The review of related studies is significant as it helps to know the research trend and research gaps, in deciding the variables, and in selection of the appropriate tools. When researcher was reviewing the relevant studies for Linguistic Skills and Reading Comprehension in children with cochlear implants following studies were noted and are presented in this chapter. A summary of the findings of the study is discussed below under the following sections:

2.1 Studies emphasizing benefits of cochlear implant for children with hearing impairment

2.2 Studies emphasizing benefits of hearing aids in children with hearing impairment

2.3 Studies related to parents decisions regarding cochlear implantation

2.4 Studies related to speech and language development in individuals with hearing impairment

2.5 Studies related to reading in individuals with hearing impairment

2.6 Studies related to speech and language development in children with cochlear implants

2.7 Studies related to reading in children with cochlear implants

2.8 Studies related to Language and Reading Comprehension in children with cochlear implants

2.9 Studies related to factors influencing Language and Reading Comprehension in children with cochlear implants
2.10 Studies on Communication, Psychosocial and Emotional development in children with cochlear implants

2.11 Studies emphasizing Educational supports for children with cochlear implants.

2.1 Studies emphasizing benefits of cochlear implant for children with hearing impairment

Following are few studies that reflect the advantages of using cochlear implants by children with hearing impairment.

Archbold (2008) investigated the benefits derived from cochlear implants from their parents. Data was collected from 101 parents of children whose average age at implantation was 4.7 years: range 1.3 to 12.4 years using a questionnaire consisting of 74 statements on a Likert scale. Findings revealed majority of parents were satisfied from cochlear implant outcomes: children developing greater confidence, becoming more independent, using spoken language for communication, and interactions within the family improved. It was also reported by the parents that the support provided by parents before implantation was more compared to after implantation and support they were offering post implant was more productive. But few expressed their concern regarding the need to be patient as the progress of the child takes time; future education, and few mentioned that the outcomes did not match their expectations. The study highlights the need for optimum functioning of the technology, and the long-term support for children with cochlear implants.

Archbold et al. (2002) examined the perceptions of 30 parents of children who were implanted on various areas such as child's functioning, parental implications, family implications, future needs, and advice given by parents to others. The analysis revealed that most of the parents were happy about the increased confidence and greater communication abilities in their children with implants. And the concerns
they brought to the fore were about the liaison between the local educational services where their children were enrolled and the cochlear implant centre from where their children were implanted, and to manage technical difficulties the need for continued specialist support from the cochlear implant centre.

A retrospective study by Bosco et al. (2005) investigated the impact of cochlear implant on schooling: the educational characteristics, gap between class enrolled and chronological age, quality in socialization with peers and adults, and learning skills. Data was collected of 50 children with cochlear implants attending regular schools through structured interviews with their parents, using school report cards, psychometric tests, and questionnaires filled by their mainstream teachers. Results revealed in linguistic and logical areas children’s greater success was related to their intensive rehabilitation received. In learning tasks, children with implants were not less performers, and only a small disparity was found between their chronological age and the class they attended. It was also found children with cochlear implants found themselves to be helpful, confident with peers and were fond of communication assistants and teachers. The study emphasized that for children with cochlear implants enrolment in regular schools proved to be satisfactory in many ways.

Fortum et al. (2007) in their research paper summarized the key findings of various research reports. The relevant point to the teachers of the deaf is that by providing cochlear implants to children would reduce costs in the education sector and fruitfully lead to better academic achievement among these children. Reviewing many reports, this paper concluded the following: There exists positive relationship consistently between cochlear implantation, and auditory performance, and spoken communication skills when demographic variables are controlled. In children
implanted before five years of age and who used implants for more than four years, it was found that there exists positive association between implantation and educational achievements, and quality of life. Cost-effectiveness of cochlear implantation is found in children who had very poor hearing levels and the benefit is maximized if they are implanted at a young age. Costs to the family turn out to be significant at a personal level but in relation to total costs, it is very small.

Geers et al. (2011) investigated the long-term outcomes of cochlear implantation among 112 teenagers who were implanted in early childhood. It was anticipated that children with cochlear implants with profound sensori-neural hearing loss would perform more closely at speech and language levels of hearing peers of the same age. A battery of auditory, speech, language, and reading tests were administered and the responses to questionnaires and written language samples were obtained. The results revealed among 112 students, only 40 returned for the follow-up study and 72 did not return. It was noticed that among 40 who returned, 75% were fully mainstreamed and only 5% were in full time special education. Their grade placement was appropriate to their chronological age. Furthermore, it was evident that even though children with cochlear implants had an access to improved access to sounds compared to those who were not implanted few years back, not all the children with cochlear implants exhibited skills commensurate with normal hearing children.

Hess et al. (2014) determined how 39 children with bilateral cochlear implants aged 4 to 9 years were tested on two standardized tests: the test of language development and the Leiter international performance scale-revised version for evaluating expressive/ receptive language skills and nonverbal IQ. Hierarchical regression analyses were used to evaluate whether language performance predicted
hearing experience. Results revealed most IQ scores of children with bilateral cochlear implants were either at or above compared to hearing children. Furthermore, the major finding of the study was on an average language score of children with bilateral implants was age appropriated and they were mainstreamed at age-appropriate grades in schools. Children whose families’ socio-economic status is high, and whose mothers’ education is high was also found to be well within the same range as normative sample of hearing children.

A study by Phillips et al. (2009) investigated the auditory perception and speech production outcomes of 112 children from centres in United Kingdom, Iran, and Turkey over a five-year test interval. Results indicated there was increase in the scores over time as assessed by Categories of Auditory Performance (CAP) and Speech Intelligibility Rating (SIR) measures. There was high correlation between the CAP and SIR scores. Age at implantation has an effect on the scores for three years period; younger implanted children had better scores. There was significant difference between scores for different language groups. It is also indicated that pre-operative CAP scores predict the post-operative SIR scores. The study emphasizes the use of CAP and SIR assessment instruments as they are validated and reliable and can be used across different countries and languages. It also provides evidence that cochlear implantation is a viable cure for children with severe-to-profound hearing loss.

A study by Spencer, Tomblin and Gantz (2012), investigated the long-term gains of cochlear implants in 41 children with bilateral cochlear implants. Data was collected on educational, vocational, affiliations and quality of life measures using questionnaires and scales. Qualitative results revealed they have high educational achievement and a very high satisfaction of life compared to their peers. Quantitative
results revealed a significant correlation between ability to hearing and ability to speak and also consistency in device use. The results also revealed relationships between mothers and individual educational statuses, hearing scores and communication system. On satisfaction with life measures younger children scored high. They felt comfortable with dual identity: one with deaf individuals and another with hearing individuals, and younger children endorsed dual identity more often. Therefore, the study diminishes the concern that children with cochlear implants will become culturally bereft and cannot function in hearing world.

2.2 Studies emphasizing benefits of hearing aids in children with hearing impairment

Following is a study that reveals the advantages of using a hearing aid by moderate severe children with hearing impairment.

Fitzpatrick et al. (2012) documented the performance of 20 children with moderate severe hearing loss using hearing aids and 21 children with cochlear implants having profound hearing loss aged 6-18 years. Data was collected using tests on speech recognition and standardized measures of literacy, language, phonology, and speech production on communication and academic skills. The results showed that the two groups did not differ in their speech recognition abilities or speech production skills based on open-set. Nevertheless, in receptive vocabulary domain, language, phonological memory, and Reading Comprehension, children with hearing aids obtained higher scores compared to children with implants. Furthermore, it is indicated that children with moderate hearing loss also can develop spoken language skills that are within the range expected for normal hearing children. The study emphasized the school-aged children with moderately severe and severe hearing loss
using hearing aids performed better in several domains than their peers with profound hearing loss who were implanted between two and five years of age.

2.3 Studies related to Parents decisions regarding cochlear implantation

Following are few studies that reflect the how parents decided to get their children with hearing impairment cochlear implanted.

A study by Hardonk et al. (2011), examined the factors in deaf parents’ decision between cochlear implantation and traditional hearing aids for their child. Sample consisted of six Flemish children (5-9 years) with severe to profound hearing loss with one deaf parent. Qualitative findings collected through parents interviews were they expressed their concerns related to the surgical procedure of implantation inside the head of the child, about the removal of residual hearing capacities in the implantation procedure, concerns about the social relations, and parents’ initiatives in seeking information in the decision-making process which were all in line with the concerns of hearing parents. Only limited importance was given to professional advice as it was considered as a denial of deaf identity, satisfied with the spoken language level achieved by the hearing aids, deafness is perceived as normal. The study stressed that parents who were deaf perceived cochlear implant as a threat to erase deaf culture, language and identify was noticed in the parents’ views however few parents did not view implant device as causing any threat to the deaf community.

A study conducted by Hyde, Punch and Komesaroff (2010a), investigated the experiences of parents making decisions about cochlear implants for their deaf children. A questionnaire was used to collect the data from 247 parents and in-depth interviews with 27 of the survey respondents were also collected. Decision making process in majority of parents was found to be difficult and stressful but few found the decision easy as there was no other option and did not delay much for implantation.
Findings indicate parents used variety of sources of information but major source has been cochlear implant centres and doctors. The study also stresses the importance of parents should be provided time, access to objective, impartial, and non-judgmental information and ongoing support in the process of making decision for implantation for their deaf children.

Hyde, Punch and Komesaroff (2010b), investigated the 247 parents’ pre-implant expectations and post-implant experiences of their children’s outcomes with cochlear implants using a questionnaire. Among them 27 parents were interviewed in depth. The Quantitative findings indicate that most of the parents’ expectations related to their children’s communicative, social, academic, well-being and future life outcomes from cochlear implantation had been relatively met. Although a tenth of the parents’ mentioned that their outcomes had not been met, most often these children were having additional problems. There was no statistical significance in most domains between parents’ expectations and experiences. In one domain, ‘social skills and participation’, parents’ experiences were significantly more positive than what they had expected. The qualitative findings revealed parents were concerned about their children’s social participation in groups; for the questions related to ‘overall satisfaction’, four fifths of the parents mentioned their expectations had been met, and some of the parents expressed their disappointment at switch-on of implant device as they expected something wonderful or rapid progress to happen. Parents’ also expressed their concern for the cost to be incurred even though they devoted time and effort.

A study by Hyde, Punch, and Grimbeek (2011) discussed on relationships between a large number of child and family-related factors. In addition to this, children performance in educational achievement, social skills and participation,
spoken language communication and independence and identity as reported by 247 children’s parents. Regression analysis was used. Findings revealed children who used oral communication were rated high by the parents in all areas except in the area of academic achievement. Children in regular schools were predictive of positive communication and academic outcomes. A strong association was found between the age at implant and outcomes. Late age at implantation was associated with lower oral communication abilities, lower social skills and participation. Positive social outcomes were associated with having more than one sibling. Incidence of additional disabilities was strongly predictive of less positive outcomes in all the areas. The findings also suggested that parents, who were optimistic and have high enthusiasm to dedicate the time, work and effort needed for best possible outcomes from implantation was related to their children’s practical outcomes, and not all children can achieve the same outcomes, and also they living in major city area had a positive impact. Gender as well as socio economic status was not associated to any of the areas. The study highlights the need for the important role of parental involvement, and the efforts to be taken by cochlear implant services, early intervention programs, and educational authorities to expand their services.

Wass et al. (2008) examined working memory, lexical access, and phonological skills- measures on accuracy and latency as development indicators in 19 Swedish children with cochlear implants aged 5; 7 to 13; 4 years enrolled in grades 0-2, fourth, fifth and sixth, and compared their scores to 56 children with typical normal hearing scores. They even examined the performance with respect to demographic factors. The results indicated that children using implants were equivalent in visuo-spatial working memory capacities to typical hearing children but there was noteworthy difference in phonological working memory between children
using implants and typical hearing. And on most of the cognitive measures in all grades no significant difference was noticed between children using implants and typical hearing children. Furthermore, there was no considerable gender difference found among both groups in all cognitive tasks. Age at diagnosis as well as implantation age did not correlate to any of the cognitive measures. According to the mode of communication they were divided in to two groups: oral and sign, significant difference was found only for one cognitive measure i.e., for the passive naming test, accuracy measure for the children who used oral mode had better performance. In addition to this, children with implants were separated into two sets based on the educational setting they attend: Regular schools and Special schools, and there was no difference found in any of the cognitive variables in both the groups.

2.4 Studies related to Speech and Language development in individuals with hearing impairment

Following are few studies that reflect the speech production and language development in individuals with hearing impairment.

A study by Cannon and Kirby (2013) presents that deaf and hard of hearing children has to put in great effort to acquire grammatical structures of English. 26 participants from a deaf school located in urban area used the Language Links software for ten minutes on every day basis for nine weeks. It has been indicated through the literature review, traditionally deaf children have particularly problem with lexical and morphosyntactic areas. The results indicated that many children struggled with regular noun singular/plural; accusative first-and second-person singular; noun/verb agreement copular ‘be’; accusative third person number/ gender; locative pronominal; auxiliary ‘be’/ regular past ‘-ed’, and pronominal determiners plural. The study recommended that it is important for teachers to understand the
specific grammatical structures that deaf and hard of hearing children struggle to acquire so that appropriate curriculum can be designed to instruct them in a targeted manner.

Fitzpatrick et al. (2011) investigated the communication outcomes of 51 children: 26 children using cochlear implants and 25 children using hearing aids at age four to five years and compared their spoken language skills to a group of typical hearing children. All children were admitted in oral language development rehabilitation programs. Their language skills were examined using an extensive series of child and parent-administered speech and language measures. The results revealed in language skills there were no considerable differences between children using cochlear implants and children using hearing aids, however children with hearing aids have enhanced articulation skills. On communication measures both the groups of children using implants and hearing aids performed lower to their age matched hearing peers. Furthermore, it is revealed that degrees of hearing loss and parent’s education influenced the language performance in children with hearing loss and it was also found that age at diagnosis of hearing loss is not a noteworthy predictor of speech-language outcomes. The study underscores the need to recognize the factors in preschool children with hearing loss that are mostly to promote age-appropriate communication skills.

Hogan et al. (2010) investigated whether better spoken language outcomes in children with hearing impairment are because of child’s social environment and family values rather than the intervention. Auditory Verbal, a national charity offered individual AV therapy to children with hearing impairment from 12 low-income families. The results revealed that there was noteworthy improvement in the language development rate from the start of children’s therapy to the end over the intervention.
period. Therefore, the study highlights that family’s financial status is not a factor that impacts spoken language outcomes of children with hearing impairment participating in AV therapy.

A longitudinal study by Jackson and Schatschneider (2014) explored the language growth rate of children in an early auditory-verbal early intervention program. It was retrospective investigation on 24 children with hearing loss who were selected based on convenience. Findings revealed across six months intervals statistically significant change was noticed in raw scores and not in standard scores. There were significant differences in language outcomes for children based on time spent in early intervention, age, and individual characteristics such as severity of hearing loss and sensory device use suggesting that intervention was contributing to growth. The study indicated that prior to receipt of nine months of therapy, 44% of expressive language scores were within normal limits, while 52% of scores gathered after at least nine months of therapy.

Jerger et al. (2013) examined whether the input mode (auditory or audiovisual) had an effect on semantic access by speech in children with sensory-neural hearing loss. Data was collected on 31 children with hearing loss and 62 children with typical hearing using author’s new multimodal picture word task. The results revealed in children with hearing impairment the auditory distracters produced neither positive nor negative effect in conformity with the proposals of competition threshold supposition whereas auditory visual distractors gave rise to the normal semantic interference effect. Furthermore, it is evident that considerable differences were found between children with hearing loss and typical hearing children in terms of auditory mode and not for the audiovisual mode. Results emphasized in children
with hearing loss, the important role of audiovisual speech in encouraging the normalcy of semantic access by spoken words.

2.5 Studies related to Reading in individuals with hearing impairment

Following are few studies that show how reading happens, problems and strategies in individuals with hearing impairment.

A study by Banner and Wang (2011) examined and compared the effective reading strategies used by five deaf adults aged 27 to 36 years and six student deaf readers aged 16 to 20 years. Data was collected using interviews and think-aloud procedures. Both the groups had high and low skilled readers. High skilled readers used multiple reading strategies and were competent of talking about the techniques outside the reading task; adults used more reading strategies effectively than students, transfer of reading strategies learnt in one language to another language was also found. Significant difference was found between adult and student deaf readers in evaluating comprehension. The study throws light on the significance of early accessible communication and exposure to reading with frequent reading opportunities leading to high proficiency in reading tasks. Few of the reading techniques used by the deaf readers identified in the study were constructing explanations from previous knowledge, summarizing parts of the text, and visualizing to construct and reconstruct meaning. The study stresses the need to identify effective reading techniques used by the deaf adult readers, to identify the causes and short of reading strategies in the area of metacognition amongst deaf children and finally suggests for the remediation measures to be developed by the educators to make deaf students successful readers.

In an exploratory study by Cawthon (2011), the possible relationship between linguistic difficulty and test performance for 64 deaf readers has been examined. They
completed fifty two multiple-choice items, consisting thirty two in mathematics and twenty in reading. The components of linguistic complexity studied in the study were vocabulary, syntax, and discourse. Findings revealed that there was no significant relationship between item linguistic complexity scores and student performance on the test items. However, mathematics items had higher linguistic complexity ratings than reading items because in Reading Comprehension, items followed a reading passage, whereas mathematics items were stand-alone concepts.

Dominguez and Alegria (2010) examined the level of reading ability and the reading mechanisms in 14 orally educated deaf adults who finished secondary or higher education. The results indicated that the relationship between the reading level and the academic level were to a certain extent strong and examined the reading mechanisms and found that deaf readers used key word reading strategy indicating it to be their specific feature; their orthographic lexicon was better off than typical hearing children of same reading level. In metaphonological tasks, deaf participants reached scores a little under the level attained by hearing group.

A descriptive, multiunit, embedded case study by Easterbrooks and Beal-Alvarez (2012), examined the reading data submitted by seven states in grades third, fifth, eighth, and in high school. These reading scores among children who are deaf and hard of hearing were based on the state standards set for deaf children in their respective states. Findings revealed that although there were variations from year to year, grade to grade, and state to state, most states reported better reading outcomes from deaf students in fourth grade and above than predicted by the “glass ceiling” compared to the past data of these children.

Friedmann and Szterman (2011) investigated the comprehension, production and repetition of Wh-questions in 11 orally trained deaf and hard of hearing student’s
age ranged from 9.1 to 12.4 years with moderate to profound hearing loss. They were Hebrew-speaking children. They had difficulty in understanding relative clauses. Comprehension of Wh-questions with the help of a picture selection task was tested by Experiment 1 tested; Experiment 2 used elicitation task to test production, and Experiment 3 tested repetition task by using Wh-movement. Findings revealed all children with hearing loss in the study demonstrate difficulty in the comprehension, production and repetition tasks and their performance was drastically low compared to their hearing peers. They do not have difficulty in the repetition of simple and embedded sentences not derived by Wh-movement. Their shortage in syntactic movement is also indicated. The results provide evidence of their difficulties with object Wh-questions and Wh-movements.

In their study by Harris and Terlektsi (2011), reading and spelling abilities among 86 deaf adolescents using cochlear implants and hearing aids age range from 12-16 years were examined. They were taken from special deaf schools, special units attached to the regular schools, and mainstream schools. Children using hearing aids, children implanted early i.e., before 42 months and children implanted later were divided into three groups who were all age-matched, nonverbal IQ and degree of hearing loss. Assessments were carried out using spelling task, pattern construction test, single word reading test, and Edinburg reading test. Findings revealed the mean reading age were a number of years below chronological age for all three groups. However when compared among the 3 groups, children with hearing aids executed best in reading tasks compared to children with cochlear implants. Cochlear implantation at an early age does not result in age-appropriate reading levels. Factors such as age of diagnosis, degree of hearing loss did not predict the reading levels. There was relationship between phonetic errors in spelling and reading level.
Differences were even noticed in educational set-ups, more number of children using hearing aids was enrolled in special schools for the deaf and relatively more number of children with cochlear implants enrolled in regular schools. The study emphasized that even with substantial advances in amplification technology, most of the deaf adolescents find literacy taxing and they would require specialized teaching support throughout their school time to achieve their maximum potential.

A quasi-experimental study by Lederberg et al. (2014), examined the effectiveness of a new early literacy preschool (NELP) intervention formed especially for deaf and hard of hearing children with functional hearing. Experimental group included 25 deaf and hard of hearing children studying in two different schools: one school used spoken language and other school used spoken language along with and without sign. Control group included 33 deaf and hard of hearing children who were in line with the children in experimental group on key characteristics. *Foundations for Literacy* was not implemented on control group children. All children with hearing loss had moderate to profound hearing loss and approximately half of them were cochlear implanted and had good speech perception skills for closed item sets. *Foundations for Literacy* was implemented by teachers for experimental group children in small groups for one hour in a day, for four days per week for the school year. Findings revealed experimental group children made significant gains on expressive vocabulary tests, phonological awareness tests, and letter-sound knowledge tests than comparison group. Additionally, on phonological awareness and vocabulary tests, they showed significant increases in standard scores of hearing children. Therefore, the study highlights that these children can acquire foundational skills in learning to read when taught using instructional practices found effective for typical hearing children but adapted to the exceptional needs of children with hearing
loss, specifically their reduced auditory access, fragile language skills and broad individual diversity. *Foundations* provide experiences intended to build semantic, visual, and kinaesthetic representations to complement and support spoken phonological representations and also teach vocabulary variety in meaningful contexts.

A mixed research design study by Nikolaraizi, Vekiri and Easterbrooks (2013) examined eight deaf students, ages 8-12 years using the visual resources of a multimedia software package which was planned to support comprehension in reading. Their interaction with multimedia software consisting of narrative texts enhanced with Greek sign language videos, pictures, and concept maps was recorded. Their Reading Comprehension was assessed using questions and retelling. After analyzing the data collected, the results revealed that they used visual resources but they did not take advantage of them in a intentional manner to assist their Reading Comprehension. Therefore, the study highlighted the need for systematic teaching in ‘visual literacy skills’ so that it enables them to learn to practice visual aids and extract more and better information from them in order to increase Reading Comprehension.

Palmer (2000) investigated the efficacy of phonological skills training specifically grapheme-phoneme correspondence in two hearing impaired children age 8 years 9 months and 9 years respectively and they were identified as underachievers in reading tasks. Data was collected before the intervention on alphabet knowledge, phonological abilities, and spoken and written language and again after twelve-week intervention they were re-tested for the same measures. The results revealed intervention program speeded up the children’s acquisition of phonological skills, grapheme-phoneme association knowledge, and their competency to apply these in
word decoding and spelling. It also improved their classroom behaviour, their attention increased in oral lessons in classroom, and also one child started paying more attention to sounds during her speech therapy. The study underscores the constructive effects of the Phonographix intervention program in instructing phonological skills and alphabet knowledge that can enhance interpreting and spelling standards in children with hearing impairment which can also lead to vocabulary improvement which can again lead to understanding in the long term.

Parault and Williams (2010) examined the relationship between the variables of reading motivation, reading amount, and text comprehension in deaf and hearing adults. Different questionnaires: MRQ to measure reading motivation; Reading activity questionnaire; Gray silent reading test and demographic questionnaire were used to collect the data from thirty hearing and twenty four deaf adults. The results indicated that deaf individuals reported reading motivation at considerably higher levels but found to read at below than a sixth-grade level and also found deaf adult males have reduced motivation to read than deaf adult females. In reading amount, no significant difference was found between hearing and deaf adults, and intrinsic motivation was found to be the best predictor. In text comprehension, reading for individual reasons was found to be the best predictor in deaf individuals.

Park, Lombardino and Ritter (2013), measured seven literacy skills in twenty one school-age children with mild to moderate sensory-neural hearing loss and compared the scores to two age-matched control groups: children with dyslexia and typically developing children. The results indicated that children with mild to moderate sensori-neural hearing loss performed below hearing children but better than the children with dyslexia. It highlights that there was a consistent trend for their literacy scores compared to hearing children suggesting that these children are at
long-term risk for reading and spelling difficulties. Findings indicate a close association between reading and spelling abilities, and phonological processing skills in children with mild to moderate sensory-neural hearing loss. The study recommends for explicit instruction to school age children in phonological awareness to ensure that these children with mild to moderate hearing loss develop precise phonological representations for speech sounds, and in both reading and spelling to ensure their success in decoding unfamiliar words and generate accurate word spellings.

Swanwick et al. (2012) investigated variations in views of deaf education practitioners on deafness and comprehension in reading consisting of communication support workers, deaf instructors, and teachers of the deaf at different levels: early, primary, and secondary settings all over UK city. Data was collected on views of 32 participants including eight deaf instructors, eight communication support workers, eight peripatetic teachers of the deaf, and eight school-based teachers of the deaf on what Reading Comprehension involves and factors that identify success among them for deaf learners. The results revealed both the groups of teachers: peripatetic and school-based identified focussing on skills and processes for Reading Comprehension are important, deaf instructors identified language learning and sign language support as important, and communication support workers identified working between the linear written language and a visual gestural language as critical. Apart from identifying decoding, vocabulary, memory, language ability, and higher level processes of inference is emphasized for Reading Comprehension in deaf children. They identified Reading Comprehension as a complex process and highlighted this being very different in different deaf population due to their interactions between themselves as individuals and the environment. The study underscores the
importance of considering the practitioners views in developing appropriate methodologies to teach reading for deaf children.

A case study by Wang et al. (2013) examined the efficacy of phonics-based intervention package on early reading skills in three preschool deaf and hard of hearing children who were different based on degree of hearing loss, amplification use, and mode of communication. Intervention was for a duration of 40-week in two children and fifty-week in one child delivered in individual and group phonics-based instruction enhanced by visual phonics infused by technology in a preschool classroom which was language-enriched. Testing was done using standardized tests at three interval levels: Pre-level, during, and post-level of the intervention. The results demonstrated that all children when explicitly trained had little use of phonemic awareness and phonics skills and these skills were sustained in early elementary school. Assessments in early elementary school indicated that all children revealed on the whole reading levels at or above age level. Furthermore, results revealed an encouraging relationship between early reading skills and the phonics-based early intervention.

A research article by Watson (1999) examined criteria important for children with normal hearing to achieve to learn literacy skills; applied these criteria to different language approaches used with deaf children, and reported the advantages and disadvantages of these various approaches. The criteria identified were a concrete language base, the capability to use the language base for the literacy purposes, a vast general knowledge both of the world and of books and stories, and efficient word-attack skills that will provide for reading purpose and writing purpose. It is highlighted that oral deaf children have greater chance of success in meeting the criteria and develop age-appropriate literacy skills; sign bilingual approach can
promote spoken English but when it comes to achieving the mastery of literacy skill, then the question arises as to how pupils can utilize this approach, and if the total communication approach is able to build a solid base of English on which literacy skills can be build then it can be promoted. But if the language they acquire is both neither complete English nor complete British sign language, then it might pose a problem. Total communication approach can be used if signing is solely used in addition to spoken language, and residual hearing is utilized to a maximum extent.

2.6 Studies related to Speech and Language development in children with cochlear implants

Following are few studies that reveal particularly the speech production and language development in children with cochlear implants.

Bell et al. (2001) investigated the speech, language, and vocal skills in a pair of monozygous twin girls: one with a cochlear implant and normal hearing. Data was collected on speech-production and language skills using standardized assessment tests and compared their scores between two occasions with seven-month gap. Results revealed on all the skills both the girls were well within normal range, although syntactic, discourse, and pragmatic skills revealed that the twin who was implanted had few persistent difficulties. Abnormalities were noticed in the voice of the implanted twin. The study emphasizes the need for implantation at an early age, using signs before implant, early intervention, and also a need to research further on children with cochlear implants voice quality.

Boons et al. (2012) evaluated language skills in 288 children using cochlear implants by five years of age to establish benchmarks; estimated the optimal age for implantation to provide maximum benefit to achieve good language skills post implant, and found the causes of variability in outcomes. Language outcomes were
collected using standardized tests at 1st, 2nd and 3rd years post implantation. Nine child-related, environmental, and auditory factors were independent variables. The results revealed that children implanted prior to two years of age performed considerably better on all language tests compared to children implanted at a later age. Better language outcomes were evident with the use of contra lateral stimulation using a second cochlear implant or a hearing aid and when there are no additional disabilities. Improved language outcomes were evident in children who were monolinguals, sufficient parental involvement, and oral communication by the parents. The study underscores that children with cochlear implants whose language scores are 0.60 or less can be regarded at risk for language development which might be problematic compared to other children with cochlear implants, and understanding that the causes in variability in outcomes help the parents and therapists to plan for appropriate intervention to promote language development.

Castellanos (2014) examined whether early preschool measures of speech and language performance envisage speech-language functioning in children using cochlear implants in long-term. The data was collected on speech intelligibility and receptive vocabulary in a sample of 35 pre-lingual deaf early implanted children during the preschool 3-6 years. These measures predicted speech perception, language, and verbal working memory skills up to 18 years later. The findings suggest that speech and language development during preschool years is predictive of continued speech and language development in children using cochlear implants. The study underscores the importance of measuring speech-language skills at preschool ages to identify and adjust interventions for very young children with cochlear implants who might be at long-term risk for reduced speech and language outcomes.
Chilosi et al. (2013) examined the trajectories of development of language in six Italian children using cochlear implants who were implanted between sixteen and twenty four months of age. Over a mean period of up to 34.8 months post implant they were assessed individually for language performance both directly and indirectly. The results revealed when compared based on chronological age, expressive language acquisition was delayed but when hearing duration was considered, children with cochlear implants demonstrated an earlier and quicker growth of expressive vocabulary than receptive vocabulary compared to hearing children. The study suggested for implementing rehabilitation in lexical comprehension and focus on grammar aspects for Italian children with cochlear implants which are due to early acoustic deficiency so as to ensure language training planning in a more enhanced manner.

Clendon et al. (2003) examined the efficiency of using computer technology in facilitating the speech and language skills of five children with cochlear implants. Intervention was obtained for eight months focussing on the development of phonological awareness skills and speech production using the Speech Viewer III and Earobics computer software programs by these children. Results indicated after intervention when the assessment was done significant increase were attained in syllabic and phonemic awareness, speech production, non-word reading, and receptive language. The study underscores the use of computer software as a resourceful method for improving the speech and language skills in children using cochlear implants.

Francis and Lam ho et al. (2003) examined the acquisition skills of three languages in a six year old early deaf child with a cochlear implant. His performance on common standardized vocabulary, and receptive and expressive language skills
was assessed and compared the scores to two-age matched hearing children with equivalent educational and social backgrounds. Results indicated that the child with cochlear implant is acquiring three languages: Cantonese, English, and Mandarin to the extent comparable to two typical hearing classmates.

Guo, Spencer and Tomblin (2013) investigated the tense markers development in nine children using cochlear implants and compared to nine children with typical hearing for a time span of three years i.e. at 3rd, 4th and 5th years after implantation. Before 30 months of age children using cochlear implants were implanted. Data was collected using story-retell task. Findings revealed children with cochlear implants were considerably less correct in tense recognition compared to hearing children at 4 and 5 years of post implantation due to the nature of degraded electrical signals and early dearth of auditory input received by the implant device. At early time points, tense marking performance and speech perception skills were correlated in children using cochlear implants. Tense marking errors were more of omission rather than commission in both children with hearing and cochlear implants. It is recommended that children with cochlear implants have to be specially trained to acquire tense markers based on their speech perception skills and even though there may be delay they will learn the tense markers.

A study by Kronenberger (2014) identified executive functioning (EF) domains with respect to speech-language skills in 64 children with cochlear implant compared to 74 typical hearing children matched on age and nonverbal intelligence. Data was collected on three domains of executive functioning: inhibition-concentration, working memory, speech language skills and fluency-speed. The results pointed to that in children with cochlear implant, fluency-speed and verbal working memory were more robustly related with speech language skills compared to
hearing children. In children with typical hearing, inhibition–concentration and spatial working memory were strongly associated with speech language skills compared to children using cochlear implants. The study suggested in neuro-cognitive development executive functioning main domains associated with speech language skills are different for children using cochlear implants and typical hearing children.

Nittrouer et al. (2014) measured the abilities of children with cochlear implants in incorporating grammatical structures into the production of their language, and compared the scores to performance of hearing children. Another objective examined whether measured grammatical abilities rely on lexical knowledge, phonological awareness, or factors related to the hearing loss or its management. The data was collected from 40 children: 19 hearing children and 21 children with cochlear implants who completed kindergarten. The results revealed inspite of technological advances in recent years children with cochlear implants continue to lag behind in the development of grammatical abilities compared to hearing children of same age. Expressive vocabulary scores and age at first implant could predict the language measures, and there was significant delay in performance on phonological abilities, lexical, and grammatical in children using cochlear implants. Therefore, the study emphasizes the need for persistent intervention to support their language learning during their schooling years even though they are placed in mainstream schools.

A study by Remine et al. (2003) investigated the contributing factors for language delay in six children with profound hearing loss along with severe delay in language. Four were implanted and two used hearing aids. They were all diagnosed early, early fitting of the sensory device, had sizeable device experience, and had gone to early intervention in auditory oral setting. The study recognized the reasons for
their slow development of spoken language such as use of device inconsistently, and functioning on speech intelligibility, conversational attentiveness, pragmatics, speech perception, behaviour, social competence, and temperament are at low levels.

Spencer and Guo (2013) investigated on consonant development before 30 months of age in 32 paediatric cochlear implant children implanted found they require time to organize their articulatory categorizing principles with their cochlear implant inputs. The study highlights even though these children after implantation produce increased number of consonants between 3 and 4 years it takes a little long duration for these children to commence to filter their phonological representation and production system. The study also revealed the acquisition patterns of speech sounds in children using cochlear implants were equivalent to the typical hearing children when duration of cochlear implants experience was used instead of chronological age. The study also provided consonants list produced by 70% of children using cochlear implants annually in the early 4 years after implantation. Most recurrent mistakes produced by children using cochlear implants were also provided such as they were more probable to omit consonants at the word-final position rather than at the word-initial position and they are often to make substitution errors in the word-initial position. It stresses the need to use standardized articulation tests.

Tobey et al. (2004) examined how placement in the classroom and communication mode impact accuracy of vowels and consonants production, oral communication skills, and speech intelligibility in 131 aged between eight and nine years old children with cochlear implants. The mean age at implantation was 3.63 years. Data was collected from parents using the questionnaire. The results revealed higher speech intelligibility scores were related to oral mode in education. Before implantation placement in oral classroom had nominal impact on speech intelligibility
but post implantation exposure to oral classrooms had higher impact on speech intelligibility which was also notice in vowel and consonant production.

Yoon et al. (2004) examined the speech production abilities variables that envisage the communication proficiency in 40 children using cochlear implants. Their mean age was 8;10, mean age of implantation 6;01, and mean duration of implant use was 2;09. The speech production abilities: speech intelligibility, articulation ability, and voice quality. The results revealed about 50% of children’s speech was understandable, and the correct phonemes mean percentage was about 78%. Furthermore, it is indicated that the age at implantation is a critical envisage factor of articulation ability, speech intelligibility, and voice in pre-lingual deafened children with implants. The level of receptive language before implantation is envisaging factor of articulation ability and speech intelligibility except voice measurement.

### 2.7 Studies related to Reading in children using cochlear implants

Following are few studies that show particularly about reading in children with cochlear implants.

A study by Asker-Arnason et al. (2007) examined language, Reading Comprehension and working memory in 16 children using cochlear implants (7.2 to 13.4 years) and compared the performance to a group of age-matched hearing children. The major findings were working memory, language and Reading Comprehension are strongly associated. 60% of children using cochlear implants have a Reading Comprehension at the level of hearing peers. Importance of working memory for reading is also highlighted. No significant gender differences were found. Furthermore, age at testing and time with cochlear implant both correlated significantly with non-word reading.
A study by Asker-Arnason et al. (2010) explored the narrative writing of 18 children with cochlear implants, aged 11 to 19 years and compared their performance with 75 children typical hearing. As children using cochlear implants differed and formed a heterogeneous group, they were divided in two ways: based on age at testing and age at implantation. Data on narrative writing was collected by key stroke logging. There was difference between both the groups in two measures: the percentage of pause time, and lexical density. The results also reflected in complex linguistic tasks like narrative writing there are linguistic and cognitive processing limitations in children using cochlear implants compared to hearing children.

A study by Bouton et al. (2011) on reading and reading-skills of 18 children using cochlear implants exposed to cued speech or who were never exposed to cued speech. Their performance was compared to age and reading level matched two hearing children. They were assessed on various tests and scores were collected on phonemic awareness, reading tasks and phonological short-term memory. The results showed cued speech improved the performance on phonemic awareness and reading skills i.e., better correspondence between grapheme and phoneme in cochlear implant children compared to children who were never exposed to cued speech but no impact was found in phonological short-term memory tasks. Therefore, results emphasized the use of cued speech.

A study by Kant et al. (2010) reported the results of two studies of Reading Comprehension of Flemish children in Belgium. Study 1 examined the effect of cultural differences: healthcare and education on the comprehension in reading of deaf children. Reading levels of 30 Flemish children using cochlear implants and 44 children using hearing aids were compared to 50 Dutch children using cochlear implants and 500 children using hearing aids and also children with typical hearing.
The results revealed that reading levels of Flemish children using cochlear implants and hearing aids were significantly better than the Dutch children reflecting the Belgian policy of early implantation, audiological CI indication criteria and the use of spoken language communication. Within both the groups, younger children performed better than the older children. There was no difference between Flemish children with implants and hearing aids whereas there were differences between Dutch children with implants and hearing aids. Study 2 investigated the variability sources by examining the underlying processes of comprehension in reading of good and poor 30 Flemish deaf readers with cochlear implants in study 1 and also working memory capacity scores, including verbal and non-verbal working memory scores, morpho-syntactic ability, and phonological encoding. Results showed in good readers there were better morpho-syntactic abilities and better working memory skills. And the other three factors indicated for better reading in Flemish children with cochlear implants were: age at implantation, duration of implant use access to spoken language through implants, and amount of spoken language input. The study underscores that even when the amount of reading instruction received is controlled, early implantation, longer experience to speech through cochlear implants facilitates comprehension in reading skills.

In a study by Dillon, Jong and Pisoni (2012) investigated the reading and phonological awareness skills of 27 deaf school-age children with cochlear implants. Standardized tests were used to collect the data. Findings revealed, two-thirds of the children performed at or above the level of their hearing peers on phonological awareness and reading tasks. Reading scores and phonological scores were strongly correlated. The study emphasized the lexicon size or the vocabulary size being the intervening factor in the relationship between the children’s phonological awareness...
and reading skills. Additionally the development and the use of other cognitive skills have also been stressed.

A study by Geers and Hayes (2011) examined the literacy skills of adolescents who were deaf with cochlear implants and reading growth from primary grades to high school and also assessed the input of early literacy levels and phonological processing skills to literacy levels at high school level. Data was collected from 112 high school children with cochlear implants, aged 15.5 to 18.5 years. Their performance was compared to 46 normal hearing children and standard scores for tests. The results revealed most of students with implants performed nearly 47 to 66% within or above the average range on reading tests as compared to hearing peers. It was also found that early good readers were also good readers in high school. Many of the students with implants maintained good reading levels on par with hearing peers. But they had difficulty with written expression and phonological processing tasks compared to hearing peers. They were poor at spellings, expository writers, and at phonological knowledge. It was also found that phonological processing skills were a critical interpreter of high school literacy skills. The study underscores that the phonological processing skills are not only important for early reading skills, like decoding, but significant for literacy skills at a later stage.

Lyxell et al. (2008) in the research article presented an overview of a set of studies in their laboratory. The summary of the results of various studies demonstrate that majority of children using cochlear implants perform at lower levels in many of the cognitive tasks. However, it is evident that many children using cochlear implants can perform better on cognitive tasks with lower demands on phonological processing. Furthermore, it is noticed that despite their poor phonological skills children using cochlear implants can reach the level of hearing children in Reading
Comprehension tasks. General working memory is related to the types of questions asked in referential communication.

Lyxell et al. (2009) on cognitive development, reading and prosodic skills in children using cochlear implants compared children with cochlear implants and a group of age- matched typical hearing children. Inspite of showing non verbal abilities, children using cochlear implants performed at tremendously at lower levels than the hearing on most of cognitive tests. Noteworthy differences between children using cochlear implants and typical hearing were found more on tasks with high phonological processing demands. Impairment of receptive and productive prosody was also evident in children with cochlear implant. 75% of children with cochlear implants reached reading skill level on par with typical hearing children.

Lyxell et al. (2011) examined cognitive and reading skills in 50 children using cochlear implants and compared with 125 age- matched typical hearing children. It was found that children with cochlear implants have fairly normal visuo-spatial working memory capacity, slightly reduced general working memory and relatively poor phonological working memory skills. For lexical access, 50% of children using cochlear implants performed within standard deviation of typically developing children. 75% of children with cochlear implants in reading tasks demonstrated Reading Comprehension and decoding tasks on par with normal hearing children. Age at implantation correlated with all cognitive tasks, except for visual working memory tasks, suggesting that implantation done early is more valuable for cognitive development compared to later implantation.

A study by Nittrouer et al. (2012) examined the early or emergent literacy in deaf children as historically deaf individuals failed to develop literacy skills compared to their typical hearing peers. Data was collected from 27 deaf children with cochlear
implants who completed kindergarten. They were tested on emergent literacy, cognitive ability and language skills: phonological awareness, executive functioning, and oral language that support emergent literacy. For comparison, there were 17 children typical hearing and eight children with hearing loss who were using hearing aids. Outcomes were compared for three groups, regression analysis was done to see if the predictor variables differed for children with implants and normal hearing, and for children with cochlear implants, factors and prosthesis configuration were also examined. On all tasks except for syllable counting, rapid serial naming, and reading fluency tested, performance of children with cochlear implants was roughly 1 SD or more below the average performance of children with normal hearing. In children with cochlear implants, it was found oral language skills were very inconsistent compared to hearing children. For several measures, age of first implant explained moderate amount of variance. Children with bilateral implants outperformed children without implants on several measures, but there was no difference between unilateral or bilateral implants. The study emphasizes deaf children, even if benefited from early identification, early intervention and implantation; they are still at the risk for emergent literacy skills that could affect their academic success. Therefore, the study stresses the need for intensive language support to be continued during the early school grades and to some extent bimodal stimulation might also help to boost emergent literacy skills.

Wass et al. (2010) investigated working memory capacity, lexical access, phonological skills and reading ability in six children using cochlear implants in grades 1 to 3. Their performance in each test was compared to grade-matched children with typical hearing. Cognitive skills were assessed by computer-based test battery. Reading Comprehension was measured by Woodcock Reading Mastery Test
and decoding was assessed in the Test of Word Reading (TOWRE) and also tested on orthographic learning. In tasks of phonological skills and phonological working memory where non-words are used as test stimuli, and in tasks on lexical access without any contextual information, children with cochlear implants had difficulties. However in tasks of phonological processing of words for which they have well defined phonological representation, children with implants do not have any problem. The study highlights children with implants are efficient in using compensatory strategies where auditory perception is insufficient, and they also tend to use both orthographic and phonological reading strategies, although many use phonological decoding.

2.8 Studies related to Language development and Reading Comprehension in children using cochlear implants

Following are few studies that reveal particularly language development and reading comprehension in children with cochlear implants.

A cross-sectional study by Edwards and Anderson (2014) investigated the relationship between visual sequential memory span and visual sequential reasoning ability. The range of speech, phonological processing, vocabulary knowledge, and reading outcomes in 66 aged 5 to 12 years children using cochlear implants were also examined. Auditory memory span was also tested, and its relationship. Findings revealed significant positive correlation between the visual memory and reasoning tests. Majority of children scored below the normal range on word reading tests and phonological processing. Auditory memory span was strongly related to phonological processing skills. Non-word repetition deficits have been strongly associated with poor vocabulary knowledge and reading skills. Therefore, the study emphasized improvement in identification of administering the nonverbal tests to children younger
than 2 years of age. It also highlighted the importance of identifying language difficulties and developing intervention strategies based on specific difficulties and abilities.

Watson (2002) assessed the development of literacy at age 7+ i.e., at the end of Key Stage 1 in England in the English National Curriculum in 10 children with cochlear implants. They were implanted before five years of age. It was aimed to explore the benefit of implant device in enabling them to access sounds and if this is being reflected in their literacy. Data was collected from the parents and particularly from the schools who provided the information on children’s performance on the areas requested. The results revealed seven out of ten children with cochlear implants were able to achieve standard literacy levels in some aspects as like their peers, and also they were using phonic strategies. Therefore, the study underscores the importance of providing more focussed teaching to children with cochlear implants as their implants are affording them the advantage of phonological strategies to be used in learning literacy skills.

2.9 Studies related to factors influencing Language and Reading skills in children using cochlear implants

Following are few different studies that reflect different factors which might have an influence on language and reading skills in children with cochlear implants.

**Early diagnosis of hearing loss, family involvement and Mode of communication**

A longitudinal study by Harrington et al. (2010) investigated the relationships between early child factors (i.e., age at identification of hearing loss, admission in early intervention, oral language skills) and school readiness skills in a group of eight preschool children with hearing loss (mean age 4 years). Six of them were using cochlear implants. The first major finding revealed negative relationship between age
at identification and enrolment in early intervention and later school readiness skills. The second major finding revealed a positive relationship between early oral language scores and school readiness skills. Another important result is that children’s cognitive skills may influence school readiness scores. Furthermore, when individual analyses was done it is noticed in mathematical concepts, at Time 1 children whose language scores were low had low school readiness skills one year later (Time 2). Therefore, the study supports the idea that early oral language skills are important for schooling for young children with hearing loss. Therefore, it is important for these children to be admitted in an appropriate early intervention program at the earliest where teachers play a vital role in oral language development and concept knowledge development. Language activities can be embedded in school day –to –day activities so that children can generalize their language skills to other situations in the environment.

A study by Yanbay et al. (2014) examined the factors influencing language in 42 children with cochlear implants and also compared their language outcomes in paediatric cochlear implant users enrolled in three different communication programs: sign and spoken language, auditory-oral, and auditory-verbal therapy. They were implanted by 3;6 years of age. Standard scores on language assessments of receptive vocabulary, auditory comprehension, and expressive communication from their files were collected. All the relevant information: demographic details, device details, and history of early intervention were also collected. Using a rating scale, family involvement was also evaluated. The results revealed there were no considerable differences in language outcomes across the three groups. But, there was a large degree of variability with some children achieving below average scores and others achieving above average scores. There was significant relationship was found
between age at diagnosis of hearing loss and family involvement with language outcomes. The study underscores the importance of early diagnosis of hearing loss and the family involvement in enabling better language scores in children with cochlear implants.

**Early implantation and Mode of communication**

A prospective cohort study by Ching et al. (2014) examined phonological awareness, language ability, reading ability and nonverbal cognitive ability using standardized tests and custom-designed questionnaire to collect demographic details of 165 children using cochlear implants at 5 years of age. It also examined the factors affecting the reading development. The results emphasized the early implantation being considerably associated with better reading ability at 5 years of age, after language ability, nonverbal cognitive ability, receptive vocabulary, and device configuration have been controlled.

A study by Davidson et al. (2011) evaluated the changes in speech perception abilities in a group of 112 adolescent cochlear implant users from the first assessment at elementary school level to the later assessment at high school level. Speech perception scores were compared based on age at test, lexical difficulty of stimuli, listening environment, input mode, and language age. The results revealed on an average, children who received cochlear implants between two and five years of age exhibited significant improvement on speech perception tests, lip reading, speech production, and language skills between assessments at elementary level and later assessments at high school.

Dunn et al. (2014) using the linear mixed-model framework determined whether implantation age has an important impact on speech perception, language, and reading performance of 83 children with pre-lingual hearing loss who received their
implants by the 4 years of age. Based on the age at implantation, they were divided into two groups: under 2 years of age and between 2 and 3.9 years of age. For speech perception, mean scores between the groups were compared at annual intervals from 5 to 13 years of age, and for language and reading, mean scores were compared at annual intervals from 7 to 11 years of age. The results revealed that there was no considerable effect of age at implantation for receptive language by 8 years of age, expressive language by 10 years of age, reading by 7 years of age. For speech perception outcomes, between 7 and 13 years significance varied. There was no significant difference in speech perception scores between groups of ages 7, 11, and 13 years. There was significant difference between children who used oral communication and children who used total communication in speech perception scores. In receptive language or reading scores, there was no significant difference between children who used oral communication and children who used total communication. Although the scores did not show significance, in expressive language scores also children who used oral communication performed higher than children who used total communication. The study underscores for higher-order skills such as language and reading, the effect of age at implantation diminishes with time. Some children who were implanted after two years of age are able to cope for the language and reading skills with the children who got implanted before two years of age, suggesting that the additional factors might have influenced outcomes over time.

Geers et al. (2013) documented the ability of sixty 9 to 12 years old children with cochlear implants in perceiving linguistic properties and indexical attributes of speech. In addition, it also examined the extent of relationship between linguistic and indexical perception skills. Data was collected on linguistic properties and indexical perception skills using comprehensive test batteries. For comparison, data on non-
word repetition, and talker and emotion-perception tasks were collected from 30 age matched children with normal hearing. Findings revealed a strong link between linguistic and indexical skills in speech perception analysis. They are interdependent and inseparable. It was found that they are processed together in parallel by the auditory system and central auditory pathways. Better speech performance was evident in children who were implanted early and who use more recent speech processor technology. In addition, children with better speech perception showed better spoken language, were mainstreamed in regular classrooms, and also had well-developed social skills. It is also found that the ability to discriminate the nuances of talker identity and emotion are strongly associated with well-developed social skills than the ability to recognize the words and sentences through listening. The study highlights the importance of early implantation i.e., before the age of 12 months, upgradation to the most recent speech processors, and program the cochlear implants to achieve the maximum potential benefit.

A study by Mikic et al. (2014) discover if the age at implantation affects auditory memory function in 50 cochlear implanted children aged 4 to 8 years. They were divided into two groups: 27 early implanted (1-3 years) and 23 late implanted (4-6 years). Immediate verbal memory test and forward and backward digit span test were used to assess their auditory memory. Results indicated that children who were implanted early performed better on both verbal and numeric tasks of auditory memory. Furthermore, especially on the complex tasks difference was statistically significant. The study emphasizes early implantation prior to three years of age along with postoperative training can significantly improve auditory memory and contribute to better cognitive and educational outcomes.
In a study by Ruggirello and Mayer (2010) language development in a hearing and a deaf twin with simultaneous bilateral cochlear implants at 1 year of age was investigated from six months to three years of age in different time frames. It was found that early bilateral implantation before one year of age supported age-appropriate language development leading to the potential overall progress that commensurate with hearing age peers. Cochlear implant allowed for language acquisition is also been stressed in the study. It also highlighted the importance of parental education and active involvement in the intervention process and daily interactions between both twins lead to improved language development. This study also suggests for a positive impact of early bilateral implantation.

A study by Salas-Provance et al. (2014) investigated the speech development process in five 42-month old children with profound deafness who were implanted between 19 and 36 months of age and five hearing children of same age. For all 10 children, conversational samples were transcribed. Sounds produced rightly within meaningful words and recognizable sounds produced in spontaneously were analyzed. The results revealed in the target condition there were variations between the two groups, whereas the in target-less condition, the two groups were more similar. They have common characteristics in the total number of vowels and consonants produced by the two groups. The study underscores the importance of examining the speech sounds to predict the end-point sound system in children with cochlear implants. It also emphasizes the early implantation for children with profound deafness so that they develop speech sounds similar to hearing age mates.

Lesinski-Schiedat et al. (2004) compared the performance of 27 children with profound bilateral hearing loss who were implanted before one year of age and 89 children who were implanted between one and two years of age. The data was
analysed in terms of individual anamnesis, implantation, rehabilitation, and speech understanding. The results showed children who were implanted before one year of age demonstrated better results in hearing and speech development and they were matching to their chronological age than with the length of time spent in rehabilitation. The study highlights the children implanted before the age of one year were not prone to any additional risks and showed better development in speech understanding, so it is suggested that cochlear implantation must be performed in very young children.

Watson et al. (2006) investigated the changes in mode of communication in 176 children with cochlear implants who received their implants in one centre in United Kingdom. They were followed up for five years post-implant. They were divided into three groups based on the age at implant: below three years of age, between three and five years of age, and above five years of age. The mode of communication: oral or sign used by them was noted at four key intervals: pre-implant, at one year, three years, and five years of post-implant. The results showed by the end of five years of implant use 83% of group 1 used oral communication, 63.5% of group 2 used oral communication, and 45.1% of group 3 used oral communication. Furthermore, it is indicated that mode of communication is significantly associated to children who were implanted younger and these younger implanted children were getting adapted to the oral mode faster.

**Duration with cochlear implant**

Fagan and Pisoni (2010) investigated receptive vocabulary development in deaf children using cochlear implants. Data was collected from 23 children, age range 6-14 years. They were implanted between the ages 1.4 and 6 years, duration of implant use ranged from 3.7 to 11.8 years. Peabody Picture Vocabulary Test was the
test used. Data was analyzed considering the hearing age and not the chronological age. Participants showed evidence of vocabulary understanding inspite of low average mean standard scores. The mean standard scores on the test performance was low the test mean recognized for hearing children when based on chronological age but were within the average range established for hearing children when calculated based on the hearing age. It indicates that role of spoken language experience in vocabulary acquisition is more critical than the age at implantation. The main finding of the study is vocabulary development being closely bound to language experience, i.e., children’s vocabulary knowledge was proportionate with numbers of years of use of the cochlear implant. The study highlights the need for early identification of hearing loss, early amplification and an accessible system of language for early word learning.

A study by Percy-smith (2010) investigated the associations between auditory skills, speech production, language comprehension, and communicative skills in 168 children with cochlear implants, and also analysed associations between professional and parental assessments. They were divided into three groups based on the length of device use: Groups one (6 to 23 months), group two (24-36 months), and group 3 (above 36 months). The children were assessed using the Tait Video Analysis, the receptive part of the Reynell test, a phonological test, and vocabulary test. The associations between the four tests scores and parental assessment of their child’s auditory capacity using CAP and speech intelligibility SIR were investigated. The results revealed a strong and positive association between the auditory capacity, speech production, language comprehension, and communication skills in children with cochlear implants. A noteworthy finding of the study is children who were using their implants for more number of years i.e., above 36 months were poor performers. In addition to this, parental assessments were positively linked with the results of the
four objective tests indicating that parents are the legitimate reporters of their child’s auditory, speech and language development.

**Other combined factors**

A research article by Powers (2011) reports the reasons for the success of 27 high achieving deaf students in England from the views of deaf students themselves, their parents, teachers, and other school professionals. Findings revealed the two major reasons in explaining the success among the deaf students being deaf children’s personal attributes and character, and the influence of parents. This article supports the notion the important role of parents in the success of their deaf children and highlights working with parents is one of the most crucial aspects of the teacher’s work.

A study by Tobey et al (2011) evaluated the changes in speech intelligibility in a group of 110 adolescent cochlear implant users from the first assessment at elementary school level to the later assessment at high school level and also examined factors influencing speech intelligibility performance at both the levels. Data was collected on speech intelligibility and consonants correctly produced in the sentences. The influence of participant and family measures: duration of deafness, gender, family size, socioeconomic status, and performance intelligence quotients on speech production was evaluated. The influence of performance measures: estimates of speech perception, working memory, sign enhancement, and duration of seven-syllable sentences on speech production was also evaluated. The results revealed significant increase of 22% approximately between the two test sessions in speech intelligibility and consonants correct. Furthermore, it has shown that 65.8% of the variance in adolescent speech intelligibility was envisaged from the participant, family and performance measures observed in primary school and 49% of the
variance was envisaged from the participant, family and performance measures observed in high school. The study underscores significant improvements between elementary and high school test sessions in consonant accuracy, sentence duration, and speech intelligibility. Greater impact of oral communication and shorter sentence duration independently accounts for variance at adolescence.

A study by Wang et al (2011) explored the parental views of their school-aged, cochlear-implanted children’s auditory performance and determines predictive factors and their contribution to auditory performance outcomes. Data was collected from 177 parents on five different domains: recipient background, cochlear implant device use, auditory performance, spoken communication skills, and education using a survey instrument consisting of open, closed, and semi-structured questions. The results revealed related to auditory performance a significant level was reached by variables such as no additional disabilities, oral/aural communication mode at home and at school, educational placement, and auditory training. Ordinal analysis revealed degree of difficulties with device use, perception of implantation decision, and hours of cochlear implant use daily significantly related to auditory outcomes. However, continuous scale analysis results indicated that duration of implant use is the significant variable. The study emphasized long term use of implants, more advanced auditory training, and environmental interactions, and also parental perception of implantation clearly reflected parent’s attitudes towards the implant.

2.10 Studies on Communication, Psychosocial, Emotional development, pragmatic and social relationship in children using cochlear implants

Following are few studies that show communication development, psychosocial, emotional, pragmatic development and social relationships in children after their implantation.
In a study by Dammeyer (2010), psycho-social development in 334 Danish children with hearing impairment was evaluated. Five scales and questionnaires measuring sign language, spoken language, hearing abilities, and psychosocial difficulties were used. Results indicated that psychosocial difficulties in children with hearing impairment are 3.7 times greater compared to hearing children and communication is most important for psychosocial well-being of hearing impaired children; no matter the mode or degree of hearing loss, but the language ability (signed or oral). It was also found that there are no significant gender differences but psychosocial difficulties are higher in boys and children with additional disabilities; no difference between psychosocial well-being of children with cochlear implant and deaf and hard of hearing children. The study highlights communication and psychosocial difficulties are inversely related, if communication is good, the risk of psychosocial difficulties are less.

A study by Edwards et al (2006) investigated the non-verbal cognitive abilities and their emotional/behavioural development in 20 young children with implants. They were assessed using Leiter International Performance Scale – Revised (LIPS-R) and the Child Behaviour Checklist (CBCL) before implantation and after implantation. Results showed a significant increase before and after implantation in LIPS-R, and also cognitive functions post implant was positively related to behavioural outcomes. It is explained that children with cochlear implants increased to encode visual material they used verbal concepts, and also reduction in behaviour problems being internalized.

A study by Huttunen and Valimaa (2010) investigated the communication and socio-emotional development of 18 unilaterally implanted children at the mean age of 3 years and 4 months. Data was collected from their parents using semi-structured
questionnaire at 6 months and then at every year up to 5 years after activation. Findings revealed changes in mode of communication from signs to speech; children calmed down and increased self-confidence and safety; and social development. Great changes were noticed after one year of implantation but five years of implantation, two-thirds of participants reported to be as independent as their hearing peers. The study stressed the importance of communication that paved the way to psychosocial development and inclusive education in Finland for children with cochlear implantation.

Jeddi et al. (2014) investigated the aural rehabilitation benefits on the development of cognition, social communication, and motor skill development in 15 deaf children using cochlear implants (mean age 45 months 27 days) using Newsha Developmental Scale before they received their implants and after implantation at 2, 4, 6, and 8 months. For each skill, the developmental age, pre-test developmental scale, Intervention Efficiency Index, and Proportional Change Index were calculated. Findings revealed there were significant differences between the developmental rate assessments of before intervention and four follow-up assessments for cognition, social communication, and motor skill development (P<0.0001). It is also observed developmental skills level of deaf children became close to their hearing peers performance. For proportional change index assessments significant differences were also observed between the four follow-up after intervention for cognition, social communication, and motor skills (P< 0.005). The study underscores the benefit of cochlear implant and aural rehabilitation in cognition, social communication, and motor skills.

In a study by Most, August and Meilijson (2010) pragmatic abilities of 24 children (age 6.3 to 9.4 years) using hearing aids and cochlear implants and no other
additional disabilities was studied. They were attending regular schools and were receiving communication therapy twice a week. Pragmatic abilities were assessed using pragmatic protocol including verbal, nonverbal, and paralinguistic aspects. The results indicated children with hearing loss use pragmatic functions but more incidents of inappropriate use compared to hearing children. In verbal parameters, significant differences were found. Pragmatic abilities were same in both groups of children using cochlear implants and hearing aids. The researchers explain the reasons for poor performance of pragmatic abilities as *use of language structures is less flexible, theory of mind difficulties, auditory perception of spoken language difficulties, and exposure to diverse pragmatic situations and strategies being less.* The study stresses the need to provide appropriate training in pragmatic abilities to children with hearing loss as a part of their intervention programs to cope with communication breakdowns in everyday interactions.

A study by Nunes, Pretzlik, and Olsson (2001) investigated the social adaptation in nine deaf children in two mainstream schools using three methods: peer ratings, socio-metric status and interviews. The results revealed no difference between deaf children ratings and hearing children’s ratings in peer ratings hence deaf pupils are not disliked by peers. However, it is evident the deaf pupils were neglected by their peers and have less friends in the classroom. Most of the hearing peers mentioned that they have communication obstacles to deal with deaf peers. The study highlights for some positive measures to be taken to enable the hearing peers to overcome the communication barriers with the deaf children.

A study by Percy smith et al (2008) identified factors associated with the level of social well-being for cochlear implanted children, to estimate effect-related odd ratios for well-being of children, and also to find the association between speech and
language level and the level of social well-being. Data was collected from 167 parents related to their child’s well being. The results showed there exists a significant association between level of social well-being and speech understanding, speech production, and vocabulary. Mode of communication at home is the most highly associated factor related to level of social well being of children, and children who used spoken language were having high level of social well-being compared to children who used spoken language along with sign support or sign language. The study emphasized the use of spoken language with cochlear implanted children as it is helpful for them to acquire speech and language and also in acquiring high level of social well-being.

Wiefferink et al. (2013) studied emotion understanding in 57 deaf children with cochlear implant and compared to 52 hearing children aged 2.5-5 years. Two aspects of emotion understanding were examined: emotion recognition in facial expressions and emotion attribution in a situational context. Findings revealed children with cochlear implants were less in understanding emotions compared to hearing children. Performance and language skills were positively associated in normal hearing children whereas language was positively associated only with verbal tasks in children with cochlear implants. Hearing loss in children is affecting all aspects of emotion understanding including nonverbal emotion despite a cochlear implant has been reflected in this study.

2.11 Studies related to Educational supports to be provided to children with cochlear implant

Following are few studies that emphasize particularly about the educational supports to be provided for children with cochlear implants.
A research paper by Archbold and Mayer (2012) reviews the impact of cochlear implantation on deaf education in terms of educational placement, choices for communication, and educational attainments. It is mentioned although some variation are found in the outcomes, more children with implants are enrolled in regular schools, use spoken language to communicate as their primary mode, and early implantation led to improved educational attainments. Further, it is discussed providing appropriate educational environment for these learners remain a challenge: parents making choices in early school grades and students managing themselves in secondary and post-secondary school settings; managing implant technology effectively in classroom remains an issue; training teachers and other educational workers in managing the technology of implant device and understanding the issues of children with implant. The paper highlights although cochlear implantation has many benefits still it demands for knowledge, skills and management of the implant device as well as to meet the needs of children among teachers and other educational workers in school environment as they develop as a diverse population.

A study by Anderson et al. (2004) assessed open-set skills in 41 pre-lingual deafened children with a minimum of three years of cochlear implant experience using the standardized test instrument EARS battery which includes open-set phoneme, word and sentence tests. Results indicated that open-set skills emerge by six months of age after implantation and even after three years of cochlear implant experience there was significant improvement. A significant effect of age at implantation was also demonstrated. Results suggested that children with cochlear implantation develop open-set speech recognition soon after implantation. The study emphasizes the need for continued therapy to maximize listening and learning of open-set speech recognition.
A research paper by Bennett and Lynas (2001) reports the findings of a small-scale study which aimed to ascertain present level of incidence of two implanted pupils being educated in mainstream schools. They were diagnosed with hearing loss before one year of age and one child was implanted at the age of 4 years 11 months and another child was implanted at the age of 3 years and 1 month and they had been using their implants for a duration of 2 years and 3 months in case of first child and 3 years and 2 months in case of a second child. Findings revealed that the two implanted children were very well accepted by school authorities and their classmates. Both children were very confident in mainstream school set-up and they in most of the areas achieved at standard scores. The study emphasizes and supports of more young children with cochlear implants being mainstreamed but the importance of collaboration and effective transfer of information between professionals and parents should not be forgotten such as ongoing teacher training program for the teachers of the deaf to improve their knowledge and skills of the implant device, and to liaison between the implant centre and the school, and acoustic modifications to be made in mainstream classrooms which can enhance attention of children in the classroom. Furthermore, specialist support is required throughout the school years to improve the performance in young children with cochlear implants.

A study by Checker et al. (2009) investigated the parent’s satisfaction of the educational support received by their children with hearing impairment placed in regular school, and measures to improve the service delivery model. Data was collected from 34 parents of the deaf located in five regional and rural areas of Western Australia. Results revealed that they were happy with the facility of visiting teacher of the deaf in mainstream classrooms but mentioned that the service could be improved through longer and frequent visits especially considering the child’s needs,
progress and accessibility to services by the visiting teacher of the deaf. Furthermore, it was also mentioned by the parents that collaboration between visiting teachers of the deaf and the teachers in classes where their children were enrolled along with their involvement in their child’s education was considered critical. The study emphasizes the need for family-centred service with clear policy and role clarity in order to establish and maintain parent-professional relationship.

A study by Convertino et al. (2014), examined word and world knowledge among 93 deaf college students with cochlear implants and 92 deaf students without cochlear implants and compared to 89 hearing peers in two different experiments. Results revealed on all tasks measuring word and world knowledge all hearing children outperformed deaf students with and without cochlear implants and there was no significant difference found between deaf students with and without cochlear implants. Neither early implantation nor age of implantation did not reveal any enhanced performance on any of the tasks. The study did not find any noticeable benefit of cochlear implant in demonstrating acquiring incidental language but it suggested that if children with cochlear implants have to reach their potential then they need to be taught in a way that builds their strengths and accommodates their needs rather than assuming that they would be able to function the same as their hearing peers because of cochlear implant device.

A study by Giezen, Baker and Escudero (2014), reported two studies that researched relationships between spoken word and sign processing in children with CI who were exposed to signs along with spoken language. In study 1, 13 children with cochlear implants, rapid word and sign language learning were assessed and found the performance in both language modalities correlated positively. In study 2, the effects of using sign-supported speech on spoken word processing in eight children with a
cochlear implant was tested. It was found that perceiving signs and spoken words together does not affect their spoken word recognition or learning. The results of two studies showed that in some children with a cochlear implant sign exposure (either sign language or sign-supported speech) does not have negative impact on speech processing or spoken language abilities.

In a study by Ingber and Dromi (2010), parental involvement in early intervention programs in six educational centres in Israel was investigated. Data measuring the level of collaboration between professionals and parents in the course of early intervention was collected using a questionnaire FOCAS: Family orientation of community and Agency services. The findings indicated satisfactory involvement of parents but suggested for further improvement of the early intervention programs by including wide range of services to address diverse needs so as to motivate the parents to be involved more. Transdisciplinary teamwork, greater professional guidance in decision making, cooperation and team support for working together has been highlighted by the mothers in this study.

A study by Inscoe et al. (2009) investigated the expressive spoken grammar skills in 45 aged 4-6 years children with cochlear implants who were using their implants consistently for three years. They were implanted between 10 and 36 months of age (mean age = 27 months). Data was collected by administering the South Tyneside Assessment of Syntactic Structures. The results showed that 26 children with implants performed at or above the level in expressive spoken language grammatical level compared to hearing children. However, 19 children with implants had performed below compared to hearing children in expressive spoken grammar skills. Furthermore, the results revealed factors such as aetiology of deafness, age at implantation, educational placement, mode of communication, and presence of
additional disorders did not have a statistical significant effect on the development of expressive spoken grammar skills. This study provides the evidence that for all children with cochlear implants early implantation and longer duration of implant use may not result in age appropriate expressive spoken grammar skills. Therefore, the study emphasizes the need for long-term monitoring of these children’s spoken language development along with the support from a team consisting of teachers of the deaf, classroom teachers, speech language therapists, and the cochlear implant teams to ensure that their listening conditions are optimized.

A review article by Yoshinaga-Itano (2014) provides 12 best practice guidelines early intervention programs that include: the provision of timely referral to early intervention services; developing partnerships with parents and professionals; longitudinal developmental assessments for monitoring child’s progress; data management system of developmental outcomes; a process to monitor the intervention fidelity, and provision of appropriate services to children with additional disabilities, non-English speaking families and special populations. The article also highlights that best outcomes can be achieved only by improving quality in early screening and identification, early diagnosis i.e., confirmation of the deafness, fitting of the suitable amplification, and the provision of high quality, individualized, appropriate and targeted early intervention services.

Luckner and Pierce (2013), provided an overview of Response to Intervention (RTI) model, discussed its advantages and disadvantages and advocated the use of RTI model with students who are deaf and hard of hearing as they are increasingly being educated in regular classrooms so that their unique needs are taken care.

A research paper by Marschark and Knoors (2012) examined the cognitive functioning among children with hearing impairment, describing them to differ
significantly from hearing peers with research evidence. Findings from the research that they differ from hearing children in domains such as visual-spatial processing, memory, and executive functioning provide directions for both practice and research. The paper underscores the importance of understanding children with hearing impairment as differently able; and teachers and other professionals can accommodate teaching methods and materials that can foster their strengths and needs. The paper emphasizes the need for research evidence for effective instructional strategies to be implemented in classrooms while teaching and learning them practically i.e., research to practice and practice to research.

A study conducted by Punch and Hyde (2010) in Australia examined the views of 151 teachers working with implanted children on academic performance, communication and social development and 15 of these teachers were also interviewed. Children with cochlear implants age ranged from 1 to 18 years attending a range of educational settings in early intervention, primary and secondary schooling. Data was collected through questionnaire and interviews. The results reported children with cochlear implants were below class levels in literacy, numeracy achievement and social development. They continue to lag behind in educational and social outcomes compared to their hearing peers. Therefore, the study stresses the need to consider the limitations and benefits of cochlear implant and the importance of providing the support personally, educationally and socially to reach their full potential. It is also indicated in the study that children with cochlear implants will continue to be a heterogeneous group with many factors affecting their progress.

A research paper by Raeve (2010) emphasized the changing role of professionals in deaf education due to the changes in the deaf population. These changes are attributable to the technological advancement, and mainstream education.
It reports that mainstream education to deaf children does not eliminate the need for the support services which might vary depending upon the age of the child, language modality, and other child specific factors. The paper emphasizes for the assessment of the progress of the deaf children and for managing their needs, there is a requirement of a multi-disciplinary team including surgeons, audiologists, teachers of the deaf, speech and language therapists, social workers, psychologists, families and deaf children if possible to meet the growing challenges, and also ongoing professional training to update the skills of staff involved in dealing deaf children, and to deliver the need-based appropriate services to deaf children.

A research paper by Raeve et al (2012) discussed the need for changing role of professionals and the need for variety of services to be offered for children with hearing impairment depending upon the age of the child, school curriculum, language abilities and other specific factors. The paper also reported on how one of the deaf schools in Belgium, called KIDS (Royal Institute for the deaf) has adapted its educational setting to address the changing requirements of deaf population. Deaf school was transformed to a service centre to deal with the very heterogeneous group having several departments: early intervention, day-care centre, pre-primary, primary and vocational support service, mainstreamed support service, audiological centre, and residential department. The paper emphasizes the challenge in the field is the need to embrace the increase in diversity of deaf population due to the technological advances, more deaf children attended regular schools, it is critical for creating opportunities for professional development and specialized staff training.

A paper by Vermeulen (2012) examined the progress and needs of children using cochlear implants in mainstream education using the Screening Instrument for Targeting Educational Risk and the assessment of mainstream progress. Findings
revealed academic skills are developing swiftly rather communicative skills lag behind. One reason for communication delay may be the lack of ability to learn incidentally or from informal classroom interactions which may be taking place in noisy backgrounds. Their subtle needs in communicative abilities may be masked by their improved speech, and academic achievement compared to the past. Furthermore, the results revealed that there is a strong relationship between age at implantation and language delay i.e., younger the age at implantation, less is the language delay. There is a significant correlation between language delay and classroom appropriate behaviour i.e., less the language delay, then more the appropriate behaviour in the classroom. Another finding was that there is strong association between language delay and academic achievement i.e., if language delay is less, academic achievement is more and vice versa. Similarly children with less language delay were more communicative implying strong association between language delay and communication. This paper highlights the need for training the children with cochlear implants in mainstream classrooms in coping with consequences of auditory impairment such as to learn to express emotions; to use repair strategies for fluent communication, to become aware of others intentions and feeling, and to detect misunderstandings. In order to address the subtle needs of children with cochlear implants, teachers have to be provided with effective support such as ongoing teacher training program that focus on the issues, knowledge about classroom acoustics and educational audiology.

2.12 Synthesis of reviewed studies and conclusions

An extensive literature review as presented has given an insight into the research studies carried out in the field of children with hearing loss and particularly children with cochlear implants. To summarize, many studies have emphasized the
potential benefit of cochlear implants in various areas for children with hearing loss (Archbold, 2008; Archbold et al., 2002; Bosco et al., 2005; Fortum et al., 2007; Geers et al., 2011; Hess et al., 2014; Phillips et al., 2009; Spencer, Tomblin & Gantz, 2012). One study by Fitzpatrick et al., (2012) emphasized the benefit of hearing aids compared to cochlear implants. Numerous studies have highlighted the reasons of parents for getting their children implanted (Hardonk et al., 2011; Hyde, Punch & Komesaroff, 2010; Hyde, Punch & Komesaroff, 2010; Hyde, Punch & Grimbeek, 2011; Wass et al., 2008). In children with hearing loss, as mentioned in the previous chapter, major struggles were related to speech, language, reading development. To understand them with evidence, researcher had reviewed literature, several studies that focused on these aspects and which were carried out research in variety of ways were found (Cannon & Kirby, 2013; Fitzpatrick et al., 2011; Hogan et al., 2010; Jackson & Schatschneider, 2014; Jerger et al., 2013), and related to reading development (Banner & Wang, 2011; Cawthon, 2011; Dominguez & Alegria, 2010; Easterbrooks & Beal-Alvarez, 2012; Friedmann & Szterman, 2011; Harris & Terleki, 2011; Lederberg et al., 2014; Nikolaraizi, Vekiri & Easterbrooks, 2013; Palmer, 2000; Parault & Williams, 2010; Park, Lombardino & Ritter, 2013; Swanwick et al., 2012; Wang et al., 2013; Watson, 1999). In addition to this, the researcher tried to understand through reviewing the literature the impact of cochlear implants in enabling children with hearing loss to overcome their challenges with respect to speech, language development (Bell et al., 2001; Boons et al., 2012; Castellanos, 2014; Chilos et al., 2013; Clendon et al., 2003; Francis & Lam, 2003; Guo, Spencer & Tomblin, 2013; Kronenberger, 2014; Nittrouer et al., 2014; Remine et al., 2003; Spencer & Guo, 2013; Tobey et al., 2004; Yoon et al., 2004) and reading development (Asker-Arnason et al., 2007; Asker-Arnason et al., 2010; Bouton et al., 2007).
et al., 2011; Kant et al., 2010; Dillon, Jong & Pisoni, 2012; Geers & Hayes, 2011; Lyxell et al., 2008; Lyxell et al., 2009; Lyxell et al., 2011; Nittrouer et al., 2012; Wass et al., 2010). While reviewing, researcher found various studies emphasizing the factors influencing speech, language and reading development in children with cochlear implants such as early diagnosis of hearing loss, family involvement, early implantation, and mode of communication (Harrington et al., 2009; Yanbay et al., 2014; Ching et al., 2014; Davidson et al., 2011; Dunn et al., 2014; Geers et al., 2013; Mikic et al., 2014; Ruggirello & Mayer, 2010; Salas-Provance et al., 2014; Lesinski-Schiedat et al., 2004; Watson et al., 2006), duration with cochlear implant (Fagan & Pisoni, 2010; Percy-smith et al., 2010), and other combined factors (Steve powers, 2011; Tobey et al., 2011; Wang et al., 2011). Furthermore, researcher also found studies related to communication, psychosocial, emotional, pragmatic, social relationship in children with cochlear implants. (Dammeyer, 2010; Edwards et al., 2006; Huttunen & Valimaa, 2010; Jeddi et al., 2014; Most, August & Meilijson, 2010; Nunes, Pretzlik, & Olsson, 2001; Percy smith et al., 2008); Wiefferink et al., 2013). Numerous studies have emphasized on the need of educational support to be provided to them (Archbold & Mayer, 2012; Anderson et al., 2004; Bennett & Lynas, 2001; Checker et al., 2009; Convertino et al., 2014; Giezen, Baker & Escudero, 2014; Ingber & Dromi, 2010; Inscoe et al., 2009; Yoshinaga-Itano, 2014; Luckner and Pierce, 2013; Marschark & Knoors, 2012; Punch & Hyde, 2010; Raeve, 2010; Raeve et al., 2012; Vermeulen, 2012).

From the above review, it was realized by the researcher that there were very few studies conducted on Linguistic Skills and Reading Comprehension in children with cochlear implants in Indian context. In addition to this, researcher developed the curiosity to explore the educational support being provided to these children in
Indian context as they were studying along with normal hearing children in regular schools. Consequently, it was important to find answers for the following questions

1. Whether cochlear implant is truly helping children with hearing impairment in improving Linguistic Skills and Reading Comprehension?

2. Is strong foundation in Kannada language (first language) enabling children using cochlear implants to learn concepts at school in English language?

3. Is cochlear implant helping children to learn English language (second language) in English medium schools?

4. What impact does cochlear implant has on Linguistic Skills in children?

5. Are there any differences between Linguistic Skills in children using cochlear implants as compared to normal hearing children?

6. What impact does cochlear implant have on Reading Comprehension in children?

7. Are there any differences between Reading Comprehension in children using cochlear implants as compared to hearing children?

8. Is there any relationship between Linguistic Skills and Reading Comprehension? and many more

Finding answers to these questions was the primary aim to do the present study. Therefore, the present research study becomes a distinct venture in reducing the gap. Every distinct venture to reduce a research gap needs a well-knit method – The method of the study is discussed in the next chapter.