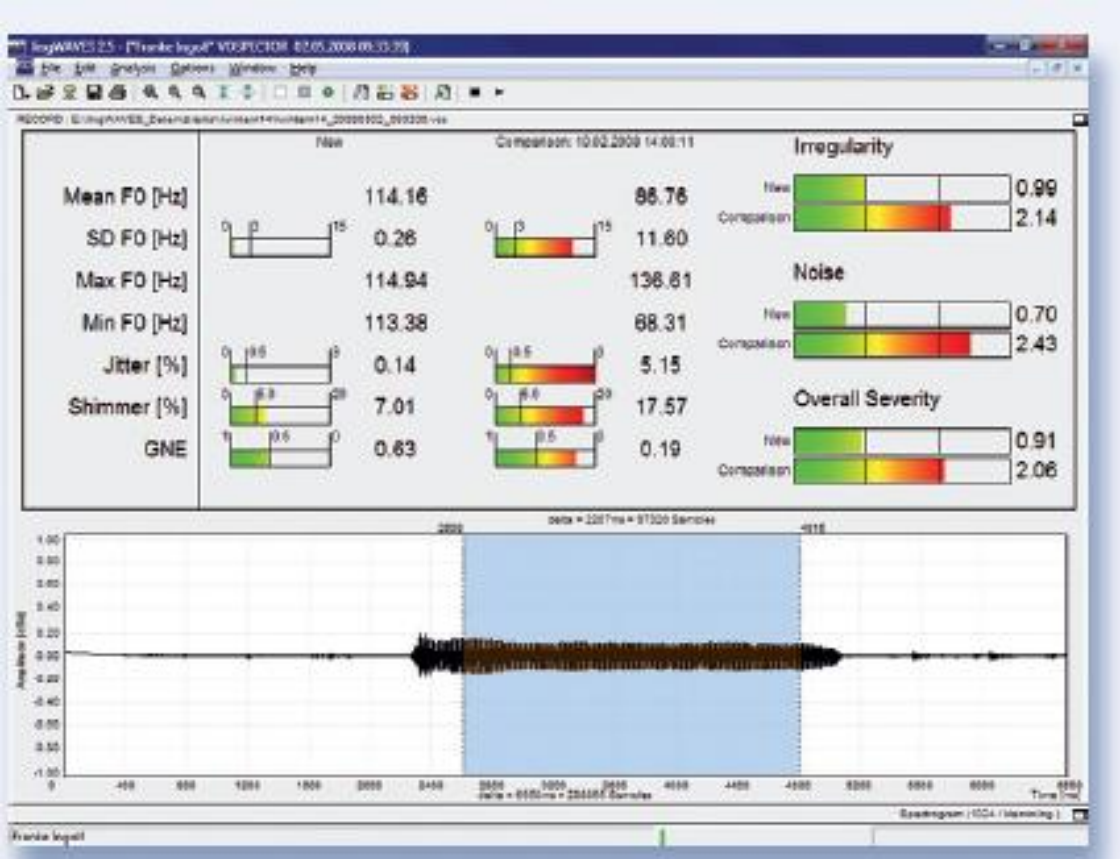
In CAPE-V score each "MI" refers to "Mildly deviant", "MO" refers to "Moderately deviant", and "SE" refers to "Severely deviant". Based on the perception of voice rater has the freedom to rate the voice samples in between mild, moderate or severe. "C" represents Consistent and "I" represents Intermittent presence of a particular voice attribute. A judgement of "consistent" indicates that the attribute was continuously present throughout the tasks. A judgement of "intermittent" indicated that the attribute occurred inconsistently within or across tasks.

The phonation, Simple conversation or counting from 1-10 was used as stimuli for CAPE-V analysis. This samples were rated by three Speech Language Pathologists using the CAPE-V score sheets. The SLP's had minimum of 3 years experience in speech and voice analysis.

Objective Analysis

Objective analysis were carried out using *ling* WAVES Voice clinic suite (version 2.5)- Vospector module. The parameters like Glottal to Noise Excitation ratio (GNE), Noise, Irregularity and overall severity can be analyzed using the Vospector module

A Steady portion of vowel /a/ of 5 seconds was selected from the phonation sample and was subjected to *Ling* WAVES Vospector analysis and parameters like Glottal to Noise Excitation ratio (GNE), Noise, Irregularity and overall severity were extracted. Picture 1 shows the screen shot of Vospector module.



Picture 1: Screen shot of Vospector module.

Statistical Analysis

The statistical analysis for validation of screening protocol were done with SPSS (Version 17) software in order to determine the relation between Voice screening protocol, Perceptual and Objective analysis. Descriptive statistics and correlation were used.

- ✓ Mean, Standard deviation and Range for each variables
- ✓ Correlation between section A(Self Report) and Section B (Observation by SLP)
- ✓ Correlation between section A(Self Report) and Perceptual Evaluation (CAPE-V)
- ✓ Correlation between section A(Self Report) and Objective Evaluation (*Ling* WAVES)
- ✓ Correlation between Section B (Observation by SLP) and Perceptual Evaluation (CAPE-V)
- ✓ Correlation between Section B (Observation by SLP) and Objective Evaluation (*Ling* WAVES)
- ✓ Correlation between the Voice screening protocol, Perceptual Evaluation and Objective Evaluation

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of the present study was to develop a screening protocol for school going children and to validate the screening protocol with perceptual (CAPE-V) and Objective measurement (*ling* WAVES VOSPECTOR).

A total of 112 native Malayalam speaking school going children of 3rd grade to 8th grade age ranged from 8-13 years served as a participant. These children were subjected to fill the first part of the Voice screening protocol i.e the self report in a bipolar manner and they were indulged in different tasks like simple conversations, counting from 1-10, phonation of vowel /a/,/i/,/u/and vocal range task in terms of both pitch and loudness. During these tasks observations were made by the Speech Language Pathologist (SLP) and it was rated on a 3 point rating scale in the second part of the Voice screening protocol. All these tasks were also recorded using Sony recorder and from this recordings the phonation, Simple conversation or counting from 1-10 were used as a stimuli for CAPE-V analysis and it was rated by three experienced Speech Language Pathologists. For objective analysis steady state portion of vowel /a/ was taken and values for parameters like Glottal to Noise Excitation ratio (GNE), Noise, Irregularity and overall severity for the vowel /a/ was extracted using *ling* WAVES VOSPECTOR.

All these data were entered into SPSS 17 software and Pearson correlation coefficient values were calculated to see the correlation between different variables which will be discussed below and for intra- rater reliability Cronbach's Alpha was calculated

The present study results and discussion were described under the following headings:

1. Mean, Standard deviation and Range of Self report, observation by SLP, Voice screening protocol, Perceptual evaluation (CAPE-V) and Objective evaluation (*ling* WAVES VOSPECTOR)
2. Correlation between Voice screening protocol, Perceptual evaluation (CAPE-V) and Objective evaluation (*ling* WAVES VOSPECTOR)
3. Frequency of all the variables
4. Prevalence of voice disorders in children
5. Correlation between self report and Observation by SLP
6. Correlation between Observation by SLP and Perceptual evaluation (CAPE-V)
7. Correlation between self report and perceptual evaluation (CAPE-V)
8. Correlation between self report and Objective evaluation (*ling* WAVES Vospector)
9. Correlation between Observation by SLP and Objective evaluation (*ling* WAVES VOSPECTOR)
10. Inter- rater reliability of perceptual evaluation (CAPE-V) parameters.

1. Mean, Standard deviation and Range of Self report, observation by SLP, Voice screening protocol, Perceptual evaluation (CAPE-V) and Objective evaluation (ling WAVES VOSPECTOR)

Descriptive statistics like mean, standard deviation and range of self report, observation by SLP, Voice screening protocol, perceptual evaluation (CAPE-V) parameters and objective evaluation (ling WAVES VOSPECTOR) parameters were shown in table 1. According to the results mean value of Voice screening protocol is more compared to CAPE-V parameters and objective measures. It shows that this Voice screening protocol is more sensitive in determining voice disorder in children than the parameters of CAPEV and objective evaluation.

A similar study with respect to the screening tool was reported by Stemple et al. (2004) and results revealed that quick screen for voice is a sensitive on line response tool for Speech language pathologists to screen for deviant voice disorders in kindergarten to fifth grade children and it is more effective in screening because it encompasses all aspects of voice production i.e respiration, phonation, resonance, vocal range and flexibility.

A study by Prathiba, Yeshoda (2012) also administered a functional voice indicators of voice problems (FIVP) Voice screening protocol to obtain information regarding voice problems in 320 children age ranged from 3.5-5.5 years and to examine the prevalence of voice problems among preschoolers in Yemmingantur town, Andhra Pradesh. The results of the study reveal that the questionnaire is sensitive enough to group the children as having deviant vocal symptoms or not and it

was listed in four domains as vocal abusive behaviours, reactions of significant others, voice related symptoms and diet habits influencing voice.

Another study using a questionnaire was carried out to check for the prevalence of hoarseness in school aged children by Emma, Elisabeth, Sofia, Jenny, and Susanna (2014) and in this study both parental and teacher report was carried out for 217 children aged 6-10 years and it also supports the present study result by the findings that the Voice screening protocol used was sensitive to screen different vocal symptoms in children. In this study the authors could also point out to the frequently occurring vocal symptoms are throat clearing or coughing (11.5%, n = 25), the voice gets low or hoarse (5.5%, n =12), and difficulty in being heard (5.1%, n =11).

Table 1

Mean, Standard Deviation and Range for all variables

	Variables	**Maximum Value**	**Mean (SD)**	**Range(Minimum-Maximum)**
Screening protocol	Self report	40	26.56 (2.80)	13 (21.00 - 34.00)
	Observation by SLP	40	2.20 (2.76)	14 (0.00 - 14.00)
	Voice screening protocol (Self report+ observation by SLP)	80	28.76 (4.60)	26.00(21.00 - 47.00)
Perceptual	Overall Severity	100	17.24 (6.98)	38.33 (6.67 – 45.00)
	Roughness	100	13.80 (7.04)	39.33 (6.67 – 46.00)
	Breathiness	100	13.95 (5.76)	33.00 (6.67 – 39.67)
	Strain	100	12.65 (6.34)	38.33 (6.67 – 45.00)
	Pitch	100	9.76 (3.99)	26.67 (8.33 – 35.00)
	Loudness	100	9.71 (4.32)	26.67 (8.33 – 35.00)

Objective	Overall Severity /a/	0-3	0.99 (0.29)	1.24 (0.54 – 1.78)
	Irregularity /a/	0-3	1.11 (0.31)	1.35 (0.59 – 1.94)
	GNE /a/	1-0	0.66 (0.18)	0.74 (0.20 - 0.94)
	Noise /a/	0-3	0.71 (0.45)	2.21 (0.20 – 2.41)

2. Correlation between Voice screening protocol, Perceptual evaluation (CAPE-V) and Objective evaluation (ling WAVES VOSPECTOR)

Pearson correlation coefficient values were calculated to compare Voice screening protocol, perceptual evaluation (CAPE-V) and objective evaluation (ling WAVES VOSPECTOR) parameters. Table 2 shows the correlation between Voice screening protocol, Perceptual evaluation (CAPE-V) and Objective evaluation (ling WAVES VOSPECTOR) parameters. Results showed most of the parameters in CAPE-V had good correlation Voice screening protocol and it was significant at $P<0.001$ level. On the other hand, there was a poor correlation between Voice screening protocol and objective evaluation parameters.

Results revealed that Voice screening protocol had good correlation with perceptual measures (CAPE-V). It may be because both the measures are subjective judgement about the voice quality. But Voice screening protocol did not show good correlation with objective measures. This may be because the objective measures uses only one dimension of voice whereas as perceptual evaluation uses multi dimension of voice.

Prathiba, Yeshoda (2012) conducted a study to examine the prevalence of voice problems among preschoolers in Yemmingantur town, Andhra Pradesh. In this study 320 children participated wherein subjects were divided onto two age groups i.e 3.5-4.5years and 4.5-5.5 years and in each group consisted of 160 children of 80 boys

and 80 girls. All subjects were native speakers of telugu. The investigator administered functional voice indicators of voice problems (FIVP) questionnaire to obtain information regarding voice problems in these children by their parents and teachers. Children were also made to phonate vowel /a/ for 2 seconds and it was subjected to acoustic analyses using Dr. Speech software. The four major parameters mainly Jitter, shimmer, Standard deviation of F0, NNE were extracted from the acoustic analysis. Voice quality was also estimated with respect to hoarseness, harshness and breathiness and quantification was done numerically. Results in general revealed that there was no positive significant association between the domains of FIVP questionnaire and the subject group and also no significant difference was there between voice quality assessment and the gender. Both males and females obtained the same value. Results of the study also revealed that jitter and shimmer values were higher for older children when compared to younger children whereas NNE and SDF0 on the other hand was lower for older children when compared to younger children. Results also showed that domains of FIVP and voice quality estimates were negative indicating that the functional indicators of voice problems did not show a relationship with any parameters of voice quality. Using voice quality estimate periodic prevalence was calculated. In that subjects who scored a total of 5 and above were labelled as deviant voices. The results showed that out of 320 children who participated in the study 71 children had deviant voices among which 51% were males and 49% were females and the periodic prevalence was estimated as 22% in the given population.

A study was done by Hassan and Kaddah (2013) to see the Correlation between the Arabic pediatric voice handicap index (p-VHI) with both the auditory perceptual assessment and acoustic analysis of voice. In this study 32 children age

ranged from 4.7–11.8 years and who were diagnosed with hyperfunctional childhood dysphonia served as the participants. For auditory perceptual assessment modified GRBAS scale was used and acoustic voice analysis was carried out using Kay Elemetrics' Computerized Speech Laboratory to obtain the different perturbation measures. Results of the study revealed that auditory perceptual measures and p-VHI showed a significant correlation of $P<0.05$ and acoustic voice analysis and p-VHI did not show good correlation.

Table 2

Correlation between Voice screening protocol, Perceptual Evaluation (CAPE-V) and Objective Evaluation (Ling wave VOSPECTOR)

	Voice screening protocol		
		r-value	p-value
Perceptual	Overall Severity	0.494**	0.000
	Roughness	0.514**	0.000
	Breathiness	0.409**	0.000
	Strain	0.375**	0.000
	Pitch	0.315**	0.001
	Loudness	0.283**	0.003
Objective	Overall Severity /a/	0.131	0.170
	Irregularity /a/	0.101	0.287
	GNE /a/	-0.140	0.141
	Noise /a/	0.094	0.325

3. Frequency of all the variables

Children with Voice screening protocol score of above 18 and children with CAPE-V score of above 25 in overall severity has been considered as voice disordered. Similarly in children with objective score of above 1.5 in overall severity was considered as children with voice disorder. After assigning all these thresholds to all the 3 measures these were subjected to descriptive statistics and frequency of occurrence of normal and abnormal subjects were obtained. Table 3 represents the frequency of occurrence of normal and abnormal subjects with respect to the thresholds being assigned. Results reveal that 80% it could be effective to separate all normal subjects from abnormal subjects. However, only 10% of error is noticed in classifying the voice disorder.

Although correlations are not showing greater relation between all the 3 measures which are the Voice screening protocol, perceptual (CAPE-V) and Objective (Ling WAVES) parameters. After assigning the threshold 80 % of the measures are in good agreement and 20% not in good agreement which helps in classifying the voice disorder as normal or abnormal based on the scores.

Considering the above values as the threshold (or) cut off to separate children with normal voice and voice disorder, 89 children showed normal in all three groups of measure and 4 children showed abnormality.

Table 3

Frequency of all the variables

Variables	**Frequency**
All Normal	89
All Abnormal	4
Voice screening protocol Normal, CAPE-V and OSa Abnormal	4
Voice screening protocol Abnormal, CAPE-V and OSa Normal	5
Voice screening protocol and CAPE-V Normal, OSa Abnormal	4
Voice screening protocol and CAPE-V Abnormal, OSa Normal	1
Voice screening protocol and OSa Normal, CAPE-V Abnormal	5
Total	112

4. Prevalence of voice disorders in children

According to the present study the prevalence results are represented in table 4 and it shows that there is a prevalence rate of 20.53% i.e out of 113 participants 23 were classified as having voice disorders based on all the three groups of measure. That is abnormal in any one group of measure was considered as children with voice disorders.

Prathiba, Yeshoda (2012) reported prevalence of voice problems among preschoolers of 3.5-5.5 years age in Yemmingantur town, Andhra Pradesh was estimated as 22% in the given population.

Konadath et al. (2013) conducted a study to see the prevalence of communication disorders in rural population of India and the study was a door-to-door survey of 15,441 individuals from 15 villages, in Mandya district, Karnataka and results revealed that a prevalence of 35.77% voice disorders was seen in the age range of 15-50 years and >50 years.

Table 4

Prevalence of voice disorders in children

Variables	**Prevalence**
All Abnormal	3.5%
Abnormal in any one of the measures	20.53%
Voice screening protocol Normal, CAPE-V and OSa Abnormal	3.5%
Voice screening protocol Abnormal, CAPE-V and OSa Normal	4.4%
Voice screening protocol and CAPE-V Normal, OSa Abnormal	3.4%
Voice screening protocol and CAPE-V Abnormal, OSa Normal	0.8%
Voice screening protocol and OSa Normal, CAPE-V Abnormal	4.4%
Total	112

5. Correlation between self report and Observation by SLP

The Voice screening protocol had two parts that is self report and observation by SLP. Pearson correlation coefficient values were performed to compare between

the two parts of the Voice screening protocol that is self report and observation by SLP. Table 5 shows the coefficient value between self report and observation by SLP and the results indicate that both the self report and observation by SLP has a fair correlation (0.382) of $p<0.001$

A study was carried out by Oliveria etal (2012) wherein the authors investigated about the patient's and clinician view point about dysphonia. In this study 96 individuals served as the participants which included 48 with vocal complaints with a mean age of 51 years and 48 with no vocal complaints with a mean age of 46 years. All participants answered the Voice-Related Quality of Life (V-RQOL) questionnaire, performed a vocal self-assessment by rating questions. For the auditory perceptual analysis phonation of vowel /a/ and number samples were taken. Results revealed that Voice-Related Quality of Life (V-RQOL) questionnaire, vocal self-assessment and auditory-perceptual analysis of voice showed a fair correlation of <0.001.

Table 5

Correlation between Self report and Observation by SLP

	Observation by SLP	
	r-value	p-value
Self Report	0.382**	0.000

6. Correlation between Observation by SLP and Perceptual evaluation (CAPE-V)

Pearson correlation coefficient values were calculated to compare between observation by SLP and perceptual evaluation (CAPE-V). Table 6 illustrated the

coefficient value between Observation by SLP and Perceptual evaluation (CAPE-V) and the results revealed that Observation by SLP and each parameter of CAPE-V like overall severity, roughness, breathiness, strain, pitch and loudness showed a highly significant positive correlation. Since both the measurement is made by the Speech language pathologist (SLP) only there was a significant high positive correlation.

A study carried out by Mozannica (2014) in which eighty dysphonic patients and 120 asymptomatic subjects were enrolled in this study and the voice signal of each participant were recorded, listened to and rated by 3 licensed speech language pathologists using GRBAS scale and the Italian version of the CAPE-V. Results revealed that the highest average correlation between GRBAS and CAPE-V judgements was found between overall severity and grade while the lowest was found between the two strain scales.

Table 6

Correlation between Observation by SLP and Perceptual Evaluation (CAPEV)

		Observation by SLP	
		r-value	p-value
Perceptual	Overall Severity	0.576**	0.000
	Roughness	0.620**	0.000
	Breathiness	0.446**	0.000
	Strain	0.516**	0.000
	Pitch	0.415**	0.000
	Loudness	0.394**	0.000

7. Correlation between self report and perceptual evaluation (CAPE-V)

Pearson correlation coefficient values were calculated to compare between self report and perceptual evaluation (CAPE-V). Table 7 illustrated the coefficient value between self report and Perceptual evaluation (CAPE-V) and the results revealed that Self report and CAPE-V showed fair correlation.

Since self report is by the children (or) the verbal responses of the children has been measured as self report and perceptual rating is made by speech language pathologist (SLP). These two individual differ in life experience and the professional skill experience. Since. There is less correlation.

Table 7

Correlation between self report and perceptual Evaluation (CAPE-V)

		Self Report	
		r-value	p-value
Perceptual	Overall Severity	0.261**	0.005
	Roughness	0.254**	0.007
	Breathiness	0.244**	0.010
	Strain	0.128	0.178
	Pitch	0.124	0.192
	Loudness	0.091	0.339

8. Correlation between self report and Objective evaluation (ling WAVES VOSPECTOR)

Pearson correlation coefficient values were calculated to compare between self report and Objective evaluation (ling WAVES VOSPECTOR) parameters. Table 8 illustrated the coefficient value between self report and Objective evaluation (ling WAVES VOSPECTOR) parameters and the results revealed that Self report and Objective evaluation (ling WAVES VOSPECTOR) parameters like overall severity, irregularity, Glottal to Noise Excitation ratio (GNE) and noise for the vowel /a/ showed poor correlation.

A similar study was done by Woisard etal (2006) to see for the correlation between subjective patient response and objective analysis of voice. In this study 58 people served as the participants and Voice handicap index was used as the subjective measure and for objective analysis minimum frequency, maximum frequency, range, minimum intensity, subglottic pressure, mean flow, maximum phonation time, jitter, and dysphonia severity index were extracted and the results of this study give similar results that the VHI and the objective measurements showed a poor correlation.

Table 8

Correlation between Self report and Objective Evaluation (Ling wave VOSPECTOR)

	Self Report	
	r-value	p-value
Objective: Overall Severity /a/	0.006	0.952
Irregularity /a/	-0.013	0.893
GNE /a/	-0.038	0.693
Noise /a/	0.001	0.992

9. Correlation between Observation by SLP and Objective evaluation (ling WAVES VOSPECTOR)

Pearson correlation coefficient values were calculated to compare between observation by SLP and Objective evaluation (ling WAVES VOSPECTOR) parameters. Table 9 illustrated the coefficient value between observation by SLP and Objective evaluation (ling WAVES VOSPECTOR) and the results showed that objective evaluation parameters like overall severity and irregularity for the vowel /a/ and observation by SLP were significantly difference at $P<0.05$ and Glottal to Noise Excitation ratio (GNE) for the vowel /a/ and observation by SLP showed a negative correlation.

Table 9

Correlation between Observation by SLP and Objective Evaluation (Ling wave VOSPECTOR)

	Observation by SLP		
		r-value	p-value
Objective	Overall Severity /a/	0.222*	0.018
	Irregularity /a/	0.192*	0.043
	GNE /a/	-0.204*	0.031
	Noise /a/	0.163	0.085

10. Inter- rater reliability of perceptual evaluation (CAPE-V) parameters

Inter-rater reliability was estimated using Cronbach's Alpha. Table 10 shows the Cronbach's Alpha value for CAPE-V parameters and the results reveal that the

reliability was good for overall severity and roughness (0.612 and 0.641 respectively) and average reliability for breathiness, strain, pitch and loudness (0.516, 0.564, 0.482 and 0.551 respectively).

One of the study supporting the similar findings was given by Kelchner Etal (2010) using perceptual (CAPE-V) parameters to look for the intra- rater reliability in rating severe paediatric voice disorders age ranging from 4- 20 years. The authors calculated the intraclass correlation coefficient (ICC) for each vocal attribute to assess intra- rater reliability and the findings shows that the average consistency of internal ratings of overall severity was strongest (ICC = 87%), followed by roughness (ICC= 82%), breathiness (ICC = 82%), loudness (ICC = 79%), and pitch (ICC = 78%). On the other hand, Strain (ICC = 63%) was

not consistently rated within the raters.

Table 10

Inter- rater reliability of perceptual evaluation (CAPE-V) parameters

CAPE-V	Cronbach's Alpha Value
Overall Severity	0.612
Roughness	0.641
Breathiness	0.516
Strain	0.564
Pitch	0.482
Loudness	0.551

CHAPTER V

SUMMARY AND CONCLUSIONS

Communication is a process of exchanging ideas or thoughts between individuals. Speech is the chief medium of communication and social adaptation. Voice is the basic source for the speech. Voice is an important attribute which contribute to an effective communication from birth till old aged individuals. There can be some deviant vocal behaviours seen in some individuals which can be a voice disorder. Voice disorder is defined as voice that differs from other persons of the same age, gender, and social group. There can be many voice symptoms or behaviours seen in school going children due to vocal loading factors in the environment, such as background noise, room acoustics, air quality, ergonomics, and psychosocial factors. Individual factors such as gender, vocal endurance, health condition, life habits, personality, and genetics also can contribute to vocal problems in children. Also in India the class room condition are poorly maintained than developed countries.

Hence, the current study aims to develop a screening protocol for school going children and to validate the screening protocol using perceptual (CAPE-V) and acoustic measurements (*ling* WAVES VOSPECTOR).

In the present study a total of 112 native Malayalam speakers in the age range of 8- 13 years were participated. The participants were from 3rd grade to 8th grade from three different schools which are in the southern part of Kerala, i.e Ernakulam. Initially the Voice screening protocol was developed and validated in different steps as mentioned earlier. These children were subjected to fill the first part of the Voice

screening protocol i.e the self report in a bipolar manner and were indulged in different tasks like simple conversations, counting from 1-10, phonation of vowel /a/,/i/,/u/and vocal range task in terms of both pitch and loudness. During these tasks observations were made by the Speech Language Pathologist and it was rated on a 3 point rating scale in the second part of the Voice screening protocol. All these tasks were also recorded using Sony recorder ICD-UX543 and from this recordings the phonation, Simple conversation or counting from 1-10 were used as a stimuli for CAPE-V analysis and it was rated by three Speech Language Pathologists who has an experience in speech and voice analysis. For objective analysis steady state portion of vowel /a/ was taken and values for parameters like Glottal to Noise Excitation ratio (GNE), Noise, Irregularity and overall severity for the vowel /a/ was extracted using *ling* WAVES VOSPECTOR.

The results of the present study revealed that the Voice screening protocol is more sensitive in determining voice disorders in children compared to CAPE-V and Ling WAVES parameters and it has a good correlation with perceptual measures (CAPE-V) than objective measures (ling WAVES). This good correlation may be because both the Voice screening protocol as well as CAPE-V gives a subjective judgement about voice quality and poor correlation with objective measures may be because of objective measures uses only one dimension of voices whereas Perceptual measures uses multi dimension of voice. Although correlations are not showing greater relation between all the 3 measures which are the Voice screening protocol, perceptual (CAPE-V) and Objective (Ling WAVES) parameters, after assigning the threshold value of 18 and above for the Voice screening protocol, 25 and above for the Overall severity in CAPE-V and above 1.5 for overall severity in objective measures results showed that 80 % of the measures are in good agreement and 20%

not in good agreement which helps in classifying the voice as normal or abnormal based on the scores. Hence, results shows that voice screening protocol is a valid tool in screening and thereby classifying children as having a voice disorder or not based on the Voice screening protocol scores. According to the present study the prevalence rate of 20.53% i.e out of 113 participants 23 were classified as having voice disorders based on all the three groups of measure.

Limitations of the study

- Although the voice screening protocol is sensitive in detecting voice disorders in children, specificity of the same need to be evaluated.
- In voice screening protocol, the sections A might be difficult to comprehend and responses for very younger children, which might affect the screening efficiency
- Very young children could not follow the instructions even after proper modelling and assistance.
- The recording of the voice samples was not done in a completely sound treated room.

Future Directions

- Efficacy of the Voice screening protocol can be checked by administrating the Voice screening protocol in voice disordered children.
- This screening protocol can be adapted to different languages

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Appendix 1

VOICE SCREENING PROTOCOL

[Section A: Self report of voice problem by child and Section B: Observation by Speech Language pathologist (SLP)] in English

School Name:
Place:

SECTION – A: Self report of voice problem by child

Put a ✓ Mark on the most suitable box

Name: **Age/Gender:** **Date:**

		No	**Yes**
1.	Do you feel any difficulty/discomfort in the throat while speaking?		
2.	Do you feel your voice is very soft/ weak?		
3.	Is your voice good in the morning and worsens as the day progress?		
4.	Do you have difficulty in raising your voice ?		
5.	Do you feel pain in the throat while speaking or shouting?		
6.	Do you feel sensation of burning in the throat often?		
7.	Do you indulge in excessive throat clearing/ coughing?		
8.	Do you have irritation/ itching sensation in the throat while speaking?		
9.	Do you have frequent cold/ throat infection?		
10.	Do you feel tired when you speak for long time?		
11.	Do you shout/ scream/ cry very often (while playing or home)?		
12.	Do you eat spicy food or drink soda very often?		
13.	Are you living (home/school) in noisy environment?		
14.	Do you speak louder than other children/ family members?		
15.	Do you participate in extra- curricular activities like sports, games, professional singing ?		
16.	Do you imitate other speech or animal sounds very often?		
17.	Do anyone in your family has hearing problem/ voice problem?		
18.	Do you think your voice is different from your friends/ classmates?		
19.	Did you consult doctor previously any time for any voice problem?		
20.	Do you think you have a voice problem or Do you get teased about your voice?		
	Total score		

Voice screening protocol for school children - AIISH
School Name:
Place:

SECTION –B : Observation by Speech Language pathologist (SLP)

Scoring: **0** – Normal condition/function **1** – Mild impairment **2** – Moderate / Severe impairment

Put a ✓ Mark on the most suitable box

		0	1	2
Observation 1: Breathing pattern of the child				
Q:1	Breathing pattern			
Q:2	Breath duration			
Q:3	Stridor during inhalation or exhalation			
Observation 2: Simple conversation (3-5 sentences) / counting from 1-10 numbers				
Q:4	Conversational pitch			
Q:5	Presents Adequate pitch and loudness variation in conversation			
Q:6	vocal strain or effort			
Q:7	Overall quality of the speech			
Observation 3: Phonation of vowels (/a/,/i/,/u/)				
Q:8	Overall voice quality			
Q:9	Roughness of voice			
Q:10	Breathiness of voice			
Q:11	Strain of voice			
Q:12	Pitch/loudness of voice			
Q:13	Voice break/ Aphonia while phonation			
Q:14	Phonation duration of vowel /a/			
Q:15	Glottal fry / glottal attack (Presences indicate abnormal)			
Q:16	Nasality of the voice/ Audible nasal emission			
Observation 4: Vocal range task (Pitch and loudness) Demonstration of glide on upward for pitch & loudness				
Q:17	Pitch range			
Q:18	Loudness range			
Observation 5: Symptoms related to child voice				
Q:19	Throat clearing or cough?			
Q:20	Muscle tension at the neck region during speaking or phonation			
Additional remark by SLP				
Name & signature of the SLP:				

Translated version of Section A (Self Report of voice problem by child) in Malayalam

SECTION – A : Self report of the voice problem by the child

Put a ✓Mark on the most suitable box

പേര്: വയസ്സ്: ആൺ/പെൺ: തീയതി:

		ഇല്ല	ഉണ്ട്
1.	നിങ്ങൾ സംസാരിക്കുമ്പോൾ തൊണ്ടയിൽ എന്തെങ്കിലും ബുദ്ധിമുട്ട്/അസ്വസ്ഥത തോന്നാറുണ്ടോ?		
2.	നിങ്ങളുടെ ശബ്ദം വളരെ ദുർബലമാണെന്ന് തോന്നാറുണ്ടോ?		
3.	നിങ്ങളുടെ ശബ്ദം രാവിലെ നല്ലതും വൈകുന്നേരമാകുമ്പോഴേക്കും മോശം ആവുകയും ചെയ്യുന്നതായി തോന്നിയിട്ടോ?		
4.	ശബ്ദം ഉച്ചത്തിൽ സംസാരിക്കാൻ ബുദ്ധിമുട്ട് തോന്നാറുണ്ടോ?		
5.	സംസാരിക്കുമ്പോഴോ ഒച്ച വെയ്ക്കുമ്പോഴോ തൊണ്ടയിൽ വേദന ഉണ്ടാവാറുണ്ടോ?		
6.	ഇടയ്ക്കിടെ തൊണ്ടയിൽ എരിച്ചിൽ പോലെ അനുഭവപ്പെടാറുണ്ടോ?		
7.	ഇടയ്ക്കിടയ്ക്ക് ചുമയ്ക്കുകയോ തൊണ്ട ക്ലിയർ ചെയ്യാറുണ്ടോ?		
8.	സംസാരിക്കുമ്പോൾ തൊണ്ടയിൽ കരകരപ്പോ/ ചൊറിച്ചിലോ അനുഭവപ്പെടാറുണ്ടോ?		
9.	ഇടയ്ക്കിടയ്ക്ക് തൊണ്ടയിൽ അണുബാധ ഉണ്ടാകുകയോ/ ജലദോഷം പിടിക്കുകയോ ചെയ്യാറുണ്ടോ?		
10.	കുറേ നേരം സംസാരിച്ച് കഴിയുമ്പോൾ ക്ഷീണം തോന്നാറുണ്ടോ?		
11.	അമിതമായി ഒച്ച എടുക്കുകയോ/ അലറുകയോ/ കരയുകയോ ചെയ്യാറുണ്ടോ? (കളിക്കുമ്പോഴോ, വീട്ടിൽ വെച്ചോ മറ്റോ?)		
12.	ഇടയ്ക്കിടയ്ക്ക് എരിവും പുളിയുമുള്ള ഭക്ഷണ പാനീയങ്ങൾ / സോഡ തുടങ്ങിയവ കഴിക്കാറുണ്ടോ?		
13.	നിങ്ങൾ താമസിക്കുന്നത് ശബ്ദ മലിനീകരണം ഉള്ള സ്ഥലത്താണോ?		
14.	നിങ്ങൾ മറ്റു കുട്ടികളേക്കാളും/ വീട്ടിലുള്ള മറ്റുള്ളവരെക്കാളും ഉറക്കയാണോ സംസാരിക്കാറ്?		
15.	മറ്റു കലാ കായിക പരിപാടികൾ (സ്പോർട്സ്, കളികൾ, പാട്ട്) പങ്കെടുക്കാറുണ്ടോ?		
16.	മറ്റുള്ളവരുടെ സംസാരമോ മൃഗങ്ങളുടെ ശബ്ദമോ അനുകരിക്കാൻ ശ്രമിക്കാറുണ്ടോ?		
17.	വീട്ടിൽ ആർക്കെങ്കിലും ശബ്ദത്തിൽ പ്രശ്നമോ/ കേൾവിക്കുറവോ ഉണ്ടോ?		
18.	നിങ്ങളുടെ ശബ്ദം മറ്റു സുഹൃത്തുക്കളുടെയോ/ സഹപാടികളുടെയോ ശബ്ദത്തിൽ നിന്ന് വ്യത്യാസം ഉള്ളതായി തോന്നിയിട്ടുണ്ടോ?		
19.	നിങ്ങൾ ഇതിന് മുമ്പ് എപ്പോഴെങ്കിലും ശബ്ദത്തിന്റെ പ്രശ്നത്തിനായി ഡോക്ടറെ കണ്ടിട്ടുണ്ടോ?		
20.	നിങ്ങളുടെ ശബ്ദത്തിന് പ്രശ്നം ഉള്ളതായി തോന്നിയിട്ടുണ്ടോ/ ആരെങ്കിലും നിങ്ങളുടെ ശബ്ദത്തെ കളിയാക്കാറുണ്ടോ?		
	Total Score		