Assessment of Self-Perceived Skill-Set in Clinical Audiological Evaluation among students of B.ASLP And Masters in Audiology

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August, 2022

CERTIFICATE

This is to certify that this dissertation entitled **'Assessment of self-perceived skill-set in clinical Audiological evaluation among students of B.ASLP and Masters in Audiology'** is a bonafide work submitted in part fulfillment for degree of Master of Science (Audiology) of the student Registration number: 20AUD010. 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.

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This is to certify that this dissertation entitled **'Assessment of self-perceived skill-set in clinical Audiological evaluation among students of B.ASLP and Masters in Audiology'** has been prepared under my supervision and guidance. It is also certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled **'Assessment of self-perceived skill-set in clinical Audiological evaluation among students of B.ASLP and Masters in Audiology'** is the result of my own study under the guidance of Dr. Sandeep M, Professor of Audiology, All India Institute of Speech and Hearing, Mysuru, and is not submitted to any other University for the award of any other Diploma or Degree.

Mysuru

August, 2022 **20AUD010**

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"No one who achieves success does so without acknowledging the help of others. The wise and confident acknowledge this with gratitude"

- *Alfred North Whitehead*

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List of Abbrevations used in the Study

B.ASLP	Bachelor of Audiology and Speech Language Pathology
M.Sc	Master of Science
RCI	Rehabilitation Council of India
AIISH	All India Institute of Speech and Hearing
NBHS	New-born Hearing Screening
HRR	High risk register
BOA	Behavioural Observation Audiometry
OAE	Otoacoustic emissions
A-ABR	Automatic Auditory Brainstem Response
ABR	Auditory Brainstem Response
LLR	Late Latency Response
(C)APD	(Central) Auditory Processing Disorders
REM	Real-ear measurements
EAM	Electro-acoustic measurements
HA	Hearing aid
IHD	Implantable hearing devices
ALD	Assisstive listening devices
HI	Hearing impairment

Chapter 1

INTRODUCTION

Skill set refers to the range of abilities of an individual. In the context of health care, it indicates the expertise in carrying out the different clinical activities. Competency in performing the different tasks can be ensured when access to good knowledge, skills as well as a positive attitude is achieved (Campion et al., 2011). With the upcoming expectations on creativity and problem-solving among professionals, the course of education must revolve around embracing these aspects as part of the curriculum.

Bloom's Taxonomy is a simple framework that assesses learning in terms of cognitive, psychomotor, and affective domains (Bloom, 1984). The cognitive domain includes a continuum of learning levels, from lower to higher, which includes remembering, comprehending, applying, followed by analyzing, evaluating and creating. Dealing with people and situations in the context of emotion is dealt within the affective domain. This refers to how the individual receives information (paying attention and respecting others), responds to it (involving in discussions), assimilates it (accepting new ideas), values it (display sensitivity to differences) and organizes it (prioritize different values). Individual's reaction to verbal and non-verbal cues, imitation and performance relates to the psychomotor domain (Muzyk et al., 2018). Incorporating this structure that incorporates features related to knowledge, skills and attitudes in the educational policy could bring about a comprehensive learning platform for the students.

Since the early 2000, the Indian government has been attempting to improvise the quality of higher education in the country in order to meet the challenges of global

competition. It has been instrumental in emphasizing the following:

- Linking education and employment
- Developing knowledge and skills that are relevant and meaningful
- Encouraging learner's participation in the acquisition of knowledge with a focus on constructivist curriculum
- Encouraging analytic learning experiences and scope to formulate queries
- Developing self-regulation, self- mediation and self-awareness among learners as part of curriculum transaction
- Limiting teacher's role to guidance of learners as opposed to direct teaching (Nigavekar, 2005).

Audiologists are allied health professionals who involve in prevention, identification, assessment and management of hearing and balance related disorders in pediatric, adult and geriatric population (Rehabilitation Council of India, 2015). The minimum qualification required to practice audiology in India has been defined as a Bachelor's degree according to the regulatory body. Hence, the curriculum of speech and hearing provides students with practical clinical training under the able guidance of qualified supervisors right from the stage of bachelor's degree thus aiming for field-ready candidates.

All India Institute of Speech and Hearing, one of the premier institutes in the country has been conducting academic training programs for more than 55 years. Currently, the undergraduate and post graduate student strength of the institute roughly estimates to about 400 and clinical rotations are in place to ascertain each student with exposure to all the different aspects of clinical practice. This mandates the students to take responsibility for their clinical decision-making to a considerable extent and necessitates them to focus on improving themselves on a daily basis.

Competence enhancement has always been one of the important aspects in terms of professional growth of students. Here, the term ‘competence’ can be operationally defined as the ability of students to carryout the different clinical tasks as determined by the scope of practice for their profession. It is well known that identifying the deficit area is fundamental to embark on a journey towards proficiency. Tools for self-evaluation can be utilized in recognizing those areas with scope for improvement. Carver and Scheier (2012) stated that the extent of an individual’s self-awareness determines his/her success in any endeavour. Also, it is reported that use of direct observation is not very effective and simple in assessing the higher order competencies (Connally et al., 2002). The self- perception measures might prove useful in these instances and can act as an indicator for the individual’s motivation to maintain and improve on his deficits. Further, the idea of self-perceived competence is said to be a constituent within the domain of self-efficacy. However, it is also important to acknowledge that the subjective measure is not always perfect and may result in difficulties while reporting results in an objective manner. This is due to the fact that skills cannot be measured using a natural numerical scale and can be affected by several factors, which can make the reliability and validity of the outcome questionable (Bandura, 1994).

1.1 Justification for the Study

Audiologists play an important role in dealing with patients in objectively defining the distress related to the audio-vestibular system to ensure an accurate and quick diagnosis of the problem. This is critical to ensure an appropriate and early management of the patient (Grenness et al., 2014). Manchaiah et al. (2015) studied the professional issues in audiology practice using 71 Indian audiologists, who highlighted improper training from institutes, outdated syllabus, deficit in encompassing relevant

topics and lack of adequate clinical exposure at educational institutes as key areas of concern in the domain of awareness and training. In the recent past, Covid-19 pandemic has become an added factor in influencing clinical training as it forced the training to be shifted to only-online mode. The pandemic situation hampered practical and clinical training, in particular (Ölçek et al., 2021).

The quality of care as well as welfare of the client is observed to greatly depend on factors such as knowledge, skills and attitudes of the examiner (British Society of Audiology, 2004; Meibos et al., 2019). Severn et al. (2011) reported that 33% of the practicing audiologists in the public domain experienced moderate or greater level of stress linked to accountability while treating patients, followed by administration or equipment and audiological management. This has been attributed to their wider scope of practice compared to a private practice. Hence, with the increasing need for accountability while dealing with a population becoming increasingly conscious of the evaluations carried out and subsequent recommendations being made, it is of essence that the student clinicians are confident and display a high level of clinical competence in providing multiple audiological services during the training period.

Currently, there is dearth of literature wherein competence of students involved in audiological clinical practice have been examined, especially in the Indian context. Hence, it has become the need of the hour to understand the quality of clinical training inculcated in an institute set-up, considering the regional and administrative differences across the educational set-ups in the country and the lack of simulated training experience that is incorporated in many developed countries. The comparison of perceived competence between the bachelor's and master's group can enable academicians to identify the domains that need to be focused further, during the practical clinical training. The attribute of motivation, in particular, can provide insights

regarding the need for modifying teaching methods in certain areas. Also, the students may benefit from consciously realizing the deficits in the different areas of clinical audiological practice, which in turn will enable them to improve on those aspects. Similarly, it is well known that the bachelor's group of participants are in the learning stage and possess lesser practical and clinical exposure when compared to the master's group. Hence, the study on effect of Covid among the bachelor's group can reveal the areas of deficit caused due to online learning and may throw some light on the measures to be taken to rectify those practical and clinical audiological aspects that were hampered due to the pandemic. Also, it can encourage students to take up active participation in rectifying the deficit areas identified.

1.2 Aim of the Study

The aim of the study was to systematically determine whether the skill-set inculcated in the B.ASLP program are perceived to be adequate for clinical audiological practice by the candidates who pursued it, and thereby identify the deficit-areas

1.3 Objectives of the Study

The three objectives of the study were to

1. To develop an online questionnaire to evaluate the self-perception of competence in various competencies of clinical audiological practice.
2. To compare graduate and post-graduate candidates of Audiology for their self-perceived competence in various competencies of screening, diagnostics and management in terms of their knowledge, skills and motivation.
3. To compare the competence of candidates who pursued B.ASLP during the Covid-19 pandemic with those who pursued before that, for their self-

perceived competence in various competencies of screening, diagnostics and management in terms of their knowledge, skills and motivation.

Chapter 2

REVIEW OF LITERATURE

Skill development has always been the primary objective of education, more so, in higher education. Skill development is considered as the most significant aspect of producing a productive workforce. It involves identifying gaps in the skill-set and honing them with best possible efforts. There are however a number of factors that affect the process of attaining competence in the required skills, which must be taken into consideration by the training institutions in order to ensure a desirable outcome. This chapter reports the literature relevant to skill development under the following headings:

1) Developing Skill-set: Student's Perspective
2) Developing Skill-set: Educator's Perspective
3) Efficacy of Self-assessment Measures

2.1 Developing Skill-set: Student's Perspective

Students, being the stakeholders of education shall be well aware of the expectations they are required to fulfil as a working professional. In health care sector, this dimension becomes even more important due to the nature of work. So, it is essential that by the end of the program, the students have sufficient expertise and confidence to make independent decisions on an array of competencies defined in the respective scope of practice. Gazibara et al. (2015) studied the preparedness of 390 final year medical students to begin professional practice in Belgrade using a 22-item questionnaire. The questionnaire included inquiry regarding demographic and various clinical skills under the sections, major interventions, minor interventions, results interpretation, basic patient assessment and other skills. The competence in each of the

patient management skills such as taking patients' history/ performing physical examination and blood pressure measurement as well as readiness to start working with patients were rated on a scale of 1 to 10. It was found that majority of the students felt highly confident in carrying out clinical tasks which had greater frequency and consistency of practice throughout the course of training. Lack of confidence was reported in those skills that were rarely utilized. Also, the average mark during studies neither correlated with the total skill score obtained using the questionnaire nor the level of readiness to begin working with patients. It was concluded that modification of curriculum to include increased hours of clinical practice, closer supervision during practical training and maintenance of self-assessment logbooks might prove useful in enhancing clinical performance and confidence in students prior to completion of their undergraduate medical training. Enhancement in training in terms of application of knowledge and critical thinking skills is also suggested to be useful (Bandhu et al., 2020).

Muthu et al. (2019) studied 72 dental interns for their self-perceived competence. The results revealed an unsatisfactory level of self-perceived competence in sections of learning and communication. The learning competence section included questions such as identifying gaps in knowledge, identifying gaps in practical performance and learning from mistakes, which were among some of those aspects with poor scores. The students also reported that although the tested competencies were highly relevant to future professional practice, the curriculum does not incorporate these to the necessary extent.

Comparable perceptions have been observed in the field of Audiology as well. Becrow and Nerbonne (2002) attempted to determine the competence in skills and knowledge possessed by students (Masters in Audiology & Doctor of Audiology)

pertaining to the field of educational audiology. A questionnaire consisting of 38 items was administered in 48 graduate programs across U.S. A majority of response (87%) came from Master's degree while about 13% was obtained from AuD program. A greater clinical practicum experience was consistently observed in carrying out pure tone, immittance and speech audiometry while it was considerably decreased in newborn, pre-school /school-age newborn hearing screening and APD assessment. The data further revealed that majority of key competency areas related to educational audiology received very less exposure in terms of both theoretical and practical training. Also, 85% programs were reported to have no internship placements in an educational set up. Therefore, the study emphasized the inclusion of additional training in terms of both academic and clinical aspects specific to educational audiology in order to prepare the students adequately for such a work environment. Counselling is another critical element for a professional dealing with communication sciences and disorders. Meibos et al. (2019) conducted a survey on 143 final year Au.D. students, which revealed that students perceived counselling to be an essential aspect of clinical audiologic practice. However, a wide variation in response was noted regarding the received supervision for counselling among the students and less than half of them reported having received regular teaching or feedback regarding their counselling skills from their clinical supervisors. Also, a significant number of students (80%) felt that education related to counselling was not well structured in their program and that they hoped for a greater emphasis in this aspect.

The mastery in carrying out an otoscopic examination and interpreting the visual is attained only by experience. Sebothoma and Khoza-Shangase (2021) assessed the utility of a 3-week video otoscopic examination training among 79 third and fouth year South African students pursuing audiology in their undergraduate study in order

to explore the self-perceived competence and confidence in undertaking otoscopic examinations. A 17-item online questionnaire was utilized to fulfil the objectives of the study through multiple choice, closed ended, open ended questions and subjective suggestions regarding the training. It was observed that while 60% participants perceived themselves to be competent in performing otoscopic examination, 63.3% were found to be less confident in interpreting the findings. About 43.3% were convinced that they can identify outer ear pathologies. However, the number of students confident in identifying both outer and middle ear pathologies were significantly low (37%). Results showed that responses were equally split such that one half of the students felt that the training helped them feel confident and competent while the other half reported of no such benefits or were unsure. However, almost 97% students felt that the training should remain a part of their practical training. Also, no significant associations were found between the quantity of video otoscopies performed or year of study and the perceived confidence and/or competence. Hence, the study highlights the need to enhance the practical clinical training by including use of pathologic ears in the curriculum and supplement the existing training methodologies with technical advancements, especially related to tele- audiology practices.

All people who reach great heights in their profession, be it any field, always dedicate a major part of their success to mentors. Students in allied health sciences report that adequate supervision and feedback from their clinical instructors were valuable in enhancing their professional development (Gard & Dagis, 2016). Thus, it is evident that mentors share a unique bond and play a key role in shaping the lives of their mentee's life or career. This relationship becomes even more comfortable when the mentors are in their peer group but possess an experience greater than their mentees. Hence, the influence of having near-peer mentor (students who are atleast one year

senior to the mentee) and the exposure to practical clinical training can have an effect on the perceived career preparedness among baccalaureate students pursuing Communication sciences and disorders. Flagge and Estis (2022) studied forty-one students in the first semester of Au.D. course, who completed a pre- and post-course survey broadly classified under the sections career plans and preparedness, perceptions of the profession of audiology and effectiveness of labs and mentoring. Furthermore, the students were encouraged to rate the effectiveness of lab exercises, in-class lecture, in class activities and mentoring in aiding career readiness on a 10-point rating scale depicting 'Not at all satisfied' to 'Extremely satisfied'. Results revealed that majority of the students were 'extremely satisfied' with lab exercises when compared to other components, which was judged to be highly useful in career preparedness. Peer mentoring was another factor reported to play a significant role in moulding themselves for a career in audiology.

Private practice is a part of the scope of practice spectrum in the Audiology profession. It can be considered the most challenging as the proprietor is bound to take up multiple roles in the setting. One needs to be aware of atleast the basic roles and functionalities of the clinic in order to manage the practice efficiently. Latif and Jamaluddin (2019) studied sixty-seven graduates, who were alumni of the audiology course at International Islamic University Malaysia. The authors explored the employment profile as well as the perception on academic and practical training and observed that the graduates perceived the curriculum and training provided at the institute to be pertinent to their career. Further, suggestions were made to incorporate business and marketing courses as well as to provide greater clinical training opportunities and exposure to a variety of auditory amplification devices.

In recent times, Covid-19 pandemic has brought about significant changes in our way of life. Like the two sides of a coin, the event has brought about alterations that are both positive and negative. The impact of this change has been noted in several dimensions of human life. Higher education is one such area that had to be revamped in a short duration in order to adapt to the tiring circumstances. Limited technical knowledge was reported as the major difficulty with online education, particularly with respect to the modification in the mode of instruction among both students and educators (Chinelatto et al., 2020). Olcek et al. (2022) conducted a cross-sectional survey on the experience of 518 undergraduate (97.3%) and graduate (2.7%) students pursuing audiology on the aspects of online learning, its impact on lack of internship placements and practical training, knowledge and practice in tele - audiology as well as their psycho social status was carried out. The online survey consisted of 29 questions to be rated on a 7-point Likert scale. Responses from students revealed that the professional knowledge obtained through online practical classes were considered 'too insufficient' and 'insufficient' by 26.6% and 20.7% of the students respectively. Also, about 40% participants reported the level of readiness to be 'too insufficient' for them to take up internship or work as an audiologist prior to the completion of practical training. The knowledge and competence in Tele-Audiology among students were also rated as 'too insufficient' by 26.6% and 33.4% of the participants respectively, wherein graduate students had a better rating than the undergraduates. The study also revealed significant effect of e-learning due to Covid-19 on the personal and professional growth in about 20-30% of the students. Further, it was concluded that online learning experience brought dissatisfaction among students, especially in an applied field like Audiology. This was expected to bring gaps in education, which necessitates the compensation of shortcomings during practical courses and internships through efficient guidance, support and good management practices.

Svec and Morgan (2022) surveyed 44 undergraduate and 24 post graduate students in communication sciences and disorders regarding utility of virtual audiology education tools. Four sub-themes: ease of use, improvement in teaching and learning skills and motivation to continue usage were assessed. The study revealed that greater than 70% participants felt that these tools effectively improved student learning as well as their faculty's teaching skills. Several considered these tools as being handy and reported their interest in continuing use. Many other studies conducted on students in health care have reported similar benefits (Aussedat et al., 2020; Bakhos et al., 2020; Kolla et al., 2020; Wilson et al., 2010; Zafar et al., 2020).

2.2 Developing Skill-set: Educator's Perspective

Allied health professionals are those individuals engaged in health care, excluding medical professionals and nurses (Turnbull et al., 2009). Practical clinical training is vital in professional training, particularly among those engaged in clinical degrees such as audiology, speech therapy, nursing and physiotherapy (Banks et al., 2000; Jones et al., 2010). The aspect of clinical supervision is essential in those professionals dealing with health sector, especially in a set up with student clinicians. This is to enable a sound practical training under a protected environment for the students. Thus, the supervisor deals with providing student support, ensuring the safety and quality of healthcare provided to patients (Kilminster et al., 2007; Lyth, 2000). The process aims to bridge the experiential gap in decision making between the student clinician and the supervisor.

Snowdon et al. (2019) studied the perceptions of allied health professionals regarding the factors leading to effective clinical supervision among 38 individuals working in a public hospital set-up. The outcome of both qualitative and quantitative measures revealed three major themes and sub-themes. The major themes that emerged

were to consider professional development as the focus of clinical supervision, to possess the skill as well as attitude to create a good supervisory relationship and to engage with an organization that facilitated both these aspects. The other key sub-themes under each of the discussed themes include the significance of relationship between the supervisor and mentee, prioritizing the role of supervision among other duties and the liberty to decide on supervision models and approaches.

The approach focused on patient-centered care (PCC) is gaining greater acceptance and importance within the discipline of health care. In the field of audiology, however, the practice of this approach is largely restricted due to a variety of factors. Tai et al. (2018) examined the perception of educators regarding facilitators and barriers in teaching PCC as part of the audiology graduate programs in Australia using a semi-structured interview. The response of 9 programme coordinators and key teaching staff from 6 such programmes across the country discussed their perspectives. One common opinion was that the audiology curriculum was highly focused on the biomedical context and was technically oriented to fulfil the professional certification criteria. Hence, they accept that some of the teaching decisions are altered to meet these demands, although it does not align with their desired inputs. Limited university resources, unavailability of sufficient time, inadequate funding for the staff, simulated patients and guest lecturers is also said to contribute to the teaching of PCC. Work pressure and lack of training to teach PCC skills among clinical instructors was reported to negatively affect their ability to model PCC practice and hinder clinical practical training. Educators were also of the view that students who are naturally good at communicating established a better rapport with patients. Hence, some aspects of PCC can also be considered as inherent. However, the ‘theory-practice gap’ in handling patients in real-life situation can be overcome by developing a curriculum which targets

integration of communication skills at both the pre- clinical and clinical setting level. A review of interns at the graduate level suggested addition of more educational modules related to skills of patient-clinician interaction. The involvement of clinical supervisors is also warranted to enhance the communication skills of students, even at the level of final year in audiology education (Tai et al., 2019).

Another key element in the field of communication sciences and disorders is the counselling. It is utilized throughout the entire scope of audiology practice in terms of screening, diagnostics and management in order to guide the patient effectively through the process. However, the counselling training programs vary in their mode of instruction across the institutions. Therefore, the perspectives of educators or supervisors in this domain could help us better understand the rationale behind the same. Muñoz et al. (2018) conducted a survey on 205 Au.D clinical supervisors to study their practices and perceptions related to necessity of imparting counselling skills, their perceived confidence and self-efficacy in facilitating student learning, mode of feedback and challenges encountered. It was evident that most supervisors (88%) advocated for a dedicated counselling course in their program. Several participants reported confidence in teaching the same while only a few of them felt being extremely confident in guiding students on how to elicit responses related to client's emotions and explain the rationale behind the different strategies of counselling used. A positive trend towards higher confidence and self-efficacy in teaching counselling skills among those with greater years of experience in supervision was noted. Also, significant differences were found in the methods used to provide feedback, evaluate students and perceptions of self-efficacy in teaching skills. Further, 96% respondees felt that establishing a good rapport with the students during the period of supervision was extremely important in order to create a positive impact on the learning process.

Students consider timely feedback as an important aspect of clinical supervision, followed by knowledge of instructor (Kelly, 2007). Feedback can be both positive and negative, with the latter being more likely in the learning stage. The challenges faced by instructors while providing negative feedback have been examined by several studies. Hoffman et al. (2005) interviewed 15 instructors in counselling education on different circumstances while providing feedback such as easy, reluctant or difficult and avoidance (no feedback). It was observed that direct feedback was provided in easy situations that included clinical issues, which resulted in immediate performance changes. The difficult scenarios consisted of clinical, personal or professional concerns and feedback was provided in a more indirect manner. This was reported to have inconsistent effect on performance change among students.

Audiologist preceptors are those involved in supervision of practical training in audiology. Brand et al. (2022) conducted an internet survey on 18 such preceptors before Covid-19 and 20 after the Covid-19. The comparison of preceptor responses disclosed no significant influence of the pandemic in terms of the quality of supervision and theoretical knowledge among students. However, the pace of practicum was reported to be more gradual post pandemic, when compared to that of the pre-pandemic situation. Also, a negative effect of pandemic was reported by 40 % preceptors on the influence the skill of result integration, proficiency in handling instruments and supervisory quality. 70% preceptors reported a decrease in the number of tests carried out by students and 35% felt that there was a decreased independence of students. Further, the supervisors suggested the need for additional learning experience through exposure to a greater number of hearing tests, wider variety and extended length of practicum training.

Tele-health services had undergone rapid changes in the recent years that had been dominated by Covid-19 pandemic. All disciplines had to make swift changes in order to provide efficient services to the possible extent. Ross et al. (2022) explored the perceptions of clinical educators in the allied health sciences sector regarding the effects of tele-rehabilitation, client outcomes and student learning. Twenty eight clinical instructors participated in the qualitative study, among which 18% belonged to the audiology field. The semi-structured interview revealed that although the instructors were confident in their supervision skills in-person, they had reservations in transferring their skills and knowledge through the new education model. Similar limitations related to the absence of practical hands on experience, uncertainities in diagnostics, concerns in management of clinical equipment and fitting of devices has been discussed in different studies (Eikelboom et al., 2022; Malliaras et al., 2021). Unfamiliarity in using online tools and softwares, inability to monitor sessions simultaneously and provide immediate feedback were some of the major barriers during online supervision. However, they also felt that the crisis enabled upgradation of both students and the faculty. Also, several participants felt that students had developed interpersonal communication skills and time management either to an equal or a better extent when compared to traditional in-person placements. Educators revealed that they were able to achieve sufficient clinical outcome for their patients by providing the necessary education on clinical skills. The role of change in mode of teaching/ supervision was not perceived to have a significant effect on the coping abilities of students. Many viewed tele health model as the future of the profession (in terms of remote programming etc.) and recommended it as a learning necessity while others had reservations about the practical skill development gap leading to difficulties in employability.

Simulation training has been an important virtual education tool utilized in health care teaching set-ups even before the pandemic. This has gained further attention in the recent past. Svec and Morgan (2022) conducted a survey on 30 educators regarding utility of virtual audiology education tools under four sub-themes such as ease of use, improvement in teaching and learning skills and motivation to continue usage. The study revealed that around 69% participants felt that these tools effectively improved their teaching skills and 85% noticed improvements in terms of student learning. This trend advocates the inclusion of simulated training tools for an enhanced teaching and learning experience, even in the traditional instruction set-up

2.3 Efficacy of Self-assessment Measures

According to the principles of neurolinguistic programming (NLP), the course of learning and skill development is segregated into four stages. The lowest level *'unconscious incompetence'* refers to the obliviousness of the individual regarding their competence. The second stage, 'conscious incompetence' deals with an individual who is aware of the skills he lacks and realizes the extent that needs to be learnt. The next level, 'conscious competence' refers to the presence of a certain level of mastery achieved through concentration and effort. The last and the highest level, 'unconscious competence' recognizes a state where the acquired skills can be put to use without a perceptible effort (Nugent, 2008). Among these, the second level forms the most important aspect to self-development in students as well as professionals. The realization of one's own competence is very essential for an individual's growth in any area of life. This can be consciously kindled by using the objective measures such as self-assessment questionnaires.

Andrade (2007) recognizes self-assessment as a process that enables students to reflect and estimate his/her performance against that of a set goal in terms of learning and work, identify strengths and shortcomings and modify accordingly. It involves a series of unguided tasks, shaped by feedback mechanisms and aimed at self-improvement. The procedure acts to complement the learner's knowledge, skills, appropriate attitude and values, thereby promoting the development of life-long, self-directed independent learning skills (Di Stefano et al., 2015; Hinchliffe, 2006). It is considered as a low-cost method of quality assessment and is believed to be essential in improving professional expertise in any field.

The ability of clinicians and students to obtain insights regarding their positive and negative attributes of patient care is essential to professional self-assessment and further development. Asadoorian and Batty (2005) reported a model that helps evaluate 4 elements that help determine weaknesses among students and practitioners. These include analysis of basic competencies, skills present, knowledge of application and tools available for application. The model stresses on role of a supportive environment on the development of competencies as well. The approach highlights the gaps in clinical practice, learning needs and ways to embed this self-reflection into everyday work/practice.

Austin and Gregory (2007) studied fourth year students pursuing B.Sc Pharmacy and found that attempts at reasoning their rating on competence positively correlated with the performance on their critical thinking skills. Alhaqwi et al. (2014) used a 40-item Clinical Learning Evaluation Questionnaire (CLEQ) administered on 182 undergraduate medical students at the end of their clinical rotations. A good reliability and a high internal consistency of the tool was observed in terms of measuring the clinical learning outcome. Driscoll et al. (2016) evaluated the efficacy of

Improving Quality in Practice Placements - Allied Health (iQIPP-AH) Student Guide tool in aiding self-reflection among students of clinical audiology. The study on 23 second year Master of Audiology students found that upto 52% of the students were willing to take the required action based on the quality indicators of the tool. Also, this intent was greater among those in the preparatory phase of clinical training as compared to the later phases. These evidences signify the utility of a self-assessment measure.

Certain studies in the literature doubt the validity and reliability of self-rating measures (Austin & Gregory, 2007; Eva & Regehr, 2007; Pop & Khampirat, 2019). This is most commonly observed due to issues in methodology. The self-assessment-based studies are often designed in such a way that the individual's ratings are correlated with those ratings of an expert in order to obtain a group mean value. This single value is then generalized for the whole group, which means high correlations are associated with better performance of self-assessment among students, and low correlations with poor self-assessment skills. This approach degrades the quality of outcome and leads to questionable interpretation (Connolly, 2006; Firebaugh, 1978; Lincoln & Zeitz, 1980). Secondly, the accuracy of results is reported to vary with the learning stage at which the assessment is made. Woolliscroft et al. (1993) found that although medical residents were fairly accurate in estimating their clinical capabilities, the self-rating was found to be better when measured at the end of the training rather than at the beginning. This was attributed to the improved understanding of the stature of their own professional knowledge. Thirdly, researchers believe that the correlation between self-perceived knowledge and state of affect and motivation is quite strong when compared to that of cognitive learning (Sitzmann et al., 2010; Weiss & Cropanzano, 1996). Hence, it is often viewed as a very subjective measure. Fourthly, the skill of using self-perception measures are reported to improve over time with feedback and experience (Levine et al., 1977).

Despite the shortfalls in self-assessment measures in evaluating the knowledge or competence of an individual, they are still utilized as a criterion for estimation among several disciplines such as education, medical education, communication, psychology, business as well as foreign language acquisition (Dobransky & Frymier, 2004; Lim & Morris, 2006). Meta-analysis of 144 studies reviewed across different disciplines by Sitzmann et al. (2010) revealed that about 17% dealing with medical education considered self assessment as a learning indicator. This suggests an obvious need to enhance the quality of self-monitoring tools and processes in order to make the instrument more reliable. Motycka et al. (2010) highlighted different steps to enhance self-assessment skills. These include emphasizing on external feedback to shape self-assessment, improving quality of feedback, developing self-reflection, responding to motivation factors that are both internal and external, and maintaining a receptive attitude to new inputs.

Chapter 3

METHODS

A cross-sectional survey design was utilized for the study. An online questionnaire was employed to assess the self-perception of competence in clinical audiological skills among students of Speech and Hearing discipline. The survey method was chosen as it is an effective way to reach a wide range of students in a limited time frame. The study was conducted in two phases: 1) Development of the questionnaire to assess self-perceived clinical competence in audiology and 2) administration of the questionnaire on participants and analysis of the responses.

3.1 Participants

Seventy two students in the internship program of Bachelor of Audiology and Speech Language Pathology (B.ASLP) program and 187 masters' students of Audiology program were recruited as participants for the study. The participant group included those hailing from different educational institutions (32) across the country and met the inclusion criteria. A subgroup of participants had completed B.ASLP before the Covid-19 pandemic (Pre-Covid group) while the others had pursued it during the pandemic (Covid group). The age of the participants ranged from 20 to 29 years (Mean age = 24 years). The inclusion and exclusion criteria are discussed below.

Inclusion criteria:

1. Individuals shall be pursuing or should have completed their internship (B. ASLP or B.Sc. Speech and Hearing) degree, either before or during the Covid-19 pandemic
2. Individuals shall be pursuing or should have completed their M.Sc. Audiology degree before the pandemic

3. The institute where they are pursuing or pursued the program should be a RCI certified institution or college
4. Coursework should have included classes, clinical practicum and demonstrations
5. Students should have been involved in supervised clinical training of at least 3 hours per day

Exclusion criteria:

1. Students who pursued their M.Sc. Audiology degree during the Covid-19 pandemic
2. Students pursuing/ completed M.ASLP degree (Master of Audiology and Speech Language Pathology)
3. Students pursuing Diploma (UG/PG) courses associated to speech and hearing discipline
4. Students pursuing Bachelors/ Masters of Education Special Education (B.Ed.Sp.Ed/ M.Ed.Sp.Ed)
5. Candidates who have the necessary educational qualification but are not actively involved in audiological practice

Phase 1: Development of the Questionnaire to Assess Self-perceived Clinical Competence in Audiology

In this phase, a questionnaire was developed to assess the self-perceived clinical competence in audiology among the participants. The competencies required for clinical audiology were noted down from the latest syllabus prescribed by Rehabilitation Council of India for the B.ASLP (Bachelor of Audiology and Speech Language Pathology) program (RCI, 2016). The competencies are operationally

defined as the ability of administering and interpreting various audiological tests. The competencies were grouped under three broad domains; hearing screening, diagnostic audiology and management of audiological disorders. It was ensured that no competency listed in the RCI syllabus is left out. A total of 32 competencies were identified from the RCI syllabus. Additionally, the investigator and the mentor added a few competencies that are dealt in the program, but were not explicitly stated in the RCI syllabus. Some of these competencies included hearing screening using BOA, OAE, AABR, carrying out functional gain measurements, selecting and fitting of assistive listening devices and providing rehabilitative services to persons with hearing and balance disorders through tele-mode. The addition of these competencies was based on the mentor's experience in clinical audiology.

In each of these competencies, it was aimed to assess the competence in administration of the test as well as interpretation of the respective test results. The competence was also assessed in terms of the 'Knowledge', 'Skills' and 'Motivation' they possess in each of the competencies. In this, 'Knowledge' indicates the understanding of the theoretical concept related to a particular task, 'Skills' indicates the ability to apply the knowledge in performing a particular task and 'Motivation' indicates the drive or inclination towards performing a particular task. Motivation was meant to indirectly assess the attitude of the participants towards the competency.

The competency list was then subjected to content validation. The listed competencies were given to 4 audiologists who had a work experience of more than 12 years in clinical audiological practice. They were instructed to verify the competencies for their relevance and verify the statements for their ease of understanding, grammatical correctness and clarity of meaning. They could also suggest addition or deletion of competencies or make open-ended remarks regarding the competencies as

well as questionnaire. The list of statements modified, added and deleted based on expert's remarks are given in Table 3.2.

Table 3.1: *List of statements modified, added and deleted based on the expert's remarks*

Sl. No.	Statements	Remarks/Suggestions
1.	Administering and interpreting tuning fork tests	To replace with performing otoscopy and interpreting results
2.	Administering and interpreting otoacoustic emissions (OAE) to - detect the presence of inner ear pathology - differentially diagnose cochlear pathology versus retrocochlear pathology in case of sensorineural hearing loss	To rephrase as administering and interpreting otoacoustic emissions (OAE) to - detect the presence of inner ear damage - differentially diagnose cochlear pathology versus retrocochlear pathology
3.	Administering and interpreting the behavioural tests of neural adaptation to - identify the presence of retrocochlear pathology - cross-verify the results of speech audiometry - suggest appropriate medical and non-medical management - counsel regarding prognosis	To change to administering and interpreting the behavioural tests of neural adaptation to - detect retrocochlear pathology - cross-check the results of speech audiometry
4.	Administering and interpreting the tests to identify functional hearing loss	To change to administering and interpreting the subjective and objective tests to identify functional hearing loss
5.	Nil	To add assessing listening needs of the patients
6.	Nil	To add carrying out functional gain measurements
7.	Carrying out real ear measurements to fit hearing aids and assistive listening devices (e.g., FM devices)	To change to selecting and fitting of assistive listening devices (e.g., FM devices)
8.	Selecting and taking impression for ear moulds	To rephrase as selecting the appropriate type of ear mould and taking impression

9.	Selecting hearing aids, programming them and evaluating the benefit of hearing aids	To rephrase as selecting and programming hearing aids appropriately and evaluating their benefit
10.	Selecting, programming/mapping them and evaluating the benefit of implantable hearing devices implantable hearing devices	To rephrase as selecting and programming/ mapping implantable hearing devices appropriately and evaluating their benefit

Diagnostic competencies

Management competencies

Based on the remarks/suggestions received from the experts, administration and interpretation of tuning fork tests was replaced by otoscopy and its interpretation, and assessment of listening needs as well as functional gain measurements were added to the list. Additionally, statements in the 7th, 11th, 14th competency of diagnostic domain and statement in the 5th, 6th and 7th competencies of the management domain were rephrased in order to make them simpler and more precise. The revised list of competencies were used to develop the questionnaire. The final list had 7 competencies in the screening domain, 18 in the diagnostics domain and 16 in the management domain.

The self-perception of the competence in each of the listed competencies was the targeted response. The responses were elicited on a five-point (0-4) Likert scale, wherein, ‘0’ indicates ‘no’, ‘1’ indicates ‘minimal’, ‘2’ indicates ‘fair’, ‘3’ indicates ‘good’ and ‘4’ indicates ‘exceptional’. To elicit the responses, one carrier phrase each was added before the list of competencies in the three domains. The carrier phrases added are shown in Table 3.2. The three carrier phrases and the list of competencies formed the final questionnaire. Appendix 1 provides the final questionnaire developed and used in the study.

Table 3.2: *Carrier phrases used before the list of competencies in screening, diagnostics and management domains of the questionnaire*

Domain	Carrier phrase
Hearing screening	Please rate your knowledge, skill and motivation in the following competencies related to hearing screening
Diagnostic audiology	Please rate your knowledge, skill and motivation in the following competencies related to diagnosis of hearing and balance disorders
Management of auditory disorders	Please rate your knowledge, skill and motivation in the following competencies related to management of hearing and balance disorders

3.2 Other Components of the Questionnaire

A passage on ***informed consent*** was included in the initial section of the questionnaire. Each participant had to read the following informed consent and sign the same to participate in the study.

"*I have been informed about the study entitled 'Assessment of self-perceived skill set in clinical Audiological evaluation among students of B.ASLP and Masters in Audiology'. I understand the purpose and procedure of the questionnaire. I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without incurring a penalty, or without being obligated to provide a reason. I understand that my participation in the study will not adversely affect me in any way and that confidentiality will be maintained about my identity at all times. I also understand that the information given by me will be used only for the purpose of the study. I do not have any financial or non-financial benefits from this study. I hereby give my consent to participate."*

Prior to the questionnaire, a section aiming to collect the demographic details of the participant was included. The list of details included name, age, gender, highest educational qualification (ongoing or completed), status of the program (ongoing or

completed), name and location of the institute, duration of course of the highest degree, year of internship completion and whether the Covid pandemic was present during the training duration. After obtaining the demographic details of the participants, they were given the following ***instructions:***

"The questionnaire is arranged under 3 key constructs – Screening, Diagnostics and Management. Under each construct, different clinical skills required for Audiological practice are listed. You are requested to go through each of those skills and rate your perception of competency in these skills on a rating scale, under the domains 'Knowledge', 'Skills' and 'Motivation', wherein,

- *'Knowledge' indicates* ***your understanding*** *of the theoretical concept related to a particular task*
- *'Skills' indicates your* ***ability to apply*** *the knowledge in performing a particular task*
- *'Motivation' indicates your* ***drive or inclination*** *towards performing a particular task*

The rating scale under the domains of Knowledge, Skills and Motivation ranges from 0 to 4. Here,
'0' indicates 'no'

'1' indicates 'minimal'

'2' indicates 'fair'

'3' indicates 'good'

'4' indicates 'exceptional'

knowledge regarding the listed clinical aspects or ability to perform the aspects competently or display intent towards performing those aspects. Your choice should be solely based on the practical clinical skills acquired until internship. If masters in audiology is your highest degree, you are instructed to rate your competence by carefully avoiding the influence of additional skills gained during your postgraduate study. An example is depicted below.

Question: *Please rate your knowledge, skill and motivation in the following competencies related to diagnosis of hearing and balance disorders*

Model response: *If you possess 'exceptional' knowledge about all the listed aspects related to pure tone audiometry, but a 'fair' competence in performing the listed skills and display 'no' motivation in performing the listed tasks, you shall select (✓) on '4' under the domain of 'Knowledge', '2' under the domain of 'Skills' and '0' under the domain of 'Motivation'".*

S. No.	Diagnostics	Knowledge	Skills	Motivation
1.	Administering pure tone audiometry and deriving the following from the audiogram • presence & degree of hearing loss • type of hearing loss • cause of hearing loss • management needed • prognosis	0 1 2 3 ✓4	0 1 ✓2 3 4	✓0 1 2 3 4

The questionnaire was then converted into a Google form in order to make the survey accessible through online mode. This modality was selected in order to expand the reach of the survey, improve the ease of answering and limit the time consumed in gathering data. The link used for the Google form is: https://forms.gle/8JWbF5cnzXAiNwok6.

Phase 2: Administration of the Questionnaire to Assess Self-perceived Clinical Competence in Audiology

About 500 potential participants studying in or graduated from about 32 RCI recognized institutions offering bachelors and/or master's degree in speech and hearing across India were invited to take part in the survey, subject to fulfilment of the set inclusion criteria. The link for the online survey was shared to the potential participants

using platforms such as Whatsapp and/or Gmail. The prescribed ethical guidelines for bio-behavioral research at AIISH was followed in a stringent manner (Venkatesan & Basavaraj, 2009).

The subject's participation was entirely voluntary and the respondees were assured regarding the confidentiality of their personal data and responses. The questionnaire also contained an initial section with simple and clear instructions for the participants, with an illustrated example on how to rate their responses appropriately. The participants were advised to read the instructions which included the example of how to rate the questionnaire before filling it. The participants were asked to rate their response on a 5-point Likert rating scale for the competence in screening, diagnostics and management in terms of knowledge, skills and motivation. The questionnaire utilized to gather responses is included in the Appendix section, as viewed in the online format (Google form). The collected data was then exported to Microsoft Excel and later SPSS (Statistical Package for Social Science) software.

3.3 Analysis

Out of the 271 collected responses, 82 responses that were found to deviate from the inclusion criteria were eliminated to result in the final sample size of 189. The study group of 189 participants included 137 students/professionals with a bachelor's degree and 52 students/ professionals with a master's degree.

All descriptive and inferential statistics for the study was carried out using Statistical Package for Social Science version 25 (SPSS) software. The percentage of responses was calculated for each response obtained in Screening, Diagnostics and Management with respect to knowledge, skills and motivation. Normality of the collected data was then determined by using Shapiro-Wilk test. Mann-Whitney U - test was used to compare the results of overall competence in screening and diagnostics as

well as competence-wise analysis in screening, diagnostics and management, in terms of both Qualification and Covid effect (non – normal distribution). One-way MANOVA was used to analyze the overall competence obtained in the management domain (normally distributed data).

Chapter 4

RESULTS

The study aimed to evaluate the self-perception of prospective audiologists about their knowledge, skill and attitude in various competencies of clinical audiological practice. The perception was tapped through a questionnaire developed in the study for the purpose. The questionnaire consisted of statements assessing different clinical skills under the sections of screening, diagnostics and management.

It was noted that 35% participants who rated the questionnaire based on their internship experience were currently enrolled as interns and were in the verge of completion, whereas, 65% participants were either pursuing their master's program or working as professionals. Similarly, 33.6% of the participants were pursuing their M.Sc Audiology degree and 66.4 % had completed it in the recent past. Figure 4.1 depicts the number of participants with bachelors or master's degree who rated their competencies based on bachelor's or master's experience. It shows that 20 students/professionals with a bachelor's degree and 41 students/professionals with a master's degree rated the questionnaire based on their clinical experience upto internship (B.ASLP) level while 52 masters students/professionals with a master's degree rated the questionnaire based on their clinical experience in M.Sc Audiology. Figure 4.2 shows the number of participants in the Pre-Covid and Covid group, who rated their competence based on bachelor's experience. It was observed that 61 participants in the undergraduate category were trained before the pandemic, while 76 participants were trained during the Covid pandemic period.

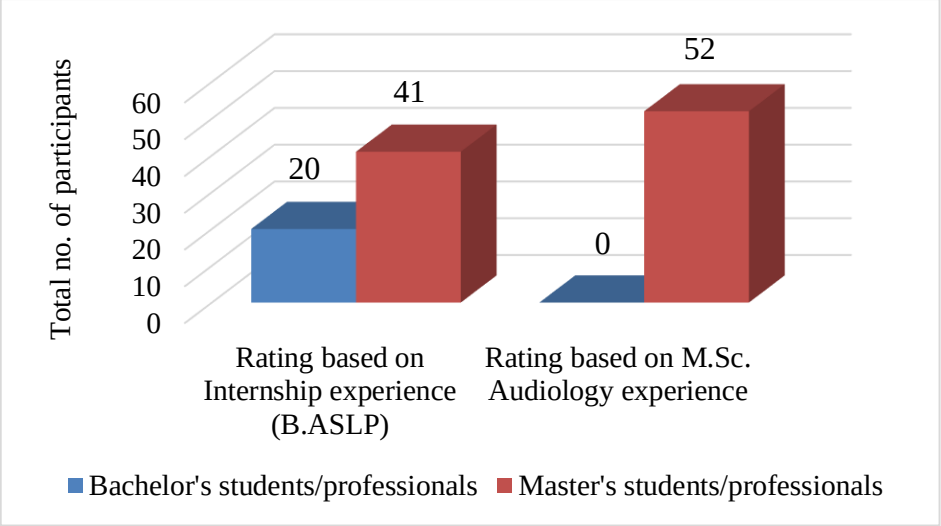

Figure 4.1: *Number of participants with bachelor's and master's degree who rated based on their experience upto Bachelor's and Master's level*

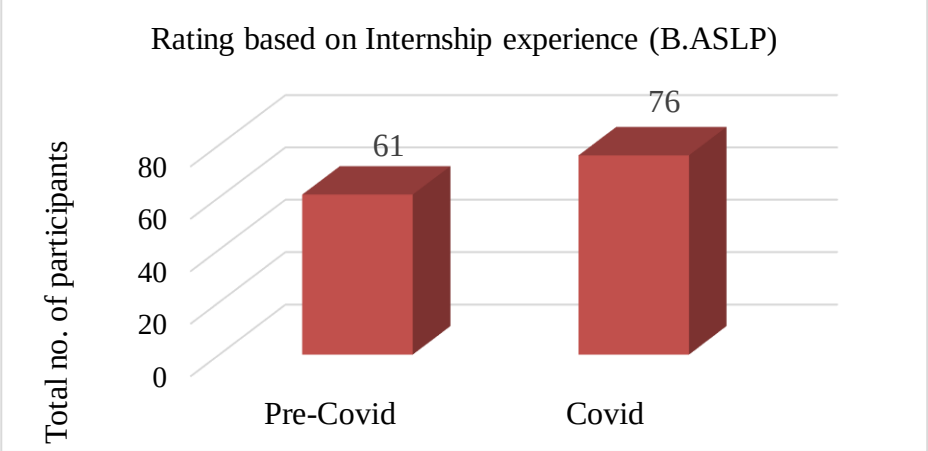

Figure 4.2: *Number of participants with Bachelor's degree who were trained before and during the pandemic*

The groups were statistically compared to derive the effect of qualification and Covid-19 pandemic on the perceived clinical competence. The results of the study are reported under the following headings:

1) Perceived Competence in Audiological Screening
2) Perceived Competence in Audiological Diagnosis
3) Perceived Competence in Audiological Management

4.1 Perceived Competence in Audiological Screening

In the screening domain, there were seven questions to assess different competencies related to hearing screening. The perceived competence is compared between bachelors' and masters' groups to derive the effect of qualification, and is compared between pre-Covid and Covid groups of bachelor's students to derive the effect of Covid-19 pandemic.

4.1.1 Comparison between Bachelor's and Master's group

Table 4.1 gives the frequency of responses (in percentage) for the perceived competence in knowledge, skills and motivation with respect to hearing screening, against each point of the rating scale in bachelor's and master's groups. The data represents responses of participants in both the bachelor's and master's group who had completed their study before the onset of Covid pandemic. It was observed that majority of the participants in both the groups had rated '3' and '4' for all questions in Screening domains. This was true for knowledge, skills as well as motivation, in both the groups.

Table 4.1*: Frequency of responses (in percentage) for the perceived competence in knowledge, skills and motivation with respect to hearing screening, against each point of the rating scale in Bachelor's and Master's groups*

Attributes	**Percentage of Responses**									
	Bachelor's					**Master's**				
	0	**1**	**2**	**3**	**4**	**0**	**1**	**2**	**3**	**4**
Knowledge	1.64	3.98	14.28	42.85	37.22	0.81	1.62	12.9	44.5	40.11
Skills	3.5	6.55	15.45	42.38	32.08	1.08	3.57	14	44.77	36.55
Motivation	4.2	6.07	15.24	45.42	29.02	0.27	4.4	14.57	42.57	38.18

Note: *The different shades in the table depict the range of responses in percentage from highest to lowest. Darkest shade represents highest percentage of responses while lightest represents the lowest percentage of responses obtained.*

Subsequently, the frequency of good and exceptional ratings was averaged to compare the perceived competence in the 7 competencies of hearing screening. The average percentages were derived separately for knowledge, skills and motivation in the bachelor's and master's groups. Table 4.2. shows that the comparison of average percentage between bachelor's and master's group showed that the average percentage was higher in master's group in all competencies compared to the bachelor's group, except administration and interpretation of AABR, in which the trend was opposite.

Table 4.2*: Frequency of responses (in percentage) for the perceived competence in the seven competencies of hearing screening in knowledge, skills and motivation against each point of the rating scale in Bachelor's and Master's groups*

Competencies	**Percentage of Responses - Screening**					
	Knowledge		**Skills**		**Motivation**	
	Bachelor's	Master's	Bachelor's	Master's	Bachelor's	Master's
New-born screening	42.6	46.15	41.8	47.1	39.35	45.2
HRR	41.0	43.3	36.85	43.3	36.85	39.4
BOA	41.0	44.25	36.05	41.35	34.4	39.45
OAE	43.45	44.25	43.45	45.2	44.25	46.15
A-ABR	36.05	35.55	34.45	29.8	36.9	36.55
School screening	40.15	43.25	37.7	41.35	36.9	40.35
Industrial screening	36.05	39.4	30.35	36.55	31.95	35.55

Note: *The darker shade in the table represents higher percentage participants with self-perception of good and exceptional responses.*

Table 4.3 shows the median rating and the interquartile range of bachelor's and master's group. The median of the group reflects the rating averaged across the seven competencies of hearing screening, separately for knowledge, skills and motivation.

The table also shows the mean rank of the two groups. The median rating was comparable between the two groups, while the mean rank was higher in master's group compared to bachelor's group in knowledge, skills as well as motivation. The responses obtained from 113 participants were subjected to Shapiro Wilk's Test of normality. The results revealed that the responses of participants with both bachelor's and master's groups failed to meet normality criteria ($p<0.05$). Therefore, the groups were statistically compared using non-parametric test. Mann - Whitney U test revealed no significant difference between the two groups in knowledge, skills and motivation (represented in Table 4.3).

Table 4.3: *Median, IQR and mean rank of overall competence in screening domain, in terms of knowledge, skills and motivation in Bachelor's and Master's groups. The results of Mann-Whitney U test are also shown*

Attributes	**Experience**	**Median (IQR)**	**Mean Rank**	**Mod Z**
Knowledge	Bachelor's	21 (8)	55.75	0.441
	Master's	21.5 (8)	58.46	
Skills	Bachelor's	21 (8)	54.58	0.853
	Master's	21 (8)	59.84	
Motivation	Bachelor's	21 (8)	53.13	1.363
	Master's	21 (8)	61.54	

Note: *The total score for screening is 28; '*' indicates $p<0.05$*

Table 4.4 depicts the competency-wise median, interquartile range and mean rank of the bachelor's and master's group in knowledge, skills and motivation. The results of Mann Whitney U-test revealed no significant difference between the master's and bachelor's groups in any of the competencies and in the three attributes (knowledge, skills and motivation) related to screening.

Table 4.4: *Median, IQR and mean rank of the 7 competencies in hearing screening, in terms of knowledge, skills and motivation in Bachelors' and Masters' groups. The results of Mann-Whitney U test are also shown*

Competencies	**Sub-domains**	**Experience**	**Median (IQR)**	**Mean Rank**	**Mod Z**
NBHS	Knowledge	Bachelor's	3 (1)	54.77	0.865
		Master's	3 (1)	59.62	
	Skills	Bachelor's	3 (1)	52.63	1.706
		Master's	3 (1)	62.13	
	Motivation	Bachelor's	3 (1)	52.16	1.849
		Master's	3 (1)	62.68	
HRR	Knowledge	Bachelor's	3 (1)	56.02	0.376
		Master's	3 (1)	58.15	
	Skills	Bachelor's	3 (2)	55.30	0.647
		Master's	3 (1)	59	
	Motivation	Bachelor's	3 (2)	56.42	0.219
		Master's	3 (1)	57.68	
BOA	Knowledge	Bachelor's	3 (1)	54.84	0.827
		Master's	3 (1)	59.54	
	Skills	Bachelor's	3 (2)	53.96	1.138
		Master's	3 (1)	60.57	
	Motivation	Bachelor's	3 (2)	53.48	1.306
		Master's	3 (1)	61.13	
OAE	Knowledge	Bachelor's	3 (1)	54.48	0.975
		Master's	3 (1)	59.96	
	Skills	Bachelor's	3 (1)	55.21	0.691
		Master's	3 (1)	59.10	
	Motivation	Bachelor's	3 (1)	54.64	0.919
		Master's	3 (1)	59.77	
A-ABR	Knowledge	Bachelor's	3 (2)	58.15	0.427
		Master's	3 (2)	55.65	
	Skills	Bachelor's	3 (1)	57.71	0.263
		Master's	3 (2)	56.16	

	Motivation	Bachelor's	3 (1)	54.23	1.045
		Master's	3 (2)	60.25	
School hearing screening	Knowledge	Bachelor's	3 (1)	54.93	0.785
		Master's	3 (1)	59.42	
	Skills	Bachelor's	3 (2)	54.35	0.996
		Master's	3 (1)	60.11	
	Motivation	Bachelor's	3 (2)	52.95	1.528
		Master's	3 (1)	61.75	
Industrial hearing screening	Knowledge	Bachelor's	3 (2)	55.33	0.624
		Master's	3 (1)	58.96	
	Skills	Bachelor's	2 (2)	53.64	1.235
		Master's	3 (2)	60.94	
	Motivation	Bachelor's	3 (1)	52.98	1.481
		Master's	3 (2)	61.71	

Note: *'*' indicates p<0.05*

4.1.2 Comparison between Pre-Covid and Covid group

To investigate the effect of pandemic on self-perceived competence in hearing screening, the bachelor's students who completed the program before and during the pandemic were compared. All of them had rated their competence based on their experience upto internship. One hundred thirty seven participants were analyzed for their perceived competence in hearing screening in terms of their knowledge, skills and motivation on a five – point rating scale. Table 4.5 gives the overall frequency of responses (average of frequency in the 7 competencies of hearing screening) for the perceived competence in knowledge, skills and motivation against each point of the rating scale in Pre-Covid and Covid groups. It was observed that majority of the participants in both the groups had rated '3' and '4' for all questions in screening domain. This was true for knowledge, skills as well as motivation.

Table 4.5: *Frequency of responses (in percentage) for the perceived competence in knowledge, skills and motivation in hearing screening, against each point of the rating scale in Pre-Covid and Covid groups*

Attributes	**Percentage of Responses**									
	Pre-Covid					**Covid**				
	0	**1**	**2**	**3**	**4**	**0**	**1**	**2**	**3**	**4**
Knowledge	1.64	3.98	14.28	42.85	37.22	0.19	5.26	24.44	42.10	28.01
Skills	3.5	6.55	15.45	42.38	32.08	1.87	9.21	26.31	41.34	21.23
Motivation	4.2	6.07	15.24	45.42	29.02	1.69	7.14	23.31	40.21	27.63

Note: *The different shades in the table depict the range of responses in percentage from highest to lowest. Darkest shade represents highest percentage of responses while lightest represents the lowest percentage of responses obtained.*

The frequency of good and exceptional ratings was averaged to compare the perceived competence separately in the 7 competencies of hearing screening with respect to knowledge, skills and motivation. Such averaged frequencies were compared between the pre-Covid and Covid groups. This is represented in Table 4.6. It was observed that the number of participants who rated the self-perceived competence as good and exceptional were higher in the pre-Covid group compared to Covid group.

Table 4.6: *Frequency of responses (in percentage) for the perceived competence in the seven competencies of hearing screening in knowledge, skills and motivation against each point of the rating scale in Pre-Covid and Covid groups*

Competencies	**Percentage of Responses - Screening**					
	Knowledge		**Skills**		**Motivation**	
	Pre-Covid	Covid	Pre-Covid	Covid	Pre-Covid	Covid
NBHS	42.6	36.85	41.8	35.5	39.35	36.8
HRR	41.0	36.15	36.85	33.55	36.85	35.55
BOA	41.0	36.85	36.05	30.9	34.4	32.9
OAE	43.45	39.5	43.45	43.4	44.25	40.8

A-ABR	36.05	31.55	34.45	27.65	36.9	34.2
School hearing screening	40.15	34.2	37.7	28.3	36.9	30.25
Industrial hearing screening	36.05	30.3	30.35	19.7	31.95	26.95

Note: *The darker shade in the table represents higher percentage of participants with good and exceptional responses.*

Table 4.7 shows the median rating and the interquartile range of pre-Covid and Covid groups. The median of the group reflects the rating across the seven competencies of hearing screening, separately for knowledge, skills and motivation. The table also shows the mean rank of the two groups. The median rating was comparable between the two groups while the mean rank was higher in the pre-Covid group compared to Covid group in knowledge, skills as well as motivation. The responses obtained from 137 participants were subjected to Shapiro Wilk's Test of normality. The results revealed that the responses of participants in both pre-Covid and Covid groups failed to meet normality criteria ($p<0.05$). Therefore, the groups were statistically compared using non-parametric test. Mann-Whitney U test revealed significant difference between the two groups in skills, but not in knowledge and motivation (represented in Table 4.7).

Table 4.7: *Median, IQR and mean rank of overall competence in screening domain, in terms of knowledge, skills and motivation in Pre-Covid and Covid groups. The results of Mann-Whitney U test are also shown*

Attributes	**Covid effect**	**Median (IQR)**	**Mean Rank**	**Mod Z**
Knowledge	Pre-Covid	21 (8)	74.94	1.575
	Covid	21 (8)	64.23	
Skills	Pre-Covid	21 (8)	76.48	1.980*
	Covid	20 (7)	63.00	

Motivation	Pre-Covid	21(8)	71.50	0.662
	Covid	20 (7)	66.99	

Note: *The total score for screening is 28; '*' indicates p<0.05*

Table 4.8 depicts the competency-wise median, interquartile range and mean rank of the pre-Covid and Covid group in knowledge, skills and motivation. The results of Mann-Whitney U test revealed no significant difference between the two groups except for knowledge and skills in school and industrial hearing screening. In these competencies the pre-Covid group had higher mean rank compared to the Covid group.

Table 4.8: *Median, IQR and mean rank of the 7 competencies in screening domain, in terms of knowledge, skills and motivation in Pre-Covid and Covid groups. The results of Mann-Whitney U test are also shown*

Competencies	**Attributes**	**Covid effect**	**Median (IQR)**	**Mean Rank**	**Mod Z**
New-born hearing screening	Knowledge	Pre-Covid	3 (1)	73.04	1.147
		Covid	3 (2)	65.76	
	Skills	Pre-Covid	3 (1)	73.25	1.209
		Covid	3 (2)	65.59	
	Motivation	Pre-Covid	3 (1)	68.80	0.055
		Covid	3 (2)	69.16	
HRR	Knowledge	Pre-Covid	3 (1)	73.84	1.369
		Covid	3 (2)	65.11	
	Skills	Pre-Covid	3 (2)	74.14	1.438
		Covid	3 (1)	64.88	
	Motivation	Pre-Covid	3 (2)	69.85	0.239
		Covid	3 (2)	68.32	
BOA	Knowledge	Pre-Covid	3 (1)	73.87	1.376
		Covid	3 (2)	65.09	
	Skills	Pre-Covid	3 (2)	75.09	1.691
		Covid	3 (1)	64.11	
	Motivation	Pre-Covid	3 (2)	71.39	0.665

		Covid	3 (1)	67.08	
OAE	Knowledge	Pre-Covid	3 (1)	69.67	0.192
		Covid	3 (1)	68.46	
	Skills	Pre-Covid	3 (1)	71.28	0.663
		Covid	3 (1)	67.17	
	Motivation	Pre-Covid	3 (1)	70.39	0.400
		Covid	3 (1)	67.88	
A-ABR	Knowledge	Pre-Covid	3 (2)	74.52	1.539
		Covid	3 (1)	64.57	
	Skills	Pre-Covid	3 (1)	72.87	1.076
		Covid	3 (1)	65.89	
	Motivation	Pre-Covid	3 (1)	70.11	0.319
		Covid	3 (1)	68.11	
School screening	Knowledge	Pre-Covid	3 (1)	75.98	1.965*
		Covid	3 (1)	63.39	
	Skills	Pre-Covid	3 (2)	77.25	2.294*
		Covid	3 (1)	62.38	
	Motivation	Pre-Covid	3 (2)	71.96	0.824
		Covid	3 (1)	66.63	
Industrial screening	Knowledge	Pre-Covid	3 (2)	76.18	1.987*
		Covid	3 (1)	63.24	
	Skills	Pre-Covid	3 (2)	79.09	2.754*
		Covid	2 (2)	60.90	
	Motivation	Pre-Covid	3 (1)	72.36	0.927
		Covid	3 (1)	66.30	

Note: *'*' indicates p<0.05*

4.2 Perceived Competencies in the Diagnostics Domain

In the diagnostic domain, there were eighteen questions to assess different competencies related to diagnosis in audiology. The perceived competence is compared between bachelors' and masters' groups to derive the effect of qualification, and is compared between pre-Covid and Covid groups of bachelor's students to derive the effect of Covid-19 pandemic.

4.2.1 Comparison between Bachelor's and Master's group

Table 4.9 gives the frequency of responses (in percentage) for the perceived competence in knowledge, skills and motivation with respect to diagnostic, against each point of the rating scale in bachelor's and master's groups. The data represents responses of participants in bachelor's and master's group who had completed their study before the onset of Covid pandemic. It was observed that majority of the participants in both the groups had rated '3' and '4' for all questions in diagnostic domain. This was true for knowledge, skills as well as motivation.

Table 4.9*: Frequency of responses (in percentage) for the perceived competence in knowledge, skills and motivation with respect to diagnostics, against each point of the rating scale in Bachelor's and Master's groups*

Attributes	**Percentage of Responses**									
	Bachelor's					**Master's**				
	0	**1**	**2**	**3**	**4**	**0**	**1**	**2**	**3**	**4**
Knowledge	1.9	7.9	19.0	43.6	27.5	0.4	3.3	17.6	42.0	36.7
Skills	4.6	11.3	23.6	36.7	23.9	1.2	5.8	20.0	39.9	33.2
Motivation	4.9	10.4	19.6	40.8	24.3	0.2	4.7	16.8	41.2	37.1

Note: *The different shades in the table depict the range of responses in percentage from highest to lowest. Darkest shade represents highest percentage of responses while lightest represents the lowest percentage of responses obtained.*

The frequency of good and exceptional ratings was averaged to compare the perceived competence in the 18 competencies of audiological diagnosis. The average percentages were derived separately for knowledge, skills and motivation in the bachelor's and master's groups. Table 4.10 shows that the average percentage was higher in master's group in all competencies compared to the bachelor's group, except subjective calibration and knowledge in (C)APD assessment, in which the trend was opposite.

Table 4.10*: Frequency of responses (in percentage) for the perceived competence in the eighteen competencies of audiological diagnosis, in knowledge, skills and motivation, against each point of the rating scale in Bachelor's and Master's groups*

Competencies	**Percentage of Responses**					
	Knowledge		**Skills**		**Motivation**	
	Bachelor's	Master's	Bachelor's	Master's	Bachelor's	Master's
Case history	43.45	46.15	42.6	48.1	41.8	45.2
Subjective Calibration	43.45	42.3	41.0	40.4	36.9	36.55
Otoscopy	39.3	45.2	33.6	41.35	38.55	47.1
Pure tone audiometry	45.05	49.05	43.45	50.0	45.1	48.05
Speech Audiometry	43.45	48.1	41.0	49.05	40.15	48.05
Tympanometry and reflexometry	44.25	46.15	39.35	45.2	40.15	48.1
OAE	43.45	46.15	39.35	46.2	39.3	47.1
ABR	41.8	44.25	38.55	42.35	41.0	47.1
LLR	27.9	33.65	18.0	29.8	21.3	30.8
Recruitment tests	34.45	39.4	26.25	34.6	27.05	33.65
Neural adaptation tests	32.8	39.45	27.05	32.65	29.5	36.55
Functional hearing loss tests	35.25	42.3	29.5	37.5	32.0	39.45
Tinnitus	28.7	34.6	22.95	29.85	27.85	34.6
Hyperacusis	22.95	25.0	16.4	22.1	20.5	28.85
(C)APD	28.7	26.95	18.85	21.15	22.95	28.85
Subjective vestibular tests	22.95	28.85	15.55	23.1	20.5	28.85
Objective	23.75	25	15.6	20.2	22.1	30.75

vestibular tests						
Counselling	38.5	45.2	36.05	44.25	39.35	45.2

Note: *The darker shade in the table represents higher percentage participants with self-perception of good and exceptional responses.*

Table 4.11 shows the median rating and the interquartile range of overall perceived competence in diagnostics domain, in terms of knowledge, skills and motivation in bachelors' and masters' groups. The median of the group reflects the rating averaged across the eighteen competencies of audiological diagnosis, separately for knowledge, skills and motivation. The median rating was higher for the master's group compared to bachelor's group in knowledge, skills as well as motivation. The responses obtained from 113 participants were subjected to Shapiro Wilk's Test of normality. The results revealed that the responses of participants with both bachelor's and master's degree failed to meet normality criteria ($p<0.05$). Therefore, the groups were statistically compared using non-parametric test. Mann-Whitney U test revealed significant difference between the two groups in skills and motivation, but not in knowledge (represented in Table 4.11).

Table 4.11: *Median and IQR of overall competence in diagnostics domain, in terms of knowledge, skills and motivation in Bachelor's and Master's groups. The results of Mann-Whitney U test are also shown*

Attributes	**Experience**	**Median (IQR)**	**Mod Z**
Knowledge	Bachelor's	50 (21)	1.839
	Master's	58 (16)	
Skills	Bachelor's	47 (20)	2.418*
	Master's	54 (18)	
Motivation	Bachelor's	49 (22)	2.720*
	Master's	54 (15)	

Note: *The total score for diagnostics is 72; '*' indicates $p<0.05$*

Table 4.12 depicts the competency-wise median, interquartile range and mean rank of the bachelor's and master's group in knowledge, skills and motivation. In general, in knowledge, skills as well as motivation, the competence rating was higher in masters' group compared to bachelor's group. But the results of Mann-Whitney U test revealed a significant difference only in:

- knowledge in pure tone audiometry and subjective vestibular tests,
- skills in pure tone audiometry, speech audiometry, subjective vestibular tests, recruitment tests, OAEs, LLRs and counselling
- motivation in speech audiometry, tympanometry and reflexometry, recruitment tests, OAE, ABR, LLR, tinnitus and hyperacusis diagnosis, and objective vestibular tests.

Table 4.12: *Median, IQR and mean rank of the 18 competencies in diagnostics domain, in terms of knowledge, skills and motivation in Bachelors' and Masters' groups. The results of Mann-Whitney U test are also shown*

Competencies	**Attributes**	**Experience**	**Median (IQR)**	**Mean Rank**	**Mod Z**
Case history	Knowledge	Bachelor's	3 (1)	53.70	1.282
		Master's	4 (1)	60.88	
	Skills	Bachelor's	3 (1)	52.92	1.589
		Master's	3.5 (1)	61.79	
	Motivation	Bachelor's	3 (1)	53.96	1.171
		Master's	4 (1)	60.57	
Subjective Calibration	Knowledge	Bachelor's	3 (1)	54.95	0.786
		Master's	3 (1)	59.40	
	Skills	Bachelor's	3 (1)	55.31	0.639
		Master's	3 (1)	58.98	
	Motivation	Bachelor's	3 (2)	55.57	0.532
		Master's	3 (2)	58.67	
		Bachelor's	3 (1)	52.69	1.653

Otoscopy	Knowledge	Master's	3 (1)	62.06	
	Skills	Bachelor's	3 (2)	52.90	1.546
		Master's	3 (1)	61.81	
	Motivation	Bachelor's	3 (1)	52.04	1.928
		Master's	3 (1)	62.82	
Pure tone audiometry	Knowledge	Bachelor's	3 (1)	51.90	2.011*
		Master's	4 (1)	62.98	
	Skills	Bachelor's	3 (1)	50.37	2.607*
		Master's	4 (1)	64.78	
	Motivation	Bachelor's	3 (1)	51.68	2.094*
		Master's	4 (1)	63.24	
Speech Audiometry	Knowledge	Bachelor's	3 (1)	52.67	1.691
		Master's	3.5 (1)	62.08	
	Skills	Bachelor's	3 (1)	50.48	2.533*
		Master's	3.5 (1)	64.64	
	Motivation	Bachelor's	3 (1)	49.36	2.947*
		Master's	4 (1)	65.96	
Tympanometry and reflexometry	Knowledge	Bachelor's	3 (1)	52.67	1.687
		Master's	3.5 (1)	62.08	
	Skills	Bachelor's	3 (1)	53.62	1.292
		Master's	3 (1)	60.96	
	Motivation	Bachelor's	3 (1)	50.18	2.635*
		Master's	3.5 (1)	65	
OAE	Knowledge	Bachelor's	3 (1)	53.39	1.405
		Master's	3 (1)	61.24	
	Skills	Bachelor's	3 (1)	51.82	1.985*
		Master's	3 (1)	63.08	
	Motivation	Bachelor's	3 (1)	50.08	2.679*
		Master's	4 (1)	65.19	
ABR	Knowledge	Bachelor's	3 (1)	51.61	2.073*
		Master's	3.5 (1)	63.33	
	Skills	Bachelor's	3 (1)	52.93	1.538
		Master's	3 (1)	61.77	

	Motivation	Bachelor's	3 (1)	50.34	2.567*
		Master's	4 (1)	64.81	
LLR	Knowledge	Bachelor's	3 (1)	52.74	1.582
		Master's	3 (1)	62	
	Skills	Bachelor's	2 (2)	48.29	3.161*
		Master's	3 (1)	67.22	
	Motivation	Bachelor's	2 (2)	48.72	3.028*
		Master's	3 (1)	66.71	
Recruitment tests	Knowledge	Bachelor's	3 (1)	52.89	1.542
		Master's	3 (1)	61.82	
	Skills	Bachelor's	3 (1)	51.11	2.154*
		Master's	3 (2)	63.90	
	Motivation	Bachelor's	3 (1)	51.57	1.989*
		Master's	3 (2)	63.38	
Neural adaptation tests	Knowledge	Bachelor's	3 (2)	53.03	1.483
		Master's	3 (1)	61.65	
	Skills	Bachelor's	3 (1)	52.76	1.557
		Master's	3 (2)	61.97	
	Motivation	Bachelor's	3 (1)	52.13	1.794
		Master's	3 (2)	62.71	
Functional hearing loss tests	Knowledge	Bachelor's	3 (2)	53.39	1.367
		Master's	3 (1)	61.24	
	Skills	Bachelor's	3 (1)	52.98	1.498
		Master's	3 (2)	61.71	
	Motivation	Bachelor's	3 (1)	53.02	1.505
		Master's	3 (0)	61.66	
Tinnitus	Knowledge	Bachelor's	3 (1)	53.32	1.363
		Master's	3 (2)	61.32	
	Skills	Bachelor's	2 (1)	52.55	1.629
		Master's	3 (1)	62.22	
	Motivation	Bachelor's	3 (1)	51.25	2.136*
		Master's	3 (2)	63.75	
		Bachelor's	2 (1)	55.12	0.695

Hyperacusis	Knowledge	Master's	2.5 (1)	59.20	
	Skills	Bachelor's	2 (2)	52.80	1.544
		Master's	2 (1)	61.93	
	Motivation	Bachelor's	2 (2)	48.89	2.954*
		Master's	3 (2)	66.51	
(C)APD	Knowledge	Bachelor's	3 (1)	56.67	0.121
		Master's	3 (1)	57.38	
	Skills	Bachelor's	2 (2)	53.41	1.308
		Master's	2 (1)	61.21	
	Motivation	Bachelor's	2 (2)	53.06	1.451
		Master's	3 (1)	61.63	
Subjective vestibular tests	Knowledge	Bachelor's	2 (2)	51.26	2.095*
		Master's	3 (2)	63.73	
	Skills	Bachelor's	2 (2)	49.54	2.715*
		Master's	2 (1)	65.75	
	Motivation	Bachelor's	2 (2)	50.11	2.495*
		Master's	3 (2)	65.08	
Objective vestibular tests	Knowledge	Bachelor's	2 (2)	53.28	1.355
		Master's	2.5 (1)	61.37	
	Skills	Bachelor's	2 (2)	52.01	1.806
		Master's	2 (2)	62.86	
	Motivation	Bachelor's	2 (2)	50.27	2.444*
		Master's	3 (2)	64.89	
Counselling	Knowledge	Bachelor's	3 (1)	52.32	1.780
		Master's	3.5 (1)	62.49	
	Skills	Bachelor's	3 (2)	51.14	2.209*
		Master's	3 (1)	63.88	
	Motivation	Bachelor's	3 (1)	51.97	1.918
		Master's	3 (1)	62.90	

Note: *'*' indicates $p<0.05$*

4.2.2 Comparison between Pre-Covid and Covid group

To investigate the effect of pandemic on self-perceived competence, the bachelor's students who completed the program before and during the pandemic were compared. All of them had rated their competence based on their experience upto internship. One hundred thirty seven participants were analyzed for their perceived competence in audiological diagnosis in terms of their knowledge, skills and motivation on a five-point rating scale. Table 4.13 gives the overall frequency of responses (average of frequency in the 18 competencies of diagnostics) for the perceived competence in knowledge, skills and motivation against each point of the rating scale in pre-Covid and Covid groups. It was observed that majority of the participants in the pre-Covid groups had rated '3' and '4' for all questions, while the Covid group had rated '2' or '3' in diagnostics domain. This was true for knowledge, skills as well as motivation.

Table 4.13*: Frequency of responses (in percentage) for the perceived competence in knowledge, skills and motivation in diagnostics domain, against each point of the rating scale in Pre-Covid and Covid groups*

Attributes	**Percentage of Responses**									
	Pre-Covid					**Covid**				
	0	**1**	**2**	**3**	**4**	**0**	**1**	**2**	**3**	**4**
Knowledge	1.9	7.9	19.0	43.6	27.5	1.38	10.59	24.84	38.82	24.33
Skills	4.6	11.3	23.6	36.7	23.9	4.82	14.26	28.80	34.36	17.77
Motivation	4.9	10.4	19.6	40.8	24.3	4.16	10.03	25.43	35.91	24.49

Note: *The different shades in the table depict the range of responses in percentage from highest to lowest. Darkest shade represents highest percentage of responses while lightest represents the lowest percentage of responses obtained.*

Subsequently, the frequency of good and exceptional ratings was averaged to compare the perceived competence in the 18 competencies of audiological diagnosis. The average percentages were derived separately for knowledge, skills and motivation in the pre-Covid and Covid groups. Table 4.14. shows the comparison of average percentage between pre-Covid and Covid groups. The average percentage was higher in pre-Covid group compared to the Covid group in all competencies except pure tone audiometry (knowledge), tympanometry and reflexometry (motivation), tinnitus assessment (knowledge, skills) and subjective vestibular tests (motivation), in which the trend was opposite.

Table 4.14*: Frequency of responses (in percentage) for the perceived competence in the eighteen competencies of diagnostics domain, in knowledge, skills and motivation, against each point of the rating scale in Pre-Covid and Covid groups*

Competencies	**Percentage of Responses - Diagnostics**					
	Knowledge		**Skills**		**Motivation**	
	Pre - Covid	Covid	Pre - Covid	Covid	Pre - Covid	Covid
Case history	43.45	43.4	42.6	40.1	41.8	40.15
Subjective Calibration	43.45	37.5	41	35.5	36.9	35.55
Otoscopy	39.3	38.15	33.6	33.55	38.55	36.2
Pure tone audiometry	45.05	45.4	43.45	42.15	45.1	42.8
Speech Audiometry	43.45	42.1	41	35.5	40.15	36.85
Tympanometry and reflexometry	44.25	41.45	39.35	36.2	40.15	40.8
OAE	43.45	37.5	39.35	34.85	39.3	38.2
ABR	41.8	32.25	38.55	28.3	41	34.25
LLR	27.9	15.1	18	9.9	21.3	15.15
Recruitment	34.45	29.6	26.25	18.4	27.05	26.95

tests						
Neural adaptation tests	32.8	25.65	27.05	15.15	29.5	21.05
Functional hearing loss tests	35.25	34.9	29.5	28.95	32	32.9
Tinnitus	28.7	29.65	22.95	23.7	27.85	27.65
Hyperacusis	22.95	18.4	16.4	13.15	20.5	19.7
(C)APD	28.7	21.05	18.85	14.5	22.95	19.75
Subjective vestibular tests	22.95	21.7	15.55	14.45	20.5	22.4
Objective vestibular tests	23.75	17.75	15.6	11.85	22.1	17.1
Counselling	38.5	36.85	36.05	32.9	39.35	36.15

Note: *The darker shade in the table represents higher percentage of participants with good and exceptional responses.*

Table 4.15 shows the median rating and the interquartile range of pre-Covid and Covid groups. The median of the group reflects the rating across the eighteen competencies of audiological diagnosis, separately for knowledge, skills and motivation. The table also shows the mean rank of the two groups. The median rating was comparable between the two groups while the mean rank was higher in the pre-Covid group compared to Covid group in knowledge, skills as well as motivation. The responses obtained from 137 participants were subjected to Shapiro Wilk's Test of normality. The results revealed that the responses of participants in both pre-Covid and Covid groups failed to meet normality criteria ($p<0.05$). The results of Mann-Whitney U test revealed no significant difference between the two groups in knowledge, skills and motivation (represented in Table 4.15).

Table 4.15: *Median, IQR and mean rank of overall competence in diagnostics domain, in terms of knowledge, skills and motivation in Pre-Covid and Covid groups. The results of Mann-Whitney U test are also shown*

Attributes	Covid effect	Median (IQR)	Mean Rank	Mod Z
Knowledge	Pre-Covid	50 (21)	73.16	1.101
	Covid	50 (20)	65.66	
Skills	Pre-Covid	47 (20)	73.84	1.278
	Covid	44 (19)	65.66	
Motivation	Pre-Covid	49 (22)	69.78	0.206
	Covid	50 (19)	68.38	

***Note**: The total score for diagnostics is 72; '*' indicates p<0.05*

Table 4.16 depicts the competency-wise median, interquartile range and mean rank of the pre-Covid and Covid group in knowledge, skills and motivation in the diagnostics domain. In general, the pre-Covid group showed higher mean rank compared to Covid group. But the results of Mann-Whitney U test revealed significant difference only in:

- knowledge in LLR and Neural adaptation tests
- skills in ABR, LLR and neural adaptation tests

Table 4.16: *Median, IQR and mean rank of the 18 competencies in diagnostics domain, in terms of knowledge, skills and motivation in Pre-Covid and Covid groups. The results of Mann-Whitney U test are also shown*

Competencies	Attributes	Covid effect	Median (IQR)	Mean Rank	Mod Z
Case history	Knowledge	Pre-Covid	3 (1)	67.77	0.356
		Covid	3 (1)	69.99	
	Skills	Pre-Covid	3 (1)	71.03	0.582
		Covid	3 (1)	67.37	
	Motivation	Pre-Covid	3 (1)	68.48	0.147

		Covid	3 (1)	69.41	
Subjective Calibration	Knowledge	Pre-Covid	3 (1)	72.02	0.857
		Covid	3 (2)	66.58	
	Skills	Pre-Covid	3 (1)	74.52	1.557
		Covid	3 (2)	64.57	
	Motivation	Pre-Covid	3 (2)	69.75	0.211
		Covid	3 (2)	68.39	
Otoscopy	Knowledge	Pre-Covid	3 (1)	72.99	1.157
		Covid	3 (0)	65.80	
	Skills	Pre-Covid	3 (2)	71.24	0.635
		Covid	3 (1)	67.20	
	Motivation	Pre-Covid	3 (1)	71.34	0.668
		Covid	3 (1)	67.12	
Pure tone audiometry	Knowledge	Pre-Covid	3 (1)	69.31	0.092
		Covid	3 (1)	68.75	
	Skills	Pre-Covid	3 (1)	69.06	0.017
		Covid	3 (1)	68.95	
	Motivation	Pre-Covid	3 (1)	70.56	0.452
		Covid	3 (1)	67.75	
Speech Audiometry	Knowledge	Pre-Covid	3 (1)	70.11	0.323
		Covid	3 (1)	68.11	
	Skills	Pre-Covid	3 (1)	73.08	0.156
		Covid	3 (2)	65.72	
	Motivation	Pre-Covid	3 (1)	70.07	0.303
		Covid	3 (2)	68.14	
Tympanometry and reflexometry	Knowledge	Pre-Covid	3 (1)	68.53	0.135
		Covid	3 (1)	69.38	
	Skills	Pre-Covid	3 (1)	71.43	0.684
		Covid	3 (2)	67.05	
	Motivation	Pre-Covid	3 (1)	65.31	1.050
		Covid	3 (1)	71.96	
OAE	Knowledge	Pre-Covid	3 (1)	72.46	0.984
		Covid	3 (2)	66.22	

	Skills	Pre-Covid	3 (1)	73.59	1.293
		Covid	3 (2)	65.32	
	Motivation	Pre-Covid	3 (1)	70.18	0.335
		Covid	3 (1)	68.05	
ABR	Knowledge	Pre-Covid	3 (1)	75.41	1.810*
		Covid	3 (2)	63.86	
	Skills	Pre-Covid	3 (1)	79.36	2.900*
		Covid	3 (1)	60.68	
	Motivation	Pre-Covid	3 (1)	73.63	1.303
		Covid	3 (2)	65.28	
LLR	Knowledge	Pre-Covid	3 (1)	78.30	2.527*
		Covid	2 (2)	61.54	
	Skills	Pre-Covid	2 (2)	77.86	2.411*
		Covid	3 (1)	61.89	
	Motivation	Pre-Covid	2 (2)	73.25	1.153
		Covid	2 (2)	65.59	
Recruitment tests	Knowledge	Pre-Covid	3 (1)	72.02	0.839
		Covid	3 (1)	66.58	
	Skills	Pre-Covid	3 (1)	75.24	1.719
		Covid	2 (1)	63.99	
	Motivation	Pre-Covid	3 (1)	68.99	0.002
		Covid	3 (1)	69.01	
Neural adaptation tests	Knowledge	Pre-Covid	3 (2)	77.93	2.466*
		Covid	3 (2)	61.83	
	Skills	Pre-Covid	3 (1)	79.93	3.016*
		Covid	2 (2)	60.23	
	Motivation	Pre-Covid	3 (1)	74.82	1.589
		Covid	2 (1)	64.33	
Functional hearing loss tests	Knowledge	Pre-Covid	3 (2)	70.37	0.386
		Covid	3 (1)	67.90	
	Skills	Pre-Covid	3 (1)	71.85	0.794
		Covid	3 (1)	66.71	
	Motivation	Pre-Covid	3 (1)	68.74	0.074

		Covid	3 (1)	69.21	
Tinnitus	Knowledge	Pre-Covid	3 (1)	68.02	0.270
		Covid	3 (1)	69.78	
	Skills	Pre-Covid	2 (1)	68.34	0.183
		Covid	2 (1)	69.53	
	Motivation	Pre-Covid	3 (1)	65.25	1.037
		Covid	3 (1)	72.01	
Hyperacusis	Knowledge	Pre-Covid	2 (1)	70.65	0.456
		Covid	2 (1)	67.68	
	Skills	Pre-Covid	2 (2)	70.95	0.538
		Covid	2 (2)	67.43	
	Motivation	Pre-Covid	2 (2)	65.43	0.984
		Covid	2 (1)	71.87	
(C)APD	Knowledge	Pre-Covid	3 (1)	74.85	1.612
		Covid	2 (1)	64.30	
	Skills	Pre-Covid	2 (2)	71.34	0.639
		Covid	2 (2)	67.12	
	Motivation	Pre-Covid	2 (2)	70.11	0.306
		Covid	2 (1)	68.11	
Subjective vestibular tests	Knowledge	Pre-Covid	2 (2)	69.26	0.072
		Covid	2 (1)	68.79	
	Skills	Pre-Covid	2 (2)	69.23	0.063
		Covid	2 (2)	68.82	
	Motivation	Pre-Covid	2 (2)	66.75	0.613
		Covid	2 (1)	70.81	
Objective vestibular tests	Knowledge	Pre-Covid	2 (2)	71.49	0.683
		Covid	2 (2)	67.00	
	Skills	Pre-Covid	2 (2)	71.77	0.757
		Covid	2 (1)	66.78	
	Motivation	Pre-Covid	2 (2)	71.56	0.698
		Covid	2 (2)	66.95	
Counselling	Knowledge	Pre-Covid	3 (1)	72.34	0.940
		Covid	3 (2)	66.32	

	Skills	Pre-Covid	3 (2)	72.41	0.955
		Covid	3 (1)	66.26	
	Motivation	Pre-Covid	3 (1)	71.48	0.698
		Covid	3 (2)	67.01	

Note: *'*' indicates p<0.05*

4.3 Perceived Competencies in the Management Domain

In the management domain, there were sixteen questions to assess different competencies related to habilitation/re-habilitation in audiology. The perceived competence is compared between bachelors' and masters' groups to derive the effect of qualification, and is compared between pre-Covid and Covid groups of bachelor's students to derive the effect of Covid-19 pandemic.

4.3.1 Comparison between Bachelor's and Master's group

Table 4.17 gives the overall frequency of responses (averaged of 16 competencies) for the perceived competence in knowledge, skills and motivation with respect to audiological management, against each point of the rating scale in bachelor's and master's groups. The data represents responses of participants who had completed their study before the onset of Covid pandemic. It was observed that majority of the participants in both the groups had rated '2' and '3' for all questions in management domain. This was true for knowledge, skills as well as motivation.

Table 4.17*: Frequency of responses (in percentage) for the perceived competence in knowledge, skills and motivation with respect to audiological management, against each point of the rating scale in Bachelor's and Master's groups*

		Percentage of Responses									
		Bachelor's					Master's				
		0	1	2	3	4	0	1	2	3	4
Management	Knowledge	4.8	15.2	23.3	36.8	20.0	3.1	7.7	25.4	38.3	23.3
	Skills	12.0	16.2	27.8	30.1	13.9	6.2	13.6	27.3	34.0	18.9
	Motivation	10.0	14.3	22.5	35.6	17.7	3.7	10.0	24.6	35.7	26.0

Note: *The different shades in the table depict the range of responses in percentage from highest to lowest. Darkest shade represents highest percentage of responses while lightest represents the lowest percentage of responses obtained.*

The frequency of good and exceptional ratings was averaged to compare the perceived competence in the 16 competencies of audiological management. The average percentages were derived separately for knowledge, skills and motivation in the bachelor's and master's groups. Table 4.18 shows that the comparison of average percentage between bachelor's and master's group demonstrated that the average percentage was higher in master's group for few of the competencies in management with respect to knowledge, skills and motivation. This did not hold true for listening needs (motivation), IHD fitting (skills), IHD troubleshooting (knowledge, motivation), rehabilitative services for HI (knowledge, skills and motivation), rehabilitative services for tinnitus and hyperacusis (knowledge), rehabilitative services for vestibular disorders (knowledge) and rehabilitative services for tele mode (motivation), wherein the trend was opposite.

Table 4.18*: Frequency of responses (in percentage) for the perceived competence in the sixteen competencies of audiological management in knowledge, skills and motivation against each point of the rating scale in Bachelor's and Master's groups*

Competencies	**Percentage of Responses - Management**					
	Knowledge		**Skills**		**Motivation**	
	Bachelor's	Master's	Bachelor's	Master's	Bachelor's	Master's
Listening needs	38.5	41.35	33.6	40.35	38.55	38.45
Functional gain measurements	30.35	31.7	25.45	28.85	29.55	29.85
REM	23.75	25.0	18.85	19.25	22.15	25.0
EAM	26.2	27.85	16.4	25.95	18.9	27.9
Ear molds	27.9	38.5	23.75	36.5	27.9	39.45
HA fitting	31.15	38.45	29.5	38.45	31.95	42.3
IHD fitting	28.65	29.85	20.5	20.2	27.9	32.7
HA troubleshooting	32.8	40.4	26.2	40.4	32.8	43.25
IHD troubleshooting	22.95	21.15	17.2	18.25	25.4	25.0
ALD fitting	22.15	23.05	12.3	16.3	20.5	22.15
Rehabilitative services for HI	36.1	33.65	31.95	26.9	32.8	32.7
Rehabilitative services for tinnitus and hyperacusis	37.85	28.85	20.5	25.0	24.6	29.8
Rehabilitative services for (C)APD	23.75	25.95	17.25	18.25	22.15	25.95
Rehabilitative services for vestibular disorders	24.6	24.05	14.8	15.35	20.5	23.05
Rehabilitative	23.75	24.0	15.55	16.35	18.85	18.3

services through tele mode						
Management-related counselling	33.6	39.4	28.7	36.55	31.95	37.5

Note: *The darker shade in the table represents higher percentage of participants with good and exceptional responses.*

Table 4.19 shows the mean rating and the standard deviation of bachelor's and master's groups. The mean of the group reflects the rating averaged across the sixteen competencies of audiological management, separately for knowledge, skills and motivation. The mean rating was higher for the master's group compared to bachelor's group in knowledge, skills as well as motivation. The responses obtained from 113 participants were subjected to Shapiro Wilk's Test of normality. The results revealed that the responses of participants with both bachelor's and master's met the criteria for normality ($p>0.05$). Therefore, the groups were statistically compared using parametric test. One-way MANOVA test revealed no significant difference between the two groups in knowledge, skills as well as motivation (represented in Table 4.19).

Table 4.19: *Mean, standard deviation, degrees of freedom and error degrees of freedom of overall competence in management domain, in terms of knowledge, skills and motivation in Bachelor's and Master's groups. The results of One-way MANOVA test are also shown*

Attributes	**Experience**	**Mean**	**Standard Deviation**	**df**	**Error df**	**F**
Knowledge	Bachelor's	40.31	14.75	1	111	1.464
	Master's	43.37	11.52			
Skills	Bachelor's	34.85	15.92	1	111	2.635
	Master's	39.31	12.72			
Motivation	Bachelor's	37.87	15.91	1	111	3.879
	Master's	43.23	12.44			

Note: *The total score for management is 64; '*' indicates $p<0.05$*

Table 4.20 depicts the competency-wise median, interquartile range and mean rank of the bachelor's and master's group in knowledge, skills and motivation. In general, in knowledge, skills as well as motivation, the competence score was higher in masters' group compared to bachelor's group. But the results of Mann-Whitney U test revealed a significant difference only in:

- knowledge in ear molds, hearing aid fitting, hearing aid troubleshooting and management-related counselling
- skills in ear molds, hearing aid fitting, hearing aid troubleshooting and management-related counselling
- motivation in ear molds, hearing aid fitting, hearing aid troubleshooting, management-related counselling and rehabilitative services for tinnitus and hyperacusis

Table 4.20: *Median, IQR and mean rank of the 16 competencies in management domain, in terms of knowledge, skills and motivation in Bachelor's and Master's groups. The results of Mann-Whitney U test are also shown*

Competencies	**Attributes**	**Experience**	**Median (IQR)**	**Mean Rank**	**Mod Z**
Listening needs	Knowledge	Bachelor's	3 (1)	54.44	0.965
		Master's	3 (1)	60	
	Skills	Bachelor's	3 (2)	52.84	1.553
		Master's	3 (1)	61.88	
	Motivation	Bachelor's	3 (1)	54.53	0.932
		Master's	3 (1)	59.89	
Functional gain measurements	Knowledge	Bachelor's	3 (2)	57.38	0.139
		Master's	3 (1)	56.56	
	Skills	Bachelor's	3 (2)	56.17	0.302
		Master's	3 (1)	57.97	
		Bachelor's	3 (1)	56.68	0.117

	Motivation	Master's	3 (1)	57.38	
REM	Knowledge	Bachelor's	2 (1)	55.71	0.474
		Master's	2.5 (1)	58.51	
	Skills	Bachelor's	2 (2)	54.60	0.877
		Master's	2 (1)	59.82	
	Motivation	Bachelor's	2 (2)	53.68	1.208
		Master's	2.5 (1)	60.89	
EAM	Knowledge	Bachelor's	3 (1)	55.40	0.585
		Master's	3 (1)	58.88	
	Skills	Bachelor's	2 (2)	52.39	1.677
		Master's	3 (1)	62.41	
	Motivation	Bachelor's	2 (2)	52.33	1.706
		Master's	3 (1)	62.48	
Ear molds	Knowledge	Bachelor's	3 (2)	50.62	2.336*
		Master's	3 (1)	64.48	
	Skills	Bachelor's	2 (2)	49.52	2.732*
		Master's	3 (2)	65.78	
	Motivation	Bachelor's	3 (1)	49.98	2.590*
		Master's	3 (1)	65.24	
HA fitting	Knowledge	Bachelor's	3 (2)	51.66	1.979*
		Master's	3 (1)	63.27	
	Skills	Bachelor's	3 (1)	49.97	2.590*
		Master's	3 (1)	65.25	
	Motivation	Bachelor's	3 (2)	50.49	2.419*
		Master's	3 (1)	64.63	
IHD fitting	Knowledge	Bachelor's	3 (1)	56.47	0.197
		Master's	3 (1)	57.63	
	Skills	Bachelor's	2 (2)	57.62	0.226
		Master's	2 (2)	56.27	
	Motivation	Bachelor's	3 (1)	54.82	0.796
		Master's	3 (3)	59.56	
HA	Knowledge	Bachelor's	3 (2)	50.98	2.238*
		Master's	3 (1)	64.07	

troubleshooting	Skills	Bachelor's	3 (1)	48.75	3.033*
		Master's	3 (1)	66.68	
	Motivation	Bachelor's	3 (2)	50.78	2.319*
		Master's	3 (1)	64.30	
IHD troubleshooting	Knowledge	Bachelor's	2 (2)	57.66	0.238
		Master's	2 (1)	56.23	
	Skills	Bachelor's	2 (2)	56.66	0.125
		Master's	2 (2)	57.40	
	Motivation	Bachelor's	2 (2)	55.28	0.624
		Master's	2.5 (1)	59.02	
ALD fitting	Knowledge	Bachelor's	2 (2)	56.25	0.274
		Master's	2 (1)	57.88	
	Skills	Bachelor's	2 (2)	54.84	0.783
		Master's	2 (2)	59.54	
	Motivation	Bachelor's	2 (2)	54.39	0.946
		Master's	2 (2)	60.07	
Rehabilitative services for HI	Knowledge	Bachelor's	3 (2)	57.22	0.082
		Master's	3 (2)	56.74	
	Skills	Bachelor's	3 (1)	57.09	0.033
		Master's	3 (2)	56.89	
	Motivation	Bachelor's	3 (1)	56.07	0.347
		Master's	3 (1)	58.10	
Rehabilitative services for tinnitus and hyperacusis	Knowledge	Bachelor's	3 (1)	55.03	0.727
		Master's	3 (1)	59.31	
	Skills	Bachelor's	2 (2)	52.64	1.589
		Master's	2.5 (1)	62.12	
	Motivation	Bachelor's	2 (2)	50.86	2.233*
		Master's	3 (2)	64.20	
Rehabilitative services for (C)APD	Knowledge	Bachelor's	2 (2)	54.33	0.980
		Master's	3 (1)	60.13	
	Skills	Bachelor's	2 (2)	53.68	1.206
		Master's	2 (2)	60.89	
		Bachelor's	2 (2)	51.67	1.936

	Motivation	Master's	3 (1)	63.25	
Rehabilitative services for vestibular disorders	Knowledge	Bachelor's	2 (2)	54.09	1.059
		Master's	2 (1)	60.41	
	Skills	Bachelor's	2 (2)	53.56	1.246
		Master's	2 (2)	61.04	
	Motivation	Bachelor's	2 (2)	51.73	1.903
		Master's	2 (2)	63.18	
Rehabilitative services through tele mode	Knowledge	Bachelor's	2 (2)	55.36	0.596
		Master's	2 (1)	58.92	
	Skills	Bachelor's	2 (2)	54.86	0.775
		Master's	2 (2)	59.51	
	Motivation	Bachelor's	2 (2)	54.70	0.828
		Master's	2 (2)	59.69	
Management-related counselling	Knowledge	Bachelor's	3 (1)	50.57	2.410*
		Master's	3 (1)	64.55	
	Skills	Bachelor's	3 (2)	50.34	2.458*
		Master's	3 (2)	64.82	
	Motivation	Bachelor's	3 (1)	50.64	2.363*
		Master's	3 (2)	64.46	

Note: *'*' indicates p<0.05*

4.3.2 Comparison between pre - Covid and Covid group

To investigate the effect of pandemic on self-perceived competence, the bachelor's students who completed the program before and during the pandemic were compared. All of them had rated their competence based on their experience upto internship. One hundred thirty seven participants were analyzed for their perceived competence in hearing screening in terms of their knowledge, skills and motivation on a five -point rating scale. Table 4.21 gives the overall frequency of responses (average of frequency in the 16 competencies of audiological management) for the perceived competence in knowledge, skills and motivation against each point of the rating scale in pre-Covid and Covid groups. It was observed that majority of the participants in the

pre-Covid and Covid groups had rated ‘2’ and ‘3’ for all questions management domain. This was true for knowledge, skills as well as motivation.

Table 4.21*: Frequency of responses (in percentage) for the perceived competence in knowledge, skills and motivation with respect to audiological management, against each point of the rating scale in Pre-Covid and Covid groups*

Attributes	**Percentage of Responses**									
	Pre-Covid					**Covid**				
	0	**1**	**2**	**3**	**4**	**0**	**1**	**2**	**3**	**4**
Knowledge	4.8	15.2	23.3	36.8	20.0	7.06	18.09	30.75	30.26	13.82
Skills	12.0	16.2	27.8	30.1	13.9	17.68	23.74	30.19	18.09	10.28
Motivation	10.0	14.3	22.5	35.6	17.7	10.69	20.07	28.53	24.09	15.70

Note: *The different shades in the table depict the range of responses in percentage from highest to lowest. Darkest shade represents highest percentage of responses while lightest represents the lowest percentage of responses obtained.*

The frequency of good and exceptional ratings was averaged to compare the perceived competence separately in the 16 competencies of audiological management. The average percentages were derived separately knowledge, skills and motivation in the pre-Covid and Covid groups. Table 4.22 shows the comparison of average percentage between pre-Covid and Covid groups. The average percentage was higher in pre-Covid group compared to the Covid group in all competencies tested.

Table 4.22*: Frequency of responses (in percentage) for the perceived competence in the sixteen competencies of audiological management in knowledge, skills and motivation against each point of the rating scale in Pre-Covid and Covid groups*

Competencies	**Percentage of Responses - Diagnostics**					
	Knowledge		**Skills**		**Motivation**	
	Pre - Covid	Covid	Pre - Covid	Covid	Pre - Covid	Covid
Listening needs	38.5	32.9	33.6	22.4	38.55	30.25
Functional gain measurements	30.35	19.7	25.45	13.15	29.55	15.75
REM	23.75	19.1	18.85	11.15	22.15	13.15
EAM	26.2	18.45	16.4	10.55	18.9	16.45
Ear molds	27.9	24.35	23.75	15.75	27.9	23
HA fitting	31.15	30.95	29.5	19.05	31.95	26.95
IHD fitting	28.65	18.45	20.5	10.55	27.9	18.4
HA troubleshooting	32.8	27.65	26.2	20.4	32.8	24.35
IHD troubleshooting	22.95	17.1	17.2	11.85	25.4	21.7
ALD fitting	22.15	17.75	12.3	9.9	20.5	15.75
Rehabilitative services for HI	36.1	28.3	31.95	21.7	32.8	26.95
Rehabilitative services for tinnitus and hyperacusis	27.85	23.65	20.5	11.85	24.6	19.75
Rehabilitative services for (C)APD	23.75	16.45	17.25	9.2	22.15	15.8
Rehabilitative services for vestibular	24.6	19.7	14.8	9.85	20.5	18.4

disorders						
Rehabilitative services through tele mode	23.75	15.15	15.55	12.5	18.85	15.8
Management-related counselling	33.6	23	28.7	17.1	31.95	23.05

Note: *The darker shade in the table represents higher percentage of participants with good and exceptional responses.*

Table 4.23 shows the mean rating and the standard deviation of pre-Covid and Covid groups. The mean of the group reflects the rating averaged across the sixteen competencies of audiological management, separately for knowledge, skills and motivation. The mean rating was higher for the pre-Covid compared to Covid group in knowledge, skills as well as motivation. The responses obtained from 113 participants were subjected to Shapiro Wilk's Test of normality. The results revealed that the responses of participants with both the groups met the criteria for normality ($p>0.05$). Therefore, the groups were statistically compared using parametric test. One–way MANOVA test revealed a significant difference between the pre-Covid and Covid groups in skills but not knowledge and motivation (represented in Table 4.23).

Table 4.23: *Mean, standard deviation, degrees of freedom and error degrees of freedom of overall competence in management domain, in terms of knowledge, skills and motivation in Pre-Covid and Covid groups. The results of One-way MANOVA test are also shown*

Attributes	**Covid effect**	**Mean**	**Standard Deviation**	**df**	**Error df**	**F**
Knowledge	Pre-Covid	40.31	14.759	1	135	2.965
	Covid	36.11	13.754			
Skills	Pre-Covid	34.85	15.925	1	135	5.088*

	Covid	28.72	15.710			
Motivation	Pre-Covid	37.87	15.912	1	135	1.584
	Covid	34.39	16.170			

Note: *The total score for management is 64; '*' indicates p<0.05*

The competency-wise responses obtained from the participants of pre-Covid and Covid groups were subjected to Shapiro Wilk's Test of normality. Results revealed that the responses obtained from both the groups failed to meet the criteria for normality ($p<0.05$). Hence, Mann-Whitney U test was utilized for analysis of the same. Table 4.24 depicts the competency-wise median, interquartile range and mean rank of the pre-Covid and Covid group in knowledge, skills and motivation in the management domain. In general, the pre-Covid group showed higher mean rank compared to Covid group. But the results of Mann-Whitney U test revealed significant difference only in:

- knowledge in assessing listening needs, functional gain measurement, fitting of implantable hearing devices and rehabilitative services for hearing impaired
- skills in assessing listening needs, functional gain measurement, real ear measurement, electroacoustic measurement, fitting of implantable hearing devices, troubleshooting of implantable hearing devices and rehabilitative services for hearing impaired
- motivation in functional gain measurement and fitting of implantable hearing devices

Table 4.24: *Median, IQR and mean rank of the 16 competencies in management domain, in terms of knowledge, skills and motivation in Pre-Covid and Covid groups. The results of Mann-Whitney U test are also shown*

Competencies	**Sub-domains**	**COVID effect**	**Median (IQR)**	**Mean Rank**	**Mod Z**
Listening needs	Knowledge	Pre-Covid	3 (1)	76.30	2.063*
		Covid	3 (1)	63.14	
	Skills	Pre-Covid	3 (2)	78.41	2.628*
		Covid	2 (1)	61.45	
	Motivation	Pre-Covid	3 (1)	73.67	1.311
		Covid	3 (1)	65.25	
Functional gain measurements	Knowledge	Pre-Covid	3 (2)	78.88	2.705*
		Covid	2 (2)	61.07	
	Skills	Pre-Covid	3 (2)	80.13	3.018*
		Covid	2 (2)	60.07	
	Motivation	Pre-Covid	3 (1)	79.07	2.738*
		Covid	2 (2)	60.91	
REM	Knowledge	Pre-Covid	2 (1)	73.05	1.112
		Covid	2 (2)	65.75	
	Skills	Pre-Covid	2 (2)	76.50	2.041*
		Covid	1 (1)	62.98	
	Motivation	Pre-Covid	2 (2)	74.88	1.600
		Covid	2 (2)	64.28	
EAM	Knowledge	Pre-Covid	3 (1)	74.69	1.551
		Covid	2 (2)	64.43	
	Skills	Pre-Covid	2 (2)	77.86	2.412*
		Covid	1 (1)	61.89	
	Motivation	Pre-Covid	2 (2)	74.61	1.524
		Covid	2 (2)	64.50	
Ear molds	Knowledge	Pre-Covid	3 (2)	71.77	0.760
		Covid	2 (1)	66.78	
	Skills	Pre-Covid	2 (2)	74.30	1.440
		Covid	2 (2)	64.75	

	Motivation	Pre-Covid	3 (1)	71.51	0.685
		Covid	2 (1)	66.99	
HA fitting	Knowledge	Pre-Covid	3 (2)	71.33	0.645
		Covid	3 (1)	67.13	
	Skills	Pre-Covid	3 (1)	75.50	1.778
		Covid	2 (1)	63.78	
	Motivation	Pre-Covid	3 (2)	73.39	1.208
		Covid	3 (1)	65.47	
IHD fitting	Knowledge	Pre-Covid	3 (1)	77.70	2.367*
		Covid	2 (2)	62.01	
	Skills	Pre-Covid	2 (2)	79.18	2.760*
		Covid	1 (2)	60.83	
	Motivation	Pre-Covid	3 (1)	77.03	2.174*
		Covid	2 (2)	62.59	
HA troubleshooting	Knowledge	Pre-Covid	3 (2)	73.84	1.333
		Covid	3 (1)	65.11	
	Skills	Pre-Covid	3 (1)	74.52	1.504
		Covid	2 (2)	64.57	
	Motivation	Pre-Covid	3 (2)	76.16	1.958
		Covid	2 (1)	63.26	
IHD troubleshooting	Knowledge	Pre-Covid	2 (2)	75.56	1.783
		Covid	2 (1)	63.74	
	Skills	Pre-Covid	2 (2)	78.66	2.620*
		Covid	1 (2)	61.25	
	Motivation	Pre-Covid	3 (2)	71.95	0.803
		Covid	2 (2)	66.63	
ALD fitting	Knowledge	Pre-Covid	2 (2)	74.16	1.404
		Covid	2 (2)	64.86	
	Skills	Pre-Covid	2 (2)	73.65	1.265
		Covid	1 (2)	65.27	
	Motivation	Pre-Covid	2 (2)	71.30	0.621
		Covid	2 (2)	67.16	
	Knowledge	Pre-Covid	3 (2)	77.25	2.306*

Rehabilitative services for HI		Covid	3 (1)	62.38	
	Skills	Pre-Covid	3 (1)	76.80	2.151*
		Covid	3 (1)	62.74	
	Motivation	Pre-Covid	3 (1)	73.35	1.202
		Covid	3 (1)	65.51	
Rehabilitative services for tinnitus and hyperacusis	Knowledge	Pre-Covid	3 (1)	71.74	0.755
		Covid	2 (1)	66.80	
	Skills	Pre-Covid	2 (2)	73.52	1.238
		Covid	2 (1)	65.37	
	Motivation	Pre-Covid	2 (2)	69.33	0.090
		Covid	2 (1)	68.74	
Rehabilitative services for (C)APD	Knowledge	Pre-Covid	2 (2)	73.37	1.192
		Covid	2 (2)	65.49	
	Skills	Pre-Covid	2 (2)	75.43	1.749
		Covid	1.5 (1)	63.84	
	Motivation	Pre-Covid	2 (2)	71.52	0.681
		Covid	2 (2)	66.98	
Rehabilitative services for vestibular disorders	Knowledge	Pre-Covid	2 (2)	71.70	0.738
		Covid	2 (2)	66.83	
	Skills	Pre-Covid	2 (2)	73.57	1.240
		Covid	1 (2)	65.34	
	Motivation	Pre-Covid	2 (2)	70.38	0.373
		Covid	2 (2)	67.89	
Rehabilitative services through tele mode	Knowledge	Pre-Covid	2 (2)	73.07	1.106
		Covid	2 (2)	65.74	
	Skills	Pre-Covid	2 (2)	73.25	1.152
		Covid	1 (2)	65.59	
	Motivation	Pre-Covid	2 (2)	70.48	0.402
		Covid	2 (2)	67.81	
Management-related counselling	Knowledge	Pre-Covid	3 (1)	63.81	1.466
		Covid	2 (2)	59.79	
	Skills	Pre-Covid	3 (2)	77.07	2.192*
		Covid	2 (2)	62.53	

	Motivation	Pre-Covid	3 (1)	73.35	1.187
		Covid	2 (2)	65.51	

Note: *'*' indicates p<0.05*

Chapter 5

DISCUSSION

The study aimed to develop a questionnaire to explore the perceived competence of audiologists and prospective audiologists in clinical audiological skills in terms of knowledge, skills and motivation. Participants rated their competence based on their experience in the bachelor's and master's programs. Also, the effect of Covid on the competencies of students in the bachelor's group was investigated. The results revealed crucial differences in the level of competency among a few clinical aspects and attributes between the participant groups tested. The outcomes of the study are discussed in this chapter.

5.1 Efficacy of the Developed Self-perception Measure

The questionnaire developed in the study was used to measure the self-perceived competence in clinical audiological testing and management. The questionnaire included all the clinical and practical aspects required for professional practice, as prescribed by RCI syllabus. Andrade (2007) considers self-assessment as a process that can enable students to reflect and estimate his/her performance against that of a set goal in terms of learning and work, identify strengths and shortcomings and modify accordingly. It can help complement the learner's knowledge, skills, appropriate attitude and values, thereby promoting the development of life-long, self-directed independent learning skills (Di Stefano et al., 2015; Hinchliffe, 2006). It is also a low cost and swift method of quality assessment, which can help improve professional expertise in audiology. Alhaqwi et al. (2014) found self-assessment tools to have a good reliability and a high internal consistency. Hence, the outcomes of the current study shall effectively identify deficit areas in clinical and practical training, so that necessary steps can be taken to overcome the same in future.

However, several studies do doubt the validity and reliability of self-rating measures (Austin & Gregory, 2007; Eva & Regehr, 2007; Pop & Khampirat, 2019) due to reasons such as lack of experience and lack of understanding the level of their own professional knowledge. The outcome of our study is also likely to be influenced by these factors. Apart from these, the lack of objective measures or assessments to validate the perceived competence, lack of supervisor's perceptions on the competence of students and variation in facilities and exposure offered by different training institutes may also restrict the generalization of the current results.

5.2 Comparison of Perceived Competencies among Bachelor's and Master's groups

5.2.1 Screening domain

Most participants in the bachelor's and master's group perceived to have good or exceptional competency in the aspects of audiological screening with respect to knowledge, skills and motivation. The percentage of the good and exceptional ratings were further observed to be higher in the master's group when compared to the bachelor's group in majority of the 7 competencies tested. No significant differences in overall perceived competency were observed between the two experimental groups in the three tested attributes of knowledge, skills and motivation. Similar results were observed in the competency-wise analysis as well. This shows that both bachelor's and master's students had almost equal training, efficiency and attitude in carrying out screening-related tasks. Gazibara et al. (2015) conducted a study on final year medical students and found that they perceived greater confidence in carrying out clinical tasks which were carried out with greater frequency and consistency during the course of training. Hence, the screening related activities are carried out more frequently at the training institutes of Audiology in the form of new-born hearing screening, industrial

screening camps, school screening camps etc. Therefore, students had greater exposure and thereby confidence in carrying out the same.

The comparison of knowledge, skills and motivation among bachelor's and master's group in the screening domain revealed that majority of the participants in both groups perceived a higher competence in the attribute of knowledge, when compared to skills and motivation. Similar trend was observed in the mean rank for bachelor's, whereas motivation scores were noticed to be the highest in case of master's group.

5.2.2 Diagnostics domain

Assessment of overall competency in diagnostics shows that majority of the participants in the bachelor's and master's group perceived to have good or exceptional competency in the audiological diagnosis with respect to knowledge, skills and motivation. The percentage of the good and exceptional ratings were further observed to be greater in the master's group when compared to the bachelor's group in majority of the 18 competencies tested. Also, significantly higher overall competence in terms of skills and motivation in performing clinical aspects related to diagnostics was perceived by the master's group when compared to the bachelor's group. However, the perception related to knowledge in these competencies remained similar in the two tested groups. The transition to master's level of study could have played a positive role in influencing the outcome in terms of education, practice and research, as noted in a study on students pursuing physical therapy (Warren & Plerson, 1994). Gazibara et al. (2015) studied final year medical students, who felt highly confident in performing those clinical tasks that were carried out more frequently during their training period and thereby had greater practice in performing the same while it was lacking in those tasks performed rarely. This holds true for the participants in the master's group who

undoubtedly have greater exposure and practice in carrying out the different aspects of audiological diagnosis and hence perceive to have greater skills. Sitzmann et al. (2010) and Weiss and Cropanzano (1996) also believe that a strong correlation exists between the perceived knowledge, affect and motivation. The greater motivation to perform the diagnostic competencies in master's group can thus be explained by the improved skills in diagnosis. The difference in the perceived competency between the two groups was greater in the master's group for knowledge, skills and motivation in pure tone audiometry, skills and motivation in speech audiometry, motivation in tympanometry and reflexometry, skills and motivation in OAE, knowledge and motivation in ABR, skills and motivation in LLR, skills and motivation in recruitment tests, motivation in assessment of tinnitus and hyperacusis, knowledge, skills and motivation in subjective vestibular tests, motivation in objective vestibular tests and skills in counselling of assessment results.

Studies have reported that both students and practicing audiologists do not implement informational counselling and supportive communication sucessfully during both the assessment and routine fine tuning appointments, despite being aware of its significance to patient outcomes (Grenness et al., 2014; Meibos et al., 2019; Muñoz et al., 2018). Coleman et al. (2018) views this to be an implication of inadequate training or lack of maintenance in counselling skills among audiology graduate students. Similarly, lack of sufficient vestibular assessments offered by audiologists is suspected to reflect a deficit in awareness of audiologist's role in this domain as well as a lack of resources towards training offered by audiology programs in terms of both assessment and treatment of vestibular disorders. This suggests the need for educational institutions to actively identify gaps in education and take appropriate measures to rectify it (Easwar et al., 2013). These results support the reasons for bachelor's group having lesser

perceived competencies in some of the aspects related to audiological diagnosis. The diminished perceptions in terms of pure tone audiometry, speech audiometry, tympanometry and reflexometry, OAE, ABR, LLR and recruitment tests could be due to the lack of adequate experience, knowledge and skills in correlating the different findings in making an appropriate provisional diagnosis. Cotterill-Walker (2012) conducted a review of 15 studies and found 5 common themes that was believed to enhance patient care at master's level nursing education. This includes a higher confidence and self-esteem, better communication, personal and professional growth, knowledge and implementing theory in practice as well as analytical thinking and decision making. This is in line with the findings of our study. The lack of motivation in carrying out tinnitus and hyperacusis evaluations could reflect an inadequate awareness on the impact of the disorder on an individual's life or insufficient knowledge in using the tools/ tests for the assessment and treatment methods.

The comparison of knowledge, skills and motivation among bachelor's and master's group in the diagnostics domain revealed that majority of the participants participants in both groups perceived a higher competence in the attribute of knowledge, when compared to skills and motivation. Similar trend was observed in the mean rank for the bachelor's and master's group.

5.2.3 Management domain

The study revealed that a large number of participants in the bachelor's and master's group possess only a good or fair self-perceived competence in the aspects of audiological management with respect to knowledge, skills and motivation. The percentage of the good and exceptional ratings were further observed to be higher in the master's group when compared to the bachelor's group in majority of the 16 competencies tested. Sykes et al. (1997) reported that the study carried out among

faculty of audiology program reported that learning opportunity in terms of diagnostic services was more frequent (ranging between 25-95%) at the training institutes when compared to rehabilitative/management services (ranging between 0-25%). Hence, the lack of exposure to adequate cases involving management services could be the reason for poorer ratings among both the bachelor's and master's group. Also, no significant difference was observed in the overall perceived competence in management between the two experimental groups in the attributes of knowledge, skills and motivation. However, a greater perceived competency in knowledge, skills and motivation was observed in the master's group in the aspects of taking ear mold impression, fitting and troubleshooting of hearing aids, management-related counselling as well as motivation in carrying out rehabilitative services for tinnitus and hyperacusis. These results could once again be attributed to the insufficient exposure to these competencies at the bachelor's level. The results of the current study is in concensus with a survey carried out by Ali et al. (2017), on 111 practicing audiologists with a bachelor's or master's degree experience and an experience of 1 month to 18 years (wherein majority of the participants held a bachelor's degree). The outcome indicated that 83% of the participants felt the need to improve their skills related to management of adult patients, especially with respect to counselling and auditory training. Other concerns that were consistently reported by greater than 10 participants include fitting of devices and management of specific disorders such as hyperacusis or vertigo. Ali et al. (2017) carried out a survey on audiology faculty in U.S.A, which showed that about 48% of the programs considered rehabilitation services for tinnitus to be important and only 10% considered it to be extremely important, which is likely to affect the extent of training provided in this domain. Therefore, the current study implies that it is essential for training institutes to focus on improving the quality of training in the aspect of

management, when compared to screening and diagnostics.

The comparison of knowledge, skills and motivation among bachelor's and master's group in the management domain revealed that majority of the participants in both groups perceived a higher competence in the attribute of knowledge, which was followed by motivation and skills. Similar trend was observed in the mean rank for the bachelor's and master's group.

5.3 Comparison of Perceived Competencies among Pre-Covid and Covid groups

5.3.1 Screening domain

On studying the effect of Covid pandemic on the bachelor's group, a higher percentage of participants in the pre–Covid group rated their overall competence in screening to be good or exceptional while those in the Covid group rated it to be fair or good in terms of knowledge, skills and motivation. This was reflected in the competency-wise analysis, wherein the percentage of good and exceptional responses were higher for the pre-Covid group in all the screening competencies and attributes tested. However, a significantly greater perceived competence in the overall screening skills was present in the pre-Covid group. This can be attributed to the limited access to hands-on experience during the pandemic period, which concurs with the study by Karakoc et al. (2022). Karakoc et al. studied 608 undergraduate (90.7%) and postgraduate (9.2%) audiology students in Turkey, which revealed that majority of undergraduate students reported online education to contribute less to the process of learning and professional competence. The study predicted this perception to be a result of undergraduate students believing that audiology science should include practical courses and applications along with theoretical education, which might not have been met adequately due to the Covid-19 regulations and restrictions leading to dissatisfaction and inadequacy. On assessing the attributes with respect to the each of

the 7 competencies, a significantly higher knowledge and skills in school and industrial screening was observed in the pre-Covid group. However, the motivation in performing the competencies did not differ between the two experimental groups. Becrow and Nerbonne (2002) noticed a reduced practical experience in carrying out new-born, pre-school and school screening among audiology students when compared to other clinical activities. Further, a lack of active learning through higher order learning, integration and reflection is bound to influence academic confidence (Chang et al., 2022). This clearly shows that lack of active experience in screening at schools and industries among the Covid participants due to the pandemic. This affected the student's confidence in performing the same, while they were optimistic in performing other activities with adequate access such as administering a high-risk register, new-born hearing screening etc.

The comparison of knowledge, skills and motivation among pre-Covid and Covid groups in the management domain revealed that majority of the participants in both groups perceived a higher competence in the attribute of knowledge, which was followed by skills and motivation. The mean rank for the pre-Covid was highest for skills, while it was greatest for motivation in the Covid group.

5.3.2 Diagnostics domain

ASHA survey on 3408 audiology and Speech language pathology undergraduate, graduate and doctoral students revealed that 100% of the students pursuing audiology felt a 'major' or 'moderate' impact of pandemic on their academic lives (Staff, 2020). This was reflected in the percentage of responses obtained for each point on the rating scale in our study. A higher percentage of participants in the pre-Covid group rated their overall competence in diagnostics to be good or exceptional while those in the Covid group rated it to be fair or good in terms of knowledge, skills

and motivation. Further testing of individual competencies showed that a higher percentage of participants in the pre-Covid group had good and exceptional perceived competencies in all the diagnostic competencies and attributes tested. However, there was no significant difference between the pre-Covid and Covid group with respect to overall diagnostic competency in terms of knowledge, skills and motivation. Although several studies (Coopasami et al., 2017; Koch, 2014; Lawn et al., 2017; Rouleau et al., 2017) report a negative effect of the pandemic on academic learning, Almoayad et al. (2020) reported that assessment of student's satisfaction in the medicine, nursing, pharmacy, dentistry, pharmacy and physical therapy disciplines among 59 studies resulted in 20 studies which showed no difference in satisfaction between online and traditional learning. This justifies the finding of no significant difference in the knowledge, skills and motivation related to audiological diagnosis among the pre-Covid and Covid group in our study. However, the knowledge and skills in carrying out diagnosis using ABR, LLR and neural adaptation tests were found to have higher competency in pre-Covid group than the Covid groups.

The outcome of no difference in terms of motivation in carrying out any of the tested competencies is observed to be in contrast to findings of Corter et al. (2011), wherein the hands-on group had greater motivation in performing the task when compared to the simulation group (simulation mode was utilized for teaching extensively during pandemic across several developed countries). Although Chermak et al. (2007) reported 52% of the participants with Doctor of Audiology degree to have insufficient knowledge and clinical exposure in the area of (C)APD due to reasons such as inadequate practical experience and coursework, the current study shows no such differences between the bachelor's and master's group as well as the pre-Covid and Covid group.

The comparison of knowledge, skills and motivation among pre-Covid and Covid groups in the management domain revealed that majority of the participants in both groups perceived a higher competence in the attribute of knowledge, which was followed by skills and motivation. The mean rank for the pre-Covid was highest for skills, while it was greatest for motivation in the Covid group.

5.3.3 Management domain

Majority of the participants in the pre-Covid and Covid groups perceived to have only a good or fair competence in the aspects of audiological management with respect to knowledge, skills and motivation. The percentage of good and exceptional ratings were further observed to be higher in the pre-Covid group when compared to the Covid group in majority of the 16 competencies tested. Compared to other disciplines, health related fields have traditionally been delivered using face-to-face sessions in order to facilitate effective transfer of technical skills (Prosen et al., 2022). This can cause anxiety among students when learning occurs through online modality (which was highly prevalent during the pandemic period), especially with respect to management aspects (Karakoc et al., 2022). Anxiety, related to the concerns of Covid 19 pandemic was a reaction most frequently associated with online learning among students (Cao et al., 2020; Liu et al., 2020). Further, perceptions of learning effectiveness was reported to be significantly correlated to anxiety levels (Almoayad et al., 2020). This can explain the lesser percentage of good and exceptional ratings among the Covid participants. Also, significant difference was observed in the overall perceived competence in management between the two experimental groups with respect to skills only. Such observations were not present with respect to knowledge and motivation. However, competency-wise analysis revealed substantial differences in few aspects related to management or rehabilitation. A greater competency was

observed in the knowledge and skills related to assessment of listening needs and knowledge, skills and management in performing functional gain measurements. Further, the skill in performing real ear and electroacoustic measurements were significantly decreased in the Covid group. Easwar et al. (2013) reported the disuse of real ear or simulated verification measure in 73% of audiology clinics, despite its availability. Similar findings were consistent in research carried out in India and America, wherein the utilization was less than 50% (Martin et al., 1994; Mueller & Picou, 2010). This was speculated to be due to lack of skill/training, apart from factors such as cost and time constraints. The adequacy of training in this area could have been hampered further due to lack of face-to-face training during the pandemic period.

Sykes et al. (1997) carried out a survey on audiology faculty in U.S.A, which showed that about 55% of the programs considered aural rehabilitation through cochlear implantation to be important and only 18% considered it to be extremely important. Also, it was reported that the access to pre-operative assessment for the cochlear implantation was restricted to only 23% of the students while post -operative counselling and rehabilitation process was limited to 25% of the students. Limited exposure to this case demographic was the reason suggested for this study findings. Also, the limited hands-on training in this domain was reported to put the students at a discomfort and disadvantage when working at a setting involving such populations, thus emphasizing the need for improved learning opportunities. Also, the special skills required for cochlear implant programming and troubleshooting was reported to be acquired while on the job rather than at the graduate school level. This implies that knowledge and skills in handling implantable hearing devices are not covered adequately in practical clinical training at educational institutions (Parisier, 2003). Motivational counselling has great evidence in predicting audiological outcomes

(Meibos et al., 2017), which is reported to improve substantially with effective training (Meibos et al., 2019). The effects of limitation in training these aspects were more likely amplified due to the pandemic. This was observed in our study as decreased competency in knowledge, skills and motivation in terms of fitting implantable hearing devices, skills in troubleshooting these devices, knowledge and skills in offering rehabilitative services for hearing impaired and skills in counselling regarding management.

Tele-audiology has become a substantial part in the field of speech and hearing during the pandemic and is currently viewed to have a great future. Hence, it is important for students of Audiology to be well acquainted with this area. The current study shows no substantial differences between the perceived competency with respect to carrying out tele-audiology practices in the pre-Covid and Covid group. In the light of the fact that pre-Covid audiology education had the least importance for audiology practice through tele-mode, this finding raises concern for the level of competence in offering tele-audiology services in terms of knowledge, skills and motivation. Studies have shown that a large number of undergraduate students, postgraduate (Chinelatto et al., 2020; Olcek et al., 2022) as well as practicing audiologists (Bishop, 2021) reported a perceived insufficiency in the theoretical knowledge and practical competence in tele-audiology services. Therefore, the current study implies that it is essential for training institutes to focus on improving the quality of training in the aspect of management, when compared to screening and diagnostics.

The comparison of knowledge, skills and motivation among pre-Covid and Covid groups in the management domain revealed that majority of the participants in both groups perceived a higher competence in the attribute of knowledge, which was followed by motivation and skills. Similar trend was observed in the mean rank for the pre-Covid and Covid group.

Chapter 6

SUMMARY AND CONCLUSIONS

Competence development has always been the primary goal for any educational institution. With the RCI regulation norms stating bachelor's degree as the minimum requirement for professional practice in speech and hearing discipline, it is essential for the training institutes to coach their students to attain maximum clinical competence at the undergraduate level itself. Thus, the study aimed to explore the perceived clinical competence attained by bachelor's and master's students in the domains of screening, diagnostics and management. Further, the Covid-19 pandemic has been reported to have had a profound effect on the learning process among students at various levels of education. This could have larger implications on the students just beginning their professional life. Hence, the current study also compared the perceived competence of students with bachelor's experience who were trained before and during the pandemic period.

The participants of the study were individuals who had either completed or were currently pursuing their bachelor's or master's degree in Audiology. An online survey was conducted utilizing a questionnaire developed for the purpose. It was circulated to the potential participants as Google forms. The questionnaire tapped the perceived competence of participants under three important domains of clinical audiology practice, i.e., screening, diagnostics and management, in terms of knowledge, skills and motivation. The responses of the participants were measured using a five-point Likert rating scale. The response data was analysed using descriptive and inferential statistics through SPSS software.

The results revealed no significant difference in the overall competence between the bachelor's and master's group in terms of knowledge, skills as well as motivation. However, a significantly higher overall competence was noticed in the master's group when compared to the bachelor's group in terms of skills and motivation but not knowledge. Also, competency-wise analysis revealed significant differences between the two groups in few of the competencies in the domains of diagnostics and management, in terms of knowledge, skills and motivation. The analysis of the effect of Covid on the overall perceived competence in knowledge, skills and motivation revealed a significantly greater competence only in terms of skills related to screening and management among the pre-Covid group compared to Covid group, whereas no such differences were noted in the diagnostics domain. The competency-wise analysis, however revealed significant differences between the two groups in few of the competencies with respect to diagnostics and management, in terms of knowledge, skills and motivation.

Based on the study findings, it can be inferred that the group with a master's degree experience will have better perceptions about some of their diagnostic and management competencies when compared to those with a bachelor's experience. This is true in terms of knowledge, skills and motivation. This could be attributed to factors such as increased knowledge, more practical exposure, better ability to integrate findings, higher emotional maturity, confidence, self-esteem and greater professional independence. Similarly, the effect of Covid was seen among some competencies in screening, diagnostics and management in terms of knowledge, skills and motivation. Hence, it requisites educational institutions offering audiology programs to re-assess the extent of gap in education and re-evaluate their teaching content and methods in order to cater to those students whose training was infleunced by the Covid-19 pandemic.

The readers shall be aware that these inferences are drawn from a self-perception questionnaire. Blanch-Hartigan (2011) reported that the accuracy in assessing performance of oneself was more in the group of students who were in the later part of the training. This could be due to the increased information, improved opportunities to perform the task, getting results of objective evaluations.

It is also essential to realize that the findings of the current study are based on the perceived effectiveness of the participants and not validated by an objective measure of assessment or perceptions of the clinical supervisor or teaching faculty. Further, the results of the study here reflects the comparison of competencies at the bachelor's and master's level with respect to the pre-Covid era only. These results may vary when the Covid comparisons are made between these two groups. The smaller sample size may also have an effect on the reported results of the study. The use of questionnaire which was not subjected to a standardization process could be another limitation. Future research can explore the Covid effect on perceived competencies between the bachelor's and master's group. The comparison of perceived competence between students in government and private institutions can also be investigated.

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APPENDIX

Questionnaire to Assess Self-perceived

Clinical Competence in Audiology

Assessment of self-perceived skill set in clinical Audiological evaluation among students of B.ASLP and Masters in Audiology

Competence enhancement has always been one of the crucial aspects in terms of professional growth of students. The curriculum of Speech and Hearing provides students with the exposure to a supervised working environment. This allows us to expand students' clinical skills during the training period. Additionally, it warrants students to be confident and display a high level of clinical competence while dealing with a population becoming increasingly conscious of the services being provided. However, we might not get the opportunity to explore certain facets of clinical practice that may be required in our career at a future date. Hence, in this study, we aim to survey those areas that students perceive to be in need of further learning or training. Furthermore, the effect of COVID pandemic on the development of clinical skills among students at the bachelor's level is explored.

If you are a student who is **currently pursuing/has completed the undergraduate (internship) / post - graduate study in Audiology, either before or during the COVID pandemic**, we invite you to participate in the study by answering the following questionnaire **based on your competency at internship or master's stage, whichever is highest**.The questionnaire is self-explanatory.

* Required

1. Email *

2. DECLARATION: *

I have been informed about the study entitled 'Assessment of self-perceived skill-set in clinical Audiological evaluation among students of B.ASLP and Masters in Audiology'. I understand the purpose and procedure of the questionnaire. I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without incurring a penalty, or without being obligated to provide a reason. I understand that my participation in the study will not adversely affect me in any way and that confidentiality will be maintained about my identity at all times. I also understand that the information given by me will be used only for the purpose of the study. I do not have any financial or non-financial benefits from this study. I hereby give my consent to participate.

Check all that apply.

- [ ] Yes
- [ ] No

Demographic details

3. Name *

_____

4. Age *

_____

5. Gender *

Mark only one oval.

- ◯ Male
- ◯ Female

6. Highest degree (ongoing or completed) *

Mark only one oval.

- ◯ Bachelor's (Internship)
- ◯ Master's (Audiology)

7. Status of program *

Mark only one oval.

- ◯ Ongoing
- ◯ Completed

8. Name and location of Institute *

_____

9. Duration of course - highest degree (Eg., yyyy to yyyy) *

_____

10. Year of internship completion (yyyy) *

_____

11. Was your study duration interrupted by COVID pandemic? *

Check all that apply.

- ☐ Yes
- ☐ No

Questionnaire

The questionnaire is arranged under 3 key constructs – **Screening**, **Diagnostics and Management**. Under each construct, different clinical skills required for Audiological practice are listed. You are requested to go through each of those skills and rate your perception of competency in these skills on a rating scale, under the domains 'Knowledge', 'Skills' and 'Motivation', wherein,

- '**Knowledge**' indicates your understanding of the theoretical concept related to a particular task
- '**Skills**' indicates your ability to apply the knowledge in performing a particular task
- '**Motivation**' indicates your drive or inclination towards performing a particular task

The rating scale under the domains of Knowledge, Skills and Motivation ranges from **0 to 4**. Here,
'0' indicates 'no'
'1' indicates 'minimal'
'2' indicates 'fair'
'3' indicates 'good'
'4' indicates 'exceptional'
knowledge regarding the listed clinical aspects or ability to perform the aspects competently or display intent towards performing those aspects. **Your choice should be solely based on the practical clinical skills acquired until internship or master's degree, whichever is the highest. You are instructed to rate your competence by carefully avoiding the influence of additional skills gained after the completion of study at the undergraduate or postgraduate level**. An example is depicted below.

Question: Please rate your knowledge, skill and motivation in the following competencies related to diagnosis of hearing and balance disorders

Model response: If you possess 'exceptional' knowledge about all the listed aspects related to pure tone audiometry, but a 'fair' competence in performing the listed skills and display 'no' motivation in performing the listed tasks, you shall select '4' under the domain of 'Knowledge','2' under the domain of 'Skills' and '0' under the domain of 'Motivation'.

S. No.	Diagnostics	Knowledge	Skills	Motivation
1.	Administering pure tone audiometry and deriving the following from the audiogram • presence & degree of hearing loss • type of hearing loss • cause of hearing loss • management needed • prognosis	0 1 2 3 ✓4	0 1 ✓2 3 4	✓0 1 2 3 4

Screening

Please rate your knowledge, skill and motivation in the following competencies related to hearing screening

12. 1. Performing **new-born hearing screening** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯

13. 1a. Administering **high risk register** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯

14. 1b. Hearing screening using **behavioural observation audiometry (BOA)** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

15. 1c. Hearing screening using **otoacoustic emissions (OAE)** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

16. 1d. Hearing screening using automatic auditory brainstem response (A-ABR) *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

17. 2. Performing **hearing screening among school children** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

18. 3. Performing **industrial hearing screening** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

Diagnostics

Please rate your knowledge, skill and motivation in the following competencies related to diagnosis of hearing and balance disorders

19. 1. Taking **case history** and deciding the referrals appropriately *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

20. 2. **Calibrating** (**subjective**) audiometer *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

21. 3. Performing **otoscopy** and interpreting results *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

22. 4. Administering **pure tone audiometry** and deriving the following from the audiogram - presence & degree of hearing loss, type of hearing loss, cause of hearing loss, management needed, prognosis *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

23. 5. Administering and interpreting **speech audiometry** to cross-check the results of puretone audiometry and differentially diagnose conductive, cochlear and retrocochlear pathology *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯

24. 6. Administering and interpreting **tympanometry and reflexometry** to differentially diagnose middle ear pathologies, cross-check the results of puretone audiometry and differentially diagnose cochlear pathology versus retrocochlear pathology in case of sensorineural hearing loss *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯

25. 7. Administering and interpreting **otoacoustic emissions** (**OAE**) to detect the presence of inner ear damage and differentially diagnose cochlear pathology versus retrocochlear pathology *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯

26. 8. Administering and interpreting **auditory brainstem response** (**ABR**) to estimate hearing thresholds objectively, identify the site of lesion in brainstem and suggest appropriate medical or non-medical management *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯

27. 9. Administering and interpreting **late latency response** (**LLR**) to estimate hearing thresholds objectively, differentially diagnose auditory maturation delay versus auditory neuropathy spectrum disorder and decide candidacy for hearing aids and cochlear implant *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯

28. 10. Administering and interpreting the behavioural tests to identify **recruitment** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

29. 11. Administering and interpreting the behavioural tests of **neural adaptation** to detect retrocochlear pathology and cross-check the results of speech audiometry *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

30. 12. Administering and interpreting subjective and objective tests to identify **functional hearing loss** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

31. 13. Administering and interpreting the tests and checklists or tools to identify the presence and severity of **tinnitus**, identify associated conditions such as hyperacusis and decide on appropriate management measure (eg. fitting of hearing aids, tinnitus retraining therapy , cognitive behavioural therapy etc.) *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯

32. 14. Administering and interpreting the tests and checklists or tools to identify the presence and severity of **hyperacusis**, identify associated conditions such as tinnitus and decide on appropriate management measure (eg. tinnitus retraining therapy , cognitive behavioural therapy etc.) *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯

33. 15. Administering and interpreting the screening tools and diagnostic tests to identify affected processes in (**central**) **auditory processing disorder** and decide on appropriate management *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯

34. 16. Administering and interpreting the **subjective vestibular tests** to differentially diagnose different vestibular disorders and suggest appropriate medical or non-medical management *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

35. 17. Administering and interpreting the **objective vestibular tests** to differentially diagnose different vestibular disorders and suggest appropriate medical or non-medical management *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

36. 18. **Counselling** stakeholders regarding the test findings *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

Management

Please rate your knowledge, skill and motivation in the following competencies related to management of hearing and balance disorders

37. 1. Assessing **listening needs** of the patients *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

38. 2. Carrying out **functional gain measurements** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

39. 3. Carrying out **real ear measurements** to fit hearing aids *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

40. 4. Carrying out **electroacoustic measurement** to verify hearing aid specifications *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

41. 5. Selecting the appropriate type of **ear mould** and taking impression *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

42. 6. Selecting and programming **hearing aids** appropriately and evaluating their benefit *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

43. 7. Selecting and programming/mapping **implantable hearing devices** appropriately and evaluating their benefit *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

44. 8. Troubleshooting of **hearing aids** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

45. 9. Troubleshooting of **implantable hearing devices** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

46. 10. Selecting and fitting of **assistive listening devices** (e.g., FM devices) *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

47. 11. Providing rehabilitative services to persons with persons with **hearing loss** * (Eg. auditory verbal therapy, speech reading, combined approaches)

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

48. 12. Providing rehabilitative services to persons with **tinnitus and hyperacusis** * (Eg. tinnitus retraining therapy, cognitive behavioural therapy)

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

49. 13. Providing rehabilitative services to persons with (**central**) **auditory processing disorders** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

50. 14. Providing rehabilitative services to persons with **vestibular disorders** in terms of manoeuvres and vestibular rehabilitation therapy (VRT) *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

51. 15. Providing rehabilitative services to persons with hearing and balance disorders through **tele-mode** *

Mark only one oval per row.

	0	1	2	3	4
Knowledge					
Skills					
Motivation					

52. 16. **Counselling** stakeholders regarding the management of hearing/vestibular disorders and the expected prognosis *

Mark only one oval per row.

	0	1	2	3	4
Knowledge	◯	◯	◯	◯	◯
Skills	◯	◯	◯	◯	◯
Motivation	◯	◯	◯	◯	◯