CHAPTER - 5

Discussion
DISCUSSION

The preceding chapter “Results” documented the findings (both qualitative and quantitative) of the current study. This chapter attempts to infer and rationalize those findings and draw conclusions on the study population and study objectives. The chosen design of “cross sectional” in this study is justified on its value for providing descriptive information about disease prevalence and related factors (Hulley and Cummings, 1988) and enabling of data collection in a practical way of large amount of information (Russell et al, 1998).

CCO’s by their lifestyle, stress at work environment and the necessity of attending phone calls continuously have clearly indicated that they are engaged in vocally demanding behaviour. Information on the prevalence of voice problems and risk factors in such a recently emerged and growing “professional voice user” group is warranted to address the concerns on their professional career. It’s felt that this information could be the base on which future research questions could be addressed, as this population group continues to grow over the coming decades. Studies in the western context of this population have been documented. However, the conditions not being totally similar between them and ours, this is probably the first study investigating the prevalence of voice problems in CCOs in the Indian context. The outcome of this study has enabled the researcher to estimate the prevalence of voice problems, note the risk factors and their impact on work performance, as well as identify the nature of the voice problems by acoustic and perceptual voice analyses; in the Indian CCO’s. As the study has been done at Bengaluru, the IT capital, a haven for CCOs, the results could be extrapolated for other metropolis and big cities, for comparison, decision and implementation.
5.1 Response rate and demographic/vocational information

In order to determine the prevalence of voice problems in this population, a questionnaire developed by Jones et al (2002) was adopted and appropriately modified. Data for this study was obtained from the CCOs working at different call centers in the city of Bengaluru, the citadel and hub of IT, in South India. Due to non-availability of documented statistics on Indian call centers and the lack of willingness by majority of the centers to participate in the study, purposive sampling was used to obtain the data. Managers of the call centers were personally contacted and apprised of the purpose of the study by the researcher. A moderate response rate (60.95%) was obtained from the call center employees, attributed to the method of distribution and collection of the questionnaires. That is, the researcher, as per the protocol, contacted the HR managers in all the call centers and requested distribution and collection of the completed questionnaires from the employees. It is felt that the attitude of HR managers towards the study in general, and the lack of personal contact between the researcher and the CCOs, both not in the control of the researcher could have played a significant role in the obtained response rate, which other wise could have been higher. However, the absolute number of useful responses obtained in the present study could be considered adequate to provide information on self-experienced voice problems among the CCOs. Questionnaires, according to Kooijman et al., (2006), are very cost effective when compared to face to face interviews for studies involving large sample sizes and large geographical areas. Whether they overestimate or underestimate the prevalence of voice complaints is difficult to answer. It could be that either people with voice problems are more interested to answer the questions or may be more reluctant due to private fears and uncertainty. Hence, survey findings of such nature need to be interpreted cautiously with their
inherent limitations (Campbell, Reich, Klockars, McHenry, 1988), considered relevant for the current study.

The results of the present study have been discussed, based on the responses obtained from 11 call centers (7 international and 4 domestic) at Bengaluru. Of the obtained responses, 632 (58%) were from male CCOs and 461 (42%), females. Taylor and Bain (2004) reported that the proportion of female call center employees varied between domestic and international call centers (60% Vs 42%). In India, males outnumber female employees by a ratio of 7:3 (Chaudhary et al, 2003) and is attributed to the higher attrition rates in females. The male preponderance over the female CCO’s as in the previously quoted study was observed in this study also.

The mean age of the CCOs in the present study was 24 years (range of 18 - 38 years), slightly lower than the mean age (29 years) reported in the limited literature on Indian CCOs (Suparna, Sharma, Khandekar, 2005). Most of the CCOs were graduates (64% males and 72% females) or with higher secondary education (29% males and 19% females). This supports the report of Batt et al., (2005) that Indian call center employees are required to have a minimum of 15 years education with good English knowledge in both domestic and international call centers. It was also observed that, 72% (males) and 67% (females) of CCOs who participated in the study reported of having an experience of two years or less. This could be attributed to the fact that, in India, the call center employee exit and burnout occur in extremes; they end up in quitting jobs due to the tough working conditions, erratic working hours, assuming false identities, copying foreign accents and changes in social and family life (Taylor & Bain, 2005).
As the call center work demands responding to telephone calls and simultaneously using display screen equipment, head set phones are more comfortable for the CCOs. This could be the possible reason for 84% of the CCOs in the present study using head set phones. As most of the data of the present study emanated from international call centers, it was expected and observed that, 72% of them were on night shifts. This further endorses the fact that, most of the call centers in India serve the international customers (companies) and to meet their requirement, night shifts are being utilized the most (Nasscom, 2003). Gender wise, more males (75%) were on night shifts as compared to females (69%). This could be explained by the factors of cultural mind set, home responsibilities and physical issues of females as compared to males. Further, 41% of the CCOs were involved in inbound calls reflecting their role in customer service enquiries such as banking service, which the primary sector is served by both international and domestic call centers in India (Batt et al., 2005).

5.2 Prevalence of vocal symptoms

The prevalence of vocal symptoms in the present study was derived from an analysis of the participant’s response to the 14 vocal symptoms listed in the questionnaire. Of the 1093 call center operators who participated in the study, 647 (59%) had either single or multiple symptoms, a finding consistent with the reports of CCOs at risk for developing voice problems (Titze et al., 1997; Grayson, 2001; Jones et al., 2002; Taylor & Oates, 2005; Matic, 2006). The consistently higher prevalence of voice problems in CCOs from different studies suggests that vocal problems are universal, owing to the vocally abusive behaviour associated with this occupation. It has been reported that continuous use of voice for two hours is the maximum allowable time and exceeding that would cause a person's vocal mechanism to be strained and tensed (Lehto et al., 2003). The current study found call center operators working
for an average of eight hours per shift with occasional (2 times) 5-10 minutes break in between and an half an hour lunch/dinner break. This further reflects on the strain that their vocal mechanism is subjected to and leading to vocal symptoms. As reported by Titze (1999), in these professionals, the accumulated injury during the work shifts can reach a point where day to day recovery is not possible. This study endorses that these could be the possible reasons for the higher prevalence of vocal symptoms in call center operators. Another possibility for the higher percentage of vocal symptoms in CCOs in the present study could be the age group (20 to 30 years) of the participants, vulnerable for strain as reported by Tavares and Martins (2007) that younger employees lack preparation to deal with the vocal demands.

The present study found more female CCOs as compared to males reporting of vocal symptoms on the day of survey (28% Vs 25%) and during their career (60% Vs 58%); however, this was not statistically significant. This finding is in consonance with studies in the literature (Lehto et al., 2003; Taylor & Oates, 2004; Oliveira et al., 2009) reporting of non-significant differences in experiencing of vocal attrition symptoms between genders. This could find an explanation in the similar nature of work for both genders in call centers. Further, the male preponderance of vocal symptoms could also be attributed to the greater number of males on night shift, with its concomitant stress and related factors. Jones et el., (2002) reported of significant association between females (CCOs) and self-reporting of vocal symptoms. Higher frequency of vocal fold vibrations during daily working hours (Vilkman, 2000), lesser concentration of HA (Butler et al., 2001; Chan et al., 2001, Ward et al., 2002) and higher concern to health related aspects (Smith et al., 1998a) in females have been attributed for the higher prevalence. This is however, not statistically substantiated in the present study.
Among the 14 vocal symptoms reported, “dryness of the throat” (40% males and 45% females) and the “need to clear the throat” (31% males and 25% females) were the most prevalent in both genders of this study. Higher prevalence of these symptoms among the call center operators has been reported and attributed to relatively low ambient humidity in call center offices (Jones et al., 2002; Lehto et al., 2003; Lehto et al., 2005). This aspect has not been measured and documented in the current study and hence is not addressed in the discussion. Lehto et al., (2003) also observed quite a high temperature (23° C) in the call center offices along with low ambient humidity, which they attributed to dry air. On a similar note, HSE (2006) reports have indicated that computers in the call centers generated heat for 24 hours a day, which in turn caused increase in temperature and low humidity and resulted in dehydration and feeling of dry throat. It is generally accepted that, when a person experiences dry throat, there is an associated feeling of something lodged in the throat necessitating frequent throat clearing. Further analysis of the parameter of self-perceived hoarseness revealed it to be more in males which was statistically significant (p = 0.012). This is similar to the reports in the literature of self-reporting of hoarseness as the major symptom associated with vocal fatigue. However, the higher percentage of male CCOs reporting of hoarseness in this study could be attributed to the association between their low pitch and perception of hoarseness (Munoz et al., 2003).

Besides the frequently encountered vocal symptoms discussed above, Table 2 depicts other symptoms, scrutiny of which indicates that CCOs in general, experience vocal fatigue. Laryngeal fatigue is a vocal symptom caused by a number of factors including voice overuse, misuse or abuse, functional voice disorders, pathologic lesions, and neurologic disorders (Boone & McFarlane, 1988). The presence of vocal fatigue among the CCOs in the present
study could possibly be related to the heavy vocal loading of 8-9 hours of their telephone conversation, with the customers under heavy work pressure. Each CCO in the present study was expected to handle around 80 -100 calls/day of overseas customers (personal communication) warranting excessive use of their voice to meet their job demands. In addition, it could also be interpreted as an outcome of functional voice disturbances and in reverse, as a consequence of voice load or inappropriate vocal behaviour (Sapir et al., 1990).

It was further observed in the present study that majority (n = 509) of the CCOs reported multiple (two or more) symptoms. Among them, 92% (92% males and 93% females) experienced them frequently (once in two months or more frequently); 40% had these symptoms daily with a greater number identifying them as of milder degree and only 4%, as of severe degree. This clearly suggests that CCOs are prone to experience more frequent voice problems, though not with great severity. Similar findings have been reported in the literature (Lehto et al., 2003; Lehto et al., 2005). It is our assumption that in spite of the presence of these symptoms having an influence on the job performance, they were not greatly debilitating which probably explains their rating as less severe. Further, as stated in the literature, telephone conversation, the main mode of job oriented communication of CCOs is a dialogue than monologue with a chance for short recovery during the calls and tends to reduce the impact on the vocal mechanism and its severity (Lehto et al., 2005).

This study was also interested in finding out as to how CCOs rated their voice quality at the beginning and at the end of the shifts with the presumption that this would serve as an indirect reflection of their vocal loading at job. Interestingly, a larger number (83%) reported of normal voice at the beginning of the shift with 61% experiencing change of voice quality
(hoarse or loss of voice) at the end of the shift. A comparatively higher percentage of female CCOs (7% Vs 3%) reported loss of voice, while higher percentage of male CCOs reported of hoarse voice. It is speculated that the reporting of loss of voice by female CCOs could be due to the progressing degree of breathiness in them with vocal loading which is perceived as loss of voice, though not practically aphonic in its true form. This reiterates on the literature reports that CCOs are prone to vocal loading effects with a linear increase in all subjective voice symptoms (hoarseness, feeling of vocal strain, feeling of mucus in the throat) (Lehto et al., 2003; Lehto et al., 2005). It can thus be stated that, CCOs are at greater risk of developing voice disorders, as substantiated in the current study and literature (Gilardi et al., 2008). As the greater frequency of occurrence of vocal symptoms is considered as the early signs of vocal attrition (Casper & Murry, 2000), the current study projects the need to educate CCOs on early identification and management.

5.3 Impact of vocal symptoms in CCOs

The presence of vocal symptoms in professional voice users has significant impact on their psychological wellbeing and performance. The impaired voice poses a serious disability and is a significant source of stress or distress in them (Sapir, 1993). To assess the impact of voice problems on their work, those CCOs who experienced one or more of the 14 symptoms, were asked to describe whether their vocal symptoms caused any stress or frustration and affected their productivity, interaction with family or friends; further, whether they resulted in their missing work. It was found that the presence of vocal symptom as a major source of frustration was in only 10% of the CCOs and affecting social interaction in 14.5% with no significant gender difference. However, significantly higher number of female CCOs reported that vocal symptoms affected their ability to do their job when compared to males ($\chi^2 =$
9.466, p = 0.002). 45% of them (39% males and 51% females) reported of their work being affected which was also statistically significant ($\chi^2 = 9.466, p = 0.002$) in female CCOs. This is similar to the findings of Yiu (2002) that the impact of voice problems on an individual does not depend merely on the severity of the symptom but on how an individual perceives, reacts and adjusts to the problem. This was evident in the present study where CCOs of both genders reported vocal symptoms with similar degree of severity and frequency of occurrence, with females CCOs finding their work being affected significantly than males. The findings also indicate that the female CCOs are more sensitive to voice changes and experience greater impact on their work performance than males.

Most of the CCOs (both genders) in the current study reported of their work productivity being affected as they needed to repeat the information and force their voices to be understood, as quoted in the literature (Jones et al., 2002). 30% of the CCOs attributed the effect of these symptoms on attending to the number of calls and the hyped enthusiasm in selling the product. It is worth noting that though a significantly higher number of female CCOs reported of work being affected due to vocal symptoms, it was the males who scored over the females in one of the aspects of impact determination i.e., taking more breaks from the phone. With reference to the gender difference in the reporting of work being affected due to vocal symptoms, it is reasonable to assume that males are more reluctant to admit of work being affected with their less concern about the consequences of vocal symptoms and concern for image (toughness) as compared to females.

Another way to estimate and interpret the impact of vocal symptoms is the number of working days missed due to the presence of the vocal symptoms. In spite of experiencing
difficulty in their work productivity due to vocal symptoms, only 28% indicated that they missed work. 24% missed work for few days or less than a week and only 4% (6% females and 2% males) missed work for a week or more. It could hence be presumed that, CCOs though prone to frequent and mild degrees of voice problems do not face extensive impact and great concern. Further, it’s to be noted that significantly higher number of female CCOs missed work than males. This could be attributed to the comments of Herrington-Hall et al., (1988) that women in general, are more likely to recognize bodily changes as symptoms of illness and are more concerned with their health problems than their male counterparts. It is felt that this higher concern about the vocal symptoms and sensitivity results in their taking more time off from work.

5.4 Seeking medical help and knowledge of voice care in CCOs

It was also intended to probe and understand whether call center employees sought help for their voice problems from medical professionals or SLPs. From the results, it’s evident that in spite of a higher number of CCOs experiencing frequent voice symptoms, considerably less number of them sought medical care. This finding in the present study is applicable to the population of teachers, documented by several studies (Russell et al., 1998; Smith et al., 1998a). On an average, 13% of the CCOs visited the physicians and only a paltry number (3%) consulted speech language pathologists. Among the 13 % CCOs who consulted physicians, 9% reported of their work being affected due to vocal symptoms while out of 3% who consulted the SLPs, 2% experienced difficulty in performing their jobs. This lower percentage of CCOs seeking professional help could be due to unawareness, lack of time owing to busy work schedule (night shifts) to honour medical appointments, financial constraints, anxiety over seeing a voice expert, apprehension regarding laryngeal endoscopy
and its outcome. Another potential factor that could be accounted for is the lack of awareness of the services provided by laryngologists and speech pathologists in voice care. Studies in the literature have reported of low levels of knowledge related to professionals involved in voice care among the professional voice users (Chan, 1994; Zeine & Walter, 2002; Yiu, 2002; Gilman, Merati, Klein, Hapner & Johns, 2009). This is rightly or more applicable in the Indian context where SLPs as voice care professionals are less known.

Basically, voice care knowledge encompasses understanding the issues of vocal hygiene, limiting vocal hyper function and reducing vocally abusive behaviours (Pannbacker, 1998). Very few CCOs are instructed on the importance of voice and its care, besides identifying the early signs of vocal symptoms, by their employers. According to Jones et al., (2002), the ground reality is that most of the call centers refused to participate in the study primarily to avoid employee awareness of occupational related voice problems, which could affect the centers’ productivity. This is found to be true in the present study, where 86% of CCOs reported of not having received any instructions regarding voice care from their employers. On an average, only 14% received some instructions regarding voice care. A meagre 4% got instructions from the SLPs. Among the CCOs who received instructions for voice care, it was observed that 70% of them reported of vocal symptoms. This supports the findings of Batt et al., (2005) that, under the heading of ‘voice training’, call centers concentrate on training the tone of voice. In other words, the employees are made to concentrate more on how to use clear, calm and polite positive tone rather than on educating them regarding voice and its care. This view finds support from 71% of the CCOs in the present study (both who experienced vocal symptoms and who did not) who evinced interest in receiving instructions for voice care. No significant association was observed between the
severity of vocal symptoms and consulting the physician or SLP. This could be interpreted as
the nature and intensity of vocal problem for seeking help being dependent on its impact and
as perceived by the patient. This further indicates that the ability to adapt to, compensate for,
and overcome voice disorders is highly individualistic and to a certain degree, independent of
voice use. Hence, it is difficult to rely only on the participants’ reports in measuring the
impact of vocal demand and strongly warrants the development of a more individualized and
occupational based vocal care technique package to educate and implement voice care
programs during their training period.

5.5 Risk factors and their association with vocal symptoms

The present study examined the relationship between the possible risk factors
(demographic, vocational/work environment, biological and personality) and the vocal
symptoms. Multiple logistic regression analysis confirmed significant association between
certain vocational (working in other jobs, rising of voice because of noise, experiencing
stressful calls), personality (rate of speech) and biological (hearing loss, acid reflux, throat
clearing, hydration) risk factors with the reporting of vocal symptoms.

Demographic, vocational/work environment related factors

No significant association between vocal symptoms and demographic factors (age,
gender, education) was observed. There are reports in the literature of association between
older age groups (> 50 years) and voice problems (Russell et al., 1998; Smith et al., 1998a;
Roy et al., 2004). This aspect has not been highlighted in the current study, as the participants
were within the mean age group of 24.32 (males) and 24.08 (females). This younger age
group of the participants could probably be the reason for not finding any association between
age and vocal symptoms. Similarly, the absence of association between educational levels and vocal symptoms in the present study could be attributed to similar educational qualification of the participants.

Thirty nine percent of males and thirty percent of females reported of working in other professions of whom, 12% (males) and 11% (females) were required to actively use their voices. As depicted in Table 12, those working in other professions were 2.1 times at greater risk of developing vocal symptoms than others. Thus, it can be stated that, working overtime, could act as a significant risk factor for the development of vocal symptoms in CCOs as evident in the current study and documented in the literature on occupational injury (Loomis, 2005). As this factor is found to have a significant association with development of vocal symptoms, educating CCOs on avoiding extended work beyond their regular routine and when unavoidable, being cautious about use of voice during extended work time is justified and needs to be emphasized and practically implemented.

Risk of developing vocal symptoms was found to be three times higher in CCOs who raised their voices frequently due to ambient noise than those who did not. Benninghoven et al., (2005), reported that poor room acoustics was the principle factor for the development of voice problems in call center operators. To communicate effectively in the presence of high background noise, the CCOs raise the volumes in their headsets and speak louder, which further increases the ambient noise levels (Jasmine, 2004). It has been documented that this behaviour can lead to overuse or misuse of the voice and contributes to the development of voice disorders (Vilkman, 2000). The findings of the present study lend support to the reports in the literature (Jones et al, 2002; Taylor & Oates, 2004), that raising of voice due to noise
was significantly associated with work being affected in telemarketers. This could be explained by the Lombard effect (Lane & Tranel, 1971), where high levels of background noise increase the speaker’s vocal intensity and fundamental frequency, which in turn increase vocal fold approximation and its pressure of adduction and the risk of vocal fold dysfunction (van Heusden et al., 1979). Further, in the current study, it was observed that female CCOs exhibited greater needs to raise their voices due to noise than males, which was statistically significant. Similar findings are reported in female teachers (Seetha, Karmegam, Ismail, Sapaun, Ismail & Moli, 2008) who are stated to be more vulnerable to vocal loading in background noise with a need to put extra efforts to speak than men (Sodersten et al., 2005). It has been reported that, noise levels in work spaces where speech communication is essential should not exceed 62 dB (A). However, the background noise levels in the call centers during the working hours has been documented as 42 dB (A) in an open plan office at a call center in Finland, considered low and non-interfering with the telephone communication (Lehto et al, 2005). Similarly, Patel & Broughton (2002) found background noise as within 57 to 66 dB (A) in some of the call centers in India, higher than reported by Lehto et al, (2005) but not high enough to cause communication disturbances. As the noise levels at the call centers have not been measured in the current study owing to the restrictions placed by HR Managers, it can only be presumed that the noise levels in the study sites are in the range or exceeding the values reported by Patel & Broughton (2002) and thus contributing or otherwise to the vocal problems.

Quite a number (61% males and 64% females) of CCOs reported of experiencing stressful calls either occasionally or very often with no significant differences between the genders. Those CCOs who experienced stressful calls very often were 4 times likely to report
of vocal symptoms than those who did not. Similar findings have been reported by Jones et al., (2002); Taylor and Oates (2004) and Lin et al., (2010) who found significant association between experiencing stressful calls and work being affected. Generally, stress is more inherited in call center professionals than others (Holman, 2003; Sudhashree et al., 2005; Rocha et al., 2005). This finding is more applicable to the Indian setup and is reflected in the present study with 62% CCOs reporting stressful calls either occasionally or frequently. It is our as well as other researchers’ observation that Indian call center operators experience a lot of stress by way of telephone interaction which demands co-ordination of optimum psychological, behavioural and environmental settings to maintain an efficient balance. Even though Indian call centers recruit employees with a minimum of 15 years education with fairly good English knowledge, they are reported to be not sufficiently empowered to handle more than a routine call satisfactorily. This is true especially at the initial stages of the CCO’s career. With the compulsion of rigidly adhering to prepared scripts, and no flexibility allowed, very often, the CCOs find it difficult to interact with an irate or abusive customer (Taylor & Bain, 2005). Further, it has been commented that a subtle change in paralinguistic vocal features of CCOs could unconsciously irritate the customer and affect the communication process. Increased psychological stress has been stated to increase musculoskeletal tension leading to vocal dysfunction as pain and discomfort of laryngeal muscles, hoarseness, reduction of pitch range, and tight laryngeal and pharyngeal constriction (Johnson, 1993; Lierde et al, 2009). It is also stated that under stressful conditions, the precision of vocal fold movements is adversely affected by the state of mind and emotions of the owner of the voice (Stemple et al, 2000) and enhances the strain levels and tension within the vocal mechanism.
Hence, there is universal consensus that call center work is stressful and warrants the understanding of the relationship between stress and voice production in CCOs.

In terms of humidity level and temperature in the working environment, significantly higher number (p < 0.001) of female CCOs described their working environment as dry and cold. However, multiple logistic regression analysis did not reveal any significant association between describing the work environment as dry or cold and experiencing vocal symptoms. This is in contrast to the findings of Jones et al., (2002), who identified a significant association between describing the work environment as dry and cold with work being affected. Environmental humidity levels below 30% have been reported to be having significant effects on mucus membrane of the nose and throat (Vintturi, 2001). Heat generated by large number of computers in call center set ups have also been attributed to the increase of temperature and low humidity. Supporting this, Lehto et al., (2005) reported quite high temperature (23°C) in a call center. However, in the present study, working area humidity and temperature were not measured. In the absence of their quantification, it was considered inappropriate to be commented upon.

In the present study, 62% of males and 66% of female CCOs indicated “average” for comfort of chair at work. Interestingly, higher percentage of females rated ‘average’ for comfort of chair at work than males. 44% males and 45% females claimed of maintaining a good posture. This finding of more female participants reporting of average for comfort of chair than their male counterparts is in contrast to the literature reports of seating arrangements in call center work stations designed for men’s dimensions and causing women to work in awkward postures (Chaudhary et al, 2002; Norman, 2005; Hannif & Lamm, 2005).
It can hence be assumed that, in the present set up, female CCOs have probably learnt to adjust and use the work station equipment to meet their needs as revealed by no significant association between seating arrangements, posture and vocal symptoms. Even though most of the CCOs of the current study rated the comfort of chair as “average”, they did not consider it “comfortable” (Table 9). This needs to be interpreted with caution and the CCOs made aware of comfortable seating in work stations to avoid excessive neck muscle tension to prevent the development of associated voice problems. The present study has not probed into the complaints of musculoskeletal tension in specific and hence offers no comments related to it.

**Personality related risk factors**

In terms of personality factors, excessive talking in social situations, loud talking and talking with higher rate of speech were considered vocally abusive behaviours, if not primary causes of voice problems in many professional and non-professional voice users (Sapir et al., 1990; Sapir et al., 1992; Teachey, Kahane, Beckford, 1991). Long duration of loud talking is reported to increase glottal closure and increase the glottal strain and result in functional voice problems (Jiang, Titze, 1994; Verdolini, Hess, Titze, Bierhals, & Gross, 1999). However, excessive and loud talking in social situations did not show any significant association with reporting of vocal symptoms among CCOs in the present study. On the other hand, CCOs talking faster than others in social situations were found to have 40% lesser chance of developing vocal symptoms as compared to those who spoke slowly. This is strange, unexpected and in contrast to the reports in the literature of rapid rate of speech contributing to laryngeal pathology due to faulty use of laryngeal mechanism (Stemple et al., 2000). Further, in the present study, a greater number of CCOs (70%) with slow speech rates in social situations reported of experiencing vocal symptoms, another unexpected outcome.
These paradoxical findings in the present study can be interpreted based on our presumption that the presence of voice problems forced a higher number of CCOs to speak slowly in social situations, volitionally or otherwise. It is hence reasonable to assume that greater amount of vocal demands as dictated by the CCO’s lifestyle and occupation could strongly influence their speaking in social situations as evident from the results of the current study.

**Biological risk factors**

As expected, significantly higher percentage of male CCOs (41%) reported that, they were currently smoking as compared to female CCOs (6%). Smoking however did not have any apparent relationship with experiencing vocal symptoms in the present study. This is in contrast to the studies in the literature on the association between smoking and vocal symptoms (Jones et al., 2002; Murphy & Doyle, 1987; Benninger, 1993; Marcotullio et al., 2002; Gonzalez & Capri, 2004). The current study however, endorses other reports (Roy et al., 2004; Miller & Verdolini, 1995) of non-significant association between voice problems and smoking in teachers.

Logistic regression analysis did not reveal any significant association between different medical problems (asthma, nasal allergies, shortness of breath, sinus problems, frequent colds, dry mouth or throat) and reporting of vocal symptoms. This again is in contrast to the studies in literature (Benninger, 1993; Long et al., 1998; Vilkman, 2000;) where respiratory illnesses such as asthma, allergic rhinitis have been significantly related to voice complaints. Lack of significant association between these medical problems and vocal symptoms as found in the present study could be attributed to the generally reduced number of CCOs who experienced these medical symptoms.
Medication of CCOs in the present study has been observed to be mainly for medical problems such as sinus problems, asthma, frequent cold, thyroid and frequent headaches. Most of them reported to be on these medications for shorter duration (for one week or 10 days), with only 2% for longer duration, for their thyroid and asthma problems. Nearly every medication in the literature has been reported to have some laryngeal effects with drugs used in treating asthma (broncho-dilators) and upper respiratory tract infections (antihistamines, cough suppressants) having a significant effect on the vocal mechanism (Sataloff et al., 1993; Martin, 1988). The present study did not find any association between medication and experiencing vocal symptoms, attributed probably to the less number of CCOs on regular medication. Since it is a cross sectional study, it’s felt that, occasional medication wouldn’t have shown significant association with experiencing vocal symptoms.

Among the regular activities that stress the voice, coaching and clearing of throat were found to have significant association with experiencing vocal symptoms in the present study. This is in agreement with the reports of Jones et al, (2002). In the present study, even though only 10% of the CCOs were involved in coaching and 20%, of frequent throat clearing, they were found to be significantly associated with the presence of vocal symptoms than those not involved in coaching and frequent throat clearing. Non-productive throat clearing is considered to be one of the most prevalent forms of vocal abuse. Individuals frequently develop this behaviour as a response to perceived laryngeal sensations (dryness, tickling, burning and lump in the throat). Even mild throat clearing leads to vigorous, aperiodic adduction of the vocal folds (Stemple et al, 2000). It is hence reasonable to assume that the amount of vocal demands involved in coaching activity and amount of hyper adduction involved in frequent throat clearing could have significantly influenced the self-reported vocal
symptoms. This is well demonstrated by multiple logistic regression analysis which revealed that throat clearing and coaching have 3.7 and 1.8 times greater risk of developing vocal symptoms respectively.

In the present study, experiencing of acid reflux after every meal has shown 5.4 times greater risk of developing vocal symptoms compared to those who did not report any symptoms of acid reflux. This finding is in consonance with the studies in the literature (Koufman et al, 1996; Pribuisine, Uloza, Kupcinskas, & Jonaitis, 2006; Sataloff, 2008; Lowden et al, 2009) stating LPR as one of the most common causes involved with voice problems. Studies endorsing the association between LPR and dysphonia have attributed it to the inflammatory process (Reinke’s edema) and frequent throat clearing associated with LPR, which in turn alters the mucosa of the vocal folds. This could be the possible reason for the significant association between experiencing symptoms of LPR and vocal symptoms as reported by the CCOs. The presence of Reinke’s edema has not been visually documented in the present study and is only extrapolated from the literature reports. However, among the 647 CCOs who experienced one or more vocal symptoms, 99 (15%) had the habit of throat clearing as well as symptoms of acid reflux. This could be one of the possible reasons for the association between LPR and the reporting of vocal symptoms in the present study as throat clearing is considered a vocal abusive behavior associated with development of vocal symptoms.

Another biological factor significantly associated with reporting of vocal symptoms was hearing difficulty among the CCOs. CCOs are at greater risk of developing hearing problems owing to the frequent noise exposure through their headsets (acoustic shock)
leading to tinnitus and hearing loss (Local Authority Circular, 2006). However, according to
the reports of Patel and Broughton (2002), risk of hearing damage in the call center profession
is extremely low, as their exposure to noise levels is unlikely to exceed 80 dB (A) to cause
hearing loss. The findings of the present study support this view, as only 4% of the CCOs
reported of having hearing difficulty. However, hearing difficulty was found to have
significant association with reporting of vocal symptoms (Lane and Tranel, 1971; Benninger,
1993; Gotaas and Staar, 1993) which supports the findings of present study as CCOs having
hearing difficulty were 3.2 times at greater risk of developing vocal symptoms. Reports in the
literature suggest that, speakers who have hearing difficulty have less control over their
voices, and use higher pitch and increased vocal fold adduction, resulting in vocal loading and
symptoms of vocal fatigue (Lane and Tranel, 1971; Benninger, 1993; Gotaas and Staar,
1993). This was found to be true in the present study as 39 (85%) out of 46 CCOs with
hearing difficulty experienced vocal symptoms. This indicates the role of impaired hearing in
the development of vocal symptoms and warrants the need to educate the employers and
CCOs regarding the relationship between this factor and development of vocal symptoms and
to consider appropriate preventive measures.

Studies have indicated that systemic and surface hydration are important factors in
professional voice users to maintain healthy vocal system (Verdolini-Marrston et al, 1990;
Titze, 1994; Gray, 2000; Fisher et al, 2001; Chan & Tayama, 2002; Yiu & Chan, 2003;
Sivasankar et al, 2008; Sivasankar, 2010). According to these studies, dehydration leads to
elevation in the viscosity of vocal fold mucus and thus increases the stiffness of the vocal
folds. This, in turn, leads to greater friction and heat dissipation during vocal folds vibration
requiring greater energy to initiate and sustain phonation and causing vocal fatigue. Hence,
for individuals working in dry environment, drinking of 6 – 10 glasses of water was recommended (Stone, 1993). The present study initially considered that consuming more than seven glasses (11/2 liters) of water/day should protect the CCOs from developing vocal symptoms. On the contrary, 65% of the CCOs consuming more than seven glasses of water/day were experiencing higher vocal symptoms than (60%) those CCOs who consumed less than seven glasses/day. This paradoxical finding in the present study has led to our interpretation that CCOs experiencing vocal symptoms consume higher quantity of water and more frequently to keep their throat hydrated and for relief from the associated laryngeal sensations.

It was also further observed that significantly higher number (37%) of female CCOs reported of consuming lesser than 6 glasses of water compared to male CCOs (27%). This could be attributed to the practical problem of their need to use the rest room more often with consumption of more water and hampering their work schedule.

Caffeine is a vasodilator and has dehydrating effect on the mucosal membrane. Excessive caffeine intake has been reported to lead to thick, sticky mucus and frequent throat clearing or coughing (Stemple et al., 2000). However, this factor (consuming coffee/tea more than two cups/day) did not emerge as having any association with experiencing vocal symptoms in the present study. This could be attributed to the relatively lesser number of CCOs reporting of consuming more than two cups of coffee/tea and as stated in the recent study contradicting the association between caffeine and vocal symptoms (Erickson-Levendoski & Sivasankar, 2011). However, it is felt that caffeine intake could have
contributed to the CCOs reporting of dry mouth and throat and frequent throat clearing (Stemple et al., 2000), and indirectly influencing vocal symptoms.

The results of the present study hence indicate that besides the vocal demands experienced by CCOs, there are other factors such as vocational, personality and biological conditions that serve as contributing factors for vocal symptoms. These findings confirm that causes of voice symptoms are multifactorial and cannot be explained only by the amount of vocal demands involved in a particular profession as mentioned in the literature (Jones et al, 2002, Lehto et al, 2003, Lehto et al, 2005). This needs to be understood by researchers and clinicians attempting to probe further into the intricacies of vocal symptoms and management strategies in this evolving and unique population of professional speakers.

5.6 Acoustic analysis of voice

The purpose of comparing the acoustic parameters of voice between the two groups (those who reported of frequent vocal symptoms and those who did not) was to determine whether they can differentiate the two groups on the presumption that, acoustic measures help understand the physiology of vocal mechanism, even when no visually detectable lesion or tissue changes are present (Colton and Casper, 1996).

For this purpose, a wide set of acoustic parameters measured by the MDVP analysis from a single vocalization was used. It was further presumed that, the more extensive the parameters used, the more likelihood of finding the difference. “MDVP holds the promise of standardized and rapid assessment of voice; it is of particular interest as a tool for the characterization of a voice disorder” (Kent, Vorperian, Kent, Duffy, 2003). In the present study, no significant differences were observed between two groups across different acoustic
parameters barring H/N ratio among the female CCOs. On analysis, the median NHR values were found to be higher in both the groups compared to normative values but were significantly higher in those reporting of vocal symptoms than those who did not. From this finding, it can be assumed that, there is an incomplete glottic closure during phonation in both the groups, which is significantly higher in the females who reported of vocal symptoms. This also finds support in the perceptual rating of breathiness in greater number of female CCOs. Though female CCOs generally have incomplete glottic closure which results in perception of breathiness, the degree of hypo-function could be higher in those experiencing vocal symptoms. Thus, incomplete glottis closure during phonation can be considered as a risk factor for the development of vocal symptoms in female CCOs. Studies in the literature suggest that, NHR is a useful quantitative index to confirm dysphonia, but not the structural lesion (Gelfer et al, 1991; Roy & Bless, 2000; Jotz et al, 2002).

Based on the findings of the current study (no significant difference in the acoustic parameters among two groups), it can be presumed that, both the groups have either normal vocal fold physiology or that which is affected slightly. This is in accordance with the report of Lehto et al (2006), which did not find any correlation between subjective vocal complaints and objective (acoustic) measures (fundamental frequency, sound pressure level, and alpha ratio) in CCOs. As individual sensitivity to various vocal symptoms varies considerably and its impact is dependent on the amount of handicap perceived by the professional voice user, it is difficult to derive any association between self-reported voice symptoms and acoustic voice parameters.
Hence, to be more comprehensive, the present study compared the acoustic parameters of CCOs (combined from those reporting of voice problems and those who did not) with normative values of adult Indian population (Hema et al, 2009).

The results did not reveal any significant effect of voice use in call center professionals on the average fundamental frequency, highest fundamental frequency or lowest fundamental frequency in both the gender groups. However, significant differences were observed in standard deviation in F0 in both male and female groups, and the Phonatory F0-range in semitones in female CCOs. Literature reports of significant increase in F0 during vocal loading (pre and post loading condition). The raise in F0 followed by vocal loading is correlated with fatigue of throat, necessitating the compensatory act of raising the F0 (Rantala et al, 1999; Lehto et al., 2006). However, post loading increase in F0 is not supported by all the studies (Neils & Yairi, 1987; De Bodt et al., 1998; Jonsdottir et al., 2002). Hence, it is difficult to comment on the significance of F0 in the vocal loading effects. However, a significant increase in standard deviation in F0 and F0 range indicates that, there is some variation in periodicity of vocal fold vibrations. Hence, it can be presumed that, vocal loading in CCOs is not heavy enough to cause organic changes, but their extensive use of voice could lead to symptoms of vocal fatigue. Further, observance of significant increase in frequency range among the female CCOs could be associated with the type of voice training such as speaking with different intonation patterns (more importance is given to prosodic training) given to the CCOs.

F0 range is the difference between the highest and lowest F0 voice in a sample which could sometimes be affected based on the extreme values and distort the interpretation. However, there are no supportive studies for the hypothesis that pitch range
increased in CCOs. Further studies are warranted to determine if this is an artifact of CCOs’ vocal training specific to their function.

Perturbation measures describe the stability of voice, either in terms of frequency or amplitude changes in sequential periods. Increased perturbation measures are almost always signs of either pathological or functional disorders of vocal folds (Laver et al., 1992). In the present study, some of the frequency perturbation measures were observed to be significantly higher in CCOs (male and female) compared to normative values, i.e., PPQ, RAP, sPPQ, and vF0. Pitch Perturbation Quotient and Relative average perturbation provide information related to short term period-to-period variability in pitch period, while, sPPQ evaluates the long term variability of the pitch period, with a smoothing factor of 55 periods. That is, this parameter is less sensitive to variations occurring between consecutive pitch periods. vF0 indicates the relative standard deviation of the fundamental frequency and reflects the very long term variations in the fundamental frequency. Increase in these frequency perturbation parameters exceeding the threshold of normality indicates that, CCOs are unable to maintain the regular pattern of vocal fold vibrations. Increase in frequency perturbation measures reflects on the perception of harsh, hoarse, or rough voice quality. This could be correlated with the perceptual analysis of the CCOs where most of the male CCOs were rated to have harsh voices and female CCOs, breathy voices (including with or without vocal symptom groups). Even though increased frequency perturbation measures are thought to reflect the associated voice disorders, these measures cannot classify the severity or the cause for dysphonia, as variations in dysphonia may occur without identifiable causes. However, the contributors to frequency perturbation are thought to consist of a wide range of factors such as; vocal fold mass, distribution of the mucous on the vocal folds, symmetry of the vocal fold
structure, timing of laryngeal muscle action potentials and glottal flow characteristics (Titze et al., 1987; Higgins et al., 1989). It can be presumed that, increased frequency perturbation measures in this study may be unique to the processes or structural changes underlying the disorder and indicate early signs of some pathological changes present in the CCOs. In the present study, however, it is difficult to predict the pathological changes depending on these measures as voice signal is a complex product of the nonlinear interaction between the aerodynamic and biomechanical properties of the voice production system (Behrman & Orlikoff, 1997).

Further, CCOs were also found to have significant variations in certain amplitude perturbation measures. Two amplitude perturbation parameters of Smoothed Amplitude Perturbation Quotient and peak to peak amplitude variations were found to be significantly higher in both the genders. However, in female CCOs, along with these two parameters, Shimmer percent and Amplitude Perturbation quotient (APQ) were observed to be significantly higher than the normative values. Shimmer percent gives information related to the short term period to period variability of peak to peak amplitude, while, APQ and sAPQ give information regarding long term variability of amplitude with a smoothing factor of 11 and 55. The results indicate that, in females, both short term and long term variability were seen while in males, a significant difference was found in only long term amplitude perturbation. From this, it can be presumed that both male and female CCOs experience difficulty in controlling regular pattern of intensity in phonation. It has been reported that short term vibratory amplitude may be affected when there is vocal fold hyper adduction (Nicastri et al., 2004). Considering this, it can be presumed that the results indicate the presence of effortful phonation in female CCOs compared to male CCOs. Excessive
amplitude variation may also indicate difficulty in using a stable projected voice due to the incoordination between laryngeal, respiratory and elastic forces altering the sub-glottic pressure owing to incomplete glottis closure. It is felt that the speaking styles used by CCOs, focusing more on using different intonation and accents to suit the customers could account for these changes. It is also felt that the CCOs may be adopting different styles of speaking by bringing some changes in their voice production with extra effort. This could have resulted in excessive amplitude variation in their phonation. However, the contribution of the amplitude perturbation to identify the specific abnormalities of the glottal function in general is not clear (Baken & Orlikoff, 2000).

The general principle of noise related measures is that, greater signal or harmonic energy in the voice reflects better voice quality while large noise energy (random aperiodicity in the voice signal) denotes abnormal vocal function (Titze, 1995). These noise related measures give information on the glottic closure and phonatory wastage. Three measures (NHR, SPI, and VTI) give information related to the harmonic and noise energy at different harmonic frequency of voice signal. In the present study, SPI was found to be higher in both genders than in normal. Along with this, among male CCOs, VTI was found to be significantly higher while NHR was found to be higher in female CCOs. From the increased values of these noise measures, it could be assumed that, there is incomplete glottic closure in both groups. Incomplete glottic closure can be seen in both organic and functional voice disorders. It is difficult to identify the reasons for this incomplete glottis closure, as voice disorders cannot be classified based just on the acoustic measures. F0-Tremor Intensity Index (FTRI) and Amplitude Tremor Intensity Index (ATRI) were found to be significantly higher in female CCOs while only FTRI was affected in male CCOs indicating the presence of
frequency and amplitude modulations of the signal. The modulations in the vocal signal can be influenced by the altered tension of the vocal folds (Baken & Orlikoff, 2000; Shao et al, 2010). It is felt that this could be the possible reason for the significantly higher tremor related measures among the CCOs in the present study.

In summary, the results of the current study indicates that work related vocal demands in CCOs of both genders demonstrates definite effects on some of the acoustic parameters of their voices on comparison with the established norms. It could hence be presumed that vocal demands specifically excessive in CCOs brings about physiological changes in their vocal folds reflected in the acoustic measures of their voice.

5.7 Auditory perceptual analysis of voice

The purpose of the perceptual analysis was to identify differences if any, in the quality of voice between CCOs who reported of frequent vocal symptoms and those who did not, using CAPE-V auditory perceptual analysis scale. Three judges rated the voice quality, i.e. whether they perceived the voice samples as normal or deviating, using a visual analog scale of CAPE-V.

The range of scores on the visual analog scale (CAPE –V) between the two groups overlapped considerably, such that, a substantial number of CCOs who did not report of any vocal symptoms were identified as having deviancy in perceptual vocal parameters. In addition, many CCOs reporting of vocal symptoms were not perceived to have deviancy in vocal quality. However, most of them were identified as having normal voice quality from both the groups with good inter and intra rater reliability. There could be several reasons for this interesting finding. During auditory perceptual evaluation of voice, the clinician usually
pays attention to the voice problems as heard by them while the voice user focuses on even a slight deterioration in the vocal quality or negative changes in the phonation related sensations even before they could be observed in the larynx. On the other hand, even clear pathological changes in the larynx may not necessarily cause severe deterioration of the vocal quality, since humans have enormous capacity for changes in their phonation conditions (Laukkanen, Ilomäki, Leppänen, Vilkman, 2008). Further, the impact of the voice problem depends on how the individual perceives, responds and adapts to the problem, and not on its severity (Yiu, 2002). Sometimes, even the pathological changes of the larynx or the voice may not cause a voice problem unless it affects the audibility or endurance of the voice. Another plausible reason for the differences could be that CCOs report the prevalence of symptoms over a longer time span while the clinicians evaluate the voice samples during single moment of the time. The present study finds support from Sapienza & Woodson (2009), that, self-reporting of voice problems is found to be subjective and depends on the person’s mood and other intrinsic and extrinsic factors as well as their illness perception. Listeners quantify the quality (comparing with concept of normalcy) and severity of vocal function or voice problems. That is, the auditory perceptual evaluation of a person's voice means that a listener is making a comparison between a not necessarily specified number of qualities that the listener can hear in the speaker's voice and the listener's own opinion about how these different qualities should sound in the normal voice (Fex, 1992). That is, auditory perceptual evaluation of voice is dependent on the auditory perception of acoustic elements of phonation that characterizes an individual speaker. Thus, it is an interaction between the acoustic speech signal and a listener’s perception of that signal. However, auditory perceptual evaluation cannot measure the impact of the voice disorder on the individual. On the other hand, self-
reported voice problems are often based on the magnitude of the voice related problems experienced by the participants in their daily activities, and the importance that they place on those problems. In the present study, it was observed that, even though 57% of the CCOs experienced one or more vocal symptoms, they were not perceived to have severe deviation of vocal quality. This could be attributed to the higher percentage of CCOs reporting physical discomfort symptoms not causing auditorily perceivable changes in the vocal quality. Hence, it could be presumed that, the vocal symptoms reported by the CCOs are related to the vocal fatigue.

Hence, it is unlikely that a correlation exists between self perceived vocal symptoms and the auditory perceptual measures (Kent, 1994), as can be seen in the present study. This leads to the question of whether the CCOs who reported of vocal symptoms would have any organic changes in the vocal folds, or whether some of the laryngeal changes are regarded as normal in the professional voice users. Further research by visualization of larynx of these two groups could provide the answer.

Further, it was observed that, across the speakers, with respect to different tasks (phonation, reading and spontaneous speech), perception of sustained vowels was judged to be more severe than sentence reading or spontaneous speech. That is, many of the CCOs were rated to have mild deviation in their voice quality during phonation tasks and were rated as normal during sentence reading and spontaneous speech. Similarly, very few CCOs (n=15) were rated to have either mild low or high pitch during phonation tasks or normal pitch during reading and spontaneous speech tasks with normal loudness and resonance across the tasks. This is in accordance with the findings of Wolf et al., (1995) and Revis et al., (1999), that
normal speakers’ voice are rated to be more dysphonic during sustained phonation than continuous speech and attributed to the sustained vowels being produced under unnatural conditions. Revis et al., (1999) further reported that, subjects changed their voices for sustained vowels especially during the onset of phonation. Hence, when a complete sustained vowel is used for perceptual evaluation (including both onset and offset part of vowel), there may be over estimation of the severity of the vocal dysfunction. This could be the possible reason for the difference in rating the voice quality in phonation and speech tasks of the present study, which used complete sustained vowels for the perceptual analysis. Besides this, other reasons for the discrepancy could be the reports of perception of pitch during phonation and speech tasks by the listeners failing to perceive the mild deviation in the pitch (high or low) during reading or speech with their attention shifted to non-vocal source of information (e.g., dialect variation, rate of speech etc) (deKrome, 1994), as well as variation in prosodic features (stress and intonation) within the connected speech segment.

Among the different perceptual vocal attributes listed in the CAPE-V (roughness, breathiness, strain), higher number of male CCOs were rated to have roughness while higher number of female CCOs were rated to have breathiness as the common vocal quality alteration. Physiologically, roughness is associated with irregular vocal fold vibration. The results of the present study are supported by the findings of Munoz et al., (2003), where given the two voices of different F0 with the same aperiodicity, the voice with lower F0 will be judged as more rough than the voice with higher F0. At the same time, higher number of female CCOs were rated to have breathy voice. Physiologically, breathy voice corresponds with hypo-adduction of the vocal folds. The presence of any disease that results in the formation of a glottic chink during phonation can produce a breathy voice (Fukazawa et al,
Even though breathy voice quality is a common feature of disordered voice, it is considered as a common feature of normal female voice quality as they exhibit incomplete glottic closure (Klatt & Klatt, 1990; Schneider & Bigenzahn, 2005). It has been suggested that posterior glottal chink is more commonly found in women, which accounts for the relatively more prominent perceived breathiness in female than in male voices (Higgins et al., 1994).

The findings of the present study has shown that, as a group of professional voice users, CCOs are at greater risk of developing voice disorders further strengthening the premise that voice problems are an occupational hazard for professional voice users. Unlike teachers (frequency of voice problems higher in females compared to males) the observation of non-significant difference in experiencing the vocal symptoms among genders, needs to be further investigated and reasoned out.

The higher prevalence of vocal symptoms as reported by CCOs, emphasizes on the dire need to analyze the handicap, activity limitation and restriction in participation, in order to truly understand the effect of voice problems in this population. Having established the fact that CCOs are at greater risk of self-reporting vocal symptoms, and the impact of the vocal symptoms on their performance, it is apparent that the CCOs need to be educated in preventive vocal measures. The educative program should address the practical strategies for maintaining a healthy voice, preventing vocal strain and enhancing professional performance. In particular, information needs to be provided on the detrimental effects of voice misuse activities on the vocal apparatus. With working environment being unique, individual workplace evaluation of call centers could facilitate appropriate preventive vocal measures to reduce the occurrence of voice problems (i.e., improving the working environment; such as
comfort, seating arrangements, reducing the noise etc). These modifications, if implemented and incorporated, should certainly help the CCOs to have a long standing and sustained healthy voice and be more productive to their employers.