In India, as in several developing countries, the challenges in providing services specifically related to speech in individuals with CLP is impacted by various factors such as social, cultural, economic characteristics of the population seeking services, geographical distribution, and access to medical care (Raju, 2000). These challenges impact service delivery at hospitals predominantly due to failure of patients to follow-up (Raman et al., 2004). This is further compounded by non-availability of trained professionals across regions to deal with such cases. Thus speech disorders in individuals with cleft are ignored or not addressed. One strategy to overcome these issues is by developing and implementing alternate models of service delivery such as community based intervention, camp based intervention, tele intervention, etc. Across the globe different models of intervention (Sell et al., 2013) and outcomes of intervention delivered by professionals and non professionals (Bessell et al., 2013; Rai et al., 2013; Makarabhirom, Prathanee, Suphawatjariyakul, & Yodee (2015); Scherer et al., 2008; Andrea et al., 2007) have been reported. Involving community based rehabilitation workers in the implementation of health and education related projects have been widely reported across the world (Lagerkvist, 1992), (WHO-SEARO, 2013), (Bowers, Kuipers, & Dorsett, 2015), (Robertson, Emerson, Hatton, & Yasamy, 2012). In countries like Thailand (Makarabhirom, et al., 2015; Prathanee et al., 2010), Laos (Prathanee B, et al.,2011), Nepal (Rai et al., 2013) speech therapy for individuals with CLP have been delivered through assistants/health workers/nurses under the supervision of an SLP. In the Indian scenario, community based workers have been involved in implementation of services in the field of health (Raj & Thomas, 2015; Chatterjee, Pillai, Jain, Cohen, & Patel, 2009; Nagarajan, 1998; Vijayakumar, Datta, Karthika, Thulasiraj, & Nirmalan, 2003; Rao, Mukundan, & Kant, 1990; Ramkumar, Vanaja, Hall, Selvakumar, & Nagarajan, 2018). This is the first known attempt in India to implement a speech correction program for pressure consonants in individuals with CLP delivered by CBWs using a systematic training and evaluation.

This study aimed at developing, implementing and evaluating the outcomes of a speech correction program for stop consonants in children with CLP delivered by CBW and an SLP at the community. The results have been discussed with respect to the following:
1. Developing and conducting a training program for CBW to understand cleft speech characteristics and provide speech correction services, and evaluating its impact on the knowledge and skill of CBWs

2. Understanding caregiver’s perspectives regarding speech of their children with cleft lip and palate and assessment of speech needs at the community

3. Implementing and assessing outcomes of speech correction program delivered by CBWs and an SLP at the community

1. Developing and conducting a training program for CBW to understand cleft speech characteristics and provide speech correction services, and evaluating its impact on the knowledge and skill of CBWs

CBWs who had previous experience of working at the community in the sectors of health or education were trained and involved in delivering the speech correction program in this study. D’Antonio and Nagarajan (2003) recommended this model as an option for India based on the proceedings of a consensus workshop with experts in speech and hearing sciences. Wirt et al. (1990) have documented that individuals from health and education background could be trained to function as speech assistants to provide speech therapy for individuals with cleft in Srilanka.

In this study all the CBWs underwent a four-day training which was spread over three months. The training module included didactic lectures, demonstrations, listening training, and practise sessions for learning the techniques of speech correction. In addition, All CBWs were also given opportunities to observe the assessment, counselling, and therapy sessions provided by SLP during camps at the community. Knowledge and skills learnt by CBWs were evaluated to ensure that only adequately trained CBWs are involved in providing the speech correction program.

Knowledge of CBWs: All CBWs showed improvement in their knowledge about CLP, speech characteristics and intervention for individuals with CLP following the training program. CBWs were aware of the causes of CLP, formation of cleft, issues in feeding, and presence of abnormal speech during the pre training assessment itself. This could possibly be attributed to the fact that these CBWs were involved in projects relating to health and education in the community in the past. It is possible
that their previous experiences while working in the field in other programs facilitated them to gather basic information relating to CLP. However, their knowledge specifically related to the condition in cleft such as, specialist involved in treatment of speech, need for speech therapy for correction of errors, timeline of speech intervention was evident only in the post training assessment. Higher scores in the post training assessment, compared to the pre training suggest that the training module was effective in providing knowledge about the condition. The findings are in agreement with those reported by Shunmugam, Subramaniyan, Nagarajan, and Hariharan (2017) and Middleton, Grace, Lass, Norman, Starr, Philip; Pannbacker, 1986) that training modules are effective in providing knowledge to non professionals regarding CLP and its treatment.

**Identification of errors in articulation of stop consonants in individuals with CLP by CBWs:** In this study, CBWs were able to correctly identify an abnormal speech during the pre training assessment itself. However, they were unable to label the abnormal speech pattern during the pre training. The deviant speech characteristics observed in the speech samples of individuals with CLP could have prompted the CBWs to mark the production of pressure consonants as abnormal in nature in the pre training assessment. This finding is in agreement with the observations reported by (Nagarajan, D’Antonio, & Chandran, 2006; Shunmugam, Subramaniyan, Nagarajan, & Hariharan, 2017) that CBWs were able to identify the speech in individuals with CLP to be abnormal.

In this study, the CBWs’ ability to identify specific error patterns (abnormal backing of oral target to glottal, abnormal backing of oral targets to velar and fronting errors) showed a statistically significant difference between the pre and post training. The percentage of identification of correct responses across error patterns increased post training. This could be attributed to the conduct of listening training sessions during the training module. CBWs were also emphasised to listen to the training samples repeatedly at home even after completing the training module. The conduct of listening sessions and emphasis on repeated listening was implemented in this study based on the recommendations of Shunmugam et al. (2017). This was especially important for the CBWs to retain the skill of labelling error patterns even after the
training module was completed. This can be interpreted in this study based on the higher scores obtained by CBWs in the assessment that was conducted three months after the completion of training module. Further, this module focussed on training the CBWs to identify error patterns restricted to stop consonants, namely, backing to glottal, backing to velar and fronting errors. The higher performances could also be attributed to this focussed listening to limited speech sounds. Studies in literature have recommended use of training modules for identifying error patterns in cleft speech (Starr, Clark, Moller, Dawson, & Graham, 1984; Lewis, Watterson, & Houghton, 2003). The training module in this study included speech samples and animation tools to explain placement of articulators for production of pressure consonants and listening training sessions. These tools prove to be beneficial to CBW in learning to identify errors in articulation of stop consonants in individuals with CLP.

Skills to correct errors of stop consonants in individuals with CLP by CBWs: CBWs’ skill was evaluated based on their ability to use materials for speech correction, apply of learnt techniques, provide reinforcements and implement the principles of therapy in a simulated environment. In this study, CBWs were able to demonstrate the learnt techniques and apply them. However, CBWs required more hands on training to master the skills. This was provided through supervised observation training sessions provided by SLPs after the training module. Skills on using reinforcement strategies appropriately had to be specifically addressed during these sessions. All the CBWs exhibited inhibitions and unrest while carrying out the activities during the initial hands on sessions. Continuous monitoring of skills of CBWs during supervised observation following the training module could have reinforced their learning and helped CBWs gain confidence. It can be inferred that all these measures could have facilitated CBWs to learn and retain the learnt concepts/skills.

2. Understanding caregiver’s perspectives regarding speech of their children with cleft lip and palate and assessment of speech needs at the community
The ground work for implementing speech correction program involved understanding perspectives of the caregivers regarding speech services in individuals with cleft and evaluating the speech needs at the community in both the districts of

Effectiveness of community based worker implemented speech correction program for children with repaired cleft lip and palate in rural districts of Tamil Nadu
Discussion

Thiruvannamalai and Cuddalore. The aspects explored included 1) understanding perceived needs of caregivers, potential challenges and barriers relating to delivery of speech services at the community and 2) identification of beneficiaries requiring speech services through perceptual evaluation. This profiling would serve as a framework for developing a speech intervention program to be delivered by CBW under the supervision of SLP.

**Perceived needs of caregivers, potential challenges and barriers relating to delivery of speech services at the community:** Eight trained CBWs provided information regarding scheduled speech assessment camps to 400 beneficiaries enlisted in the project database. For the ease of beneficiaries, multiple camps were held within the districts at locations accessible by public transport and within three hours of travel distance. In spite of these efforts, a little more than 50% (217/400) of the participants reported to the camps. It is possible that only those parents or participants who had concerns about speech attended the camps. Among those, there was a group of 25 participants, predominantly above 15 years of age, who categorically stated that they did not wish to receive any further speech services. All of them were either employed or enrolled for higher education that did not permit them to avail any form of periodic services related to speech. This suggested that speech correction program need not be anticipated for every beneficiary enrolled in the community based program, and could be tuned for specific age group. This had important implications for allocation of financial/human resources in the execution of the program.

The focus group discussions to understand the caregivers’ perspectives had some significant pointers for future planning. The responses reflected the reach of the project and the expectations of caregivers. It is noteworthy that caregivers were able to describe the types of speech deficits; specifically, they were able to identify nasality, and difficulty in production of sounds. This level of sensitivity towards speech disorders could have been facilitated by the CBWs linked with the child. There was also a group of caregivers who reported that they didn’t perceive any issue with their children’s speech at home environment. It could be possible that contextual cues and familiarity could have made the communication at home environment easier for
them to understand their children’s speech. Further, the communication with their children might have been restricted primarily to daily chores. From the excerpts, it was very clear that the families who were regular to the camps conducted and involved in the community based program were clear about the immediate needs related to speech in their children. Monthly speech camps at the community and the linkage with CBW could have contributed to their involvement. Caregivers’ also attributed the basic knowledge and awareness about issues related to speech in children with CLP to their interaction with professionals in the multidisciplinary cleft team at the hospital. A study in Thailand reported that parents expressed concerns about speech problems in their children with CLP and wished to know if their children could speak or not, or if the child could speak clearly or not (Chuacharoen, Ritthagol, Hunsrisakhun, & Nilmanat, 2009).

Further in this study, all children of school going age were enrolled in schools. Though caregivers reported of teasing in school and low self-esteem in their children, no drop outs from school was reported during the discussion. The SSA (Sarva Shiksha Abhiyan) scheme “Education for All” implemented by Government of India in rural districts of India could have ensured enrolment of these children in school. Caregivers expressed that their children’s acceptance in the school and community was determined by their speech. The status of speech was also reported to influence their performances/requirements in school. The findings of this study are in consonance with results of the study carried out in rural India by Weatherley-White, Eiserman, Beddoe, and Vanderberg (2005), where parents expectations were all about speech, self-confidence, and better acceptance by peers. Mitkitti and Prathanee (2016) also reported that caregivers of children with CLP who did not enroll in the community speech therapy camps expressed concerns that unclear speech would impact acceptance in their community at Thailand.

When probed about reasons for not being able to visit the nearest speech therapy clinic, caregivers cited remote living environment, caregiver’s occupation and schooling issues as the reasons. These are not different to the challenges faced by families of children with CLP living in other parts of the developing world as reported by D’Antonio and Nagarajan (2003). Caregivers in this study were not agreeable to
completing home training exercises, citing the lack of time and cooperation of the children. However, they universally were willing to have speech correction services for their child if it was provided in close vicinity and did not require absence from school. The experiences in the project in the past have also revealed that parents are unwilling to allow their children to miss school to attend speech therapy. Due to the above perceptions and the geographical spread of children, it is difficult to identify a central point in the district to provide therapy. Scheduling therapy in a mutually convenient time for speech therapy further makes availing speech therapy a remote possibility. These challenges have also been highlighted by Raman et al. (2004); Prathanee et al. (2006).

The community based program for cleft in rural districts of Tamilnadu has been in existence since 2006. Analyzing the challenges reported over years, it is evident that the logistics related challenges have not changed over the past 12 years. Therefore, it is important to consider these logistic factors to ensure compliance and success for any model of speech correction program that may be developed.

**Identification of beneficiaries requiring speech services through perceptual evaluation:** Speech profile was obtained for 180 participants who attended the speech assessment camps (excluding a group of 12 participants below 06 years of age and 25 participants above 15 years of age). Speech intervention was indicated in 165/180 participants. The most common error pattern observed was backing to glottal (glottal stops) for stop consonants [k], [t], [ʈ] and was observed in 151 participants. The speech profile is similar to that reported by George (2007) and Sampath (2013) in Thiruvannamalai district in the earlier stages of the project. Prathanee, et al. (2014) profiled articulation disorders and patterns in children with CLP in Thailand and also reported that the compensatory articulation deficit, particularly abnormal backing of oral consonants was the most common speech defects in children with cleft. This information was used for planning/designing of training programs for CBWs to listen and identify abnormal patterns in stop consonants, implement strategies to correct, provide reinforcement and document speech.
Analysis revealed that a major group of participants in this study exhibited some form of speech disorder requiring speech intervention. This profiling provided a breakup and profile of the number of participants who were ready for direct speech intervention or required surgical intervention prior to speech correction. The participants ready for speech intervention (exhibited errors in articulation and had velopharyngeal closure) were mapped to their residences/schools in both districts for planning logistics. This mapping helped to identify the geographical clusters to link CBW with the participants. Within each cluster, participants were randomly allotted to the CBW and SLP for availing speech correction service at the community. This was important in order to ensure that the service provided were effective with reference to cost and time involved for travel.

3. Implementing and assessing outcomes of speech correction program delivered by CBWs and an SLP at the community

Trained CBWs were identified as service providers in the remote villages in the district. Speech correction program was designed specifically to correct placement errors of stop consonants [t], [ʈ], and [k]. Correction of this specific pattern was considered, as this error is one of the most common error pattern observed in individuals with CLP (Kummer, 2008; George & Nagarajan, 2007; Sampath & Nagarajan, 2013; Prathanee et al., 2014). The investigator also provided therapy at the community in order to evaluate the CBW model of speech correction and its feasibility.

Seventy-four participants completed speech correction program delivered by CBW (37) and SLP (37) at the community. Perceptual evaluation of recorded speech samples were used to evaluate outcomes of speech correction program. It has been established that perceptual evaluation of speech is the gold standard for assessment of speech outcomes in individuals with cleft (Henningsson et al., 2008; Sell, 2005).

None of the participants in this study depicted error pattern in the production of [p] sound. This could probably be due to the ease with which bilabial sounds are produced. The occurrence of error production in [ʈ] sound was also noticed only in a small group of participants. Majority of the participants demonstrated progress and
maintained learnt productions even after 03 months’ post intervention. Among the speech sounds, [k] sound demonstrated maximum movement from abnormal production to correct production. The pattern of progress observed among speech sounds in CBW delivered speech correction program was similar to what was observed in the SLP delivered speech correction program. In this study no attempt was made to directly compare the outcomes of the speech correction delivered by CBW and SLP, considering the variables and confounding factors among the personnel delivering the speech correction program.

The number of participants exhibiting error in single sound or more than one sound pre and post speech correction program were documented for both CBW and SLP delivered program. It was more challenging for a CBW to work with participant with multiple error than a participant with single sound error. In particular, the combination of [k] and [ʈ] errors were more difficult than [t] and [ʈ] or errors in isolated sounds. This could probably be because these CBWs were just beginning to practise speech correction. Further, when errors were restricted to anterior positions, they were easy to correct.

Another measure that was explored was sessions taken to achieve correct consonant production in both models of intervention. In both the models establishing the target at sound level took more no of sessions than generalization to word and sentence levels. This could possibly be due to the participant learning the correct motor movements for the target sound. Bankson and Bernthal (2004) reported that children appear to be sluggish in the initial stages of the developing a motor behaviour because they are still in the process of acquiring the motor patterns. There was not much difference in the time taken to establish the sound in isolation with different vowels. However, the CBWs required 2 to 3 additional sessions than the SLP to generalise the productions to word and sentence level. In spite of taking more number of sessions, CBWs were able to facilitate generalisation across levels. This can be interpreted based on the participants’ correct production scores in the assessment three months’ post intervention. Overall findings of the study revealed that participants in the CBW model showed similar patterns of progress compared to participants who received intervention through SLP.
The present study provides valuable framework for developing a speech intervention program to be delivered in the community. Assessment of needs at the community helped to design the service delivery suiting the specific needs of the community. Community based workers could be trained as facilitators for delivering such a program. In Nepal, speech correction model was implemented to correct errors in articulation delivered by nurses under the supervision of a SLP (Rai et al., 2013). Authors reported that the total articulatory errors reduced from 2294 in the pre-therapy speech assessment to 1792 after a week-long speech therapy by the trained nurses. However, this study was retrospective in nature, and no clear information regarding speech program and target sound selection criteria were specified. The authors concluded that this model was effective in reducing the articulatory errors and could be a possible model of intervention to overcome the challenges of non-availability of speech therapists. In Thailand, a networking model of speech correction was evaluated by Pumnum, Kum-ud, and Prathanee (2015). In their study, parents implemented activities recommended by the SLP which were overseen by speech assistants (Hospital nurse) in their region. Authors reported improvement in percentage of correct consonant production in 03/06 children and recommended this as a model in regions where services of SLP are limited. Engaging parents as a service provider in the rural districts of Tamilnadu is a challenge owing to the lack of education of parents, and their unwillingness to take time off their daily schedule for providing speech services. Further, during the focus group discussions, caregivers conveyed that their children would not cooperate with them for speech correction services. Therefore, the model of service delivery involving trained CBWs to provide speech correction services under the supervision of an SLP was explored in this region.

In summary, given the challenges in designing the structure of the speech program, measures were taken to develop an optimal therapeutic intervention program. This program clearly specifies the entire time period of the study, target goals for speech sound correction and methods followed in implementation. All these were decided based on the available resources, time and logistics. In this study traditional motor based approaches were used for correction of stop consonants. This was chosen as this
method could be the easier for CBWs to learn and implement. There is also evidence that traditional approaches based on motor learning principles has proven successful with several clinicians over a period of time (Bankson & Bernthal, 2009). The duration of this speech correction program was chosen in such a way that it could be executed continuously without interruption by exams, monsoons, local/regional festivals, etc.

In order to document the benefits of CBW delivered speech correction program, follow up rates, cost incurred and travel time of participants were estimated for both CBW and SLP delivered speech correction program at the community. It was observed that maximum attrition was present when the SLP intervention was planned at the tertiary care hospital. The reasons for drop out are similar to findings reported by Raju (2000). Their socio economic and financial status of the families did not permit them to avail these services at the tertiary care hospital, as the family had to spend for travel and also miss wages for the day. Even when the speech correction program was provided in the district by the SLP, 15 participants dropped out from the study citing reasons related to travel, time and cost. The SLP provided sessions at the district at a venue that was easily accessible for all. It was observed that some participants still faced challenges to avail services. Any community based program would have to take into account barriers and challenges that beneficiaries may have even if the services are provided close to their community. Parents attributed their inability to attend camps to one or more of the following reasons: a) couldn’t take leave from work due to loss of income; b) no permission from school; c) family/social obligations/function; d) father was not available to accompany the participant to the camp, etc. The challenges in providing timely speech intervention in this study are similar to the problems reported in South Asian countries too (Prathanee, Lorwatanapongsa, Makarabhirom, Suphawatjariyakul, Thinnaithorn, & Thanwiratananich, 2010; Prathanee et al., 2006).

**Caregivers’ views of speech correction program delivered in the community through CBW:** The focus group discussion provided much needed information about the caregivers’ perception of this program delivered in the community. Most caregivers opted to continue the program delivered by the CBW. Reasons for
Effectiveness of community based worker implemented speech correction program for children with repaired cleft lip and palate in rural districts of Tamil Nadu

Discussion

caregivers’ acceptance of this program could be attributed to the design and delivery of the program. The entire program was structured after considering the caregivers’ inputs, primarily addressing the challenges reported. The services were provided without any burden on the family in terms of organizing logistics, had minimal or no impact on their daily work/earnings and most importantly it was provided at no cost.

Caregivers were able to identify changes in speech behaviour restricting to correct articulation of stop consonants. This conveyed that the CBWs had briefed the caregivers about the activities carried out at the end of the session and periodically informed them about their child’s speech. This could also be the reason for them to identify further need of speech therapy in their children.

The cooperation/support from the school and teachers was helpful in conduct of speech correction sessions during school hours. This is very similar to a pull out therapy model approached practiced in the West Masterson (1993). The communication by the CBW with school management which was further reinforced by the parents/family members of the child with CLP made this possible in this study. This method of providing speech services at the school had its own challenges in terms of obtaining permission for CBW, who are not part of the school management, to enter the premises and provide services on a regular basis. During the group discussions, few of the caregivers suggested implementing such programs by collaborating with government agencies/school authorities so that these challenges could be addressed. One possible option to address this could be considering collaboration or public private partnership models. This level of program can be carried out only when there is cooperation from the family and the community. This level of program also requires a lot of time to implement as the family has to develop trust and a working relation with CBW.

In this study, the investigator carried out periodic field visits to home and schools of these children who received speech correction services. This could have facilitated smooth conduct of the program and reassured parents when any concern arose. Caregivers reported that even this structure of program had a minimal impact on the daily routines of families. Few caregivers suggested scheduling such programs only during vacations and holidays to reduce this impact.