INTERVENTION TECHNIQUES FOR SPEECH SOUND DISORDER: A

SYSTEMATIC REVIEW

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20SLP033

This Dissertation is submitted as

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Pathology

University of Mysuru, Mysuru

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August, 2022

Dedicated to
my parents

CERTIFICATE

This is to certify that this dissertation entitled **"Intervention techniques for Speech Sound Disorder: A systematic Review"** is a bonafide work submitted in part fulfilment for the degree of Master of Science (Speech-Language Pathology) of the student with Registration Number 20SLP033. This has been carried out under the guidance of the faculty of this institute and has not been submitted earlier to any other university for the award of any other Diploma or Degree.

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DECLARATION

The is to certify that this dissertation entitled **'Intervention techniques for Speech Sound Disorder: A systematic Review'** is the result of my own study under the guidance of Dr. N. Sreedevi, Professor & Head, Department of Prevention of Communication Disorders, All India Institute of Speech and Hearing Mysore and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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Chapter- 1

Introduction

Speech sound disorders are the most prevalent communication difficulty in preschool and young children (Broomfield & Dodd, 2004). According to the American Speech-Language-Hearing Association's (2006) School Survey, the most common intervention area was for children with speech disorders. As a result, numerous therapies focus on SSDs; for instance, Williams, McLeod, and McCauley (2010) documented 23 distinct interventions.

Many options are available for Speech-Language Pathologists (SLPs) when deciding how to treat children with speech sound disorders. These intervention options include the unit to target (e.g., sound, error patterns, whole word, and whole language); target selection (e.g., the specific sounds or pattern to target first); the number of contrasts to target; the approach to the delivery of intervention; and service delivery options. Several widely used phonetic treatment approaches focus on producing individual speech sounds: articulator placement/movement, traditional, tactile-kinaesthetic, phonetic context, stimulability, behaviour modification, and others. The strategies presented here include phonetic placement, palatometer instrumental system, stimulus (traditional), wedge, multiple phonemic, moto-kinesthetics, PROMPT, sensory-motor, paired stimuli, integral stimulation, stimulability enhancement, programmed instruction, heterogeneous group, and nonsense material. Specific approaches have unique features, but there are also commonalities among them. Some procedures and techniques are based on older traditional practices. Each method has effectively treated at least some clients with articulatory/phonologic disorders. Speech-language pathologists (SLPs) have historically approached correcting speech sound errors by teaching motor behaviour. The majority of doctors believe that speech sound

faults reveal a person's failure to develop the intricate motor skills necessary for producing speech sounds. According to a survey done by Brumbaugh & Smit (2013) many continue to use motor-based approaches and thus appear to be making this same assumption about the underlying problem.

Phonetic sound elicitation techniques are often needed during the initial stages when using a phonological treatment approach for clients to learn to produce sounds missing from the speech sound inventories of persons with phonologic disorders, sounds that contain targeted distinctive features and speech sound patterns. These approaches are generally appropriate for clients with multiple speech sound errors that appear to be systematic and do not have significant limitations to their motor speech mechanism. Commonly, phonological approaches focus on distinctive features and patterns rather than individual phonemes of the speech sound system, as is the case for phonetic processes. The specific intervention strategies and methodologies vary among the specific phonological intervention approaches, although there is considerable overlap in the procedures used. Some begin treatment with isolated speech sounds, although most begin production in words. Some include practice in nonsense syllables and words, but most have production practice only in actual words. Some incorporate contrastive production of speech sounds and words, while others focus only on production practice of the targeted sound or syllable/word structure pattern. Finally, some incorporate speech perception training, some use phonological awareness training, and others use only production practice.

Several linguistically based treatment approaches have been developed since the 1970s. The bases for the treatment strategies come from phonological acquisition data and psycholinguistic theories. Many of these approaches focus on instructing clients with disordered phonological rules of their language. However, a phonetic

component to the articulatory/phonologic disorder often needs to be addressed with techniques from more traditional phonetic approaches. Most treatment approaches use different sounds in various production levels to teach how one speech sound or speech sound/word pattern differs from another. These approaches include distinctive features, minimal meaningful contrasting pairs, maximal opposition, and Metaphon approaches. With one exception, these approaches have clients producing opposite pairs of words that differ only in the targeted phonological feature.

The first type of phonological treatment approach that was developed focused on distinctive features of phoneme classes. Later, specific phonological deviations (processes) treatment approaches were developed by Howell and Dean (1994), Hodson and Paden (1991) and others. Phonological deviation intervention strategies aim to reduce the frequency of occurrence of certain phonological deviations while increasing correct phonological patterns. Two types of phonological deviation treatment programs have been devised:

1. Meaningful contrasting pairs (Fokes, 1982; Weiner, 1979, 1981);

2. The cycle format targets deficient phonological patterns (or reduction of phonological deviations) (Hodson, 2004; Hodson & Paden, 1991).

A variant of the contrasts approach was developed by Elbert and Gierut (1986) in which maximally contrasting speech sounds are targeted, with the later developing phonemes being targeted early in the treatment process. The Metaphone approach was developed in England by Howell and Dean (1994), which begins with phonological awareness activities and proceeds to the production of phonological contrasts of target phonological processes. A nonlinear approach was developed by Bernhardt and Sternberger (2000), in which the client works on speech sound production in various prosodic (suprasegmental elements, such as syllable stress), syllable/word structure,

and segmental (such as distinctive features and word position) contexts using a cycling format.

Clinicians and researchers working in the field of speech-language pathology agree that it is imperative to treat kids who have moderate to severe speech sound issues effectively. Treatment for these children is often difficult and gradual because multiple sounds and sound structures need to be adjusted (Rvachew & Nowak, 2001). The literature has proposed employing communicative activities to promote generalisation during speech sound intervention, even if imitation and structured practice are the key tactics used by speech-language pathologists (Hoffman & Harn, 2004). Speech-language intervention's greatest benefit lies in its capacity to raise the client's standard of living. An adverse effect of a communication issue on a child's social and academic growth during the school years is one of the risks to a child's quality of life. Reducing the probability that children with speech and language deficits would experience academic and social issues is thus a crucial goal of speech-language intervention. The most important thing is to make sure that the intervention reaches the people who need it the most, assuming that it is successful. Some children who want assistance might not be getting it if the system for referral and service delivery is not functioning properly. Thus, a crucial component of research on the provision of clinical services is the intake of clinical services.

SLPs work to develop the best effective treatment plans to address children's spoken language issues and avoid subsequent literacy issues. However, it can be challenging to correctly identify and implement the programmes based on the academic literature. It can be challenging to demonstrate the intervention's goals and the kids most benefit from it. Determining how the intervention varies from other programmes in subtle or not-so-subtle ways can be difficult. SLPs find it challenging to choose an

"evidence-based strategy" to guide their intervention choices because of the abundance of contradictory results presented in the literature. Comparing the effectiveness and efficiency of various intervention strategies hasn't been the subject of many studies. Instead of finding the best approach, a more recent study has looked at the impact of modifying one variable within a specific parameter. The chosen target, the preferred strategy, and course implementation are three main areas where intervention programmes diverge from one another.

Regarding the quantity, kind, and severity of errors, as well as their level of understandability and therapeutic responsiveness, SSD-affected kids don't typically present as a homogeneous bunch. It is more challenging to choose a therapy approach when employing study data since they may display phonological, articulation, or both. In research, there is a strong request for a more thorough assessment and study of SSD due to the realisation that different intervention strategies may be required for kids with diverse presentations of SSD. SLPs frequently combine just a couple of approaches into an eclectic package in the absence of this, hoping that one of the elements will concentrate on the child's specific requirements (McLeod & Baker, 2004). The methods listed by SLPS as being most frequently utilised typically lack specifics and are unclear in terms of how they are communicated or interpreted. There are a number of regularly utilised interventions that are mentioned, including "auditory discrimination," "meaningful minimal contrast," "phonological awareness," "conventional articulation therapy," "minimal pairs," "auditory discrimination," and "sequencing sounds" (Roulstone et al. 2015). As a result, it is unclear how closely the methods employed by doctors correspond to those detailed in the intervention literature.

Harding et al. 2018 have compiled articles on the intervention of SSD up to 2012, and the age range included was 3-5.11 years. Seven out of the eleven intervention

subcategories had the most evidence supporting them for pre-schoolers with SSD.

The evidence for SSD intervention needs to be carefully evaluated, and that evidence needs to be mapped into the clinical techniques. With a busy and diverse caseload, speech and language therapists would be better equipped to recognise the quality of the evidence for interventions that align with the strategy they decide is required for a certain kid. Speech-language therapy tries to help clients' communication change. In an age of accountability, it has become increasingly important to know that any observed differences are due to the intervention we have provided. SLPs are frequently asked to demonstrate or document that the intervention provided caused the changes in the client's speech behaviour. This means that it is becoming increasingly necessary to enter our clients' performance as objectively as possible. Doing so is part of what has come to be known as evidence-based practise (EBP). ASHA (2005) has adopted EBP principles, including suggestions for how clinicians can objectively document treatment outcomes. Interventions must be approached systematically to be effective, efficient, and accountable. This involves employing what we know from the existing literature and EBP principles for making informed decisions regarding every step in the process.

Need for the study

The advancement of intervention techniques for speech sound disorder would have made a difference in treatment approaches over the years. SLPs working in clinical settings have a limited amount of time and resources to review all pertinent research and choose the best course of action for the patients they are treating. Therefore, SLPs appear to be drawn to employing different perspectives to intervention for kids having SSDs (Pring & Martin, 2010). The findings based on diverse intervention techniques are not, however, properly documented. However, there is a lack of proper documentation on these findings based on various intervention procedures.

Harding *et al*. 2018 have compiled articles on the intervention of SSD up to 2012, and the age range included was 3-5.11 years. All the studies examined were high-quality according to quality appraisal checklists, however much of the evidence they contained was of a lesser calibre. In order to accurately appreciate the strength of the evidence for various interventions, higher rated studies are required. Therefore, a study with a wider age range and a wider selection of articles is required. In order to improve the evidence for intervention of speech sound abnormalities, the results of the current study must be compiled. Hence such systematic review of SSD intervention methods is much warranted.

Aim of the study

To systematically review the existing studies on various intervention techniques applied for Speech Sound Disorder.

Objectives of the Study

1. To compile different therapy procedures used in the intervention of speech sound disorders.

2. To compile and classify the findings of the intervention techniques of speech sound disorders.

Chapter 2

METHODS

Aim of the present study is to systematically review the existing studies on various intervention techniques applied for intervention of Speech Sound Disorder.

2.1 Review Questions

The study was performed with the following questions.

1. What are the various intervention techniques used for speech sound disorders?

2. Which is the most frequent intervention technique used for speech sound disorders?

3. What is the evidence reported for various SSD intervention techniques?

4. What are the differences in the duration of various intervention techniques of speech sound disorders?

2.2 Searches

The review was carried out using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The search strategy employed three key elements:

1. The creation of a thorough and pertinent list of search phrases to guarantee the retrieval of all possibly reliable studies pertaining to therapies for speech and language disorders without concurrent issues.

2. Researching a sufficiently wide range of databases to find as many research articles that might be reliable as possible, including published and conference proceedings.

3. The definition of precise inclusion criteria that can be used to screen research for validity and give the dataset for analysis.

Possible key-words, related search words, their derivatives, and Medical Sub Heading (MeSH) terms relevant to the research question were developed and included:

"Speech-Sound Disorder" OR "Phonological Disorders" OR "Phonological Treatment" OR "Speech Sound Errors" OR "Phonological Awareness" OR "Intervention Intensity" "Phonological Intervention" OR "Atypical Errors" were the search words used.   These search words were used in various databases for literature search. These databases included both national databases (IndMed, J-1SHA, and Institutional databases like AIISH Repository) and international databases (PubMed/Medline, Google Scholar, J-Gate, Science Direct, and Com-Disdome (ProQuest) and PsyNet. Attempts were made to include Scopus, Web of Science and Cochrane for literature search. But due to technical limitations (lack of subscriptions by the institute) these databases could not be accessed.

The titles and/or abstracts obtained through the search strategies were screened to identify the studies that meet the inclusion criteria. Those titles/or abstract with any relevant keywords or MeSH terms were passed on for further analysis and were discarded if they did not fulfil the inclusion criteria. The full text of the potential studies was then retrieved and matched for eligibility.

2.3 Selection Criteria

The clinical questions was formulated while using the PICO (Population, Intervention, Comparison, Outcomes) approach and the criteria for inclusion and exclusion of studies were established priorly (see Table 2.1)

Table 2.1

Inclusion and Exclusion criteria

	INCLUSION CRITERIA
POPULATION	Participants included children (up to 15 years of age) diagnosed as SSD including either articulation or phonological disorders
INTERVENTION	Any sort of intervention aimed at enhancing the child's phonological and articulatory abilities. The intervention can be given to an individual or a group, with varying frequencies and durations, in a variety of situations (home, clinics, community and school).
OUTCOME	The outcome of the study will give an understanding of various intervention techniques used for speech sound disorders and also helps SLPS to adopt more evidence-based techniques for quick remediation of SSD.
STUDY DESIGN	Articles considered are: - a. Published in peer-reviewed journals from 2000 to 2020 b. Reports available in English (SSD intervention provided in any language)
EXCLUSION CRITERIA	a. SSD with any other comorbid conditions (structural/ or sensory/ or neurological).

	b. Children with speech or language delays who also have learning disabilities, autism, cleft lip and palate, or cerebral palsy, among other persistent or developmental problems.

2.4 Data Extraction (Selection and Coding) and Quality Assessment

Studies that match the inclusion requirements were found by screening the titles and/or abstracts found through the search strategies. Those titles/or abstract with any relevant keywords or MeSH terms were passed on for further analysis and were discarded if they did not fulfil the inclusion criteria. The full text of the potential studies was then retrieved and matched for eligibility.

The data from the chosen studies were extracted using a pre-piloted, standardised form (see Appendix). The form was validated by two specialists (Speech Language Pathologists) in the area of communication problems. According to their recommendations, the necessary adjustments were performed. The information that was retrieved covered the following topics: study population, methodology, participant demographics and/or disorder characteristics, data on derived measures, including assessment methods, and the results of the derived measures. Additionally, Data were retrieved from eligible studies that matched the inclusion criteria, including the year of publication, kind of publishing, study design, research type, research emphasis, source of the study, and author characteristics with their affiliation. Studies that described articulation or phonological problems with concomitant conditions as a type of speech sound disorder were comprehensively reviewed. Quality Assessment of eligible studies was carried out by using: -

1. The methodological quality of randomised and non-randomized controlled studies was evaluated using the Physiotherapy Evidence Database quality assessment instrument (PEDro-P; Perdices & Tate 2009), which has a score range of 0–9.

2. To reduce the potential of bias, single case studies were conducted using the single-case experimental design (SCED), which has a score range of 0–10.

At least two researchers read each work, and if there was dispute, it was intended to discuss it and come to an agreement. Since there was complete consensus over the quality assessment, this method was not necessary. Higher scores for both tools were related to higher standards of technique used and reported in the study. According to earlier evaluations (Camarinos & Marinko 2009; Maher et al. 2003), studies with a score of 6 or higher were considered to be of acceptable quality and will be taken into review. The classification of intervention methods from most popular to least popular was then applied to these investigations.

Chapter 3

RESULTS AND DISCUSSION

3.1 Records/Article Selection

Database searches yielded a total of 221 articles, including 14 duplicates. The title and abstract screening involved a total of 207 publications. Thirty-nine papers were chosen for full-text screening. The study used ten articles that satisfied the inclusion requirements. The inter-judge selection was used to confirm the selection procedure, and debate came next. The pertinent papers were chosen following PRISMA principles (Selcuk, 2019). Figure 1 shows the precise PRISMA flow diagram for selecting studies.

Out of the total records/articles identified through database search (N-221), 160 articles were obtained from ProQuest, 40 from PubMed, and 21 from Google scholar. Fourteen duplicates obtained from various databases were removed using Endnote citation Manager. Title and abstract screening were carried out for 207 articles after removing duplicate articles, out of these 168 articles were excluded as they did not either include the keywords or meet the inclusion criteria of the study. Thirty nine papers were ultimately chosen for full-text evaluation. 29 of these 39 articles were excluded for the justifications listed in table 3.1.

Table 3.1

Reasons for exclusion of articles

Reasons for exclusion	No. of articles excluded
Irrelevant study design	19
Irrelevant study population	7
Case reports	3

Finally, 10 articles after assessing full texts were selected for the systematic review. Summary of the selected articles are presented in Table 3.4
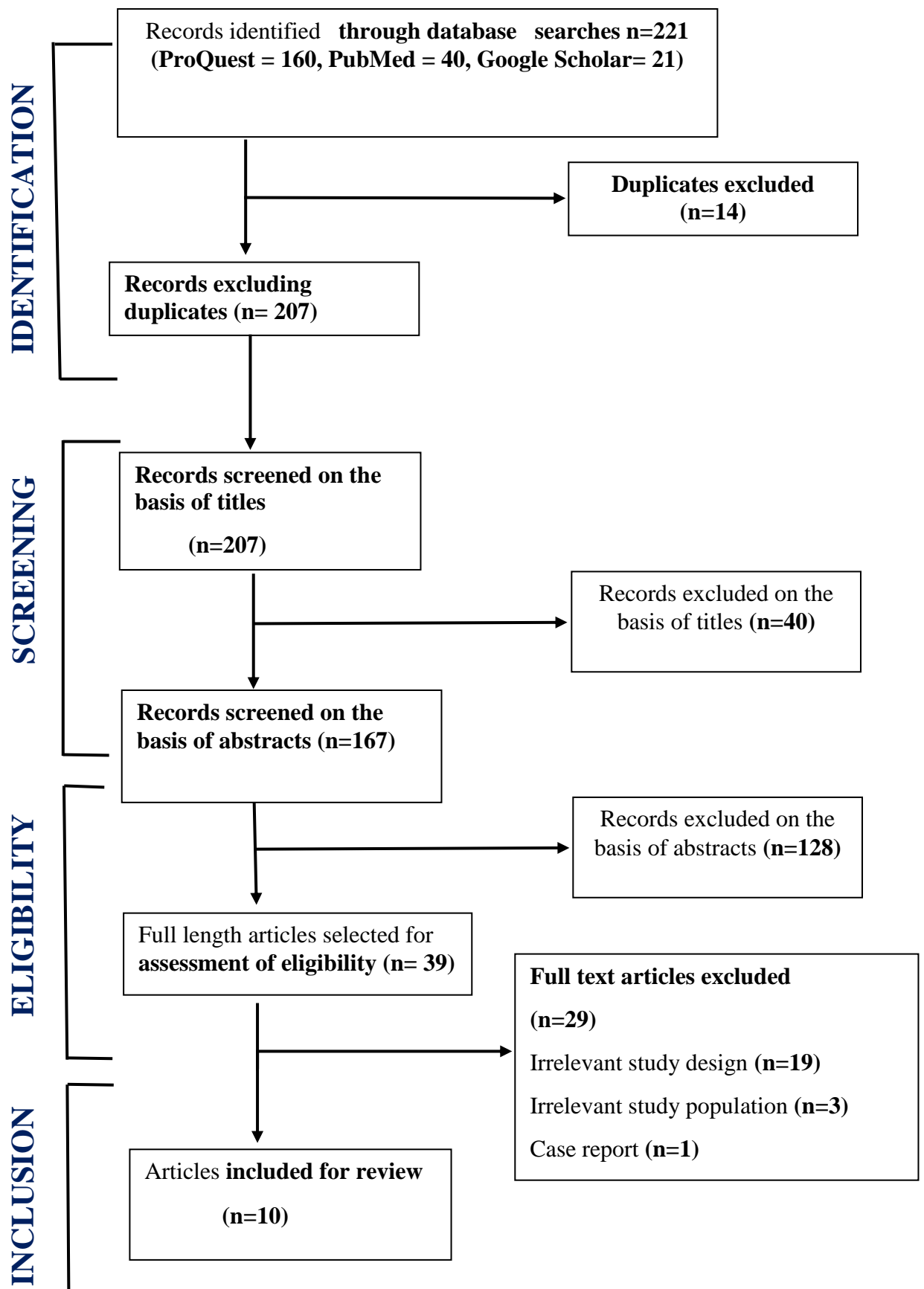
Figure 3.1 Prisma Flowchart for selection of the articles

3.2 Quality Assessment of records

The Physiotherapy Evidence Database quality assessment tool (PEDro-P), created by Perdices and Tate in 2009, was used to analyse the quality of eligible research in order to determine the dependability of the chosen studies. 11 questions are included to help you analyse the content of the paper and evaluate the methodological merits of randomised and non-randomized controlled trials. With the help of the tool, users of the PEDro database will be able to swiftly identify which known or suspected randomised clinical trials have a sufficient amount of statistical evidence to render their conclusions understandable (Perdices & Tate, 2009). Scores range from 0 to 9. The questions in table 3.2 below correspond to the presentation of the items in a controlled trial that was both randomised and non-randomized.

To assess the validity of the chosen single-subject research, Tate et al. created a single-case experimental design (SCED) in 2008. Eleven questions analyse the article to reduce the possibility of bias in single case studies. The tool covers the characteristics of single-subject designs that are generally acknowledged as essential for results to be valid and to distinguish between reports of various quality. It ranges from 0 to 10. The questions in table 3.3 below were presented in the same order as the items in a single subject study.

Higher scores for both tools were related to higher standards of the technique used and reported in the study. According to earlier evaluations (Camarinos & Marinko 2009, Maher et al. 2003, Wren et al. 2018), papers of acceptable quality were identified as those with a score of 6 or higher and are included in the review.

Table 3.2

Quality Assessment for methodological quality of records considered in the present study

S.N	Items	Glogowska et al., 2000	Allen et. al., 2013	Crosbie et. al., 2005	Denne et. al., 2005	Soares et. al., 2007	Rvachew et. al., 2001	Rvachew et. al., 2004
1	Eligibility criteria were specified	9	9	9	9	9	9	9
2	Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received)	7	4	8	5	8	7	6
3	Allocation was concealed	8	8	3	6	7	6	5

4	The groups were similar at baseline regarding the most important prognostic indicators	8	7	9	6	7	8	4
5	There was blinding of all subjects	8	9	0	6	6	6	6
6	There was blinding of all therapists who administered the therapy	9	9	0	4	0	3	4
7	There was blinding of all assessors who measured at least one key outcome	8	9	0	6	0	3	5
8	Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	7	9	9	6	6	4	4
9	All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the	8	9	9	4	7	4	6

	case, data for at least one key outcome was analysed by "intention to treat"							
10	The results of between-group statistical comparisons are reported for at least one key outcome	8	9	9	4	8	6	6
11	The study provides both point measures and measures of variability for at least one key outcome	8	9	9	8	8	6	6

0   9

Low Quality   High Quality
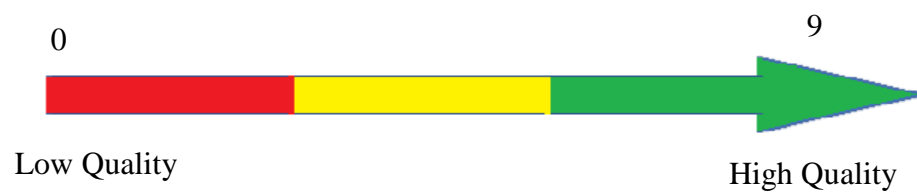
Table 3.3.

Quality Assessment for single-subject designs

S.N	Item	Forrest et. al., 2001	Dodd et. al., 2008	Hart et. al., 2010
1	Clinical history	7	8	8
2	Target behaviours	6	7	8
3	Design	8	7	8
4	Baseline	8	6	8
5	Sampling behaviour during treatment	5	5	7
6	Raw data record	5	5	9
7	Inter-Rater reliability	5	5	8

8	Independence of assessors	5	5	8
9	Statistical analysis	6	5	8
10	Replication	5	6	8
11	Generalisation	4	5	8

0   10

Low Quality

High Quality

Table 3.4

Summary of the selected studies

S.No.	Author/ Year	Country of origin	Number of participants	Age range (months)	Study design (type of evidence)	No. of therapy sessions/ agent of delivery	Length of each session (minutes)	Frequency of sessions	Duration of intervention	Type of speech sampled	Analysis used to measure change	PEDro-P/ SCED Score
1.	Glogowska et al., 2000	UK	159	Group 1: 18-42 Group 2: 24-42	Comparative Studies-randomised therapy approach	8/ SLP	47 minutes	Once a month	Avg. of 8.4 months	Unclear	Error rate	Pedro-P 8
2.	Allen et. al., 2013	USA	54	36- 60	Randomised	24/ SLP	45 minutes	3 times per week	8 weeks	Conversation	PCC	Pedro-P 7

3.	Crosbie et. al., 2005	UK	18	56-77	Comparati ve Studies	16/ SLP	30 minutes	Weekly	8 weeks	Probe list	PCC	Pedro -P 6
4.	Denne et. al., 2005	UK	20	60-72	Comparati ve Studies	8/ SLP	90 minutes	Weekly	8 weeks	Probe list	Accuracy of production sound identificati on	Pedro -P 6
5.	Soares et. al., 2007	USA	66	40-98	Comparati ve Studies	15-25/SLP	NA	NA	NA	NAS, PCC	PCC	Pedro -P 6

6.	Rvachew & Nowak (2001)	Canada	48	Group 1: average 51.46 Group 2: average 49.63	Randomised	12/SLP	NA	Weekly	12 weeks in two blocks of six	PPKP conversation	PPKP PCC	Pedro -P 6
7.	Rvachew et. al., 2004	Canada	34	Group 1: average 52.88 Group 2: average 50.29	Randomised	16/SLP	15	Weekly	4.73 months	conversation	PCC	Pedro -P 6
8.	Forrest et. al., 2001	USA	4	59-63	Single subject studies-multiple	NA/ SLP	Weekly twice	NA	NA	Probe list	PCC for target phoneme	SCED 6

					baseline design							
9.	Dodd et. al., 2008	Australia	3	36-50	Single subject pre-post-intervention design	Between 12 and 38/ SLP	30-40 minutes	Twice weekly	Between 6 and 19 weeks	Single word naming test, Connected speech task, Repeated production of word	PVC, PCC, PPC	SCED 6
10.	Hart et. al., 2010	USA	3	43-59	Single subject studies-multiple baseline design	12/SLP	30 minutes	Twice a week	6 weeks	Spontaneous speech sample	Process analysis percentage sample correct	SCED 8

Note: NAS - Non-Acquired Segment, PCC- Percent Consonants Correct, PPC- Percent Phonemes Correct, PVC- Percentage Vowels Correct

(Shriberg and Kwiatkowski 1982), PPKP – productive Phonological Knowledge profile (Gierut et al. 1987), NA. – Not available.

3.3 Review Question-1: What are the various intervention techniques used for speech sound disorders?

3.3.1 Number and availability of reports in different database

The results of a web search on the most popular database identified only ten articles reported from the world that specifically studied the intervention of Speech Sound Disorder including either articulation or phonological disorders from 2000 to 2022, are depicted in table 3.5.

Table 3.5

Number of reports obtained from different database

Databases	Number of Records Identified, n=10 (%)
PubMed/ MedLine	3 (27.27%)
Google Scholar	3 (27.27%)
ProQuest	3 (27.27%)
J-Gate	1 (9.09%)
Google Search	1 (9.09%)
Total	**10 (100%)**

Since in-house publications are unknown and unavailable to researchers, concealed data (data not available online) significantly hinder studying speech sound disorders. Researchers aware of potential institutes and organisations engaged in speech sound disorder research may search for information. Still, they risk missing out on pertinent research papers if they are not published in widely available sources, including current investigators. There are also a lot of databases with scientific publications in them. However, many of them demand a paid subscription. As a

result, the researcher or investigator in that discipline is forced to curb their desire to conduct further research.

3.3.2 Geographical Location (Country of Study)

Table 3.6 summarizes the country of origin or where the study was done. On database search, ten works of literature fulfilled the inclusion criteria. Out of 10 articles retrieved, studies from USA were the most documented. Four pieces of literature were from USA. Similarly, three studies from UK and Canada with two studies were also available. Only one study from Australia fulfilled the inclusion criteria of the present study.

Table 3.6

Country of the Study

Country of study	Number of Records Identified, n=10 (%)
UK	3 (27.27%)
USA	4 (36.36%)
Canada	2 (18.18%)
Australia	1 (9.09%)
Total	**10 (100%)**

The literature search was carried out throughout languages that are spoken in the world. There are 193 countries on the seven Continents. Despite Asia and Africa being the largest and second largest continents globally and comprising 102 countries, the table above reveals no literature from these countries. North America is the third largest continent globally and consists of 23 countries; the table above reveals there are six pieces of literature from these countries. Europe and Australia, which consists of 71 countries, the table above reveals there are five pieces of literature from these countries.

This indicates that fewer specialists are working in speech and hearing, which signifies that it is still not well established globally.

Moreover, most countries in the world have to explore the vast scope and practice of the field. This suggests that there have to be decisive steps to create chances for professionals to explore and increase the investigations in this area of Speech Pathology. There exist limited institutes that produce professionals in the field of speech and hearing. Those qualified as professionals from speech and hearing too majorly focus on language disorders, and very few are into speech pathology. Another primary reason for limited studies in this most countries, even with the professional courses running, is a lack of adequate resources for persons/experts in speech sound disorders. Nevertheless, there have been attempts from SLPs to explore intervention and apply it clinically.

3.4 Review Question-2: Which is the most frequent intervention technique used for speech sound disorders?

Several speech sound intervention strategies employed by the study's authors are listed in Table 3.7. The following list includes the intervention strategies mentioned in ten articles that met the requirements for inclusion.

Table 3.7.

Different intervention techniques used by Authors of selected articles

S. No.	Authors	Intervention Techniques used by the Author
1.	Allen et. al., 2013	Multiple opposition approach
2.	Crosbie et. al., 2005	I. Phonological contrast therapy II. Core vocabulary approach
3.	Denne et. al., 2005	Gillon Phonological Awareness Program (Gillon, 2000)
4.	Soares et. al., 2007	I. ABAB withdrawal II. Multiple Probe Model III. Modified Maximal Opposition Model
5.	Rvachew & Nowak, 2001	Target Selection
6.	Rvachew et. al., 2004	I. Cycle Approach II. Sensorimotor Approach III. Phonetic placement approach
.7.	Forrest et. al., 2001	Imitation and drills
8.	Dodd et. al., 2008	Core vocabulary approach

9.	Hart et. al., 2010	Key Word stimulation
10.	Glogowska et al., 2000	Unspecified

Two research employed the core vocabulary method, which is beneficial for children who have some phonological variability during intervention (Crosbie et al., 2005, Dodd et al., 2008). Through connected speech and single words, it teaches kids how to put together words phonologically on line.

Denne et al. (2005) developed an intervention programme that was based on the Gillon Phonological Awareness Training Program (Gillon 2000), which focuses on improving phoneme awareness and knowledge of graphemes and phonemes rather than correcting speech output. As part of the intervention programme, there are:

The goal of the **Phonological Awareness Intervention** was to increase children's understanding of the phonological makeup of spoken language and to help them develop a conscious understanding of the relationship between spoken and written forms of words.

a. The **traditional intervention** emphasised the development of expressive phonological and language abilities.

b. **Minimal Intervention**, in which children receive recommendations from a speech-language pathologist for activities at home or in the classroom, and the frequency of consultation is no more than once per month.

Three models were employed by Soares et al. (2007) to treat speech sound problems in young children. Included are the Modified Cycles Model, Modified Maximal Opposition Model, and Withdrawal and Multiple Probe Model. The Implicational Model of Complexity of Traces (Mota, 1996) was utilised to select the

treatment targets in the ABAB- Withdrawal and Multiple Probes Model (Tyler & Figursky, 1994), which was built on the implicational hierarchy of distinctive traces. The stages of therapy are as follows: speech data collection (A1), treatment cycles (B1), withdrawal interval (A2) without immediate treatment on the target sound. The course of treatment is as follows: another cycle of treatment (B2), followed by another withdrawal period (A3). The purpose of ABAB- Withdrawal is to verify that the worked traces apply to the sounds that were not acquired during the withdrawal phase. Patients completed two cycles of treatment, each of which focused on no more than two sounds, with the progress of the target sound being tracked using the Multiple Probes Model. The Modified Maximal Opposition Model (Bagetti, Mota, and Keske-Soares, 2005) compares words that share a single phoneme but have one or more different traces that set them apart. When there are numerous phonological processes occurring in the speech, the Modified Cycles Model (Tyler, Edwards, & Saxman, 1987) is employed.

For the intervention of children with speech sound abnormalities, Rvachew et al. (2001) adopted the target selection criteria approach based on linguistic theories regarding the structural links between phonemes rather than on developmental stage models of phonological acquisition.

Children with speech difficulties were treated using the imitation and drill technique by Forrest et al. (2001), whereas children with speech sound issues were treated using the key word stimulation technique by Hart et al. (2010). The method Glogowska et al. (2000) employed to help youngsters with speech sound abnormalities was not made clear.

For the intervention of children with speech sound abnormalities, Rvachew et al. (2004) used the Cycle Approach (Hodsen & Paden, 1983), the Sensorimotor Approach (Mc Donald, 1964), and the Phonetic Placement Approach (Scripture &

Jackson, 1927). The most widely utilised intervention for speech sound issues is the core vocabulary approach.

3.5 Review Question-3: What is the evidence reported for various SSD intervention techniques?

3.5.1 Intervention techniques for speech sound disorder

Speech sound disorder (SSD) is a developmental disorder that affects a child's capacity to communicate with others through articulatory and phonological challenges, rather than because of cognitive, sensory, motor, structural, or affective problems. There is a wealth of literature accessible for the treatment of speech sound abnormalities, and many writers have contributed to the development of intervention strategies.

In 2013, Allen et al. looked into the effectiveness and intensity of interventions for American kids with speech sound disorders. 54 English-speaking kids between the ages of 3 and 7 were taken into account for the study. One-time-per-week phonological intervention (P1), three-times-per-week phonological intervention (P3), or the active control intervention were allotted to the same number of kids (C).

The P1 condition had 19 children, the P3 condition had 19 children, and the C condition had 16 children. Selected intervention targets and the calculation of the outcome measure were based on the Sounds-in-Words subtest of the GFTA-2. It was reported for descriptive purposes using the Khan-Lewis Phonological Analysis—Second Edition (KLPA-2; Khan & Lewis, 2002), which was used to analyse the words generated on the GFTA-2 for phonological patterns. The transcription of the GFTA-2 Sounds-in-Words subtest was used to determine PCC as the outcome measure. When the entire intervention duration was set at eight weeks, they evaluated all of the kids at

the conclusion of the period to determine how frequency affected the outcome measure. Following the intervention period, children in the P1 and P3 conditions were given a maintenance period of 6 weeks during which no phonological targets were addressed. A final evaluation was then finished (at 15 weeks for P3 and 31 weeks for P1). As soon as the 8-week storybook intervention was over, the children in condition C received the phonological intervention. Children in the P1 condition have undergone four assessments, those in the P3 condition three assessments, and those in the C condition two assessments.

After the eighth week of intervention, the results showed that only the P3 condition considerably outperformed the C condition, and that there were no significant differences between the P1 and C conditions. After 24 sessions, there is no discernible difference in the phonological outcomes between interventions delivered once per week for six weeks or three times per week for two weeks. These various results would suggest that six sessions are sufficient to have a major impact on phonological skills. During the maintenance period, children in both intervention conditions made phonological progress.

By contrasting two methods, Crosbie et al. (2005) studied the intervention for children with severe speech difficulties (Phonological contrast therapy and Core vocabulary therapy). For the study, 18 English-speaking kids between the ages of 4 and 6 were taken into consideration. The two groups were similar in age and the severity of speech impairment, with 10 children having an inconsistent speech issue and eight having a consistent one. With a normal score range of 7 to 13, the Diagnostic Evaluation of Articulation and Phonology (DEAP) was used to measure severity. For the purposes of the study, a standard score of 3 on the Phonology Assessment's Percent Consonants Correct (PCC) metric was used. If a child received a score of 40 percent or more, they

were deemed to have an inconsistent speech disorder. In contrast, kids were deemed to have a consistent speech impairment if they received a score on the Inconsistency Assessment of less than 40%. Every intervention was given to every child twice, for eight weeks each.

According to the findings, phonological contrast therapy greatly improved the speech of children with consistent speech disorders while core vocabulary therapy had a more notable impact on children with inconsistent speech disorders. Between the final evaluation and post-treatment (8 weeks after therapy discontinuation), a variation in consistency measures was seen. Word production consistency kept increasing in both groups, but the most notable improvement was seen in the kids with inconsistent speech disorders.

Denne et al. (2005) looked at phonological awareness therapy's effectiveness in environments more akin to speech and language therapy clinics. 20 kids between the ages of 5 and 7 who were divided into treated and untreated groups at random were taken into consideration. Children were seen in three-child groups. Their development in phonological awareness was tracked using the phonological abilities test both before and after the intervention. Phonological awareness was addressed using the Gillon Phonological Awareness Program (Gillon, 2000). The phonological awareness test results showed that the treated group advanced much more rapidly than the untreated group (PAT).

Soares et al. (2007) examined the efficacy of three various therapeutic strategies in terms of phonological system modifications in patients with varying degrees of phonological disorder (PD) severity. They employed the ABAB- Withdrawal and Multiple Probe Model, the Modified Maximal Opposition Model, and the Modified Cycles Model as their three intervention models. They looked at 66 English-speaking

kids between the ages of 4.4 and 8.2 years. Three groups were formed from the participants. The percentage of consonants correctly pronounced (PCC) (Shriberg Kwiatkowski, 1982), which is divided into four categories: moderate disorder (MD), mild-moderate disorder (MMD), moderate-severe disorder (MSD), and severe disorder (SD), was used to determine the severity of PD. The percentage of Non-Acquired Segments (NAS) in the phonological system, which was less than 80%, was regarded as the absent segment. Group 1 has 36 participants (4 SD, 7 MSD, 17 MMD, and 8 MD) who receive ABAB- Withdrawal and Multiple Probe treatment. Group 2 has 17 participants (1 SD, 4 MSD, 9 MMD, and 3 MD) who receive Modified Maximal Opposition treatment. Group 3 has 13 participants (3 MSD, 9 MMD, and 1 MD) who receive Modified Cycles treatment.

Results showed that after a period of treatment, the number of acquired segments increased in all groups treated with the various therapy models, demonstrating that all of these intervention strategies were equally effective in the treatment.

When utilised in the context of conventional treatment techniques employed by doctors, two alternative sets of target-selection criteria were the subject of an investigation by Rvachew et al. in 2001. 48 preschool-aged children with moderate to severe phonological delays were taken into consideration. They were randomly divided into two groups: LL (slightest knowledge, latest developing), which received treatment for phonemes that are slightly later developing and for which they had the least productive phonological knowledge, and ME (most knowledge, earliest developing), which sought treatment for phonemes that are slightly earlier developing and for which they had the most productive phonological knowledge. Every kid in both groups completed a first assessment (A1), six weekly therapy sessions (referred to as the first treatment block, or B1), a second assessment (A2), six further weekly treatment

sessions (referred to as the second treatment block, or B2), and finally a post-treatment assessment (A3). Three assessment sessions were held, and they involved administering the Productive Phonological Knowledge Profile (PPKP) as described by Gierut et al. (1987), using an imitative task that consists of a list of 198 words, a Sample of conversational speech, and using the picture book Carl Goes Shopping by Day (1989) as a stimulus and scoring it for the percentage of consonants correctly (PCC) and two outcome measures—general satisfaction with the treatment programme and happiness with their child's growth throughout therapy—were developed from the department's standard Client Satisfaction Questionnaire, which comprised of 15 statements covering various elements of their service. Following either conventional or unconventional target-selection criteria, four phonemes were chosen for intervention.

The results showed that during therapy sessions, children in the ME group acquired the target sounds substantially more quickly than children in the LL group. This development became particularly apparent during the first treatment block. Generalization outcomes were demonstrated to be unaffected by the target-selection technique during the second treatment block, and treatment progress persisted to be greater for the ME group when the children receive therapy for multiple phonemes that represent a variety of location and method differences.

When treating expressive phonological delay, Rvachew et al. (2004) looked into the advantages of a perceptual approach. They considered 34 pre-schoolers who had moderate to severe expressive phonological difficulties. The children were divided into the 17-person experimental or control Group at random. Along with their regular speech-language therapy, the participants underwent 16 treatment sessions. For pre- and post-assessments, the Bird et al. (1995) test of phonological awareness, the GFTA-2 (Goldman-Fristoe Test of Articulation- Second Edition), and the SAILS

(Speech Assessment and Interactive Learning System, Version 1.2) test of phonemic perception were used. Three outcome metrics were investigated:

1. Using the SAILS test, determine the kids' phonemic perception abilities.

2. Their articulation abilities, as determined by the PCC in conversation for those consonants that were pronounced by the majority of the kids before treatment with less than 60% accuracy (i.e., PCC difficult) and by the quantity of GFTA-2 errors.

3. The results of the phonological awareness test they took.

The results demonstrated that a phonemic perception intervention significantly boosts the effectiveness of speech therapy aimed at improving children's articulation issues. The results of the pre-treatment and post-treatment assessments demonstrate a connection between phonological awareness and phonemic perception as well as between articulation accuracy and phonemic perception.

Treatment for children with varied substitution patterns and phonological disorders was examined by Forrest et al. in 2001. They took into consideration four boys between the ages of 4 and 11 and 5 and 3 years. Before the treatment, each patient had a thorough phonological investigation that sampled consonants in all word positions where they can be found in US English. To determine whether individuals could generalise the treated sound to untreated circumstances, generalisation probes were created. The same generalisation probe was administered to those who had the same sound treatment. The generalisation probes included

- 25 words with ten exemplars in word-initial position,

- Ten tokens in word-final position, and

- The remaining five words containing the target sound in word-medial position.

The findings showed that children with varied replacements do not generally generalise their understanding of untreated word locations. Additionally, they showed that beginning a therapy with a word's more approachable places could help lay the groundwork for learning the missed sound.

Dodd et al. (2008) looked at three treatment case studies to assess the effectiveness of Core Vocabulary intervention for three boys with inconsistent speech disorder between the ages of 3 and 4 years old. All participants received twice-weekly sessions lasting between 12 and 38 minutes each. Children with atypical speech, which is characterised by many mistake forms in the production of single words, were identified using the Inconsistency Assessment of the DEAP (Dodd, Zhu, Crosbie, Holm & Ozanne, 2002). The youngster is taken into consideration for the study if they create 40 percent (10 out of 25) or more of their words differently over the three trials.

The outcomes showed that all three of the youngsters had favourable outcomes. A Core Vocabulary-based strategy to intervention that emphasises the planning of full words was found to improve the correctness and consistency of the speech of three youngsters.

Hart et al. (2010) looked at the efficacy of a communication-centered intervention in enhancing speech production. In this study, three kids aged 3 to 7 and 4 to 11 with mild to severe speech sound problems took part. Both before and after the intervention, the Hodson Assessment of Phonological Patterns, Third Edition (HAPP-3; Hodson, 2004) was given. Video and audio language samples were gathered before, after, and one month after the intervention. Each youngster was given a stimulable example of the fricative class of sounds. According to the findings, children who have severe speech sound abnormalities may also gain from phonological remediation that is communication-centered.

Glogowska et al. (2000) compared regular speech and language therapy to a "watchful waiting" period of 12 months for pre-schoolers with delayed speech and language. They divided the 159 pre-schoolers with noticeable speech or language problems into two groups at random: Group I, which received therapy, had 71 participants, and Group II, which was placed on watchful waiting, had 88 people. Measurements were made before and after treatment on 5 key outcomes and 11 secondary outcomes.

Only one of the five main outcomes—audible comprehension—showed a significant improvement in the therapy group when compared to the watchful waiting group. Additionally, the two secondary outcomes that were significant for each measure various factors.

3.6 Review Question-4: What are the differences in the duration of various intervention techniques for speech sound disorders?

3.6.1 Duration of various intervention techniques

The time frame during which the intervention is offered is known as the *total intervention period*. It could either be reported by a specified time frame or the amount of time required to fix an SSD (Baker & McLeod, 2011). The predefined time frame may be related to an intervention protocol's required number of sessions or the amount of time required to meet a particular criterion. The predefined time ranges for speech sound interventions, according to Baker and McLeod (2011), have varied from three sessions to two years. Please take note that the stated time limit does not imply that the SSD will be fixed. Studies examining the period ranged from 3 to 46 months, with phonological interventions taking an average of 12 months to complete.

Table 3.8.

Duration of various intervention techniques in the reviewed articles

S. No.	Author	Intervention Techniques	Duration of Intervention
1.	Glogowska et al., 2000	Unspecified	Avg. of 8.4 months
2.	Allen et. al., 2013	Multiple opposition approach	8 weeks
3.	Crosbie et. al., 2005	I. Phonological contrast therapy II. Core vocabulary approach	two 8-week blocks
4.	Denne et. al., 2005	Gillon Phonological Awareness Program (Gillon, 2000)	2 months
5.	Soares et. al., 2007	I. ABAB withdrawal and Multiple Probe Model II. Modified Maximal	Not available

		Opposition Model III. Modified Cycles Model	
6.	Rvachew & Nowak (2001)	Target Selection	12 weeks in two blocks of six
7.	Rvachew et. al., 2004	I. Cycle Approach II. Sensorimotor Approach III. Phonetic placement approach	4.73 months
8.	Forrest et. al., 2001	Imitation and drills	Not available
9.	Dodd et. al., 2008	Core vocabulary approach	Between 6 and 19 weeks
10.	Hart et. al., 2010	Key Word stimulation	6 weeks

The objective of the present investigation was to comprehensively analyse the prior research on different intervention strategies used for Speech Sound Disorder from 2000 to 2020 globally. For the study, four review questions were collected. What different types of intervention strategies are employed for speech sound issues was the first review question. Using keywords like speech-sound disorder, phonological disorders, phonological treatment, speech sound errors, etc., national and international databases were searched. After eliminating duplicates, a total of 221 articles were found, which were then checked for title and abstract. Of those, 39 were found to be pertinent to the study's goal. The full-text screening of these 39 papers was done to choose the pertinent ones based on our inclusion criteria. Using the Physiotherapy Evidence Database quality assessment tool, which is designed to evaluate the methodological quality of randomised and non-randomized controlled trials (Perdices & Tate 2009), 10 articles were produced as a result. These articles were then subjectively evaluated (Tate et al. 2008). After quality evaluation, the chosen studies were examined, and information was gleaned from them.

United States, followed by United Kingdom, Canada, and Australia, reported the highest number of publications on the use of different intervention approaches for speech sound disorders.

Which intervention method for speech sound abnormalities is most frequently employed was the second review question. Our analysis revealed that speech-language pathologists frequently employ phonetic procedures including the Sensorimotor Approach, Phonetic Placement Approach, Imitation and Drills, Key Word Stimulation, etc. Phonemic treatment methods are employed with some variations and are less common among speech-language pathologists.

What evidence has been published for different SSD intervention approaches was the third review question. According to research by Allen et al. (2013) into the effectiveness and intensity of interventions for American children with speech sound disorders, six sessions may be sufficient to have a meaningful influence on phonological abilities. By contrasting two interventions (Core Vocabulary Therapy and Phonological Contrast Therapy), Crosbie et al. (2005) investigated the intervention for children with severe speech disorders and found that Core Vocabulary Therapy produced more notable changes in children with inconsistent speech disorders than Phonological Contrast Therapy did in those with consistent speech disorders. Denne et al. (2005) looked examined phonological awareness therapy's efficacy in settings more like those found in speech and language therapy offices. It showed that the treatment group significantly improved on the phonological awareness test compared to the control group (PAT).

Soares et al. (2007) examined the efficacy of three various therapeutic strategies in terms of phonological system modifications in patients with varying degrees of phonological disorder (PD) severity. They employed three intervention models, including the Modified Cycles Model, Modified Maximal Opposition Model, and ABAB- Withdrawal and Multiple Probe Model, and discovered that each was equally effective in the treatment of the condition.

Rvachew et al. (2001) looked into the relative efficacy of two various sets of target-selection criteria when applied to treatment processes that doctors frequently utilised. The acquisition of the target sounds by children in the ME group throughout therapy sessions was significantly more advanced than that of children in the LL group, according to the results. This improvement was especially noticeable during the first treatment block. As the children get therapy for several phonemes that represent a

variety of location and method contrasts, generalisation outcomes were shown to be unaffected by the target-selection strategy during the second treatment block and treatment progress continued to be greater for the ME group.

The advantages of a perceptual approach to treating expressive phonological delay were examined by Rvachew et al. in 2004. It was discovered that a phonemic perception intervention greatly increases the efficacy of speech therapy targeted at correcting children's articulation mistakes. Treatment for children with varied substitution patterns and phonological disorders was examined by Forrest et al. in 2001. Established that treatment that begins with more approachable word positions might assist lay the groundwork for acquiring the omitted sound. It was revealed that children with variable substitutes exhibit little generalisation of their knowledge of untreated word positions. Dodd et al. (2008) looked at three treatment case studies to assess the effectiveness of Core Vocabulary intervention for three boys with inconsistent speech disorder between the ages of 3 and 4 years old. The intervention strategy is successful in terms of precision and consistency, according to the results.

Hart et al. (2010) looked at the efficacy of a communication-centered intervention in enhancing speech production. According to the findings, children who have severe speech sound abnormalities may also gain from phonological remediation that is communication-centered. In a 2000 study, Glogowska et al. compared regular speech and language therapy to "watchful waiting" for 12 months in pre-schoolers with delayed speech and language. Revealed that the therapy group had significantly improved as compared to the watchful waiting group.

The fourth review question was regarding the differences in the length of the various intervention strategies for speech sound abnormalities. The planned time

frames for speech sound therapies have been found to range from three sessions to two years, according to our review. The findings of the present study augment SLPs awareness on many aspects of the frequently used intervention strategies for SSD, which is a highly prevalent condition in children.

Chapter 4

SUMMARY AND CONCLUSIONS

With the aim of reviewing the studies on the existing studies on various intervention techniques applied for Speech Sound Disorder, literature search was carried out in various national and international databases using keywords related to speech sound disorder across the world, from the year 2000 to 2020, for 20 years. PRISMA guideline i.e., title screening following duplicates removal and abstract screening before full text screening , was followed to find the relevant articles as per the inclusion criteria. Ten out of 221 literatures fulfilling inclusion criteria were selected for the review. Quality Assessment of all ten articles were carried out. Information relevant to our study was retrieved in detail from each article.

We found that most of the studies related to the intervention technique of speech sound disorder have been done in USA followed by UK, Canada and Australia. All the studies tried to find out which intervention technique useful for the intervention of speech sound disorder in terms of duration and severity. Phonetic approaches are widely and most frequently used intervention techniques for speech sound disorders used by the speech-language pathologist, such as Sensorimotor Approach, Phonetic placement approach, Imitation and drills, and Key Word stimulation. Phonemic Treatment approaches are less popular intervention techniques for speech sound disorders among speech-language pathologists and are used with some modifications. For speech sound interventions, the intended time limits varied from three sessions to two years.

The present systematic review helped in understanding the gap in literature in terms of intervention techniques for speech sound disorder. It also helped in understanding the most often used intervention techniques of speech sound disorder in

terms of intensity and duration which were not studied previously. Such review studies

benefit SLPS to base their intervention strategies from a wider perspective.

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Appendix: Sample Form for Data Extraction

Article No:	
Name of the Article:	
Authors:	
Year of Publication:	
Journal Published on:	
Country of origin:	
Retrieved from (Name of database)	
Methodology	
1. Type of research	
2. Study Design	
3. Type of Research	
4. Participants a) Total	
b) Study Group with age range	
c) Control group with age range	
Procedure a) Technique used	
b) Duration of Intervention	
c) Frequency of Intervention	
d) No. of Therapy sessions	
Results	